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ESCAPEMENTS OF CHINOOK SALMON IN SOUTHEAST ALASKA AND TRANSBOUNDARY RIVERS IN 1989[1]

By

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ABSTRACT

The estimated total escapement of chinook salmon *Oncorhynchus tshawytscha* for all Southeast Alaska and transboundary rivers declined from 60,500 fish in 1988, to 54,100 fish in 1989, reversing the trend of increasing escapements observed over the last six years. The total escapement of chinook salmon in 1989 was 11 percent or 6,400 fish less than in 1988 and only 85 percent of the management escapement goal of 64,000 chinook salmon. The 1989 escapement represented an increase of approximately 108 percent or 28,100 chinook salmon over the 1975-1980 average of 26,000 chinook salmon, and an increase of 38 percent or 15,000 chinook salmon over the 1981-1985 average of 39,100.

Although total escapements of chinook salmon declined in 1989, increases were still observed in the Taku (15 percent) Chilkat (74 percent), Alsek (24 percent), Keta (101 percent), Chickamin (19 percent), and King Salmon rivers (16 percent) and in Andrew Creek (13 percent). Chinook salmon escapements declined in four of the 11 index systems. The largest decline occurred in the Stikine River where the 1989 escapement of 18,860 chinook salmon was 35 percent (10,308 fish) below the 1988 record escapement of 29,168 fish. Escapements of chinook salmon also declined in the Unuk (minus 34 percent), Blossom (minus 10 percent), and Situk rivers (minus 26 percent).

KEY WORDS: Chinook, *Oncorhynchus tshawytscha*, escapement, Taku River, Stikine River, Alsek River, Chilkat River, Unuk River, Chickamin River, Blossom River, Keta River, Marten River, Wilson River, Chilkat River, King Salmon River, Situk River, Andrew Creek, Behm Canal, southeast Alaska, U.S./Canada Treaty.

INTRODUCTION

Populations of chinook salmon are known to occur in some 34 river systems throughout southeast Alaska, northwestern British Columbia, and the Yukon Territory, Canada. In the mid-1970's it became apparent that the majority of chinook salmon stocks in the southeast Alaska region were depressed relative to historical levels of production. As a result, a fisheries management program was implemented to rebuild depressed stocks of chinook salmon in southeast Alaska and transboundary rivers (rivers that originate in Canada and flow into southeast Alaska coastal waters). Initially, this management program included regulatory closures of commercial and recreational fisheries in terminal and near-terminal areas. This program was formalized and expanded in 1981 to a 15-year (roughly 3 life-cycles) rebuilding program for the transboundary Taku, Stikine, Alsek, Unuk, Chickamin, and Chilkat rivers and the non-transboundary Blossom, Keta, Situk, and King Salmon rivers. The objective of this program, which included regionwide, all-gear catch ceilings for chinook salmon, was to rebuild spawning escapements to management goals by 1995. Then, in 1985, the southeast Alaska rebuilding program was incorporated into a broader, coastwide, rebuilding program for natural stocks of chinook salmon under the auspices of the U.S./Canada Pacific Salmon Treaty (PST).

In accordance with the PST, escapement indices are used to ascertain progress towards meeting escapement goals for the chinook salmon stocks of southeast Alaska and transboundary rivers. The Joint Chinook Technical Committee of the Pacific Salmon Commission combines the indices of escapements of the major, medium, and minor stocks and makes expansions to total estimates of escapements according to set formulas. These expansions are compared with similarly constructed historical estimates of escapement and appropriate fishery regulations are promulgated.

The overall goal of the Chinook Salmon Research Project is to collect information needed to manage commercial and recreational fisheries to ensure maximum sustained yield of chinook salmon populations of southeast Alaska and transboundary rivers. Estimates of escapements by brood year will be used to investigate the relationship between spawners and subsequent recruitment. In 1989, the objective of this project was to estimate the peak escapement of large (age 1.3 and 1.4) chinook salmon to tributaries and mainstem areas of the Taku, Stikine, Alsek, Unuk, Chickamin, Chilkat, Blossom, Keta, Wilson, Marten, and King Salmon Rivers.

METHODS

Of the 34 river systems with documented spawning populations of wild chinook salmon, three, the transboundary Taku, Stikine, and Alsek, are classified as major producers of chinook salmon with total run sizes potentially exceeding 10,000 fish. Nine systems are considered medium producers with run sizes between 1,500 and 10,000 fish. The remaining 22 rivers are placed in the minor production category with run sizes less than 1,500 chinook salmon. Although chinook salmon have been observed in small numbers in other southeast Alaska streams, successful spawning has not been documented.

Many index areas in the known chinook salmon spawning streams are surveyed annually to document escapements and to expand the database for southeast Alaska. In addition, of the surveys conducted in the rivers and streams with documented runs of chinook salmon, results from three major, seven of the medium, and one of the minor producing systems are used to calculate an abundance index for all southeast Alaska chinook salmon spawning streams. Descriptions of the index areas and expansion methods are summarized in the following text and in Appendices A1 and A2. A detailed description of survey areas and spawning distribution in index tributaries can also be found in Mecum and Kissner (1989).

Description of Study Areas

The Taku River originates in northern British Columbia and flows into the ocean 48 km east of Juneau, Alaska (Figure 1). The Taku River drainage covers over 16,000 km^2 and annual flows range from 787 to 2,489 m^3. Principal tributaries include the Sloko, Nakina, Sheslay, Inklin, and Nahlin rivers. The clearwater Nakina and Nahlin rivers contribute less than 25% of the total drainage discharge, with most of the remainder originating from glaciated areas on the eastern slope of the Coast Range of British Columbia. The drainage above the abandoned mining community of Tulsequah, British Columbia, remains in pristine condition; no mining, logging, or other development activities have ever been allowed. The upper Taku River area is extremely remote with no road access and few year-round residents. All of the important chinook salmon spawning areas in the Taku River are found in tributaries in the upper drainage in British Columbia. These include the Nakina, Nahlin, Dudidontu, Tatsamenie, Hackett, and Kowatua rivers and Tseta Creek.

The Stikine River (Figure 2) originates in northern British Columbia and flows to the sea approximately 32 km south of Petersburg, Alaska. The Stikine River drainage encompasses approximately 52,000 km^2. The Stikine River's principal tributaries include the Tahltan, Chutine, Skud, Iskut, and Tuya rivers. Approximately 90% of the river system is inaccessible to anadromous fish due to natural barriers and velocity blocks and the lower river and most tributaries are glacially occluded (e.g., Chutine, Skud, and Iskut rivers). Only 2% of the Stikine River drainage is in Alaska (Beak Consultants Limited 1981) and the majority of the chinook salmon spawning areas in the Stikine River are located in British Columbia, Canada in the mainstem Tahltan and Little Tahltan rivers (including Beatty Creek). However, Andrew Creek, in the lower Stikine River, also supports a significant spawning run of chinook salmon.

The Alsek River originates in the Yukon Territory, Canada and flows in a southerly direction until it empties into the Gulf of Alaska approximately 75 km southeast of Yakutat, Alaska (Figure 3). The Dezadeash and Tatshenshini rivers are the largest tributaries of the Alsek River. Similar to the glacial Taku and Stikine rivers, velocity barriers and blockages prohibit migration of anadromous salmonids to most of the Alsek River drainage. The Alsek River is considered a major producer of chinook salmon; only the Taku and Stikine River support larger spawning populations in southeast Alaska. Most of the significant chinook salmon spawning areas are found in tributaries of the Tatshenshini River including the Klukshu, Blanchard, and Takhanne rivers and Village and Goat creeks.

The Unuk River originates in a heavily glaciated area of northern British Columbia and flows for 129 km to Burroughs Bay 85 km northeast of Ketchikan, Alaska; only the lower 39 km of the river are in Alaska. The Unuk River drainage encompasses an area of approximately 3,885 km^2 (Figure 4). Most Unuk River chinook salmon spawn in tributaries in the lower 39 km of the U.S. portion of the

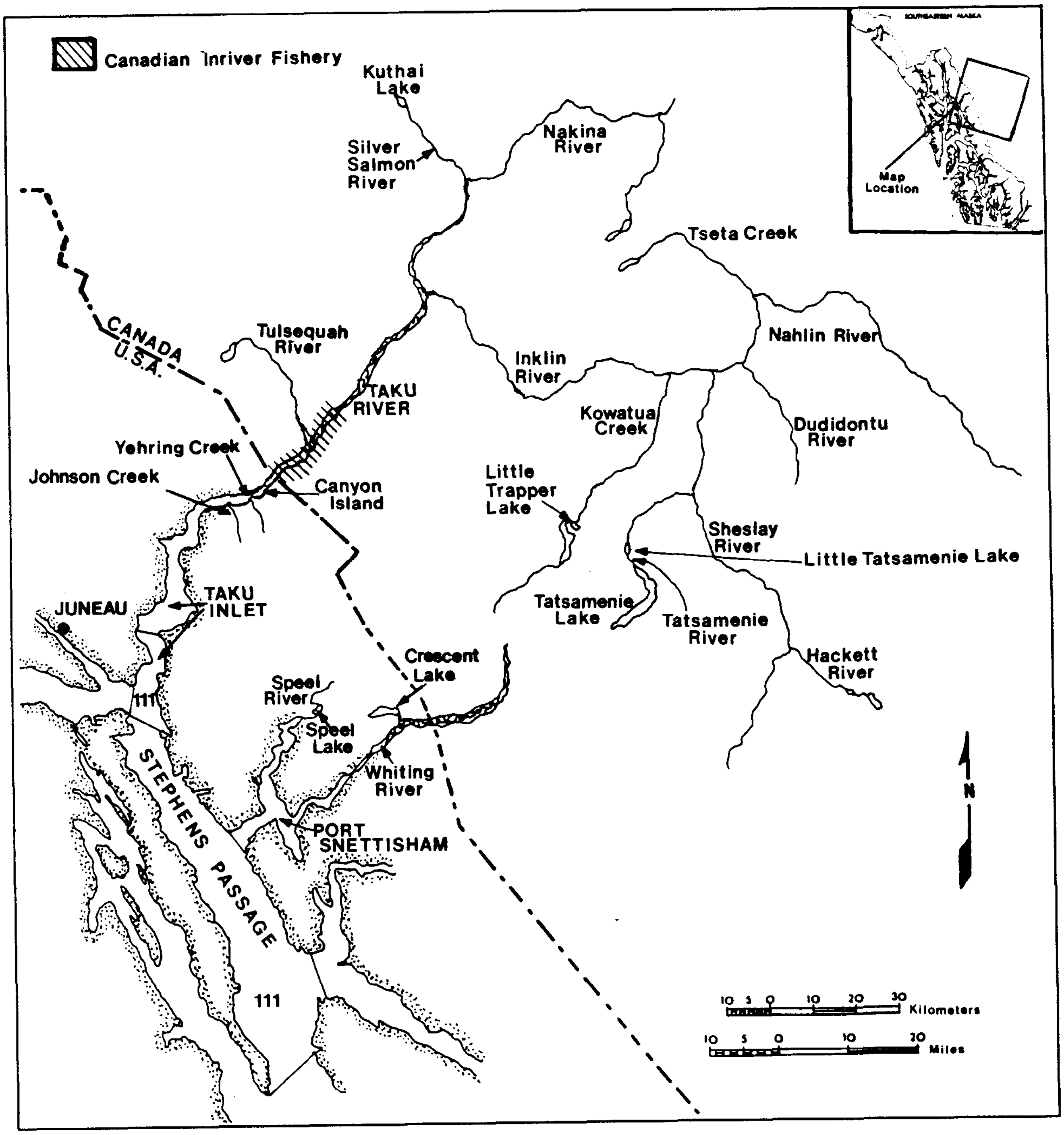

Figure 1. Taku River drainage.

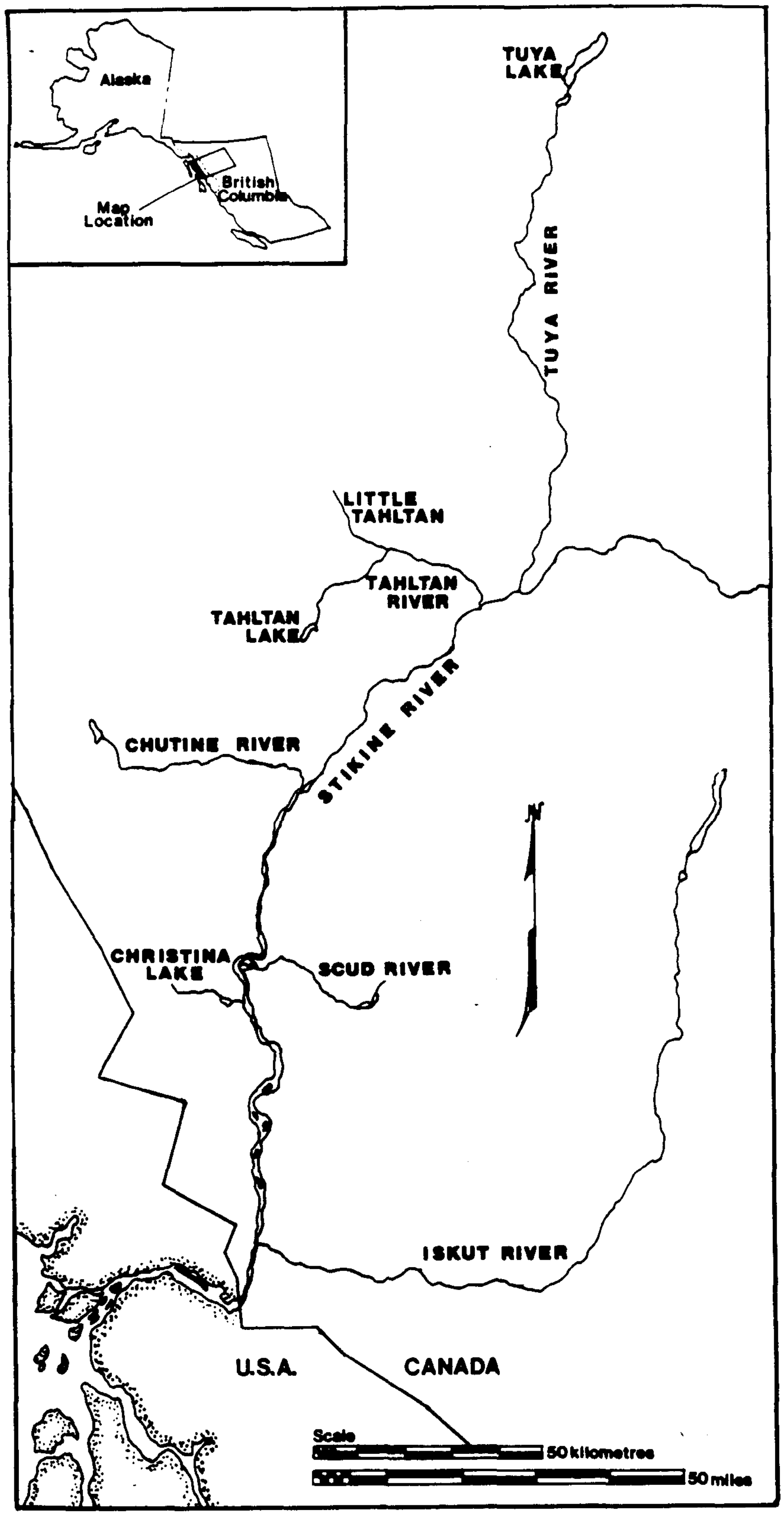

Figure 2. Stikine River drainage.

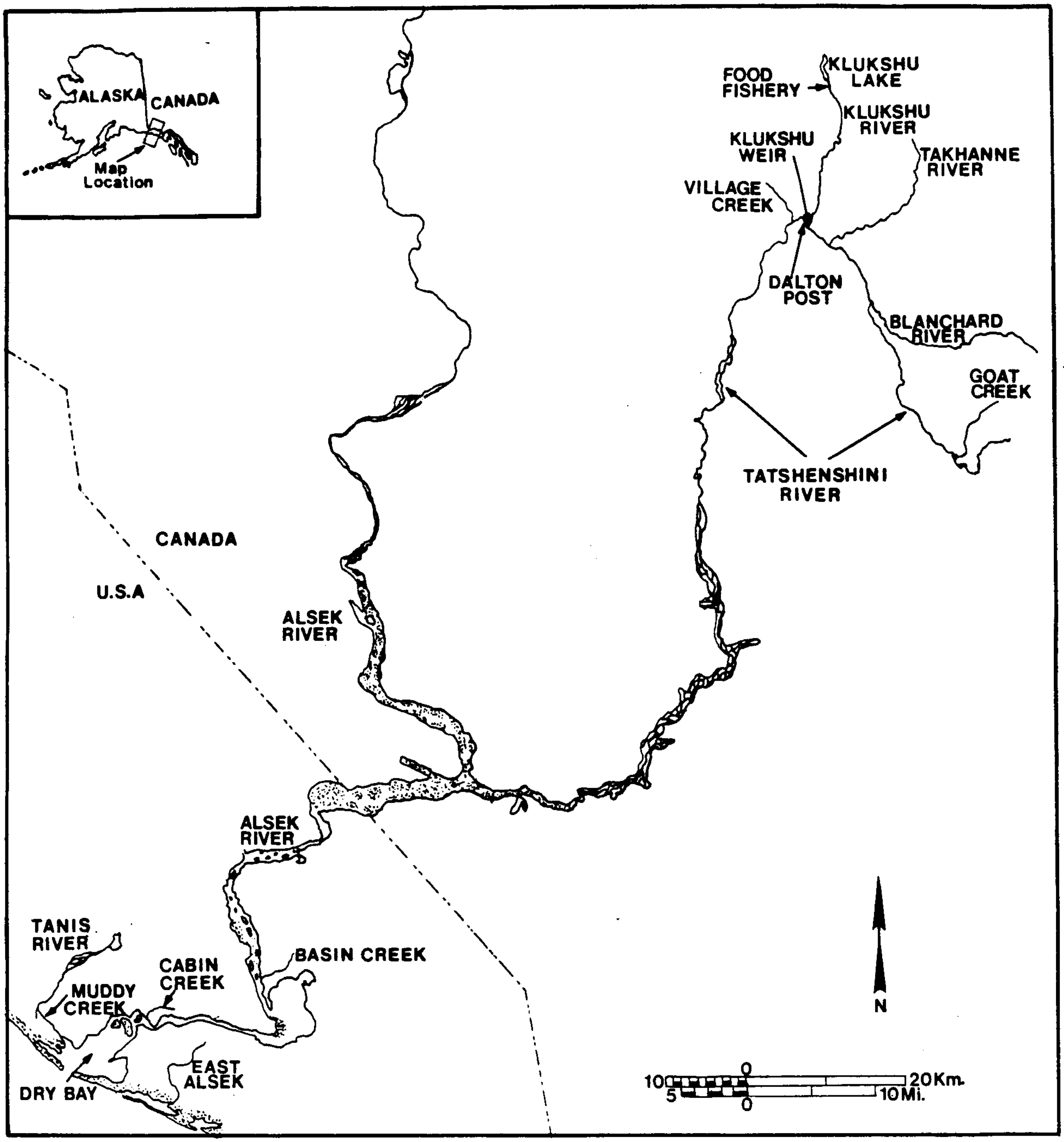

Figure 3. Alsek River drainage.

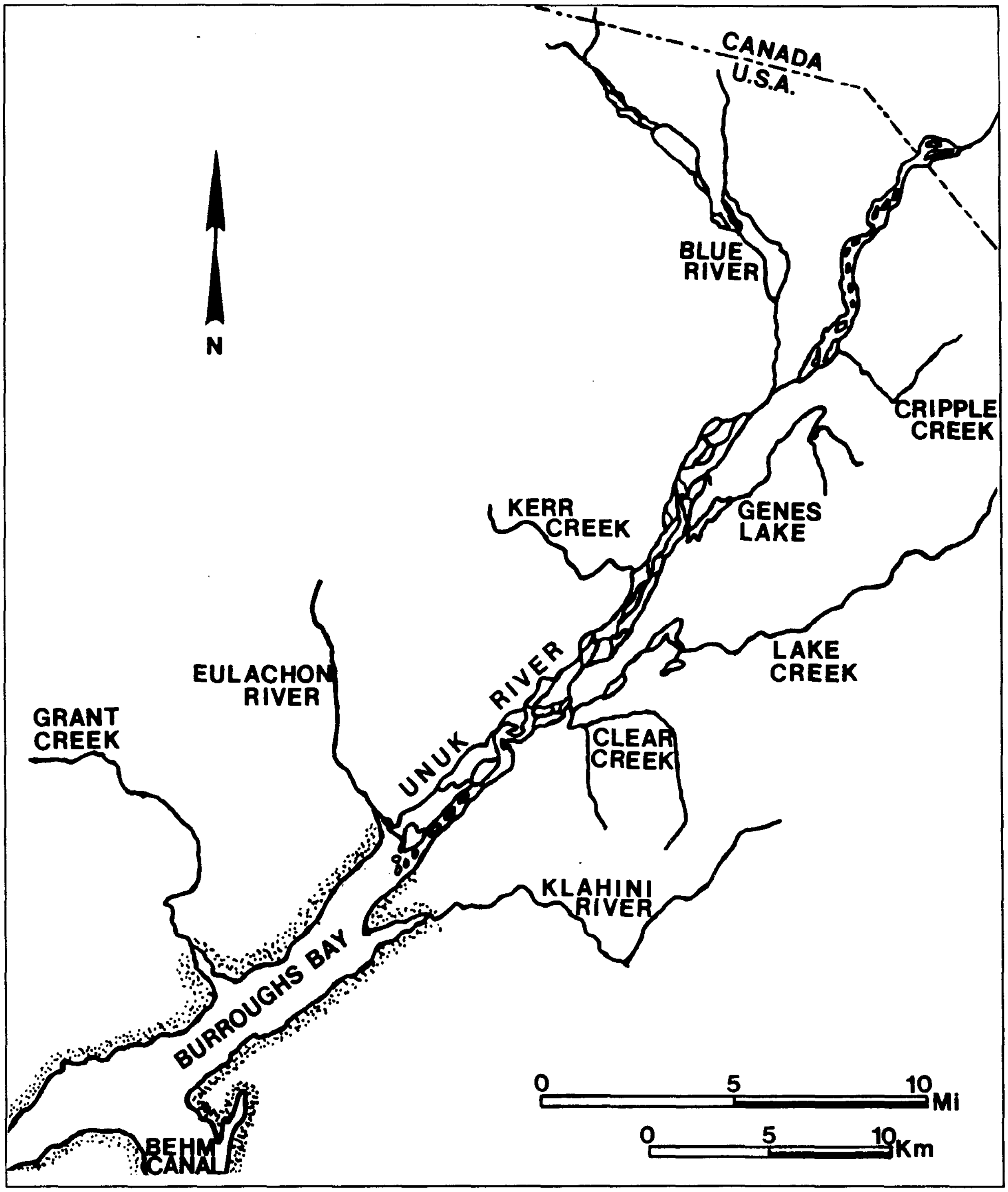

Figure 4. Unuk River drainage.

river, including the Eulachon River and Cripple, Genes Lake, Clear, Lake, and Kerr creeks.

The Chickamin River ranks fifth in chinook production in southeast Alaska behind the Taku, Stikine, Alsek, and Unuk Rivers. This large, glacial river originates in northern British Columbia, flowing into Behm Canal approximately 32 km southeast of Burroughs Bay and 65 km northeast of Ketchikan, Alaska (Figure 5). Important tributaries for spawning chinook salmon are the South Fork of the Chickamin and Barrier, Butler, Indian, Leduc, Humpy, King, and Clear Falls Creeks.

The Chilkat River (Figure 6) originates in the Yukon Territories, Canada and flows into northern Lynn Canal near Haines, Alaska. Lynn Canal is bounded by the U.S. - Canadian border to the north and west and the Takhinsha Mountains and the ice fields of Glacier Bay National Park to the south. This large, glacial river flows through a broad flood plain, forming numerous, braided stream channels, gravel bars and islands covered with dense stands of willow and cottonwood (Mills et al. 1983). The transboundary Chilkat River supports large runs of sockeye, chum, and coho salmon and a smaller (1,000 to 2,000 large chinook salmon) run of chinook salmon that are very important to local recreational and subsistence fisheries as well as commercial drift gill net fisheries.

The Blossom, Keta, Wilson, and Marten Rivers are non-transboundary rivers that flow into Behm Canal approximately 45 km east of Ketchikan, Alaska (Figure 7). These rivers lie within the boundaries of the Misty Fjords National Monument in an area known as Boca de Quadra that has received considerable attention in recent years due to the potential development of a large scale molybdenum mine (Quartz Hill) located near the divide of the Blossom and Keta Rivers. Chinook salmon escapements to the Wilson and Marten Rivers have been monitored on an intermittent basis in recent years.

The King Salmon River drains an area of approximately 100 km^2 on Admiralty Island, flowing into King Salmon Bay in the eastern portion of Stephens Passage approximately 48 km south of Juneau, Alaska (Figure 8). The King Salmon River is the only southeast Alaska river system located on an island that supports a significant population of spawning chinook salmon. The only other island system with a documented run of chinook salmon is Wheeler Creek, also on Admiralty Island. An upstream weir has been operated by the Alaska Department of Fish and Game (ADF&G), on the King Salmon River since 1983 to collect chinook salmon eggs for developing broodstock for the Snettisham Hatchery.

The Situk River is located approximately 16 km east of Yakutat, Alaska (Figure 9). The Situk River supports a large run of sockeye salmon which are harvested in commercial and subsistence set gill net fisheries concentrated at the mouth of the Situk River. Situk River chinook salmon are harvested incidentally in the set gill net fishery and a recreational fishery in the lower river. A weir was operated on the Situk River at the upper limit of the inter-tidal area from 1928 to 1955 to enumerate all five species of Pacific salmon spawning in the river. From 1976 to 1988, a weir was operated further upstream near the 9-mile road bridge, primarily to enumerate chinook and sockeye salmon. This weir was moved downstream closer to the old weir location in 1988.

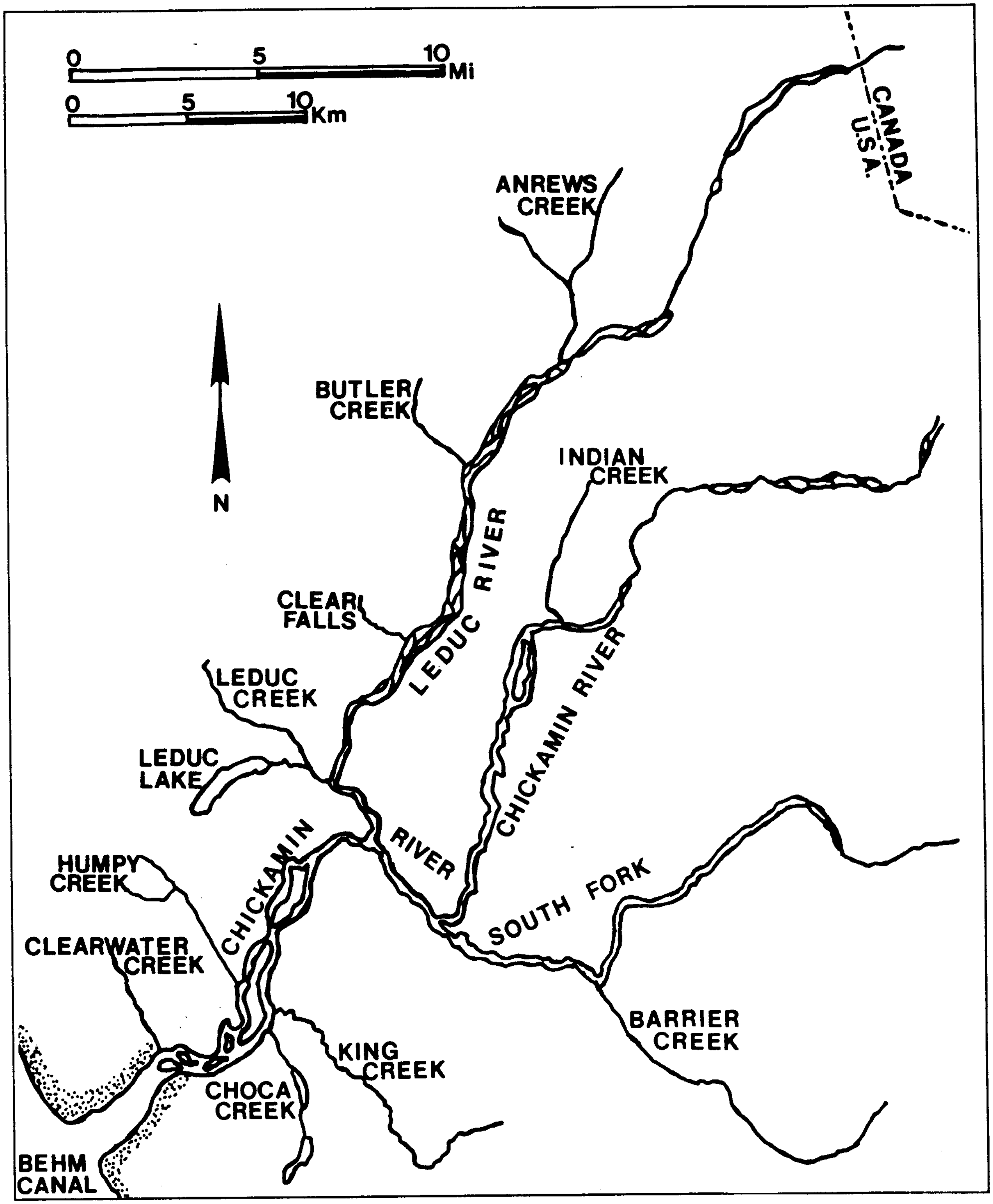

Figure 5. Chickamin River drainage.

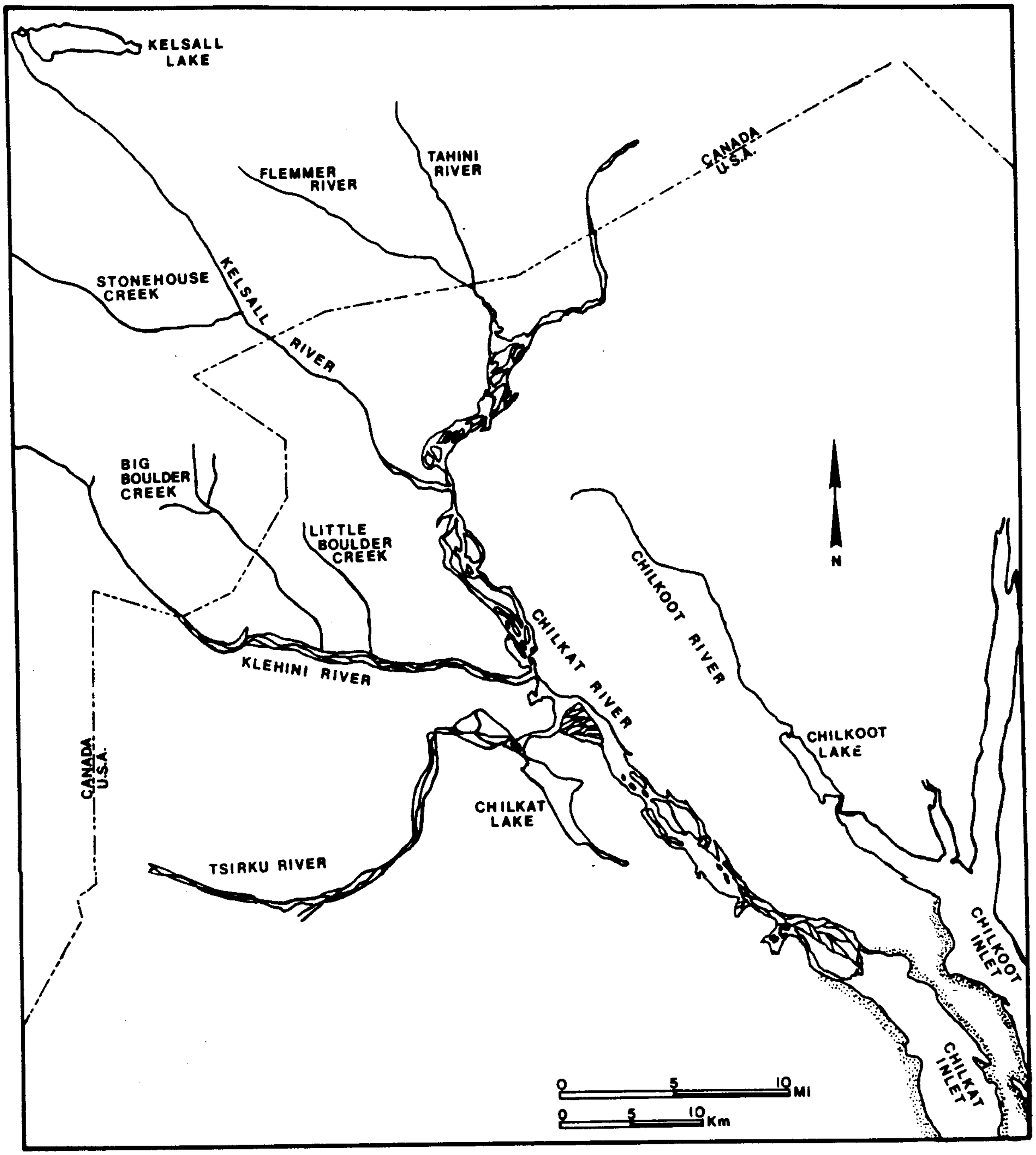

Figure 6. Chilkat River drainage.

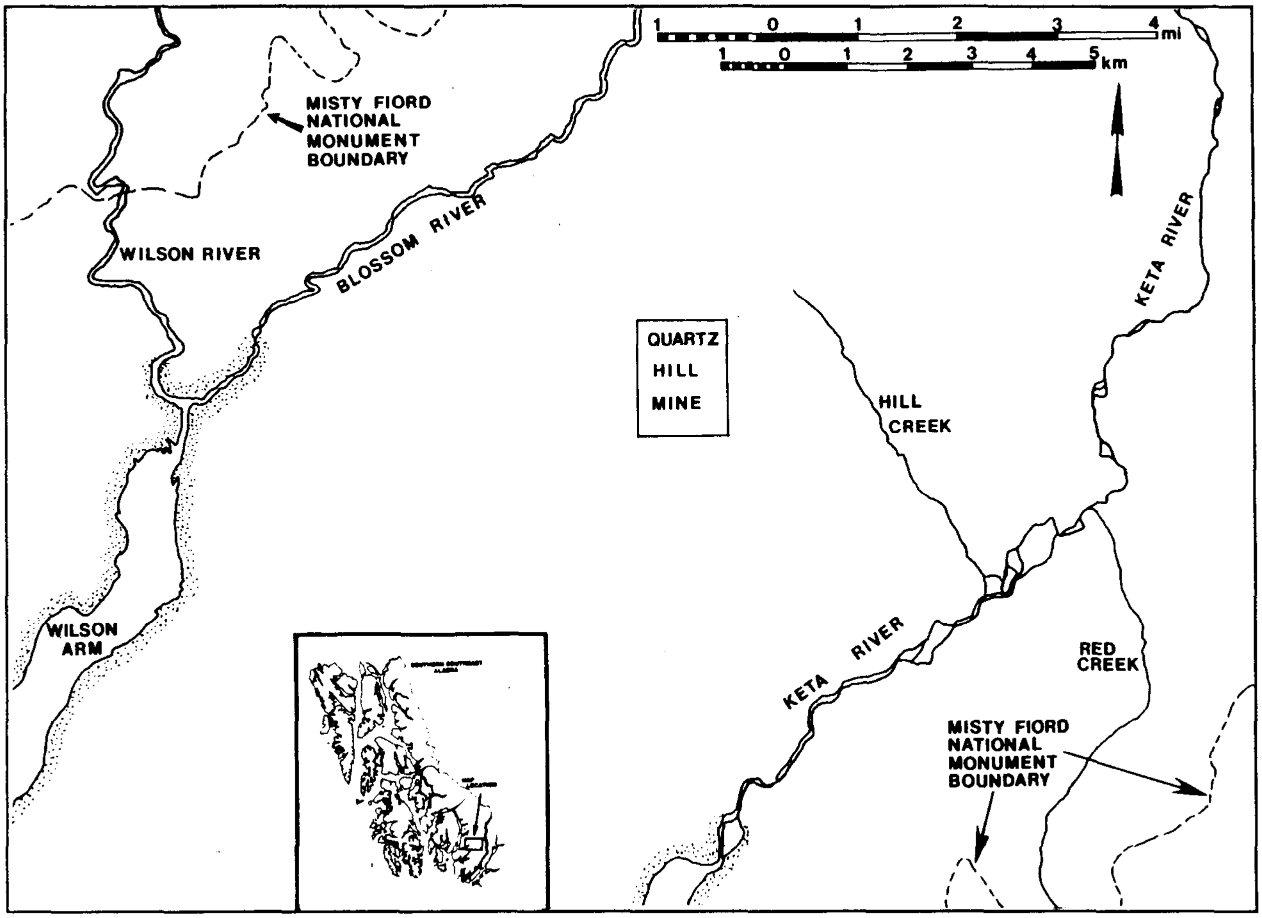

Figure 7. Blossom and Keta River drainages.

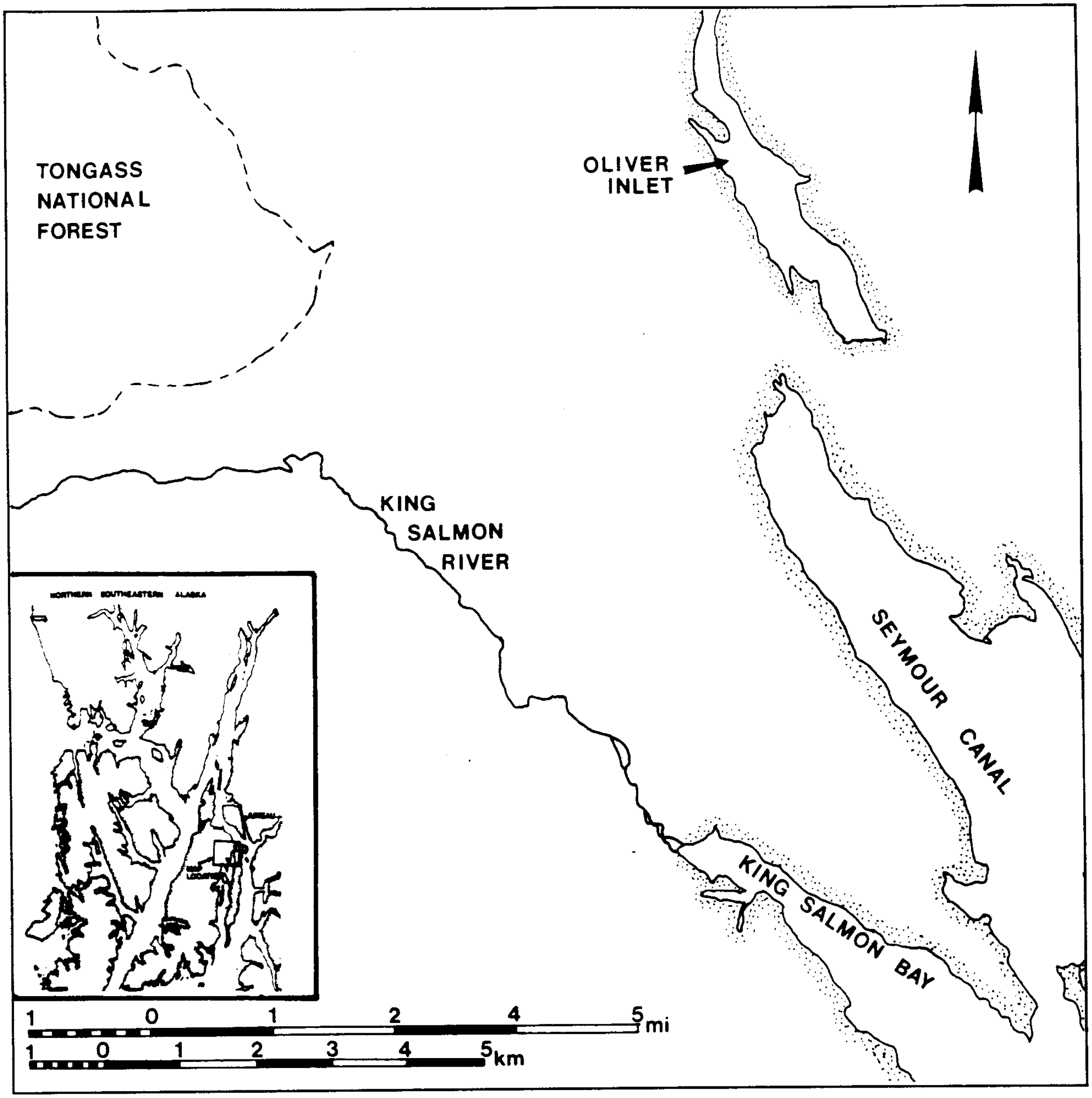

Figure 8. King Salmon River drainage.

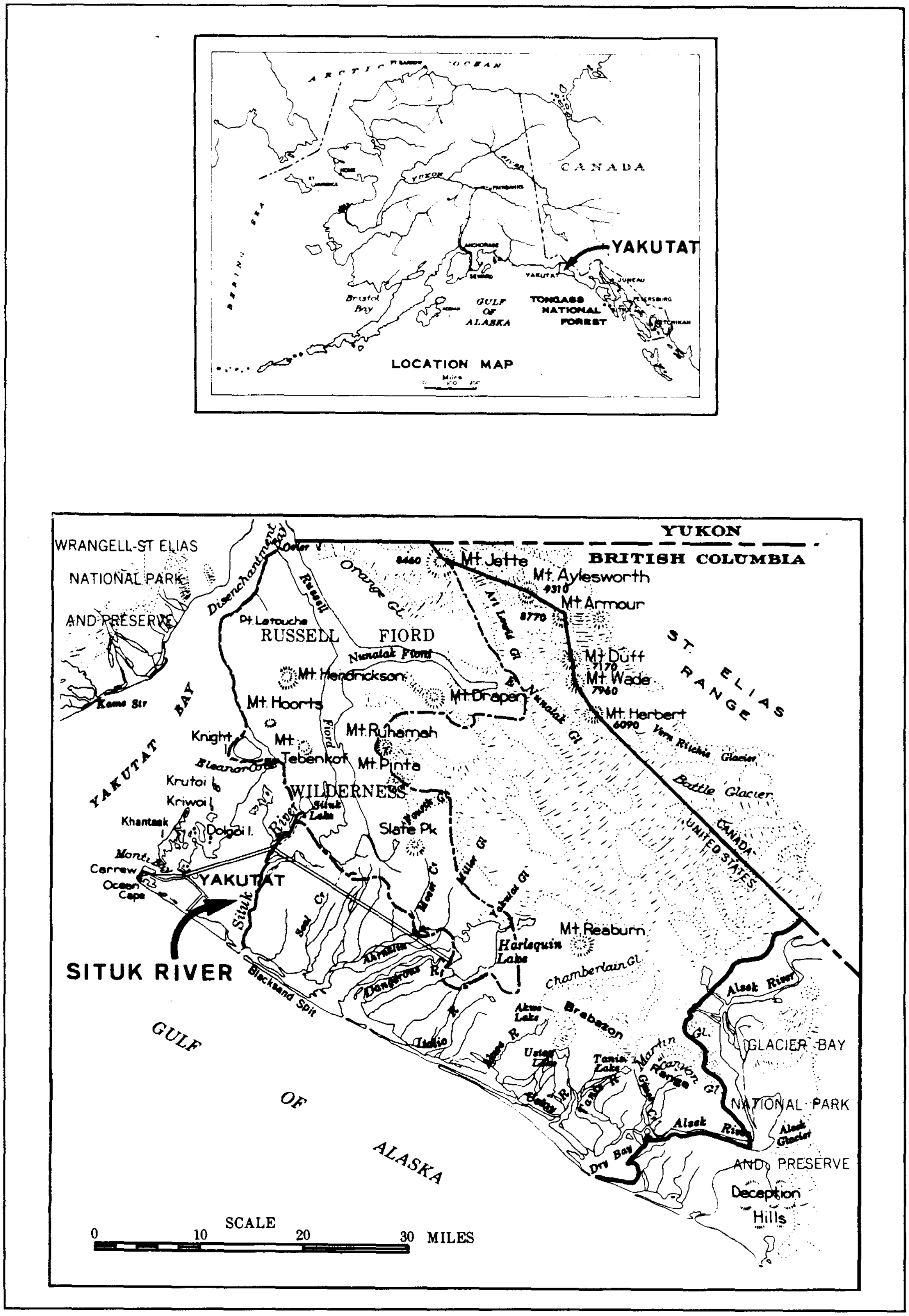

Figure 9. Situk River drainage.

Enumeration of Adult Chinook Salmon

Escapements of chinook salmon in selected index areas of nine river systems in southeast Alaska, northwest British Columbia, and the Yukon Territory, Canada are estimated annually as a part of the southeast Alaska Chinook Salmon Research Project. Aerial or foot surveys were conducted shortly before, during, or shortly after the peak of spawning. Peak spawning times, defined as the period when the largest number of adult chinook salmon are actively spawning in a particular stream or river, are well documented from previous surveys of the same index areas conducted over the past 15 years (Kissner 1982). These escapement counts have been used as a comparable index of escapements since 1975. A subset of these areas (Appendix A1) was used to form an index of abundance for southeast Alaska. In accordance with the U.S./Canada Pacific Salmon Treaty, this abundance index was used to determine the progress of rebuilding for the chinook salmon stocks of southeast Alaska and transboundary rivers.

Escapement counts of selected index spawning areas were expanded by the percentage of the total season escapement observed during the peak spawning period. These expansion factors varied according to the difficulties encountered in observing spawning chinook salmon due to overhanging vegetation, turbid water conditions, presence of other salmon species (i.e., pink and chum salmon), or protraction of run timing. Survey expansion factors ranged from 1/0.80 for Big Boulder and Stonehouse Creeks to 1/0.625 for most other systems (Appendix A1). No survey expansions were necessary for those systems where upstream counting weirs were used to enumerate spawning chinook salmon. Peak aerial, foot, or weir counts were also expanded for the percentage of the total escapement to the entire drainage observed in index tributaries (i.e., not all tributaries or spawning areas were surveyed).

The validity of these expansion factors was unknown for the majority of the index systems. In fact, comparison of aerial surveys with weir counts on some systems indicates the survey expansion factors for the larger systems may have been too low. However, these expansion factors have been used since 1981 and have been adopted by the Joint Chinook Salmon Technical Committee (CTC) of the Pacific Salmon Commission. Therefore, a formal review of these index expansion methods by ADF&G, the Canadian Department of Fisheries and Oceans (CDFO) and the CTC should occur before modifications are made. The primary purpose of the index expansion program has been to gauge the annual progress of rebuilding for the chinook salmon stocks of the southeast Alaska region.

Peak escapement surveys were conducted on foot or from a Bell 206 or Hughes 500D helicopter during periods of peak spawning. An attempt was made to survey each of the index areas twice unless turbid water or unsafe flying conditions preclude the second survey. Pilots were directed to fly the helicopter from 6 to 15 meters above the river bed at a speed of 6 to 16 kilometers per hour. The helicopter door on the side of the observer was removed and the helicopter was flown sideways while observations of spawning chinook salmon were made from the open space. Only large (age 1.3 and 1.4) chinook salmon greater than 660 mm fork length (FL) or 28 in. total length (TL) were counted during aerial or foot surveys. No attempt was made to accurately count small age 1.1 and 1.2 chinook salmon that average less than 660 mm FL or 28 in. (TL). These small chinook salmon, also called jacks, are early maturing, precocious males that were considered to be surplus to spawning escapement needs. These small chinook salmon were easy to visually separate from their larger age 1.3 and 1.4 counterparts due to their short, compact body configuration and lighter coloration. Length composition by age for Taku River chinook salmon is shown in Figure 10.

Chinook escapement counts were also obtained from fish counting weirs operated by the CDFO on the Little Tahltan (Stikine), Tatsamenie (Taku), and Klukshu (Alsek) Rivers, and by ADF&G on the King Salmon River (Admiralty Island) and Situk River. Except for the Situk River, where aerial surveys were not practical due to overhanging vegetation, weir counts were compared with aerial or foot surveys to determine the relative accuracy of surveys of peak escapement in predicting total escapements.

Differences in escapement counts between index tributaries on the Taku River were tested by a chi-square test of independence (Conover 1980), where rows in the contingency table are years, and columns are the different index tributaries (Conover 1980). This comparison was conducted to determine the appropriateness of using additional Taku River tributaries in the index expansion. Only two tributaries, the Nakina and Nahlin Rivers, have been used to estimate total escapement to the Taku River in prior years, even though escapement surveys have been conducted annually on the Tatsamenie, Kowatua, and Dudidontu rivers and on Tseta Creek. This analysis was not conducted on any of the other river systems because: 1) all tributaries were surveyed and used in the index (e.g., Unuk and Chickamin rivers); 2) no long-term database of escapement counts existed for all tributaries (e.g., Stikine, Alsek, and Chilkat rivers); or 3) there were no unsurveyed tributaries that supported spawning populations of chinook salmon in the particular drainage (e.g., Blossom, Keta, and King Salmon rivers and Andrew Creek).

RESULTS

Thirty-one index locations were surveyed in 1989 (Appendix A2). Surveys generally progressed as planned, and poor weather and water conditions only precluded aerial surveys of the Kowatua (Taku tributary), Blanchard (Alsek tributary), and Tahltan (Stikine tributary) rivers. The Wilson River was not surveyed due to time and funding constraints. None of the unsurveyed index areas were used to construct the abundance indices for the respective river systems.

Taku River

The observed peak escapement of 9,480 large chinook salmon into the six major spawning tributaries of the Taku River was the second largest escapement observed since methods for conducting aerial escapement surveys were standardized in 1973 (Table 1). Escapements were above recent year averages in all tributaries except the Dudidontu River (Table 2). Expanding the Nakina (5,141) and Nahlin (1,812) river index escapement counts by the survey (1/0.75) and tributary (1/0.60) expansion factors resulted in a total escapement estimate for the Taku River of 15,451 large chinook salmon. Except for 1987, chinook salmon escapements to the Taku River have increased every year since 1983. Despite this increasing trend, chinook salmon escapements to the Taku River have fallen below a linear rebuilding schedule every year since 1982 (Figure 11) and the estimated escapement for 1989 is still 40% below the management escapement goal of 25,600 large chinook salmon.

The index expansion method used for the Taku River, relied on the assumption that escapements to the index tributaries are a constant proportion of the total

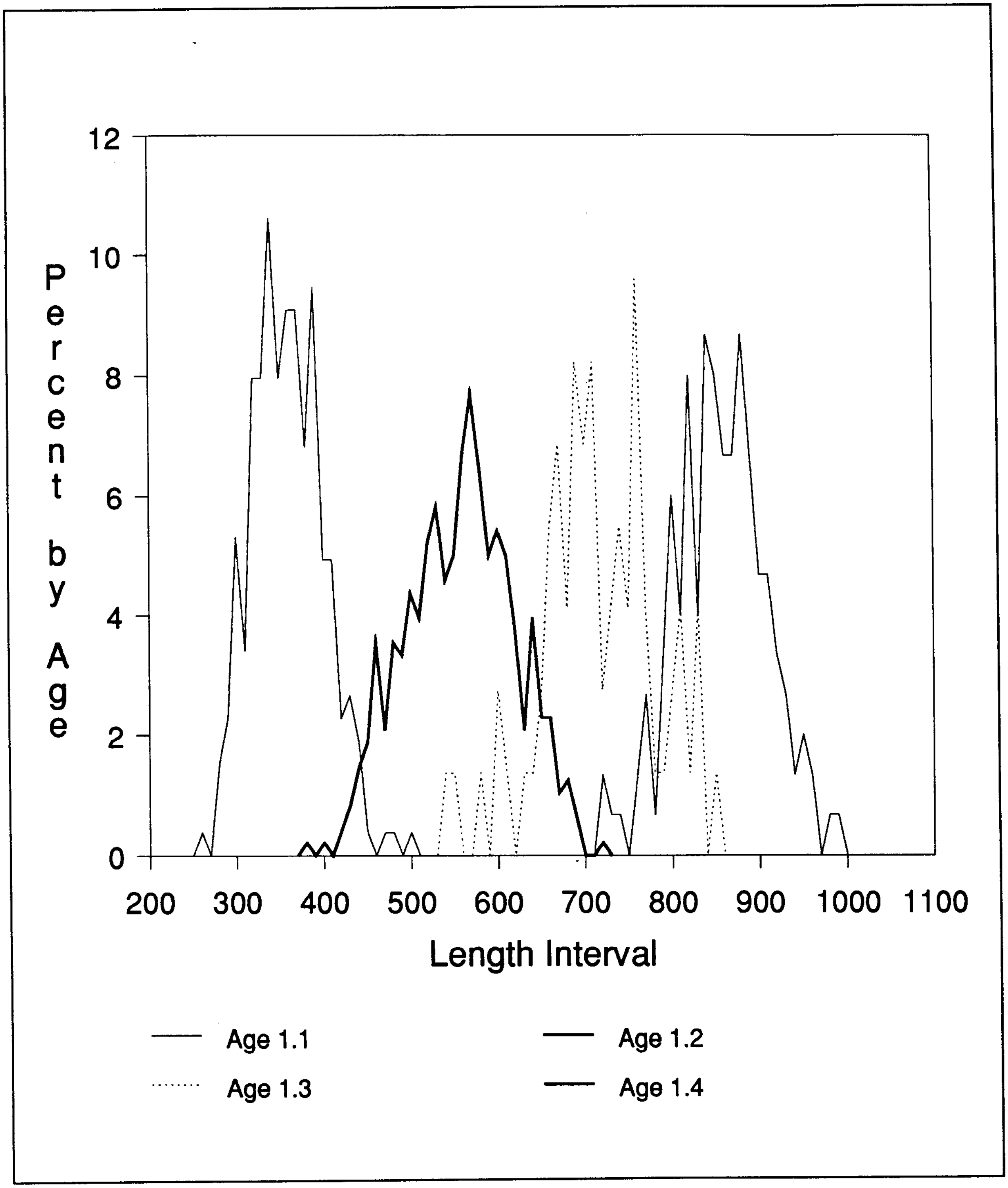

Figure 10. Length distribution by age of Taku River chinook salmon captured in the Canyon Island fishwheel, 1988.

Table 1. Peak escapement counts of chinook salmon for tributaries of the Taku River, 1951-1989.[a,b]

Year	Nakina River	Kowatua River	Tatsamenie River	Dudidontu River	Tseta Creek	Nahlin River	Total
1951	5,000 (F)	-	-	400 (F)	100 (F)	1,000 (F)	6,500
1952	9,000 (F)	-	-	-	-	-	9,000
1953	7,500 (F)	-	-	-	-	-	7,500
1954	6,000 (F)	-	-	-	-	-	6,000
1955	3,000 (F)	-	-	-	-	-	3,000
1956	1,380 (F)	-	-	-	-	-	1,380
1957	1,500	-	-	-	-	-	1,500[c]
1958	2,500	-	-	4,500 (A)	-	2,500 (A)	9,500[c]
1959	4,000	-	-	-	-	-	4,000[c]
1962	-	-	-	25 (A)	81 (A)	216 (A)	322
1965	3,050 (H)	200 P(A)	50 P(A)	110 (A)	18 (A)	35 (A)	3,463
1966	3,700 P(A)	14 P(A)	100 P(A)	252 (A)	150 (A)	300 (A)	4,516
1967	700 (A)	250 P(A)	-	600 (A)	350 (A)	300 P(A)	2,200
1968	300 P(A)	1,100 (A)	800 E(A)	590 (A)	230 (A)	450 (A)	3,470
1969	3,500 (A)	3,300 (A)	800 E(A)	-	-	-	7,600
1970	-	1200 P(A)	530 E(A)	10 (A)	25 (A)	26 (A)	1,791
1971	500 (A)	1,400 E(A)	360 E(A)	165 (A)	- (A)	473 (A)	2,898
1972	1,000 (F)	170 (A)	132 (A)	102 (A)	80 P(A)	280 (A)	1,764
1973	2,000 N(H)	100 N(H)	200 E(H)	200 E(H)	4 (A)	300 E(H)	2,804
1974	1,800 E(H)	235 (A)	120 (A)	24 (A)	4 (A)	900 E(H)	3,083
1975	1,800 E(H)	-	-	15 N(H)	-	274 E(H)	2,089
1976	3,000 E(H)	341 P(A)	620 E(H)	40 (H)	-	725 E(H)	4,726
1977	3,850 E(H)	580 E(H)	573 E(H)	18 (H)	-	650 E(H)	5,671
1978	1,620 E(H)	490 N(H)	550 E(H)	- (H)	21 E(H)	624 E(H)	3,305
1979	2,110 E(A)	430 N(H)	750 E(H)	9 E(H)	-	857 E(H)	4,156
1980	4,500 E(H)	450 N(H)	905 E(H)	158 E(H)	-	1,531 E(H)	7,544
1981	5,110 E(H)	560 N(H)	839 E(H)	74 N(H)	258 N(H)	2,945 E(H)	9,786
1982	2,533 E(H)	289 N(H)	387 N(H)	130 N(H)	228 N(H)	1,246 E(H)	4,813
1983	968 E(H)	171 E(H)	236 E(H)	117 E(H)	179 N(H)	391 N(H)	2,062
1984	1,887 (H)	279 E(H)	616 E(H)	-	176 (H)	951 (H)	3,909[d]
1985	2,647 N(H)	699 E(H)	848 E(H)	475 (H)	303 E(H)	2,236 E(H)	7,208
1986	3,868 (H)	548 E(H)	886 E(H)	413 E(H)	193 E(H)	1,612 E(H)	7,520
1987	2,906 E(H)	570 E(H)	678 E(H)	287 E(H)	180 E(H)	1,122 E(H)	5,743
1988	4,500 E(H)	1,010 E(H)	1,272 E(H)	243 E(H)	66 E(H)	1,535 E(H)	8,626
1989	5,141 E(H)	601 P(W)	1,228 E(H)	204 E(H)	494 E(H)	1,812 E(H)	9,480[e]

[a] - = No Survey Conducted
(F) = Foot Survey; (A) = Fixed-wing aircraft; (H) = Helicopter
P = Survey conditions hampered by glacial or turbid waters
N = Normal water flows and turbidities; average survey conditions
E = Survey conditions excellent

[b] Escapement counts before 1975 may not be comparable due to changes in survey dates and methods.

[c] Partial survey of Nakina River in 1957-59; comparisons made from carcass weir counts.

[d] Surveys in 1984 conducted by CDFO; partial survey of Tseta Creek and Nahlin.

[e] Carcass weir at Kowatua River used to partially enumerate escapement due to unfavorable water conditions.

Table 2. Percentages of escapement observed in tributaries of the Taku River during years when all index tributaries were surveyed.

Year	Nakina River	%	Kowatua River	%	Tatsamenie River	%	Dudidontu River	%	Tseta Creek	%	Nahlin River	%	Total
1981	5,110	52	560	6	839	9	74	1	258	3	2,945	30	9,786
1982	2,533	53	289	6	387	8	130	3	228	5	1,246	26	4,813
1983	968	47	171	8	236	11	117	6	179	9	391	19	2,062
1985	2,647	37	699	10	848	12	475	7	303	4	2,239	31	7,211
1986	3,868	51	548	7	886	12	413	5	193	3	1,612	21	7,520
1987	2,906	51	570	10	678	12	287	5	180	3	1,122	20	5,743
1988	4,500	52	1,010	12	1,272	15	243	3	66	1	1,535	18	8,626
Average	3,219	49	550	8	735	11	248	4	201	4	1,584	24	6,537

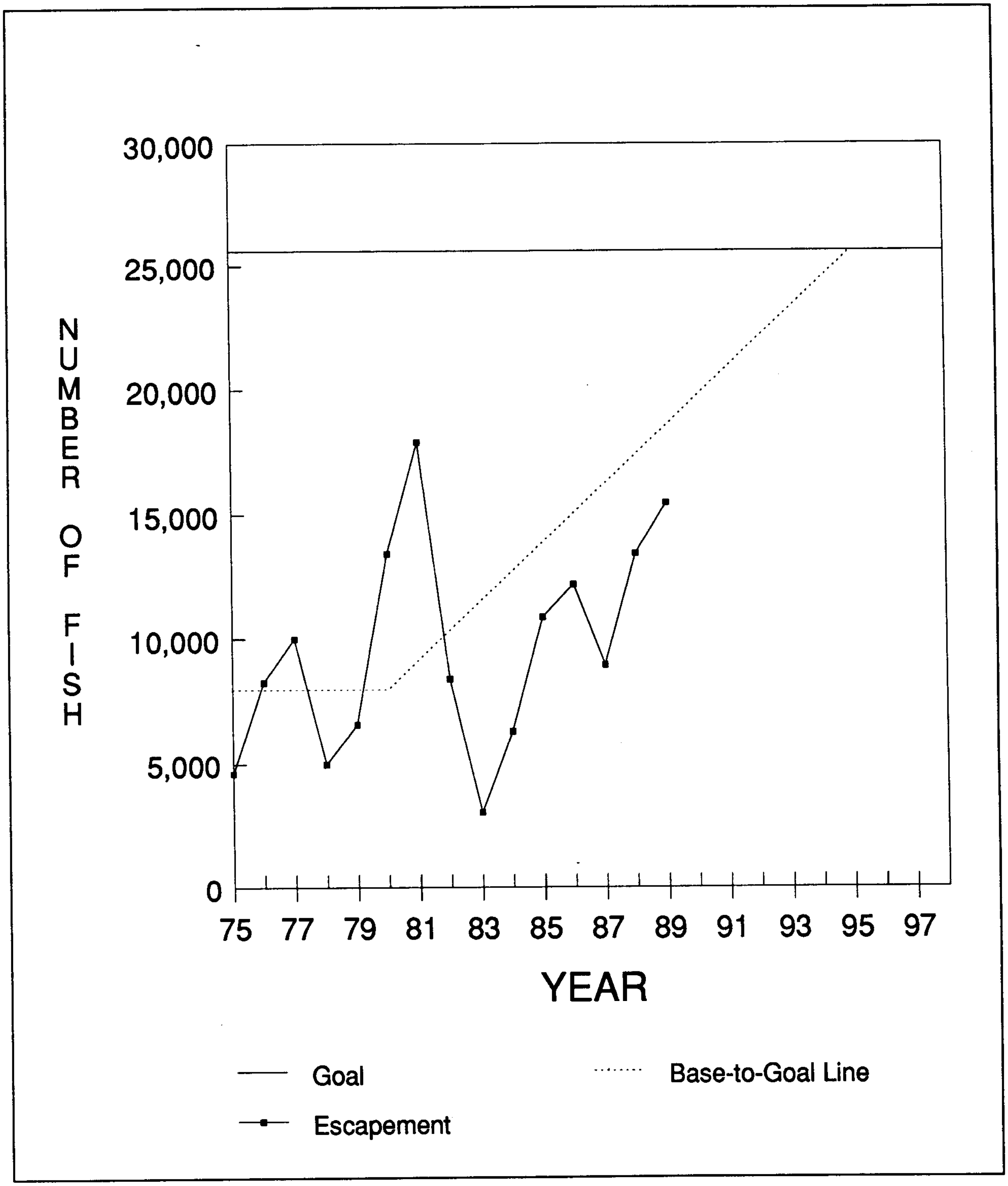

Figure 11. Estimated escapements of chinook salmon to the Taku River, 1975-1989. The base-to-goal line is a linear rebuilding trend starting in 1981 at the average escapement level during the first cycle of rebuilding (1975-1980), and ending at the management escapement goal of 25,600 large chinook salmon in 1995, the final year of the three-cycle rebuilding program.

escapement and are, therefore, "indicative" of the total escapement to all systems. The validity of this assumption can be evaluated from a chi-square test of independence where rows in the contingency table are years and columns are the six major spawning tributaries (Conover 1980). The null hypothesis can be stated as "the escapement to a particular tributary in a given year is independent of escapements in other years and tributaries". This could also be interpreted to mean that the percentage of escapement to each of the tributaries is a constant proportion of the total escapement. In other words, as the total escapement to all tributaries increases, the escapement to each tributary increases in a similar manner. This hypothesis was clearly rejected for the Taku River tributaries for those years when all tributaries were surveyed ($p < 0.001$).

Those stocks that contributed most to the significant test statistic can be ascertained by plotting the individual chi-square values for each tributary and year combination, versus the six stocks ordered by run timing (Early Stocks = Nahlin River, Dudidontu River, and Tseta Creek; Late Stocks = Tatsamenie and Kowatua). It appeared that stocks with earlier run timing exhibited higher variability in escapements and did not increase or decrease in the same proportion as changes in total escapement (Figure 12). Conversely, escapements to the Tatsamenie and Kowatua Rivers and to the Nakina River generally represented a more constant proportion of the total escapement to the Taku River than the earlier stocks.

The Tatsamenie and Kowatua Rivers originate from large lakes and the majority of chinook salmon spawn just downstream from the lake outlets. Perhaps spawning and rearing conditions experienced by chinook salmon in these lake-fed systems are more stable than in the Nahlin River drainage, and it may be that fluctuations in environmental conditions like winter water temperatures, depth of snow pack, and stream flows impact the Nahlin, Dudidontu, and Tseta Creek chinook salmon stocks to a greater extent than the Tatsamenie and Kowatua stocks. The above analysis suggests that using all of the index tributaries to estimate total escapement rather than just the Nakina and Nahlin, would lower the variability in estimating escapements to the Taku system.

Stikine River

Low-level helicopter surveys of the Little Tahltan River index area have been conducted every year since 1975. Since 1985, the CDFO has operated a fish counting weir at the mouth of the Little Tahltan River. During this time, aerial surveys have been conducted without prior knowledge of the escapement through the weir so that the relationship between peak aerial counts and actual total escapement could be quantified. From 1985 to 1989, the percentage of the total escapement of chinook salmon observed during peak aerial surveys has varied from 41.5% in 1986 to 56.6% in 1987 and averaged 50.9% (Table 3). The low percentage of the total escapement observed in 1986 resulted from poor survey conditions caused by a mudslide that occurred approximately 1.5 km above the weir site. In 1985 and 1987-1989, the percentage of the total escapement observed during helicopter surveys ranged from 50.8% to 56.6% and averaged 53.3%. No escapement survey was conducted on the mainstem Tahltan River in 1989 due to highly turbid water conditions during the peak spawning period.

The peak aerial count of chinook salmon in the Little Tahltan River of 2,527 large chinook salmon was 33% lower than the record count of 3,796 observed in 1988 (Table 4). A total of 4,715 chinook salmon were enumerated through the

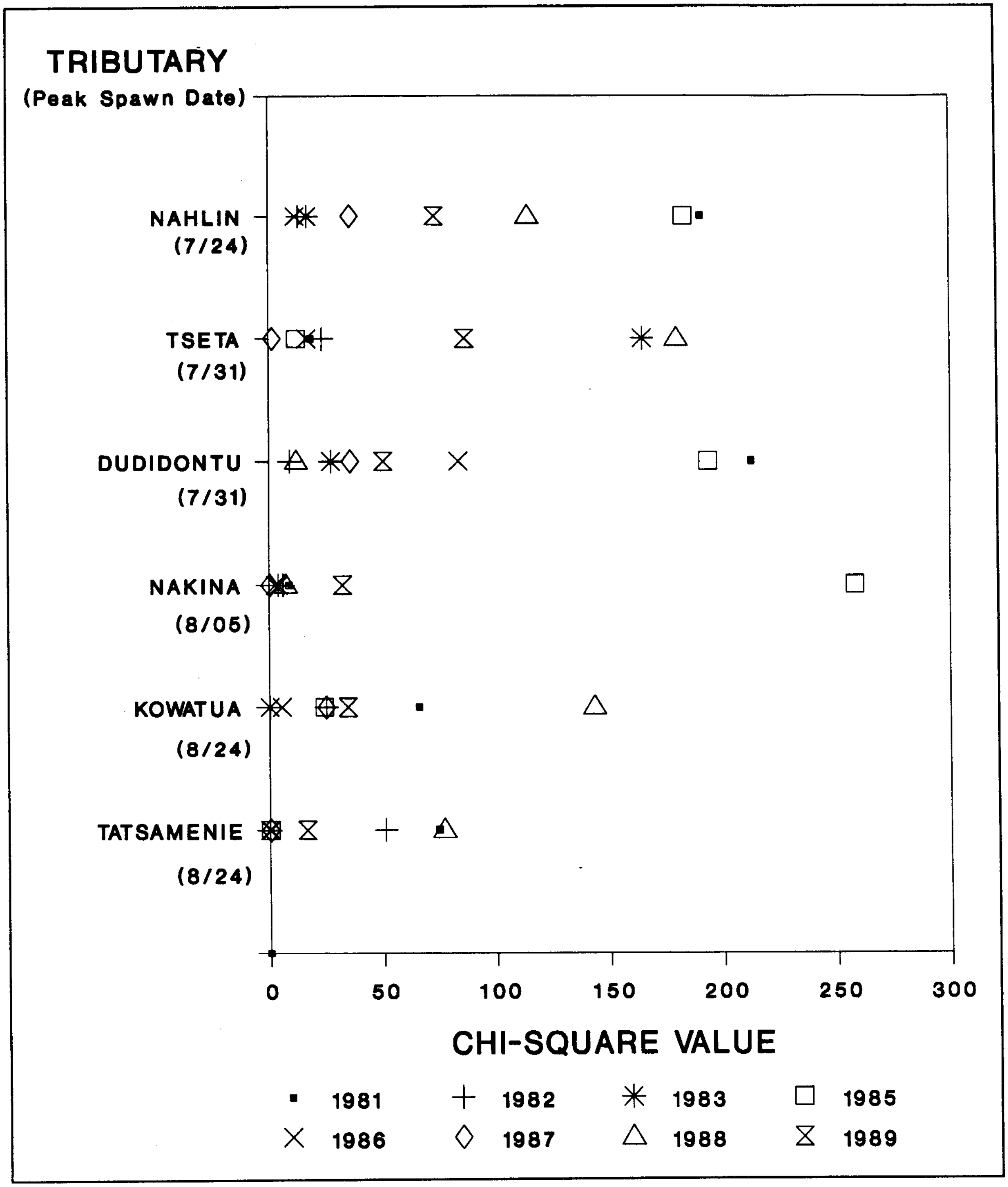

Figure 12. Distribution of chi-square values from chi-square test of independence, ordered by run timing (early versus late stocks) for index tributaries of the Taku River for years when all tributaries were surveyed.

Table 3. Peak escapement counts for Stikine River tributaries, 1956-1989.[a,b]

Year	Little Tahltan River		Mainstem Tahltan River	Beatty Creek	Andrew Creek	Total
	Peak Count	Weir Count				
1956	493 (F)	-	-	-	4,500 (A)	4,993
1957	199 (F)	-	-	-	3,000 (F/A)	3,199
1958	790 (F)	-	-	-	2,500 (F/A)	3,290
1959	198 (F)	-	-	-	150 (F/A)	348
1960	346 (F)	-	-	-	287 N(F)	633
1961	-	-	-	-	103 (F)	103
1962	-	-	-	-	300 (A)	300
1963	-	-	-	-	500 (A/H)	500
1964	-	-	-	-	400 (H)	400
1965	-	-	85	-	100 (A)	185 [c]
1966	-	-	318	-	75 (A)	393 [c]
1967	800 N(H)	-	-	-	30 (A)	830
1968	-	-	-	-	15	15
1969	-	-	-	-	12 (A)	12
1970	-	-	-	-	-	-
1971	-	-	-	-	305 (A)	305
1972	-	-	-	-	-	-
1973	-	-	-	-	40 (A)	40
1974	-	-	-	-	129 (A)	129
1975	700 E(H)	-	2,908 E(H)	-	260 (F)	3,868
1976	400 N(H)	-	120 (H)	-	468 (W)	988 [d]
1977	800 P(H)	-	25 (A)	-	534 (W)	1,359
1978	632 E(H)	-	756 P(H)	-	400 (W)	1,788
1979	1,166 E(H)	-	2,118 N(H)	-	382 (W)	3,666
1980	2,137 N(H)	-	960 P(H)	122 E(H)	362 (W)	3,581
1981	3,334 E(H)	-	1,852 P(H)	558 E(H)	629 (W)	6,373
1982	2,830 N(H)	-	1,690 N(F)	567 E(H)	910 (W)	5,997
1983	594 E(H)	-	453 N(H)	83 E(H)	444 (W)	1,574
1984	1,294 (H)	-	-	126 (H)	355 (W)	1,775 [e]
1985	1,598 E(H)	3,146	1,490 N(H)	147 N(H)	319 E(F)	5,102 [f]
1986	1,201 E(H)	2,893	1,400 P(H)	183 N(H)	707 N(F)	5,183
1987	2,706 E(H)	4,781	1,390 P(H)	312 E(H)	651 E(H)	7,134
1988	3,796 E(H)	7,292	4,384 N(H)	593 E(H)	470 E(F)	12,739
1989	2,527 E(H)	4,715	-	362 E(H)	530 E(F)	5,607

a (F) = Survey conducted by walking.
(A) = Survey conducted by fixed-wing aircraft.
(H) = Survey conducted by helicopter.
(W) = Weir count.
(F/A) = Combined foot and aerial count.
N = Normal survey conditions.
P = Survey conditions hampered by glacial or turbid waters.
E = Excellent survey conditions.
\- = No survey conducted or data not comparable.

b Escapement counts prior to 1975 may not be comparable. due to differences in survey dates and counting methods.

c Chinook lifted over barrier on mainstem Tahltan.

d Late count on mainstem Tahltan, minimal estimate.

e Surveys by CDFO in 1984.

f Total = Little Tahltan weir count plus aerial or weir counts on other systems.

Table 4. Peak escapement and weir counts of chinook salmon for Andrew Creek, 1976-1989.[a]

Year	Adult Males Above Weir	Adult Males Spawned for Hatchery	Jacks Above Weir	Adult Females Above Weir	Adult Females Egg Take	Adult[b] Males Below Weir	Adult Females Below Weir	Total Adults Below Weir	Total Adult Male Return	Total Adult Female Return	Total Adult Return	Total Adult Male Spawners	Total Adult Female Spawners	Total Adult Spawners	Survey Date or Weir Removed
1976	151	29	50	200	35	23	30	53	203	265	468	174	230	404 (W)	8/23
1977	224	24	36	172	54	31	29	60	279	255	534	255	201	456 (W)	8/22
1978	165	5	75	178	7	22	23	45	192	208	400	187	201	388 (W)	8/09
1979	154	27	89	135	28	20	18	38	201	181	382	174	153	327 (W)	8/06
1980	80	39	272	160	42	15	26	41	134	228	362	95	186	281 (W)	8/13
1981	250	57	119	190	61	39	32	71	346	283	629	289	222	511 (W)	8/22
1982	224	109	124	300	166	46	65	111	379	531	910	270	365	635 (W)	8/21
1983	143	31	38	173	47	22	28	50	196	248	444	165	201	366 (W)	8/30
1984	124	0	200	191	0	16	24	40	140	215	355	140	215	355 (W)	8/25
1985	-	-	-	-	-	-	-	-	-	-	-	147	172	319 (F)	8/11[c]
1986	-	-	-	-	-	-	-	-	-	-	-	325	382	707 (F)	8/14
1987	-	-	-	-	-	-	-	-	-	-	-	299	352	651 (H)	8/11
1988	-	-	-	-	-	-	-	-	-	-	-	216	254	470 (H)	8/12
1989	-	-	-	-	-	-	-	-	-	-	-	244	286	530 (F)	8/12

[a] (F) = Foot survey; (A) = Fixed-wing aircraft; (H) = Helicopter; (W) = Weir count

[b] Adult males below weir = (males through weir/total adults)x(total adults below weir).
Adult females below weir = (females through weir/total adults)x(total adults below weir).
Total adults below weir = for 1976-1978, 1980, 1981, 1983 estimated from ratio of adult chinook through weir to adults below weir during 1979, 1982, and 1984.

[c] Total adult male spawners for 1985-1988 = ratio of males to females in prior years (0.459) x total adult return
Total adult female spawners for 1985-1988 = ratio of females to males in prior years (0.541) x total adult return
Total adult return (spawners) for 1985-1988 = peak escapement count (helicopter survey)

Little Tahltan weir in 1989, 35% lower than record weir count of 7,292 large chinook salmon observed in 1988. No escapement survey was conducted on the mainstem Tahltan River in 1989 due to highly turbid water conditions during the peak spawning period. The peak escapement count of 362 large chinook salmon in Beatty Creek was 39% lower than the record count of 593 chinook salmon seen in 1988. The escapement of chinook salmon to Andrew Creek increased from 470 in 1988, to 570 in 1989 (Table 5).

Expansion of the 1989 Little Tahltan weir count of 4,715 large chinook salmon by the tributary expansion factor (1/0.25) results in a total Stikine River escapement estimate of 18,860 large chinook salmon. This is 35% lower than the record Stikine River escapement estimate of 29,168 in 1988 but still 40% higher than the management escapement goal of 13,440 large chinook salmon. Escapements of chinook salmon to the Stikine River have been well above the management escapement goal and linear rebuilding trend since 1987 (Figure 13). Escapements to Andrew Creek have been above the linear rebuilding schedule since 1985 and above the escapement goal since 1986 (Figure 14).

Alsek River

Escapement data on Alsek River chinook salmon has been collected since 1962. Since 1976, the CDFO has operated a counting weir at the confluence of the Klukshu and Tatshenshini Rivers to enumerate chinook, sockeye, and coho salmon into the Klukshu River drainage. Helicopter surveys of chinook salmon escapements to index tributaries of the Alsek River have been conducted by ADF&G since 1981. Before 1976, chinook salmon escapement surveys were usually conducted from fixed-wing aircraft. Escapements of chinook salmon have not been estimated for Village and Mile 112 creeks since 1975. Turbid water conditions during the peak spawning period precluded aerial surveys of the Blanchard River in 1989.

The escapement of 2,289 large chinook salmon through the Klukshu River weir in 1989 was 15% above the 1988 escapement of 1,994 fish (Table 6). The 1989 peak aerial counts of 158 and 34 large chinook salmon in the Takhanne River and Goat Creek, respectively, were similar to 1988, but below recent year averages. The total escapement for the Alsek River drainage, estimated by expanding the weir escapement count for the Klukshu River by 1/0.64 (tributary expansion factor), was 3,577 large chinook salmon. This was 24% above 1988 but 28% less than the management escapement goal of 5,000 large chinook salmon. Escapements of chinook salmon to the Alsek River have exceeded the management escapement goal only once since 1976 and average escapements during the first cycle of the rebuilding program (1981-1985) actually declined relative to the 1975-1980 base period (Figure 15).

Unuk River

Escapements of chinook salmon to the Unuk River have historically been the largest of any river system in Behm Canal, and only the Taku, Stikine, and Alsek Rivers support larger runs of chinook salmon in southeast Alaska. In 1989, 1,149 large chinook salmon were observed in index areas of the Unuk River (Table 7). Escapements were below average in Cripple and Genes Lake creeks but above average in all other index tributaries (Table 8).

Table 5. Comparison of weir counts and aerial survey estimates of chinook salmon escapements to the Little Tahltan River, 1985-1989.

Date	Weir Count	Low Level Helicopter Count	Percent of Escapement Observed From Helicopter
8/02/85	2,379	1,262	53.1
8/06/85	2,864	1,598	55.8
Final	3,146	1,598	50.8
8/01/86	2,323	1,101	47.4
8/05/86	2,646	1,143	43.2
Final	2,893	1,201	41.5
7/31/87	3,903	2,446	62.7
8/03/87	4,456	2,706	60.7
Final	4,781	2,706	56.6
7/30/88	5,573	3,484	62.5
8/05/88	6,822	3,796	55.6
Final	7,292	3,796	52.1
7/29/89	3,772	2,515	66.7
8/04/89	4,394	2,527	57.5
Final	4,715	2,527	53.6

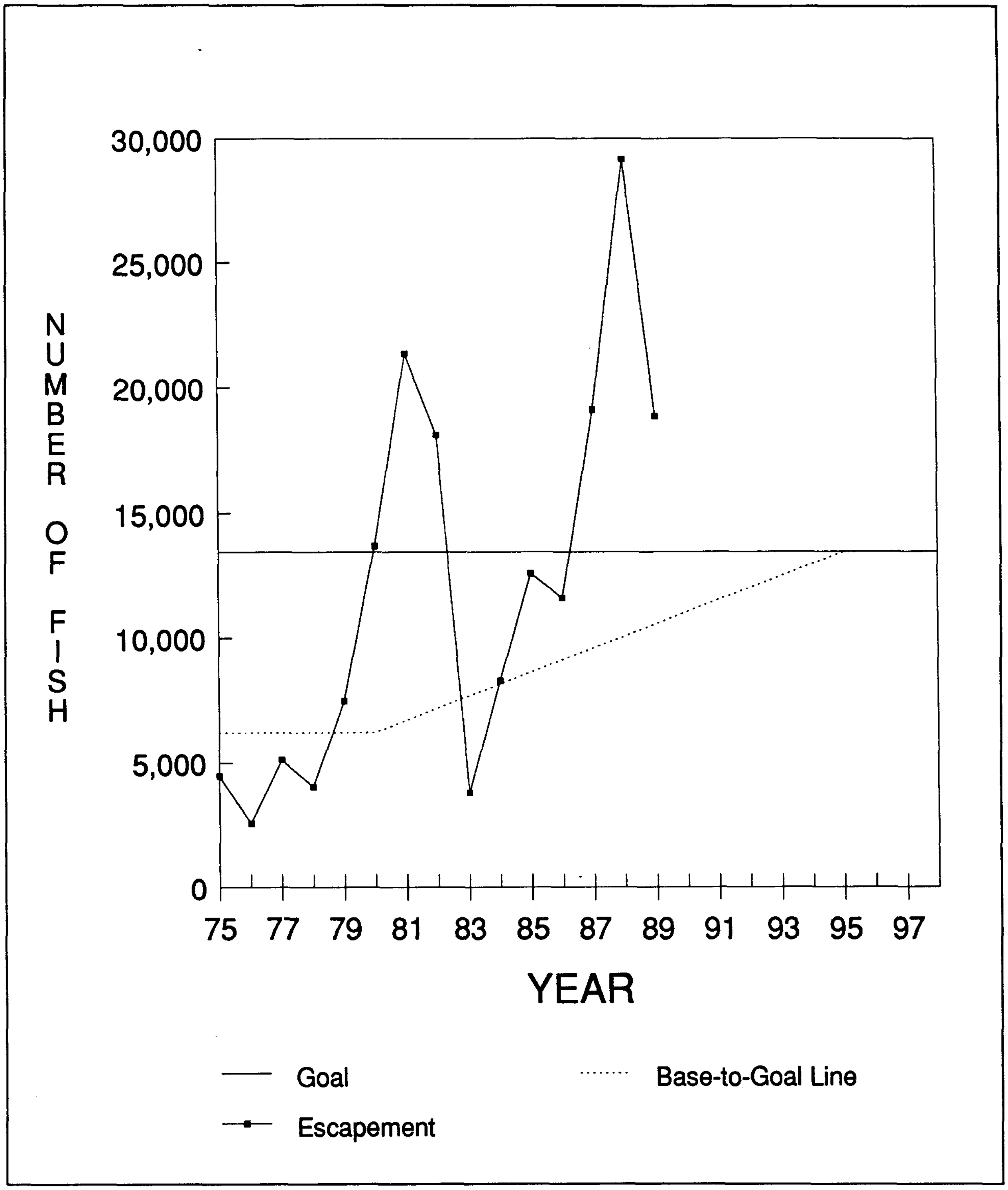

Figure 13. Estimated escapements of chinook salmon to the Stikine River, 1975-1989. The base-to-goal line is a linear rebuilding trend starting in 1981 at the average escapement level during the first cycle of rebuilding (1975-1980), and ending at the management escapement goal of 13,440 large chinook salmon in 1995, the final year of the three-cycle rebuilding program.

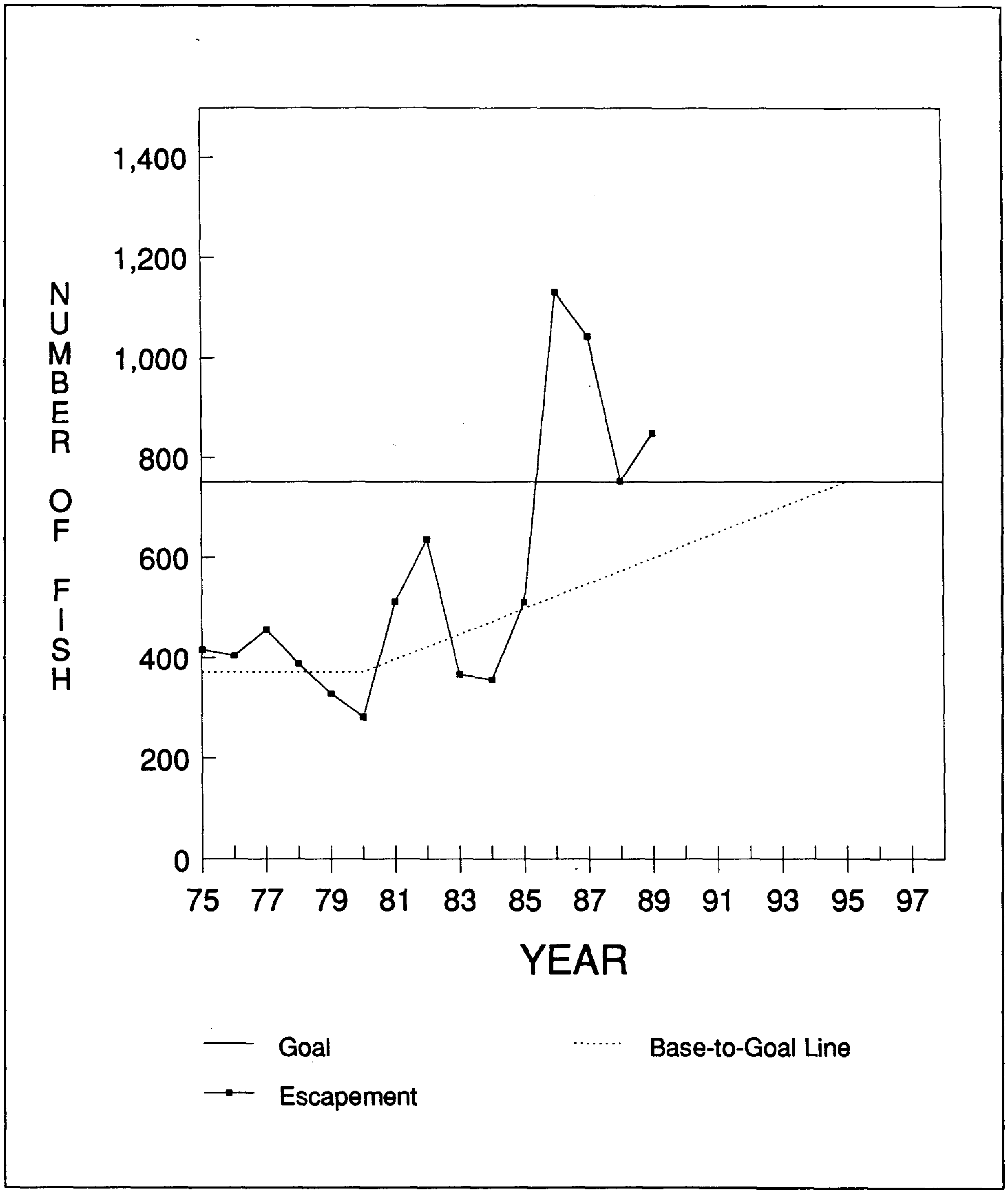

Figure 14. Estimated escapements of chinook salmon to Andrew Creek, 1975-1989. The base-to-goal line is a linear rebuilding trend starting in 1981 at the average escapement level during the first cycle of rebuilding (1975-1980), and ending at the management escapement goal of 750 large chinook salmon in 1995, the final year of the three-cycle rebuilding program.

Table 6. Peak escapement and weir counts of chinook salmon for tributaries of the Alsek River, 1960-1989.[a,b]

Year	Village System	Mile 112 Creek	Klukshu Weir Count	Klukshu Escape-ment[c]	Blanchard River	Takhanne River	Goat Creek	Total[d]
1962	-	-	86	86	-	-	-	86
1963	-	-	-	-	-	-	-	-
1964	-	-	20	20	-	-	-	20
1965	-	-	100	100	100	250	-	450
1966	-	-	1,000	1,000	100	200	-	1,300
1967	-	-	1,500	1,500	200	275	-	1,975
1968	-	-	1,700	1,700	425	225	-	2,350
1969	-	72	700	700	250	250	-	1,272
1970	100	-	500	500	100	100	-	800
1971	50	60	300	300	-	-	-	410
1972	-	32	1,100	1,100	12 (A)	250	-	1,394
1973	-	-	-	-	-	49 (A)	-	49
1974	14	183	62	62	52 (A)	132	-	443
1975	17	-	58	58	81 (A)	177 (A)	-	333
1976	-	-	1,244	1,153	-	-	-	1,153
1977	-	-	3,144	2,894	-	-	-	2,894
1978	-	-	2,976	2,676	-	-	-	2,676
1979	-	-	4,403	4,274	-	-	-	4,274
1980	-	-	2,637	2,487	-	-	-	2,487
1981	0	-	2,113	1,963	35 (H)	11 (H)	-	2,009
1982	-	-	2,369	1,969	59 (H)	241 (H)	13 (H)	2,282
1983	-	-	2,537	2,237	108 (H)	185 (H)	-	2,530
1984	-	-	1,672	1,572	304 (H)	158 (H)	28 (H)	2,062[e]
1985	-	-	1,458	1,283	232 (H)	184 (H)	-	1,699
1986	-	-	2,709	2,607	556 (H)	358 (H)	142 (H)	3,663
1987	-	-	2,615	2,491	624 (H)	395 (H)	85 (H)	3,595
1988	-	-	2,018	1,994	437 E(H)	169 E(H)	54 E(H)	3,116
1989	-	-	2,456	2,289	-	158 E(H)	34 E(H)	3,577

[a] (F) = Escapement survey conducted by walking river.
(A) = Escapement Survey conducted from fixed-wing aircraft.
(H) = Escapement survey conducted from helicopter.
E = Excellent survey conditions.
\- = No survey conducted or data not comparable.

[b] Escapement counts prior to 1975 may not be comparable due to differences in survey dates and counting methods.

[c] Klukshu River escapement = weir count minus subsistence fishery harvest.

[d] Surveys conducted by CDFO in 1984.

[e] Total escapement = Klukshu escapement plus aerial counts of other systems.

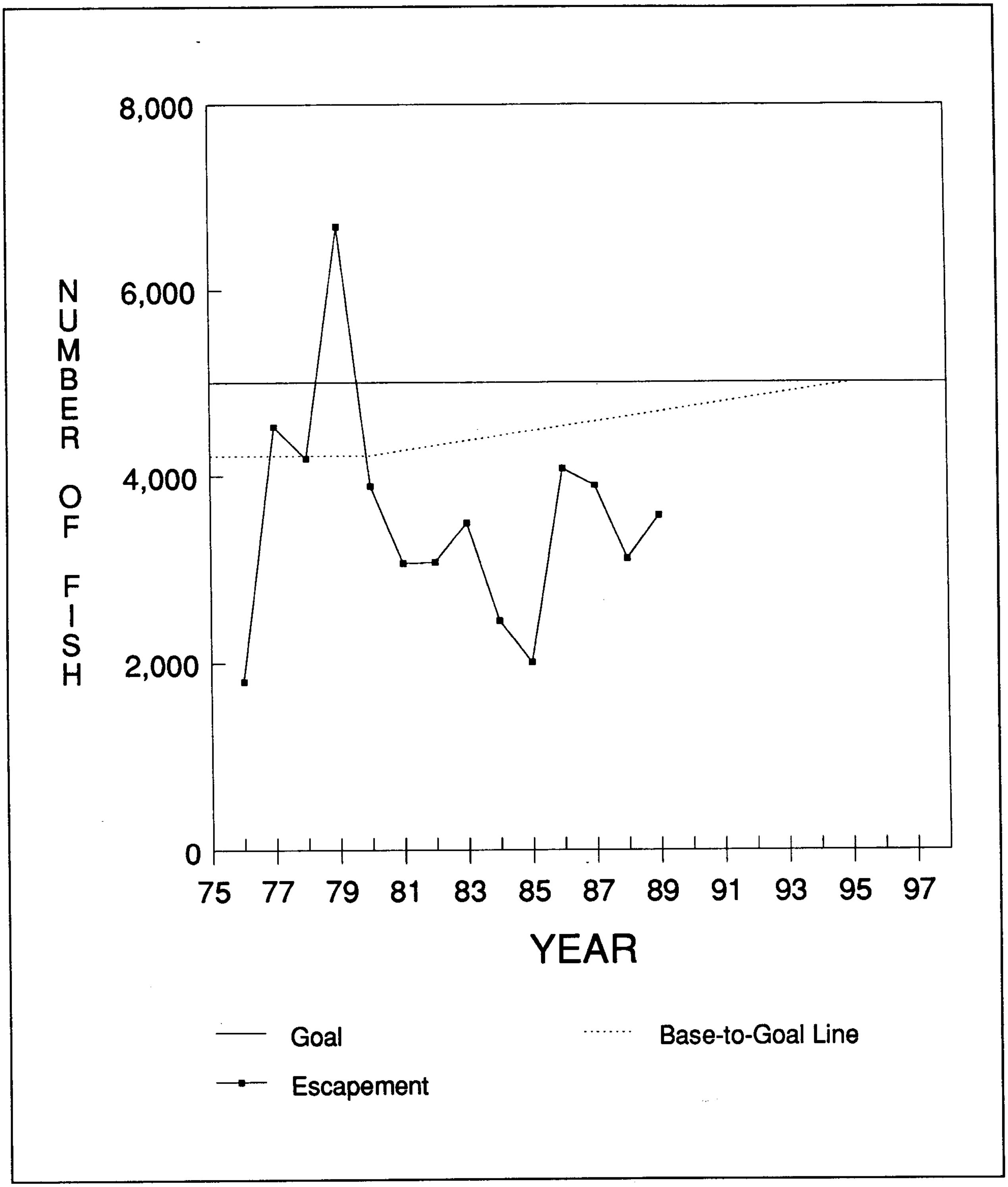

Figure 15. Estimated escapements of chinook salmon to the Alsek River, 1975-1989. The base-to-goal line is a linear rebuilding trend starting in 1981 at the average escapement level during the first cycle of rebuilding (1975-1980), and ending at the management escapement goal of 5,000 large chinook salmon in 1995, the final year of the three-cycle rebuilding program.

Table 7. Peak escapement counts of chinook salmon to index tributaries of the Unuk River, 1960-1989. [a,b]

Year	Cripple Creek	Genes Lake Creek	Eulachon Creek	Clear Creek	Lake Creek	Kerr Creek	Total
1960	-	-	250 (A)	-	-	-	250
1961	3 (F)	200 (F)	270 (F)	65 (F)	-	53 (F)	591
1962	-	150 (A)	145 (A)	100 (A)	30 (A)	-	425
1963	100 (A)	750 (A)	150 (A)	25 (A)	-	-	1,025
1964	-	-	25 (A)	-	-	-	25
1965	-	-	-	-	-	-	-
1966	-	-	-	-	-	-	-
1967	-	-	60 (H)	-	-	-	60
1968	-	-	75 (H)	-	-	-	75
1969	-	-	150 (H)	-	-	-	150
1970	-	-	-	-	-	-	-
1971	-	-	30 (A)	-	-	-	30
1972	95 (A)	35 (A)	450 (A)	90 (A)	55 (A)	-	725
1973	-	-	64 (H)	-	-	-	64
1974	-	-	68 (H)	-	-	-	68
1975	-	-	17 (H)	-	-	-	17
1976	-	-	3 (A)	-	-	-	3
1977	529 (F)	339 (F)	57 (H)	34 (H)	-	15 (H)	974
1978	394 (F)	374 (F)	218 (H)	85 (H)	20 (H)	15 (H)	1,106
1979	363 (F)	101 (F)	48 (H)	14 (H)	30 (H)	20 (H)	576
1980	748 (F)	122 (F)	95 (H)	28 (H)	5 (H)	18 (H)	1,016
1981	324 (F)	112 (F)	196 (H)	54 (H)	20 (H)	25 (H)	731
1982	538 (F)	329 (F)	384 (H)	24 (H)	48 (H)	28 (H)	1,351
1983	459 (F)	338 (F)	288 (H)	24 (H)	12 (H)	4 (H)	1,125
1984	644 (F)	647 (F)	350 (H)	113 (H)	32 (H)	51 (H)	1,837
1985	284 (F)	553 (F)	275 (H)	37 (H)	22 (H)	13 (H)	1,184
1986	532 (F)	838 (F)	486 (H)	183 (F)	25 (H)	62 (H)	2,126
1987	860 (F)	398 (F)	520 (H)	107 (H)	37 (H)	51 (H)	1,973
1988	1,068 (F)	154 (F)	146 (F)	292 (H)	60 (H)	26 (H)	1,746
1989	351 (F)	302 (F)	298 (H)	128 (H)	27 (F)	43 (H)	1,149

[a] (F) = Escapement survey conducted by walking river
(A) = Escapement Survey conducted from fixed-wing aircraft
(H) = Escapement survey conducted from helicopter
- = No survey conducted or data not comparable

[b] Escapement counts prior to 1975 may not be comparable due to differences in survey dates and counting methods.

Table 8. Percentages of total escapements of chinook salmon to index tributaries of the Unuk River for years when all index tributaries were surveyed.

Year	Cripple Creek	%	Genes Lake Creek	%	Eulachon Creek	%	Clear Creek	%	Lake Creek	%	Kerr Creek	%	Total
1978	394	35.6	374	33.8	218	19.7	85	7.7	20	1.8	15	1.4	1,106
1979	363	63.0	101	17.5	48	8.3	14	2.4	30	5.2	20	3.5	576
1980	748	73.6	122	12.0	95	9.4	28	2.8	5	0.5	18	1.8	1,016
1981	324	44.3	112	15.3	196	26.8	54	7.4	20	2.7	25	3.4	731
1982	538	39.8	329	24.4	384	28.4	24	1.8	48	3.6	28	2.1	1,351
1983	459	40.8	338	30.0	288	25.6	24	2.1	12	1.1	4	0.4	1,125
1984	644	35.1	647	35.2	350	19.1	113	6.2	32	1.7	51	2.8	1,837
1985	284	24.0	553	46.7	275	23.2	37	3.1	22	1.9	13	1.1	1,184
1986	532	25.0	838	39.4	486	22.9	183	8.6	25	1.2	62	2.9	2,126
1987	860	43.6	398	20.2	520	26.4	107	5.4	37	1.9	51	2.6	1,973
1988	1,068	61.2	154	8.8	146	8.4	292	16.7	60	3.4	26	1.5	1,746
1989	351	30.5	302	26.3	298	25.9	128	11.1	27	2.3	43	3.7	1,149
Mean	547	43.0	356	25.8	275	20.3	91	6.3	28	2.3	30	2.3	1,327

Expansion of the peak aerial survey count by the survey expansion factor of 1/0.625 results in a total escapement estimate of 1,838 large chinook salmon. The 1989 estimated total escapement was 34% below the 1988 escapement of 2,794 chinook salmon and only 64% of the management escapement goal of 2,880 large chinook salmon. The 1989 estimated escapement of chinook salmon to the Unuk River was 8% below the average escapements observed during the first rebuilding cycle (1981-1985) and only 25% above the 1975-1980 average of 1,469 chinook salmon. Escapements of chinook salmon to the Unuk River have declined every year since 1986, and actually fell below the linear rebuilding schedule in 1989 (Figure 16).

Chickamin River

Chinook salmon have been enumerated by foot or helicopter surveys in index tributaries of the Chickamin River each year since 1977. The 1989 observed escapement to the eight index tributaries of the Chickamin River was 934 large chinook salmon compared to 786 in 1988 (Table 9).

Expansion of the total observed peak escapement by the survey expansion factor of 1/0.625 gives an estimated total escapement to the Chickamin River drainage of 1,494 chinook salmon, approximately 4% above the management escapement goal of 1,440 large chinook salmon. The 1989 total escapement was 19% higher than in 1988, and 342% and 28% higher than the 1975-1980 and 1981-1985 average escapements, respectively. Escapements in 1989 were above average in all of the Chickamin River tributaries except Humpy, Barrier and King Creeks (Table 10). Total escapements of chinook salmon to the Chickamin River have been above the linear rebuilding schedule since 1980, and close to or above the management escapement goal since 1984 (Figure 17).

Chilkat River

Escapements of chinook salmon to the Chilkat River declined significantly in 1985 and 1986 leading ADF&G to implement a number of restrictions on the Haines marine recreational fishery (Mecum and Kissner 1989). These fishery restrictions have resulted in improved escapements since 1986. In 1989, 305 large chinook salmon were observed during the peak aerial surveys of the Big Boulder and Stonehouse Creek index streams. The observed peak escapement for Stonehouse Creek of 231 large chinook salmon exceeded the management escapement goal of 225 fish (Table 11). This was the first time that the escapement goal has been obtained for Stonehouse Creek since aerial surveys of this system began in 1981. Expanding the peak aerial count of 305 chinook salmon for Big Boulder and Stonehouse Creek, combined, by the tributary (1/0.28) and survey (1/0.80) expansion factors results in an estimate of 1,362 large chinook salmon for the Chilkat River system. Despite the improvement in 1989, escapements of chinook salmon to the Chilkat River are still well below the total escapement goal of 2,000 large chinook salmon (Figure 18).

Other Rivers

The observed peak escapement of 344 large chinook salmon to the Blossom River in 1989 was 10% less than the 1988 escapement of 384 and well below aerial counts recorded in recent years (Table 12). The expanded escapement estimate for the

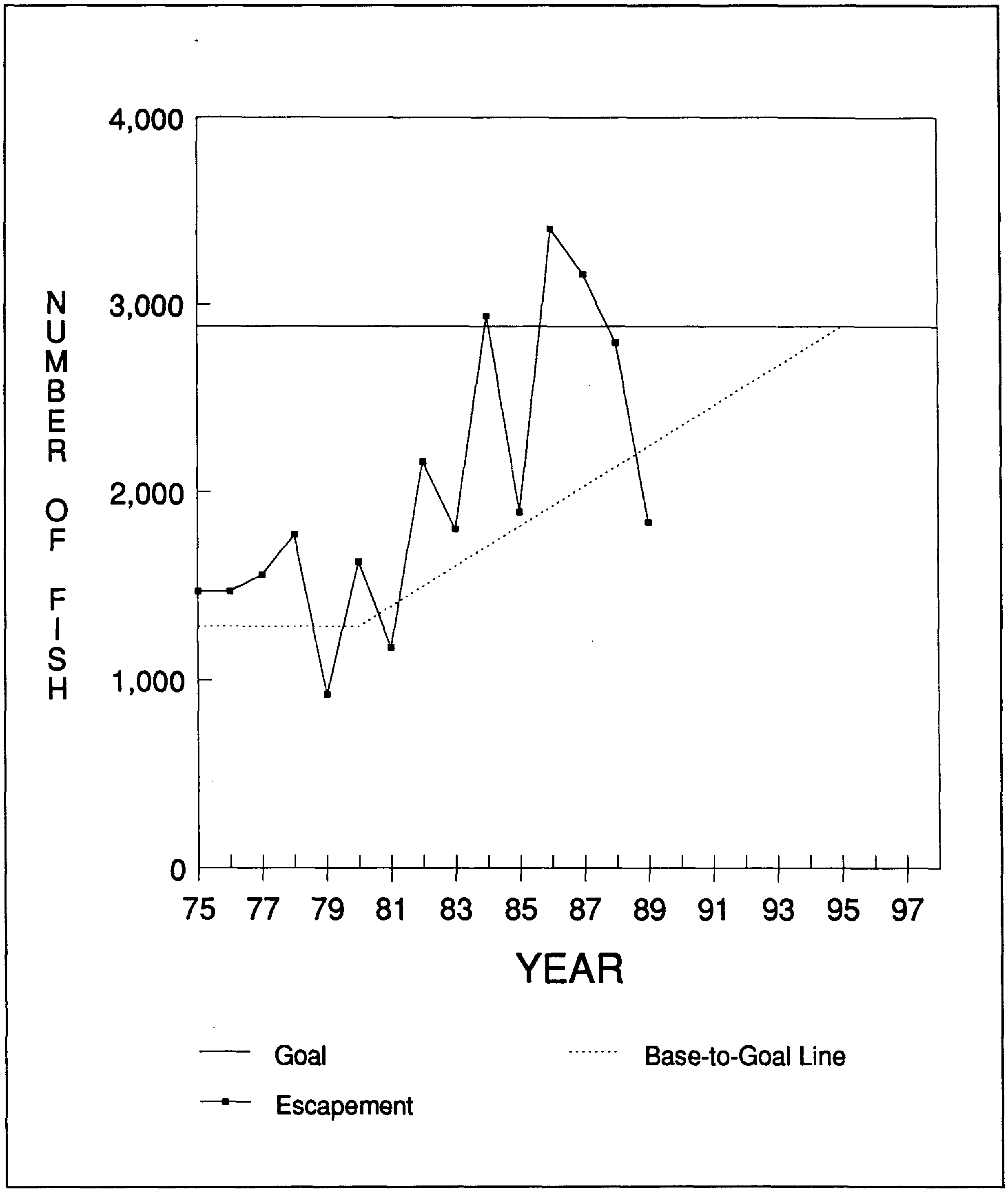

Figure 16. Estimated escapements of chinook salmon to the Unuk River, 1975-1989. The base-to-goal line is a linear rebuilding trend starting in 1981 at the average escapement level during the first cycle of rebuilding (1975-1980), and ending at the management escapement goal of 2,880 large chinook salmon in 1995, the final year of the three-cycle rebuilding program.

Table 9. Peak escapements of chinook salmon to tributaries of the Chickamin River, 1960-1989. [a,b]

Year	South Fork Creek	Barrier Creek	Butler Creek	Leduc Creek	Indian Creek	Humpy Creek	King Creek	Clear Falls Creek	Total
1960	-	-	-	-	-	3 (A)	-	-	3
1961	-	36 (A)	77 (A)	42 (A)	5 (A)	120 (A)	48 (A)	-	328
1962	400 (A)	35 (A)	-	-	-	150 (A)	-	-	585
1963	350 (A)	115 (A)	-	-	-	3 (A)	200 (A)	-	668
1964	-	-	-	-	-	-	-	-	-
1965	-	-	-	-	-	-	75 (A)	-	75
1966	-	-	-	-	-	50 (F)	-	-	50
1967	-	-	-	-	-	-	45 (H)	-	45
1968	-	-	-	-	-	30 (H)	20 (H)	-	50
1969	-	-	-	-	-	10 (H)	45 (H)	-	55
1970	-	-	-	-	-	-	-	-	-
1971	-	-	-	-	-	-	-	-	-
1972	350 (A)	25 (A)	-	85 (A)	-	65 (A)	510 (A)	-	1,035
1973	-	-	-	-	-	14 (A)	65 (A)	-	79
1974	144 (H)	-	-	-	-	-	11 (H)	-	155
1975	141 (H)	9 (H)	66 (H)	6 (H)	90 (H)	7 (H)	30 (H)	-	349
1976	46 (H)	10 (H)	15 (H)	12 (H)	9 (H)	-	-	-	92
1977	52 (H)	66 (H)	30 (H)	26 (H)	53 (H)	0 (H)	-	-	227
1978	21 (H)	94 (H)	4 (H)	42 (H)	20 (H)	-	-	-	181
1979	63 (H)	17 (H)	29 (H)	0 (H)	31 (H)	-	-	-	140
1980	56 (H)	62 (H)	104 (H)	17 (H)	22 (H)	-	-	-	261
1981	51 (H)	105 (H)	51 (H)	25 (H)	12 (H)	4 (F)	105 (F)	31 (H)	384
1982	84 (H)	149 (H)	37 (H)	36 (H)	30 (F)	37 (F)	165 (F)	33 (H)	571
1983	28 (H)	138 (H)	91 (H)	30 (H)	47 (H)	-	212 (F)	30 (H)	576
1984	185 (H)	171 (H)	124 (H)	15 (H)	103 (H)	88 (F)	388 (F)	28 (H)	1,102
1985	163 (H)	129 (H)	92 (H)	8 (H)	125 (H)	50 (H)	377 (H)	12 (H)	956
1986	562 (H)	168 (H)	203 (H)	20 (H)	120 (H)	-	564 (H)	40 (H)	1,677
1987	261 (H)	76 (H)	120 (H)	19 (H)	115 (H)	26 (H)	310 (H)	48 (H)	975
1988	280 (H/F)	82 (H/F)	159 (H)	25 (H/F)	32 (H)	19 (H/F)	164 (H)	25 (H/F)	786
1989	226 (H/F)	90 (H)	137 (H)	57 (H)	84 (H)	22 (H/F)	224 (H)	94 (H)	934

[a] (F) = Escapement surveyed by walking stream
(H) = Escapement surveyed by helicopter
(A) = Escapement surveyed by fixed-wing aircraft
(H/F) = Escapement surveyed by combination of walking and helicopter
- = No survey conducted or data not comparable

[b] Escapement counts conducted prior to 1975 may not be comparable due to differences in survey dates and counting methods

Table 10. Percentages of total escapements of chinook salmon to index tributaries of the Chickamin River for years when all index tributaries were surveyed.

Year	South Fork Creek	%	Barrier Creek	%	Butler Creek	%	Leduc Creek	%	Indian Creek	%	Humpy Creek	%	King Creek	%	Clear Falls Creek	%	Total
1981	51	13.3	105	27.3	51	13.3	25	6.5	12	3.1	4	1.0	105	27.3	31	8.1	384
1982	84	14.7	149	26.1	37	6.5	36	6.3	30	5.3	37	6.5	165	28.9	33	5.8	571
1984	185	16.8	171	15.5	124	11.3	15	1.4	103	9.3	88	8.0	388	35.2	28	2.5	1,102
1985	136	14.2	156	16.3	93	9.7	8	0.8	125	13.1	50	5.2	377	39.4	12	1.3	957
1987	261	26.8	76	7.8	120	12.3	19	1.9	115	11.8	26	2.7	310	31.8	48	4.9	975
1988	280	35.6	82	10.4	159	20.2	25	3.2	32	4.1	19	2.4	164	20.9	25	3.2	786
1989	226	24.2	90	9.6	137	14.7	57	6.1	84	9.0	22	2.4	224	24.0	94	10.1	934
Mean	175	20.8	118	16.2	103	12.6	26	3.7	72	7.9	35	4.0	248	29.6	39	5.1	816

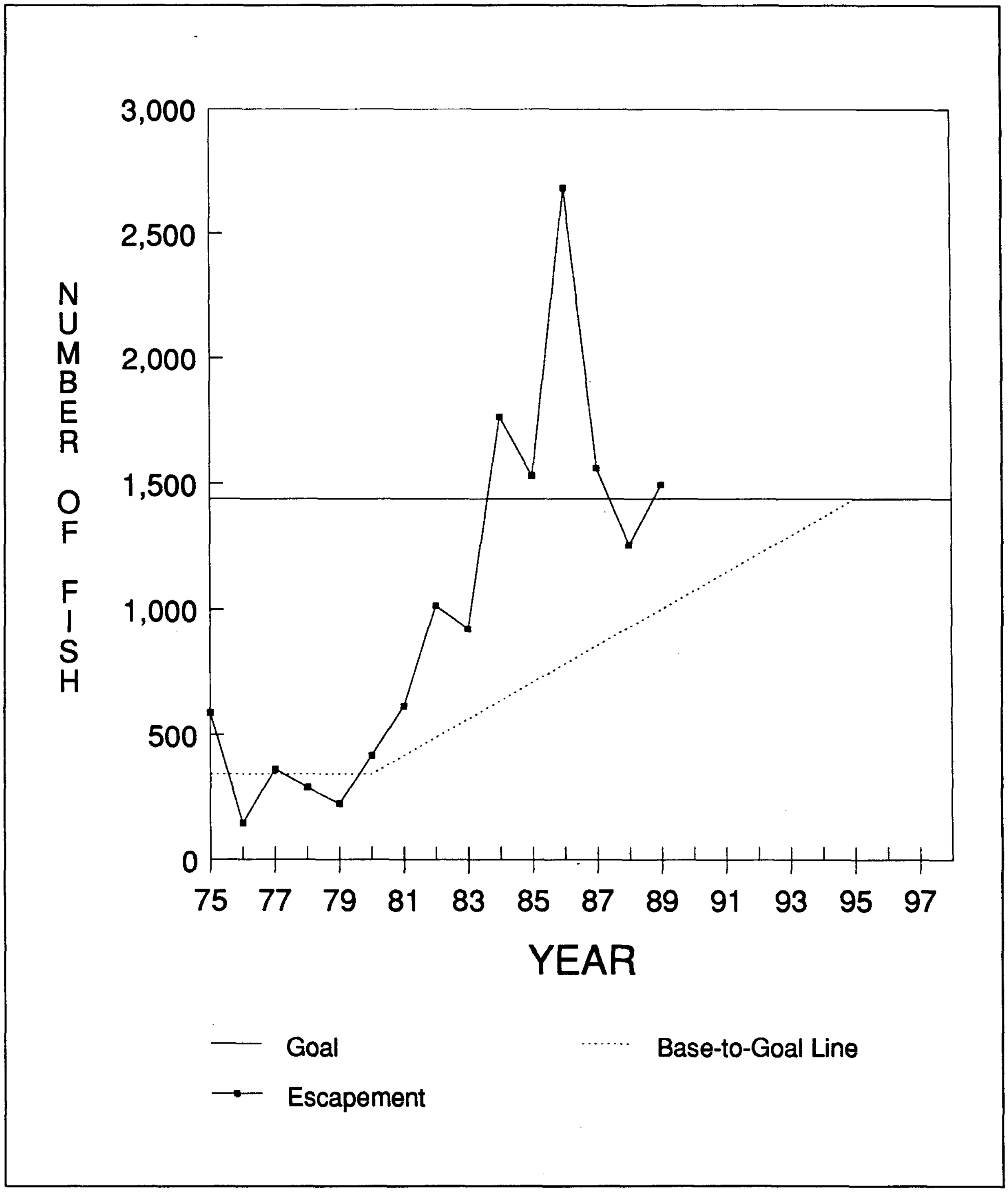

Figure 17. Estimated escapements of chinook salmon to the Chickamin River, 1975-1989. The base-to-goal line is a linear rebuilding trend starting in 1981 at the average escapement level during the first cycle of rebuilding (1975-1980), and ending at the management escapement goal of 1,440 large chinook salmon in 1995, the final year of the three-cycle rebuilding program.

Table 11. Peak escapements of chinook salmon to index tributaries of the Chilkat River, 1960-1989.[a,b]

Year	Big Boulder Creek	Stonehouse Creek	Total
1960	316 (F)	-	316
1961	88 (F)	-	88
1962	-	-	-
1963	-	-	-
1964	-	-	-
1965	-	-	-
1966	330 (F)	-	330
1967	150 (F)	-	150
1968	259 (F)	-	259
1969	-	-	-
1970	176 (F)	-	176
1971	56 (F)	-	56
1972	-	-	-
1973	-	-	-
1974	0 (F)	-	0
1975	21 (F)	-	21
1976	25 (F)	-	25
1977	25 (F)	-	25
1978	-	-	-
1979	-	-	-
1980	-	-	-
1981	187 (H/F)	69 (H)	256
1982	56 (H/F)	123 (H)	179
1983	121 (H/F)	126 (H)	247
1984	229 (H/F)	104 (H)	333
1985	70 (H/F)	50 (H)	120
1986	20 (F)	9 (H)	29
1987	98 (F)	190 (H)	288
1988	86 (F)	89 (H)	175
1989	74 (H)	231 (H)	305

[a] (F) = Escapement surveyed by walking stream.
(A) = Escapement surveyed from fixed-wing aircraft.
(H) = Escapement surveyed from helicopter.
(H/F) = Escapement surveyed from helicopter and by walking portions of stream.
- = No survey conducted or data not comparable.

[b] Escapement counts prior to 1975 may not be comparable because of differences in survey dates and counting methods.

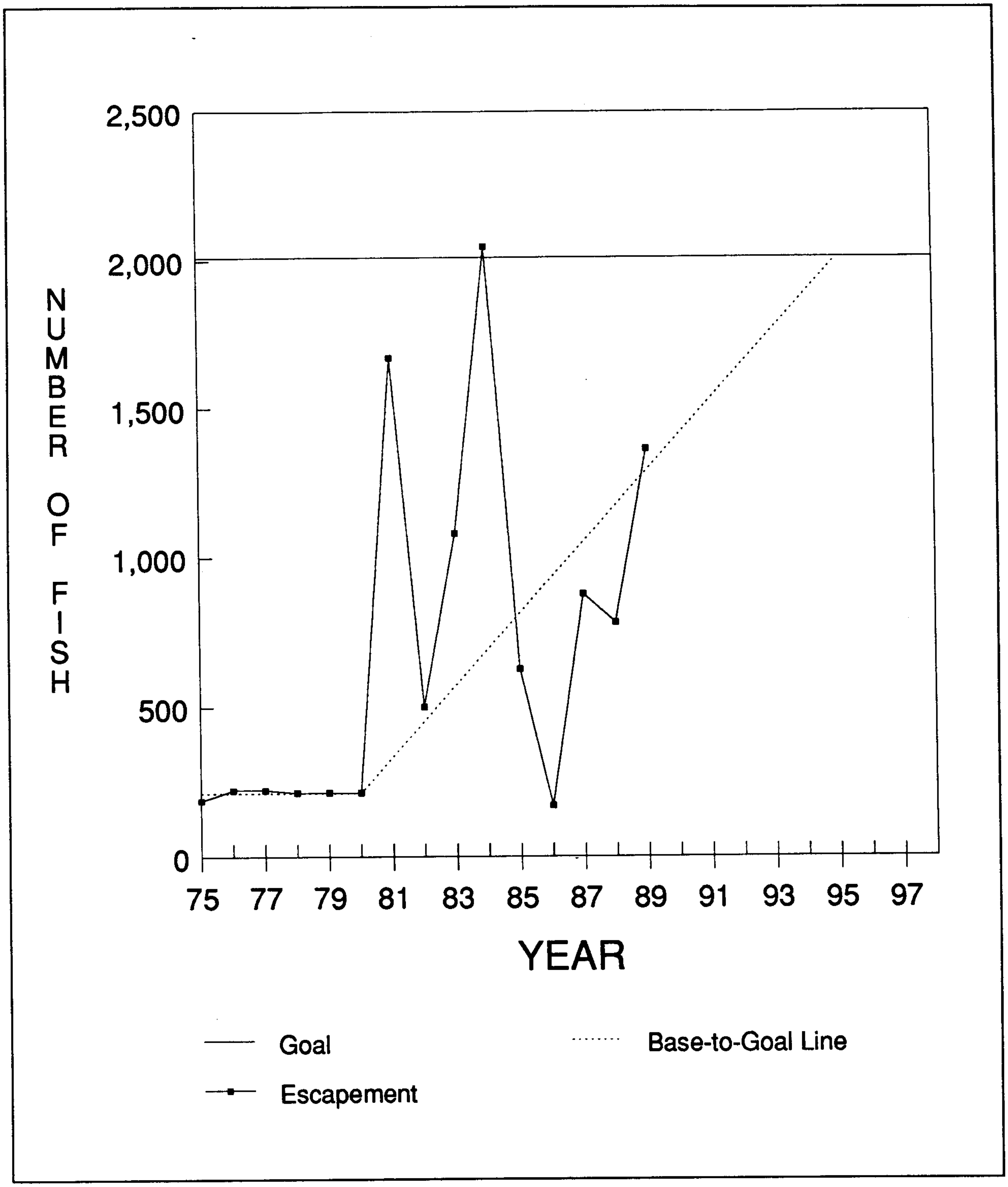

Figure 18. Estimated escapements of chinook salmon to the Chilkat River, 1975-1989. The base-to-goal line is a linear rebuilding trend starting in 1981 at the average escapement level during the first cycle of rebuilding (1975-1980), and ending at the management escapement goal of 2,000 large chinook salmon in 1995, the final year of the three-cycle rebuilding program.

Table 12. Peak escapement counts of chinook salmon for selected rivers in Behm Canal, 1948-1989. [a,b]

Year	Keta River	Blossom River	Wilson River	Marten River	Grant Creek	Klahini River	Total
1948	500 (F)	-	-	-	-	-	500
1949	-	-	-	-	-	-	-
1950	210 (F)	-	-	-	-	-	210
1951	120 (F)	-	-	-	-	-	120
1952	462 (F)	-	-	-	-	-	462
1953	156 (F)	-	-	-	-	-	156
1954	300 (A)	-	-	-	-	-	300
1955	1,000 (A)	-	-	-	-	-	1,000
1956	1,500 (A)	-	-	-	-	-	1,500
1957	500 (A)	-	-	-	-	-	500
1958	-	-	-	-	-	-	-
1959	-	-	-	-	-	-	-
1960	-	-	-	-	-	-	-
1961	44 (F)	68 (F)	-	22 (F)	40 (A)	-	174
1962	-	-	-	-	6 (A)	100 (A)	106
1963	-	450 (A)	375 (A)	-	15 (A)	-	840
1964	-	-	-	-	-	-	-
1965	-	-	50 (A)	43 (H)	-	-	93
1966	75 (A)	200 (A)	60 (A)	10 (A)	100 (A)	3 (A)	448
1967	86 (H)	-	8 (H)	7 (H)	15 (H)	-	116
1968	-	-	-	-	4 (H)	-	4
1969	200 (A)	-	10 (A)	10 (A)	69 (H)	3 (H)	292
1970	-	100 (H)	-	-	-	-	100
1971	-	-	-	-	-	-	-
1972	255 (A)	225 (A)	275 (A)	-	25 (A)	150 (A)	930
1973	-	-	30 (A)	-	38 (A)	7 (H)	75
1974	25 (H)	166 (H)	-	-	-	-	191
1975	203 (H)	146 (H)	7 (H)	15 (H)	-	-	371
1976	84 (H)	68 (H)	-	-	-	-	152
1977	230 (H)	112 (H)	-	-	-	-	342
1978	392 (H)	143 (H)	-	2 (A)	-	-	537
1979	426 (H)	54 (H)	36 (H)	-	-	-	516

-(Continued)-

Table 12. (page 2 of 2)

Year	Keta River	Blossom River	Wilson River	Marten River	Grant Creek	Klahini River	Total
1980	192 (H)	89 (H)	-	-	-	-	281
1981	329 (H)	159 (H)	76 (F)	-	25 (H)	42 (F)	631
1982	754 (H)	345 (H)	300 (B)	75 (F)	33 (F)	79 (F)	1,586
1983	822 (H)	589 (H)	178 (B)	138 (F)	8 (A)	10 (H)	1,745
1984	610 (H)	508 (H)	133 (F)	12 (B)	124 (F)	54 (F)	1,441
1985	624 (H)	709 (H)	420 (H)	69 (F)	55 (F)	20 (F)	1,897
1986	690 (H)	1,278 (H)	-	-	-	-	1,968
1987	768 (H)	1,349 (H)	-	270 (H)	33 (A)	-	2,420
1988	575 (H)	384 (H)	-	543 (H)	-	40 (H)	1,542
1989	1,155 (H)	344 (H)	-	133 (H)	-	-	1,632

[a] (F) = Escapement surveyed by walking stream
(A) = Escapement surveyed from fixed-wing aircraft
(H) = Escapement surveyed from helicopter
(B) = Escapement surveyed from boat
\- = No survey conducted or data not comparable

[b] Escapement counts prior to 1975 may not be comparable due to differences in survey dates or methods.

Blossom River of 550 fish was approximately 43% of the escapement goal of 1,280 fish. This escapement goal was exceeded in both 1986 and 1987. Blossom River escapements in 1988 and 1989 fell below the linear rebuilding schedule (Figure 19).

In contrast, escapements to the Keta River increased dramatically in 1989, from the 1988 peak aerial count of 575 large chinook salmon to 1,155 in 1989 (Table 12). Expanding the peak aerial count by the survey expansion factor of 1/0.625 results in an estimate of 1,848 large chinook salmon, roughly 1,048 fish above the escapement goal of 800 fish. Chinook salmon escapements to the Keta River have increased steadily since implementation of the rebuilding program in 1980, and have exceeded the management escapement goal every year since 1983 (Figure 20).

The Marten River is not used as a chinook salmon index stream and no escapement goal has been established. Escapements to this system have, however been regularly monitored since 1982. The 1989 peak escapement count for the Marten River of 133 large chinook salmon was 76% lower than the 1988 count of 543 fish (Table 12). Chinook salmon escapements to the Wilson River were not estimated in 1989.

The 1989 weir count of 249 large chinook salmon to the King Salmon River was 8% above the 1988 escapement and sightly above the 1983 to 1988 average escapement of 241 fish (Table 13). The addition of 29 adult chinook salmon observed spawning below the weir results in an estimated total return of 278 adult chinook salmon. A total of 40 large chinook salmon were taken for brood stock production for the ADF&G Snettisham hatchery, resulting in 238 large chinook salmon naturally spawning in the King Salmon River in 1989. Since 1983, chinook salmon escapements to the King Salmon River have been slightly below the management escapement goal of 250 large chinook salmon, but have still been ahead of the linear rebuilding schedule (Figure 21).

Escapements of chinook salmon to the Situk River in 1989 declined to 652 large chinook salmon (Table 14). The 1989 escapement was 26% lower than the 1988 escapement of 885, and 34% and 53% lower than the 1981-1985 and 1975-1980 average escapements, respectively. Escapements of chinook salmon to the Situk River in both 1988 and 1989 were less than 50% of the management escapement goal and well behind the linear rebuilding schedule (Figure 22).

DISCUSSION

The estimated total escapement of chinook salmon for all Southeast Alaska and transboundary rivers declined from 60,500 fish in 1988, to 54,100 fish in 1989, reversing the trend of increasing escapements observed over the last six years. The total escapement of chinook salmon in 1989 was 11% or 6,400 fish less than in 1988 and only 84% of the management escapement goal of 64,000 chinook salmon. The 1989 escapement still represented an increase of approximately 109 percent or 28,100 chinook salmon over the 1975-1980 base period average of 26,000 chinook salmon, and an increase of 38% or 15,000 chinook salmon over the 1981-1985 average of 39,100 chinook salmon. Although escapements of chinook salmon declined overall in 1989, increases were observed in seven of the 11 index systems. If the Stikine River is excluded, escapements to the remaining index systems actually increased by 15% over 1988. Chinook salmon escapements to the Stikine River declined by 35% in 1989 from 1988 but the management

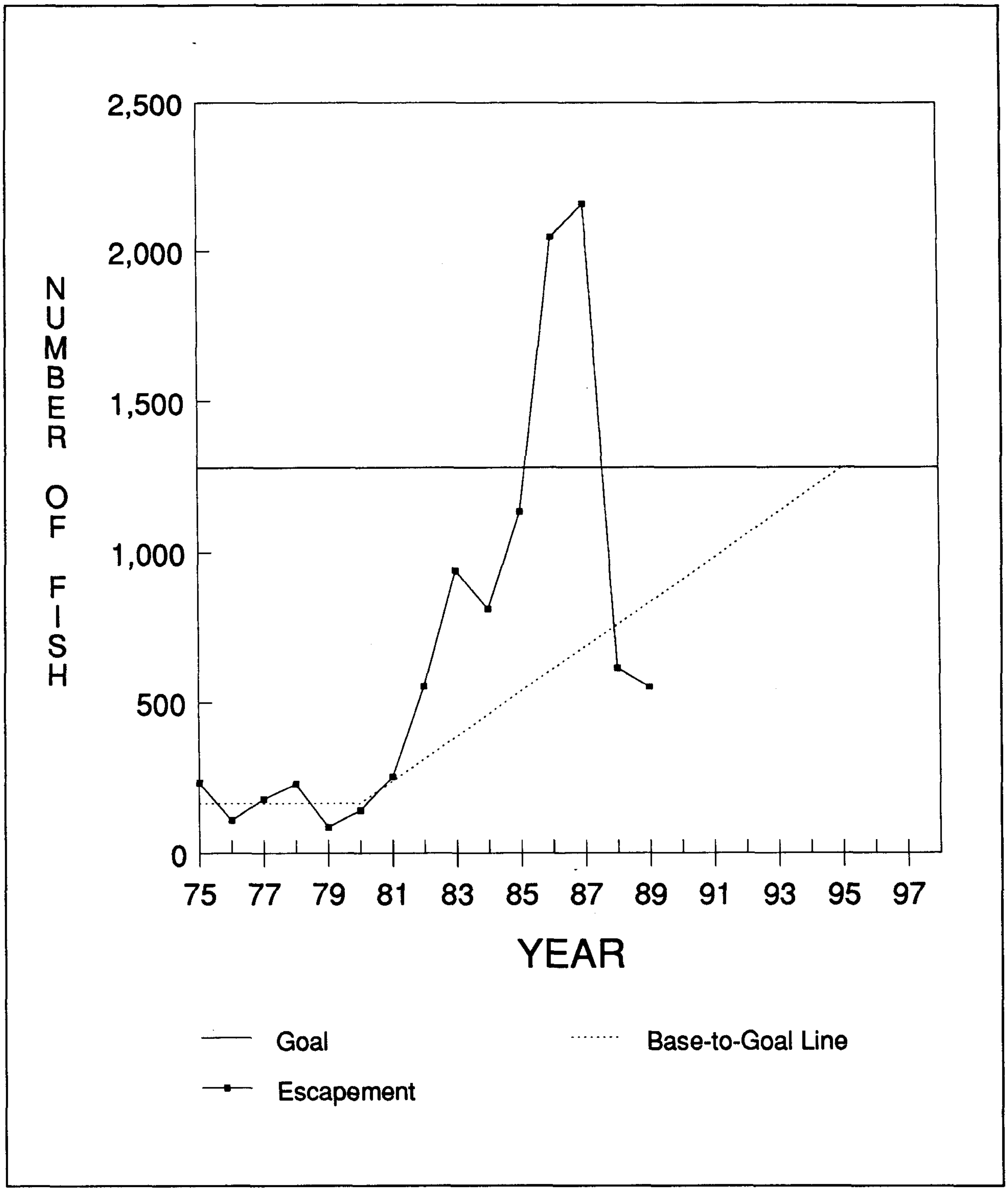

Figure 19. Estimated escapements of chinook salmon to the Blossom River, 1975-1989. The base-to-goal line is a linear rebuilding trend starting in 1981 at the average escapement level during the first cycle of rebuilding (1975-1980), and ending at the management escapement goal of 1,280 large chinook salmon in 1995, the final year of the three-cycle rebuilding program.

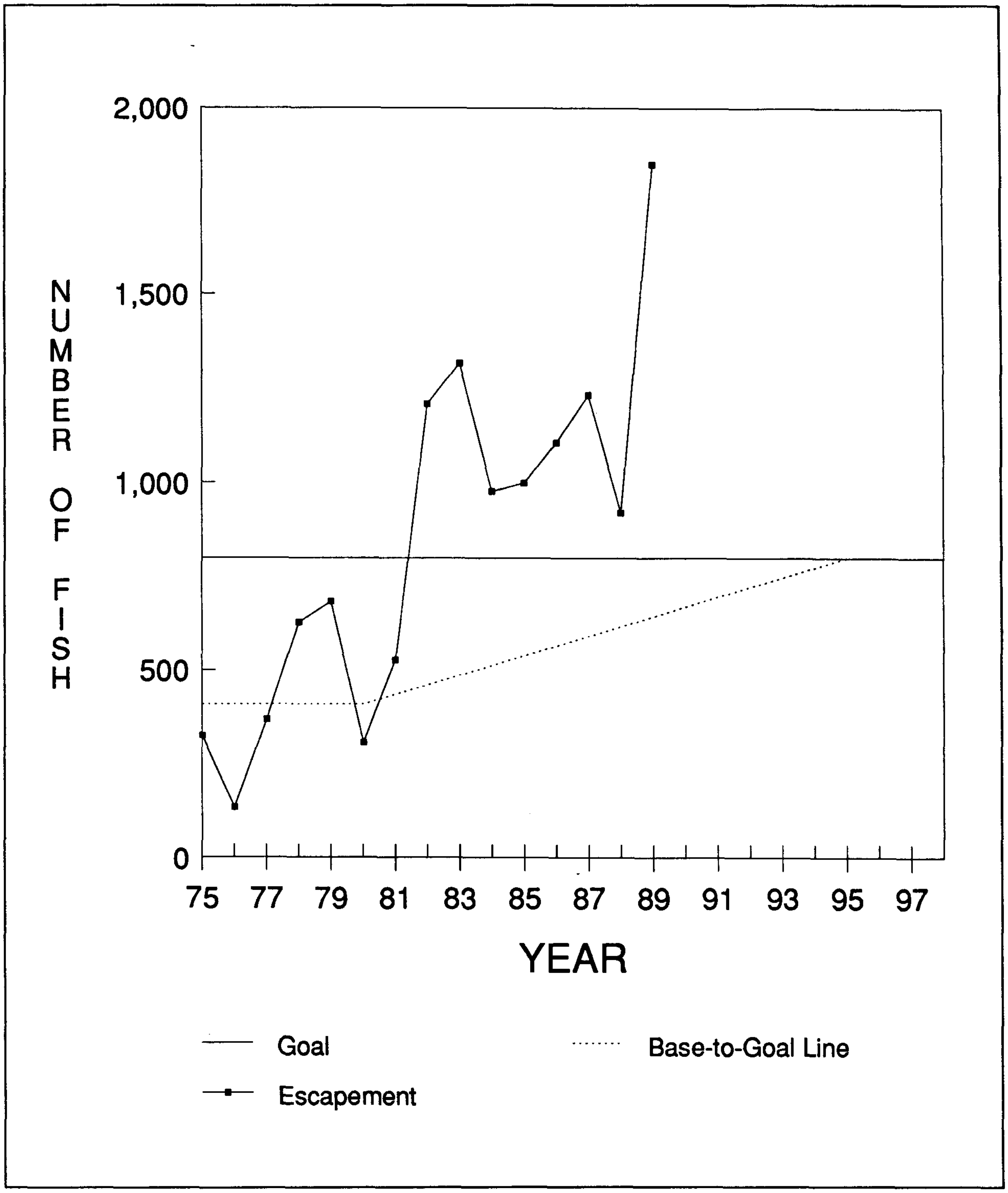

Figure 20. Estimated escapements of chinook salmon to the Keta River, 1975-1989. The base-to-goal line is a linear rebuilding trend starting in 1981 at the average escapement level during the first cycle of rebuilding (1975-1980), and ending at the management escapement goal of 800 large chinook salmon in 1995, the final year of the three-cycle rebuilding program.

Table 13. Peak escapements and weir counts of chinook salmon for the King Salmon River, 1957-1989.[a,b]

Year	Aerial Count Below Weir	Aerial Count Above Weir	Aerial Count as Percent of Weir Count[c]	Total Snettisham Egg Take	Total Weir Count (adults)[d]	Total Weir Count (jacks)[e]	Spawners Below Weir (Foot Count)	Total Return[f]	Total Natural Spawning[g]
1957	-	200 (F)	-	-	-	-	-	200	200
1960	-	20 (F)[h]	-	-	-	-	-	20	20
1961	-	117 (F)	-	-	-	-	-	117	117
1971	-	94 (F)	-	-	-	-	-	94	94
1972	-	90 (F)	-	-	-	-	-	90	90
1973	-	211 (F)	-	-	-	-	-	211	211
1974	-	104 (F)	-	-	-	-	-	104	104
1975	-	42 (H)	-	-	-	-	-	42	42
1976	-	65 (H)	-	-	-	-	-	65	65
1977	-	134 (H)	-	-	-	-	-	134	134
1978	-	57 (H)	-	-	-	-	-	57	57
1979	-	88 (H)	-	17	-	-	-	88	71
1980	-	70 (H)	-	-	-	-	-	70	70
1981	-	101 (H)	-	11	-	-	-	101	90
1982	-	259 (F)	-	30	-	-	-	259	229
1983	25	183 (H)	0.85	37	252	20	30	282	245
1984	14	184 (H)	0.77	61	299	82	12	311	250
1985	12	105 (H)	0.65	33	194	45	10	204	171
1986	9	190 (H)	0.83	36	264	72	17	281	245
1987	19	128 (H)	0.74	34	207	62	20	227	193
1988	5	94 (H)	0.52[i]	37	231	54	12	243	206
1989	34	133 (H)	0.64	40[j]	249	71	29	278	238

[a] (F) = Escapement surveyed by walking stream
(H) = Escapement surveyed from helicopter
- = No survey conducted or data not comparable

[b] Escapement counts prior to 1975 may not be comparable due to differences in survey dates and counting methods

[c] (total aerial count above weir)/(total weir count excluding jacks - egg take)

[d] Includes adult spawners used for egg take

[e] Minimum count as jacks could pass through weir

[f] Total return (adults) = weir count + spawning below weir

[g] Natural spawning (adults) = (weir count - egg take & mortality) + spawners below weir (83-89)

[h] Accuracy of count questionable (minimal number of spawners)

[i] Four females and two males were held but not spawned for egg take

[j] Includes holding mortality of 4 males and 6 females for egg take

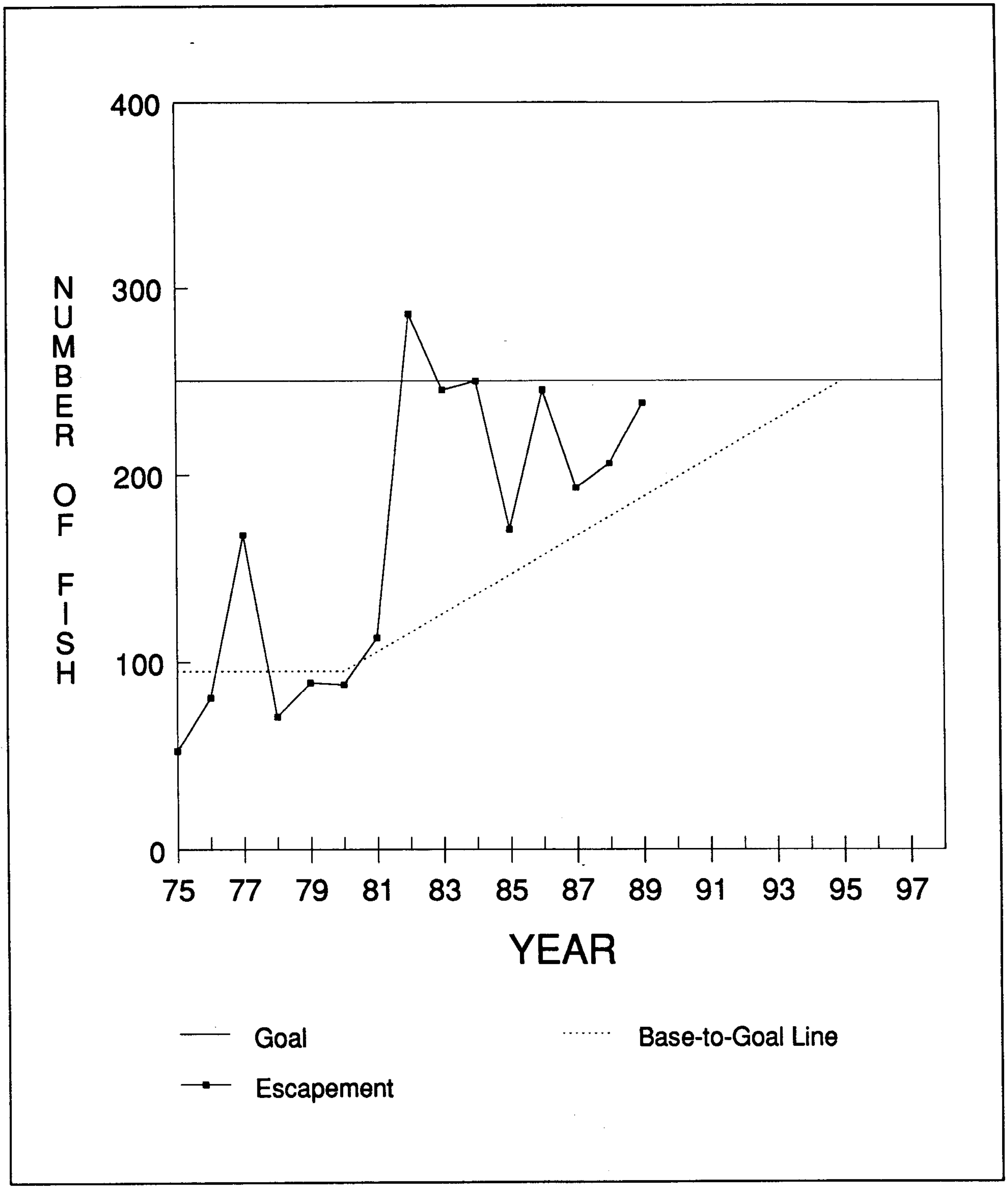

Figure 21. Estimated escapements of chinook salmon to the King Salmon River, 1975-1989. The base-to-goal line is a linear rebuilding trend starting in 1981 at the average escapement level during the first cycle of rebuilding (1975-1980), and ending at the management escapement goal of 250 large chinook salmon in 1995, the final year of the three-cycle rebuilding program.

Table 14. Harvest, escapement, and minimum total run of Situk River chinook salmon, 1915-1989.

Year	Commercial Chinook Harvests			Recreational		Escapement			Total Run Size[a]	
	Yakutat	Situk River				Large	Small		Large	All
	Bay	Commercial	Subsistence	Large	Small	Chinook	Chinook	Total	Only	Chinook
1915	-	836	-	-	-	-	-	-	-	836
1916	-	931	-	-	-	-	-	-	-	931
1917	-	2,499	-	-	-	-	-	-	-	2,499
1918	-	1,036	-	-	-	-	-	-	-	1,036
1919	-	316	-	-	-	-	-	-	-	316
1920	-	782	-	-	-	-	-	-	-	782
1921	-	1,952	-	-	-	-	-	-	-	1,952
1922	-	2,118	-	-	-	-	-	-	-	2,118
1923	-	1,761	-	-	-	-	-	-	-	1,761
1924	-	1,351	-	-	-	-	-	-	-	1,351
1925	-	1,087	-	-	-	-	-	-	-	1,087
1926	-	1,851	-	-	-	-	-	-	-	1,851
1927	-	1,687	-	-	-	-	-	-	-	1,687
1928	-	-	-	-	-	-	-	1,224	-	1,224
1929	-	-	-	-	-	-	-	3,559	-	3,559
1930	-	-	-	-	-	-	-	1,455	-	1,455
1931	-	-	-	-	-	-	-	2,967	-	2,967
1932	-	-	-	-	-	-	-	1,978	-	1,978
1933	-	267	-	-	-	-	-	-	-	267
1934	-	450	-	-	-	-	-	1,486	1,936	1,936
1935	-	558	-	-	-	-	-	638	1,196	1,196
1936	-	-	-	-	-	-	-	816	-	816
1937	-	-	-	-	-	-	-	1,290	-	1,290
1938	-	1,220	-	-	-	-	-	2,668	3,888	3,888
1939	-	495	-	-	-	-	-	2,117	2,612	2,612
1940	-	164	-	-	-	-	-	903	1,067	1,067
1941	-	390	-	-	-	-	-	2,594	2,984	2,984
1942	-	430	-	-	-	-	-	2,543	2,973	2,973
1943	-	947	-	-	-	-	-	3,546	4,493	4,493
1944	-	844	-	-	-	-	-	2,906	3,750	3,750
1945	-	692	-	-	-	-	-	1,458	2,150	2,150
1946	-	1,468	-	-	-	-	-	4,284	5,752	5,752
1947	-	885	-	-	-	-	-	5,077	5,962	5,962
1948	-	694	-	-	-	-	-	3,744	4,438	4,438
1949	-	410	-	-	-	-	-	1,978	2,388	2,388
1950	-	378	-	-	-	-	-	2,011	2,389	2,389
1951	-	948	-	-	-	-	-	2,780	3,728	3,728
1952	-	225	-	-	-	-	-	1,459	1,684	1,684
1953	-	378	-	-	-	-	-	1,040	1,418	1,418
1954	-	314	-	-	-	-	-	2,101	2,415	2,415
1955	-	740	-	-	-	-	-	1,571	2,311	2,311
1956	-	1,867	-	-	-	-	-	-	-	1,867
1957	-	1,796	-	-	-	-	-	1,500	-	3,296
1958	-	187	-	-	-	-	-	300	-	487
1959	-	426	-	-	-	-	-	-	-	426
1960	24	312	-	-	-	-	-	500	-	812
1961	28	367	-	-	-	-	-	400	-	767
1962	99	337	-	-	-	-	-	1,000	-	1,337
1963	141	466	-	-	-	-	-	-	-	466
1964	115	706	-	-	-	-	-	725	-	1,431
1965	86	442	-	-	-	-	-	1,500	-	1,942
1966	43	411	-	-	-	-	-	800	-	1,211
1967	241	203	-	-	-	-	-	200	-	403
1968	31	312	-	-	-	-	-	700	-	1,012
1969	29	1,089	-	-	-	-	-	2,500	-	3,589

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Table 14. (page 2 of 2)

	Commercial Chinook Harvests					Escapement			Total Run Size[a]	
	Yakutat	Situk River		Recreational		Large	Small		Large	All
Year	Bay	Commercial	Subsistence	Large	Small	Chinook	Chinook	Total	Only	Chinook
1970	119	927	-	-	-	-	-	1,100	-	2,027
1971	106	473	-	-	-	-	-	964	-	1,437
1972	115	303	-	-	-	-	-	400	-	703
1973	79	752	-	-	-	-	-	510	-	1,262
1974	64	791	-	-	-	-	-	702	-	1,493
1975	41	562	27	-	-	-	-	1,180	-	1,769
1976	69	1,002	41	200	-	1,433	509	1,942	2,676	3,185
1977	53	833	24	244	-	1,732	148	1,880	2,833	2,981
1978	108	382	50	210	-	814	289	1,103	1,456	1,745
1979	51	1,028	25	282	-	1,400	367	1,767	2,735	3,102
1980	164	969	57	353	-	905	220	1,125	2,284	2,504
1981	151	858	62	130	-	702	105	807	1,752	1,857
1982	419	248	27	63	0	434	177	611	772	949
1983	371	349	50	42	10	592	257	849	1,033	1,300
1984	145	512	50	146	5	1,726	475	2,201	2,434	2,914
1985	240	484	81	294	217	1,521	461	1,982	2,380	3,058
1986	211	202	87	0	37	2,067	505	2,572	2,356	2,898
1987	329	891	22	76	319	1,884	494	1,884	2,873	3,192
1988	196	299	81	185	3	885	193	1,078	1,450	1,646
1989	297	1	29	0	0	652	1,217	1,869	682	1,899

[a] Total run = chinook escapement + Situk commercial, sport, and subsistence harvests.

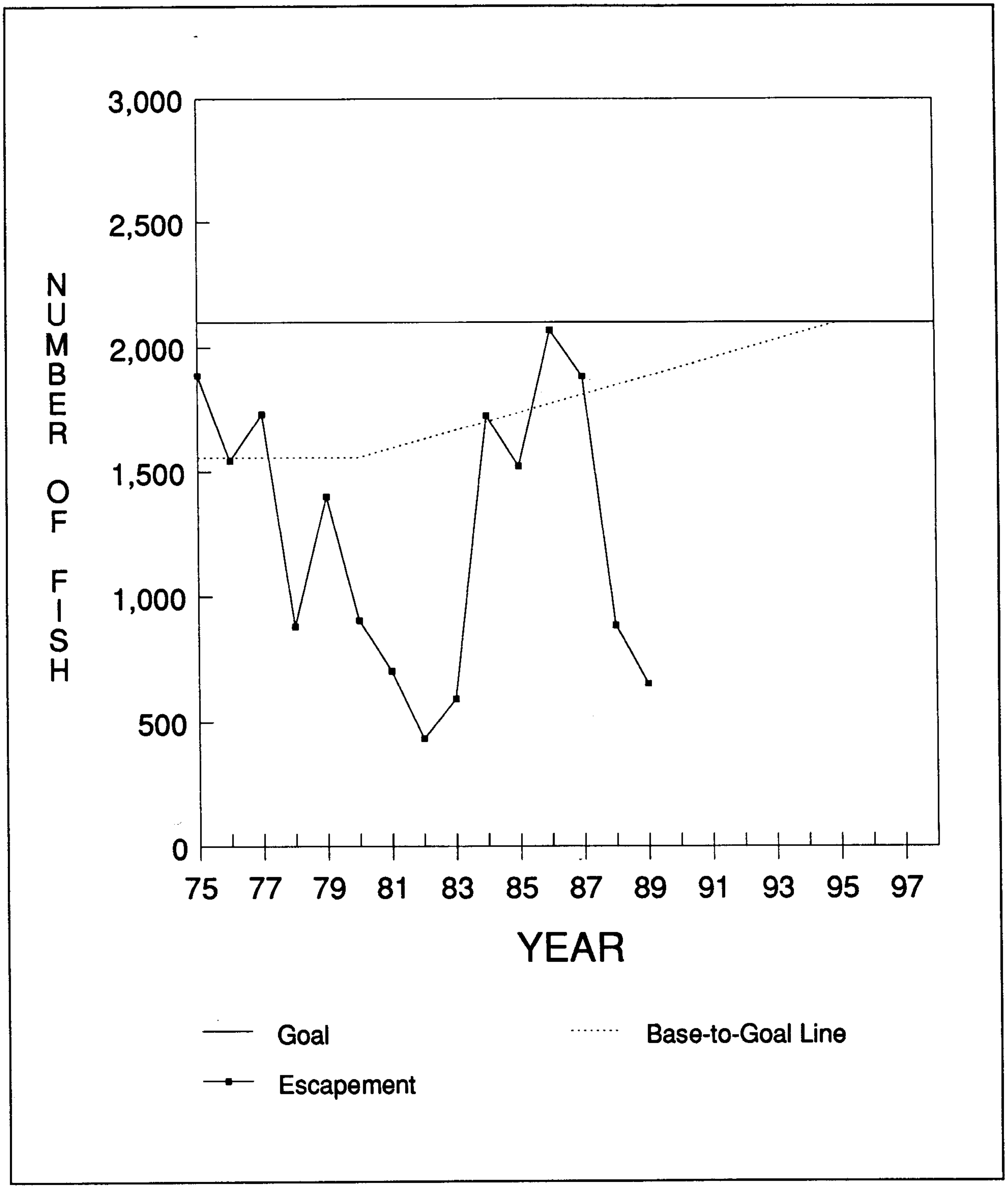

Figure 22. Estimated escapements of chinook salmon to the Situk River, 1975-1989. The base-to-goal line is a linear rebuilding trend starting in 1981 at the average escapement level during the first cycle of rebuilding (1975-1980), and ending at the management escapement goal of 2,100 large chinook salmon in 1995, the final year of the three-cycle rebuilding program.

escapement goal was still exceeded by 40% (5,420 fish).

Chinook salmon escapements to the majority of the index systems have exhibited a consistent trend towards rebuilding by 1995 (Figure 23). Five of the index systems have lagged behind the rebuilding schedule. These are the Situk, Chilkat, Alsek, Taku, and Blossom rivers. Except for the Blossom River, all of these systems are located in northern southeast Alaska. Coded-wire tagging studies (Kissner 1973-1980, 1982, 1984, 1985; Kissner and Hubbartt, 1986; Kissner and Bethers 1981; Hubbartt and Kissner 1987; and Mecum and Kissner 1989) have shown that chinook salmon wild stocks from southern southeast Alaska (e.g., Unuk and Chickamin Rivers) tend to contribute to fisheries throughout the region at all stages of maturity while more northerly stocks (e.g., Taku River) are generally available only for a short period of time as they migrate through the waters of southeast Alaska on their return to spawning streams. Regionwide, all-gear catch ceilings have reduced commercial troll fishing effort to a very short period in late-June or early July in recent years. This has likely provided increased protection of immature chinook salmon which would tend to benefit the more southerly stocks to a greater degree than the more northerly Taku, Stikine, Alsek, and Situk stocks that apparently never contributed significantly to non-terminal fisheries as immature fish. In addition, salmon stocks in southern southeast Alaska rivers may spawn and rear under generally more favorable climatic and habitat conditions with more consistent survival and production (Alexandersdottir 1987).

If the more northerly stocks are in fact contributing to marine fisheries at a lower rate, a weaker response in escapements might be expected when conservation measures are implemented. However, the observed decline in escapements to the Alsek and Situk Rivers are not expected, particularly since harvests of these stocks in terminal net and recreational fisheries have been greatly reduced in recent years. Although harvests have been reduced, chinook salmon escapements to the Alsek River are still below management escapement goals. Gmelch (1982) hypothesized that increased siltification and subsequent changes in channel morphology in the lower Alsek River estuary in Dry Bay, may be contributing to the slow rebuilding progress of this stock. Other possible factors include 1) the management escapement goal for the Alsek River stock is higher than it should be to achieve optimum sustained production, 2) Alsek River chinook salmon may be harvested to a greater extent in mixed stock domestic or high seas foreign gill net fisheries than previously believed, or 3) some combination of all of the factors listed above (Mecum and Kissner 1989). Recently initiated coded-wire tagging studies on the Alsek (Mecum 1989) and Situk rivers will provide information on migratory patterns and harvest rates, and may provide insight into the primary reasons for the decline of these stocks.

The decline in escapements of Chilkat River chinook salmon in recent years can be partially explained by higher than average harvests in the Chilkat Inlet marine recreational fishery. Prior to 1985, recreational harvests averaged less than 1,000 chinook salmon annually, increasing to over 1,500 fish in 1985 and 1986 (Suchanek and Bingham 1989). Preliminary information from recoveries of coded-wire tagged chinook salmon fingerlings released in the Chilkat River in 1985 and 1986 however, indicate that this stock may also be harvested to a greater extent than previously recognized in the Lynn Canal drift gill net fishery, the Juneau area marine recreational fishery, and in the commercial troll fishery in Icy Straits (Pahlke, Mecum, and Marshall in press). Furthermore, it appears that the loss of spawning and rearing habitat resulting from road construction activities on Big Boulder Creek and the Kelsall River have also

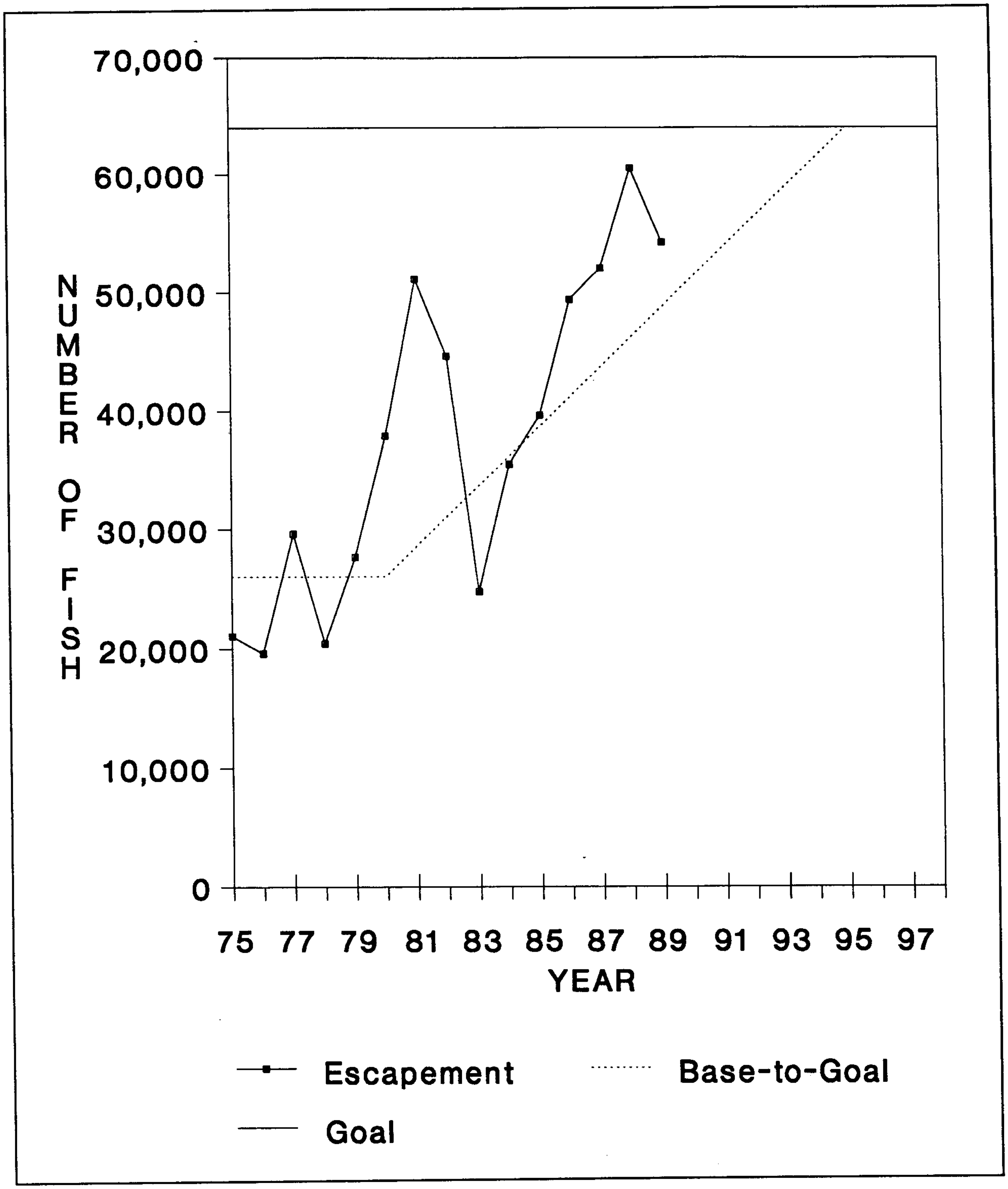

Figure 23. Estimated total escapement of chinook salmon to southeast Alaska and transboundary river index systems, 1975-1989. The base-to-goal line is a linear rebuilding trend starting in 1981 at the average escapement level during the first cycle of rebuilding (1975-1980), and ending at the management escapement goal of 64,000 large chinook salmon in 1995, the final year of the three-cycle rebuilding program.

contributed to the decline of this stock (Mecum and Kissner 1989).

Continued restriction of harvests of mature fish in the Haines marine recreational and commercial fisheries will be required to rebuild this important stock of chinook salmon. In addition, information on migratory timing, areas of harvest, and harvest rates of Chilkat River chinook salmon should be obtained from continued coded-wire tagging of juveniles and recovery of adults in commercial and recreational fisheries and on the spawning grounds (Mecum and Kissner 1989). If necessary, new fishery regulations should be developed in cooperation with local advisory committees, the Alaska Board of Fisheries, and ADF&G to ensure continued rebuilding of this stock. In addition, enhancement strategies should be implemented. These include 1) remote releases of hatchery-reared smolt in areas that will offer continued protection of the natural stock while allowing recreational fishing opportunity, and 2) restoration of damaged spawning and rearing habitat in the Chilkat River drainage.

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APPENDIX A

Appendix A1. Management escapement goals and survey and tributary expansion factors for southeast Alaska and transboundary rivers. The total escapement goal for each category equals the survey escapement goal times the survey and tributary expansion factors.

River System	Index Tributaries Surveyed	Survey Escapement Goal	Survey Expansion Factor	Tributary Expansion Factor	System Escapement Goal	Category Expansion Factor	Category Escapement Goal
		Major Production Systems (Total = 3)					
Alsek	Klukshu	3,200 (W)	1/1	1/.64	5,000		
Taku	Nakina/Nahlin	11,500 (A)	1/0.75	1/.60	25,556		
Stikine	Little Tahltan	3,360 (W)	1/1	1/.25	13,440		
Major Category Subtotal		18,060			43,996	3/3	43,996
		Medium Production Systems (Total = 9)					
Situk	All	2,100 (W)	1/1	1/1	2,100		
Chilkat	Big Boulder/Stonehouse	450 (A)	1/0.80	1/0.28	2,009		
Andrew Cr.	All	470 (A)	1/0.625	1/1	750		
Unuk	All	1,800 (A)	1/0.625	1/1	2,880		
Chickamin	All	900 (A)	1/0.625	1/1	1,440		
Blossom	All	800 (A)	1/0.625	1/1	1,280		
Keta	All	500 (A)	1/0.625	1/1	800		
Medium Category Subtotal		7,020			11,259	9/7	14,476
		Minor Production Systems (Total = 22)					
King Salmon	All	250 (W)	1/1	1/1	250		
Minor Category Subtotal		250			250	22/1	5,500
All Systems Total		25,330			55,504		63,971

(W) = weir count; (A) = aerial survey peak escapement estimate.

Appendix A2. Survey dates for indexing escapements by helicopter (h) or foot (f) during 1989. Dates are selected to encompass the historical dates of peak spawning.

Location	Survey Dates	Survey Type
TAKU RIVER		
Nakina River	31 July and 5 August	h
Nahlin River	24 and 31 July	h
Dudidontu River	31 July and 5 August	h
Tseta Creek	31 July and 5 August	h
Kowatua River	17 and 24 August	h
Tatsamenie River	17 and 24 August	h
STIKINE RIVER		
Little Tahltan River	1 and 5 August	h
Tahltan River	5 August	h
Beatty Creek	1 and 5 August	h
Andrew Creek	12 August	f
ALSEK RIVER		
Klukshu River	2 August	h
Blanchard River	2 August	h
Takhanne River	2 August	h
Goat Creek	2 August	h
BLOSSOM RIVER	21, and 28 August	h
KING SALMON RIVER	20 and 27 July	h
CHILKAT RIVER		
Big Boulder Creek	3, 10, and 17 August	h
Stonehouse Creek	3, 10, and 17 August	h
KETA RIVER	21, and 28 August	h
UNUK RIVER		
Cripple Creek	5 and 10 August	f
Eulachon Creek	21 and 28 August	h & f
Genes Lake Creek	21 August	f
Clear Creek	7 and 14 August	h & f
Lake Creek	7 and 14 August	h & f
Kerr Creek	7 and 14 August	h
CHICKAMIN RIVER		
South Fork	7 and 14 August	h
Barrier Creek	7 and 14 August	h
Butler Creek	7 and 14 August	h
Indian Creek	7 and 14 August	h
Humpy Creek	21 and 28 August	h
King Creek	21 and 28 August	h
Leduc Creek	7 and 14 August	h
Clear Falls Creek	7 and 14 August	h