Fishery Manuscript No. 91-4

Status of Coho Salmon in the Delta Clearwater River of Interior Alaska

by

James F. Parker

September 1991

Alaska Department of Fish and Game

Division of Sport Fish

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ABSTRACT

The largest known coho salmon *Oncorhynchus kisutch* escapement in the Yukon River drainage occurs in the Delta Clearwater River. This unique spring fed system, and others like it, provides ice free spawning habitat for late returning coho salmon. Coho salmon enter the lower Yukon River in late July to mid September, and are caught incidentally in the fall chum salmon commercial and subsistence fisheries. Sport harvests of coho salmon in the Delta Clearwater River have dramatically increased in recent years, largely due to increased returns and escapement from lower Yukon River commercial fisheries. Most coho salmon fingerlings rear in the Delta Clearwater River for three years before smolting, and spend one winter in the ocean before returning. Escapements of coho salmon in the Delta Clearwater River have been recorded annually since 1971. The highest escapement of 22,300 fish occurred in 1988.

KEY WORDS: Delta Clearwater River, coho salmon, *Oncorhynchus kisutch,* life history, commercial harvest, subsistence harvest, sport harvest, personal use harvest, escapement, age, sex, and size.

INTRODUCTION

The Delta Clearwater River (DCR), otherwise known as Clearwater Creek, is located 160 km (100 mi) southeast of Fairbanks (Figure 1). The DCR averages 6,600 angler-days a year (Mills 1979a-1990), and is the fifth most popular location for sport fishing in the interior of Alaska. The DCR is the largest of all clearwater spring-fed rivers in the Tanana drainage. Good access (Figure 2) makes this river a popular attraction to recreational river users (Ridder 1985). The clear waters provide prime summer Arctic grayling *Thymallus arcticus* fishing. An increasingly popular late fall coho salmon *Oncorhynchus kisutch* sport fishery has also developed. This report summarizes available information concerning the coho salmon resource of the Delta Clearwater River. It is intended that this summary report be used as a guide in assessing the status of the coho salmon fishery in the DCR, and in formulating management plans in regards to this resource.

All five species of salmon enter the Yukon River. Coho salmon ranks third behind chum *O. keta* and chinook *O. tshawytscha* salmon in importance to the Yukon River commercial and subsistence fisheries. Timing of coho salmon entering the Yukon River overlaps with that of the fall chum salmon run, however, the peak of the coho salmon run is approximately two weeks later than that of the chum salmon run. Because of this overlap, coho salmon are caught incidentally in the commercial fall chum salmon fishery.

Even though comprehensive surveys have not been conducted for the entire Yukon River system, the largest known spawning concentrations of coho salmon in the Yukon River drainage are in tributaries of the Upper Tanana drainage (Whitmore et al. 1990). The DCR supports the largest escapement of coho salmon in the Tanana drainage (Buklis and Wilcok 1985).

Sport harvest of coho salmon in the Tanana River drainage has averaged 664 fish between 1977 and 1989 (Mills 1990). Seventy percent of the coho salmon sport harvest is from the Delta Clearwater River (Mills 1979a-1990). The remainder of the harvest is caught primarily in the Nenana River drainage near Clear Missile Early Warning Station along the Parks Highway.

Escapement counts have been collected since 1971 by boat on navigable portions of the DCR. Mainstream counts represent a majority of the spawning salmon. Since 1984, coho salmon carcasses have been collected for information on age, sex, and length composition.

DELTA CLEARWATER RIVER CHARACTERISTICS

The DCR flows over an alluvial plain which was formed by the Tanana River. The DCR is fed exclusively by an aquifer common to the Delta, Gerstle, and Tanana rivers and partially fed by mountain creeks (SWCD 1987). Sawmill, Rhodes, and Granite creeks originating in the Granite Mountains flow northwest across broad glacial and flood plains to a bog adjacent to the DCR. Surface flows in these creek beds north of the Alaska Highway occur only during high flooding or during snow melt conditions.

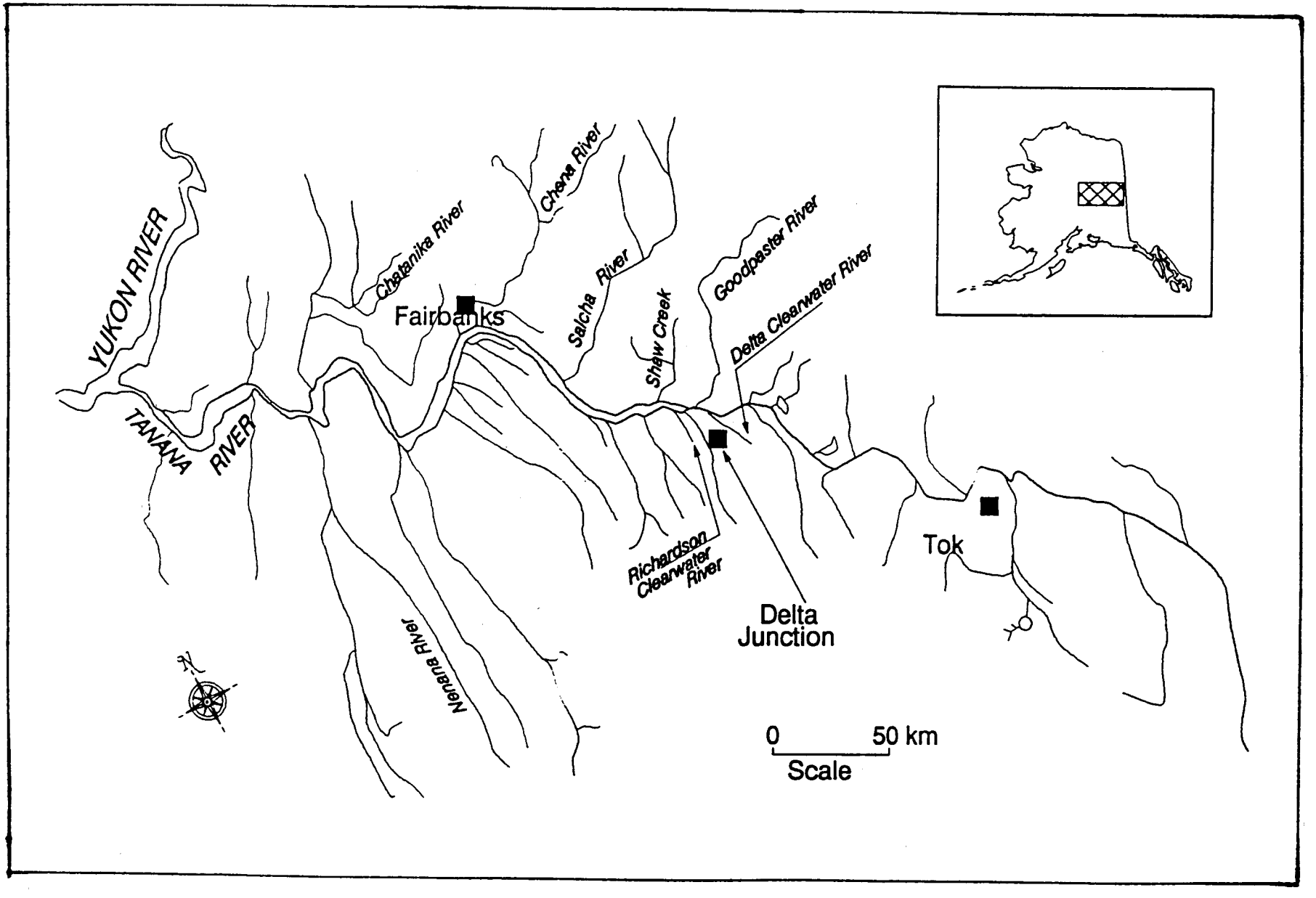

Figure 1. Tanana River drainage.

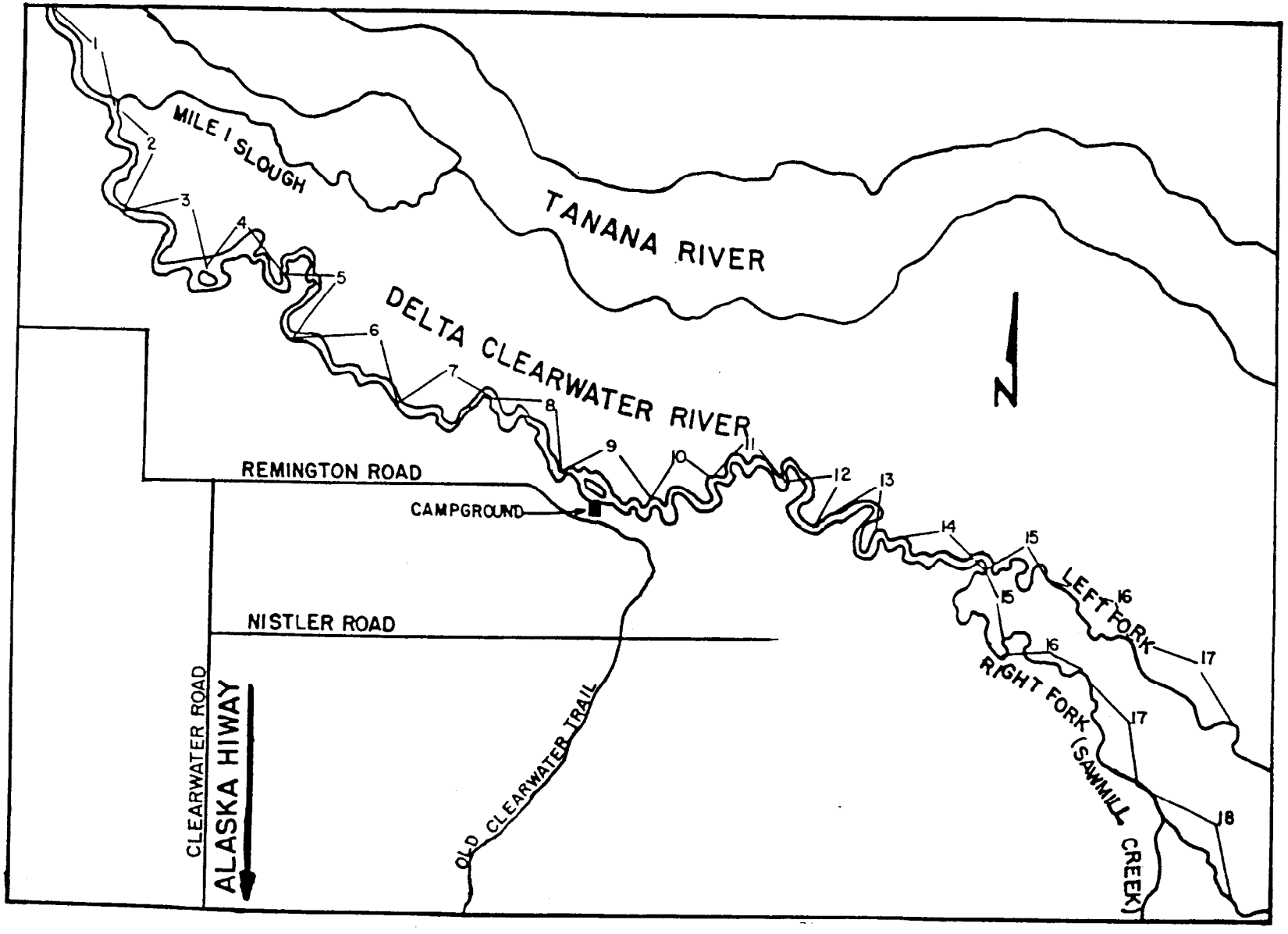

Figure 2. Delta Clearwater River.

The DCR is only 32 km (20 mi) in length and enters the Tanana River approximately 20 km upstream of the Big Delta Highway bridge crossing. The alluvial aquifer underlying this region of the Tanana drainage discharges into the DCR, Clearwater Lake, Tanana River, and extends to the mouth of the Delta River (Wilcox 1980). Discharge yields from the aquifer are fairly constant - a gauging station on the DCR showed discharge ranging from 198 to 236 cubic meters per second from May 1977 to July 1979 (Wilcox 1980). The springs maintain a fairly constant temperature. Surface water temperatures monitored between 1978 and 1979 ranged from 0 C in February to 7.5 C in July with temperatures declining by August (LaPerriere 1979). Upwelling of warmer spring water prevents freezing during the winter, with the exception of shelf ice in slower moving waters.

The DCR is a highly productive system. Chlorophyll analyses of streambed algae yielded high standing crops of primary production (LaPerriere 1979). Contributive factors to high standing crops of benthic algae are: stable physical and chemical characteristics, high alkalinity, and phosphorus concentrations. Of 13 streams and rivers tested for the production of benthic algae in interior Alaska, production was highest in the DCR (LaPerriere et al. 1989). Throughout the DCR, and particularly in the upper third of the river, mats of aquatic moss *Crato Nevron* cover the graveled stream bottom, providing additional habitat for aquatic insects and invertebrates.

The Clearwater Lake and its 1.6 km outlet connects with the Tanana River approximately 1.6 km downstream from the mouth of the DCR. Clearwater Lake outlet and other spring upwellings in close proximity to the DCR (Figure 3), are much smaller than the DCR in size. However, they provide important spawning and rearing areas for coho salmon. Numerous small spring tributaries increase available habitat and provide warmer water for rearing coho salmon. Desirable habitat and high primary production underscores the importance of the DCR system as a producer of coho salmon.

COHO SALMON LIFE HISTORY

Because little is known regarding the life history of coho salmon in the DCR, data collected on coho salmon from other locations is included in this report to familiarize the reader with the general biology of coho salmon.

Migrations

Returning coho salmon enter the Yukon River from late July through mid September. In 1988, coho salmon were not captured in test nets at the mouth of the Yukon River until August 5. Significant entry began on August 8-16 (Whitmore et al. 1990). Coho salmon enter the DCR in mid September through the first week of November with the peak of the run occurring approximately mid October. Only a few spawning coho salmon have been observed in the DCR after the first week in December. Similar timing of spawning coho salmon is found in Clear Creek, a spring fed tributary of the Nenana River (Raymond 1978).

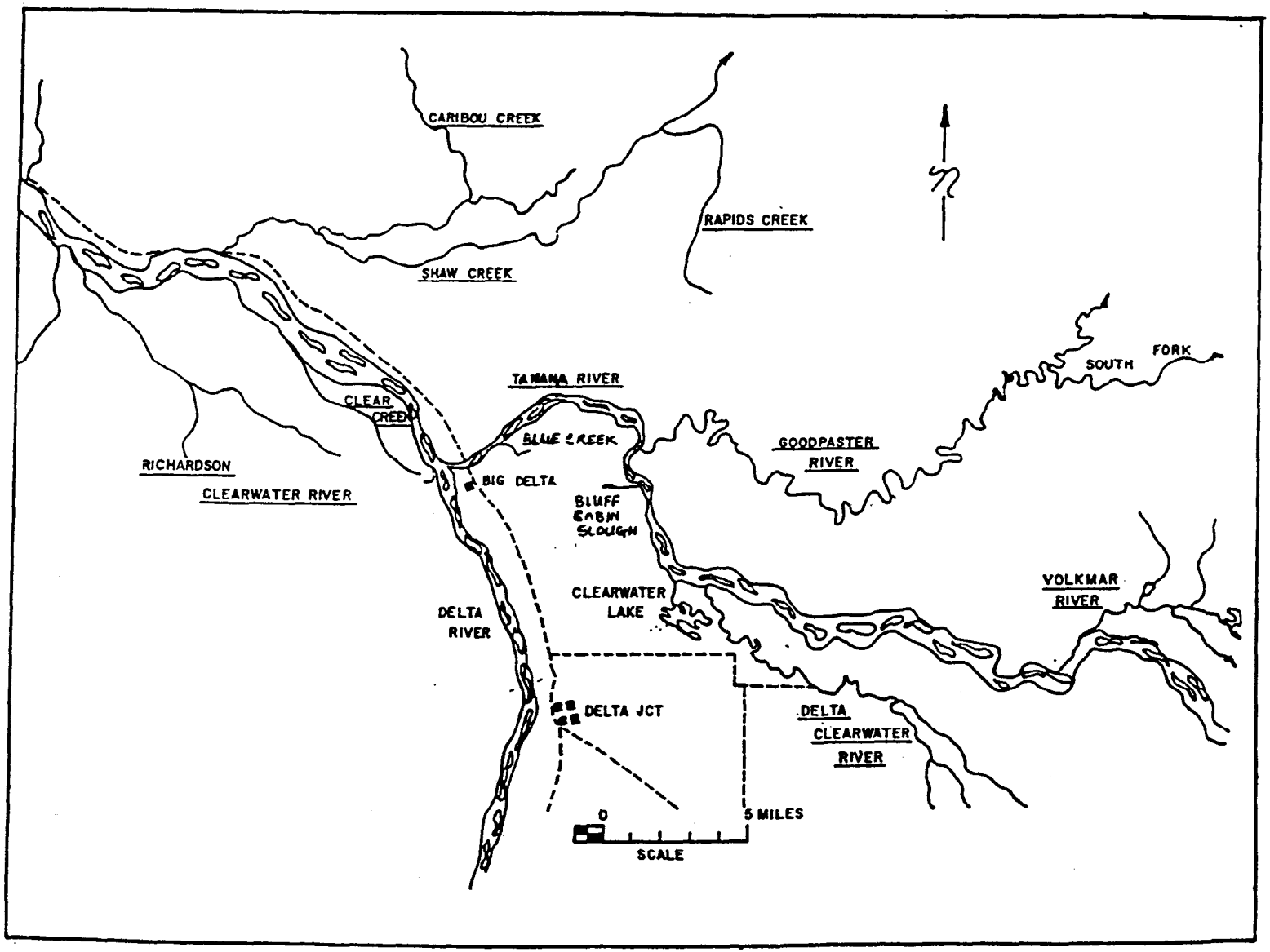

Figure 3. Upper Tanana River drainage near Delta Junction.

The DCR is located 576 km from the mouth of the Tanana River and 1,694 km from the mouth of the Yukon River. Coho salmon enter the DCR in significant numbers approximately 45 days after beginning their upriver migration at the mouth of the Yukon River. Coho salmon average about 37 km each day to reach the DCR. One coho salmon tagged in a Yukon River fish wheel was later recovered at the Alaska Department of Fish and Game (ADFG) Clear Creek weir site (Nenana River drainage); it averaged 32 km per day (Raymond 1978).

Coho salmon are brightly colored and considered to be of high quality in the lower 322 km of the lower Yukon River. Coho salmon then gradually begin to take on freshwater markings (pinkish and reddish hues), which by market standards are of a poor quality. By the time they enter the Tanana River the majority of fish are heavily water-marked, from light to bright red (Andersen pers. comm.[1]).

Spawning and Early Life History

Coho salmon spawn throughout the DCR. Fall chum salmon along with coho salmon spawn within the first kilometer of the DCR. Fewer coho salmon are counted in the mid section of the river than in upper and lower sections (from river kilometer 10 to 14), probably a consequence of low velocity, sand and fine gravel in the streambed in this area.

Fall chum and coho salmon require spawning areas where upwelling ground water prevents freezing (Buklis and Barton 1984). During January and February surface and intragravel temperatures were checked in tributaries to the Nenana River. In upper Wood Creek (tributary to Clear Creek) where spring upwellings and documented spawning coho salmon occurred, surface temperatures were 0 C and gravel temperatures ranged from 0 to 6 C. At the confluence of Clear and Julius creeks 16 km downstream (no documented coho salmon spawning), surface temperatures as well as gravel temperatures were 0 C (Skaugstad pers. comm.[2]) No spawning summer chum nor chinook salmon have ever been reported in upper Tanana River drainage spring fed systems.

Personnel with the ADFG fish hatchery at Clear Air Force Station obtained coho salmon eggs from Wood Creek from 1981 to 1988. This stock of coho salmon averages 217 Accumulated Temperature Units (ATU) to the eye up stage, 477 ATU's to the hatching stage, and 688 ATU's to emergence (Appendix A1). Each TU represents one degree per day. Coho salmon at Clear Hatchery accumulated five daily temperature units over an average of 138 incubation days. In the natural environment, daily accumulation of TU's would be significantly less than that of the hatchery environment, and total accumulated temperature units may vary slightly (Parks pers. comm.[3]).

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[1] Andersen, Fred. 1991. Personal Communication. ADFG, Division of Sport Fish, 1300 College Road, Fairbanks, Alaska 99701.

[2] Skaugstad, Cal. 1991. Personal Communication. ADFG, Division of Sport Fish, 1300 College Road, Fairbanks, Alaska 99701.

[3] Parks, Dave. 1991. Personal Communication. Clear Hatchery, P.O. Box 40219, Clear, Alaska 99704-0219.

An estimated 173,000 eggs were taken from 50 female coho salmon as part of an experimental egg take at the DCR in 1973. Average fecundity was 3,460 eggs. Egg diameter averaged 5.5 mm (Pearse 1975). In comparison, average mean fecundity of females captured at Wood Creek from 1981 to 1988 was 4,069 (Appendix A1).

Using escapements of female fish, average fecundity, and estimated wild yearling populations of Wood Creek coho salmon, Raymond (1986) estimated survival from egg deposition to yearlings (19 months) at 6.0% for the 1981-brood year, 3.7% for the 1982-brood year, and 5.2% for the 1983-brood year. By doubling the population of yearling size coho salmon in Wood Creek with hatchery reared coho salmon, no affect on growth in wild or hatchery coho occurred. However, by tripling the population, growth was depressed in both wild and hatchery fish (Raymond 1986).

Absence of emerging fry during fyke trap sampling April 14 - May 11 at Mile One Slough, DCR, indicates emergence occurred after the first week in May (Ridder 1983). Mean lengths from coho salmon ponded at Clear Hatchery ranged from 27.2 to 30.7 mm from 1981 to 1988. Twenty four age zero coho salmon sampled June 14 from the DCR had a mean length of 37 mm and a mean weight of 0.5 g. Fourteen age zero coho salmon sampled July 25 averaged 35 mm (fork length) and ranged from 0.4-0.7 g (Pearse 1975).

Coho salmon fry are territorial in behavior holding selected positions in the stream (Hart 1973). Early emerging fry have an initial size advantage for prime rearing areas (Raymond 1986). Coho salmon fry initially inhabit the river margins and are virtually absent from the mainstream river by fall as they migrate to the small spring tributaries and backwater areas of the river. The springs maintain higher temperatures than the main river, and are the preferred overwintering habitat (Pearse 1975).

Based on sampling in a small spring-fed tributary at river kilometer 1.6 DCR (Mile One Slough), coho salmon smolt emigration from the DCR begins in mid-April. The spring becomes a slough of the Tanana River after the first week of May when the Tanana River rises. Water at the mouth of the spring moves with minimal velocity and is deep. It is a natural holding or resting area for migrating fish and can be completely closed off with a fyke net to capture fish. Water temperatures from this spring are 1-2°C higher than the mainstream river which may also attract fish (Ridder 1983). Coho salmon generally predominate in the fyke net catches and numbers of coho salmon tend to increase during the last week of April and early May (Appendix A2; Table 1). Range of lengths for all samples was 64 mm to 120 mm in fork length.

Small catches of coho salmon at a smolt weir (confluence of Julius and Clear Creeks) during the first week of May indicated coho salmon smolt migrations were earlier than that of chinook and chum salmon smolts (Raymond 1986).

Food Habits

Coho salmon fry feed on drifting terrestrial insects (Hart 1973). Once coho salmon enter the ocean, feeding is active and growth is rapid. Young coho

Table 1. Mean fork length of juvenile coho salmon taken from Mile One Slough, 1980 - 1985.

Year	Number in Sample	Mean Length of Sample (mm)	Range of Lengths (mm)
1980	52	87	70 - 110
1981	31	87	67 - 120
1984	18	80	64 - 103
1985	73	88	67 - 119

salmon feed on larval herring and various kinds of crustacea and fish (Hart 1973).

COHO SALMON HARVEST

Sport Fisheries

The DCR has the largest known escapement and supports the biggest sport fishery for coho salmon in the Yukon drainage. The Anvik River is the only other tributary to the Yukon River with significant coho salmon sport harvests. The remainder of the river-run coho salmon sport harvest in the Arctic-Yukon-Kuskokwim region (AYK) is in the Kuskokwim River drainage. Larger than normal runs, with restrictive management of the lower Yukon River fall chum salmon commercial fisheries, have produced higher escapements of coho salmon to the Tanana River drainage in recent years. Record numbers of coho salmon have been observed, and a sizable sport fishery has developed in the DCR. Few coho salmon were harvested by sport fishermen between 1977 and 1983 (Figure 4). Sport harvests have increased dramatically since that time with harvests exceeding 1,000 fish annually since 1986 (Table 2).

Harvest of coho salmon in the column titled "other streams" in Table 2 is a summation of harvest in streams where location was mixed. Upon examination of these reported streams in Mills (1990) statewide harvest records (not published), 37% or 125 coho salmon were from the Nenana River drainage (Julius and Clear Creek), and another 37% (125 coho salmon) were attributable to the DCR (Clear Creek on the Richardson Highway). The remainder of the harvest (26%) is from mixed locations. In the Nenana River drainage, Julius Creek, Clear Creek, Wood Creek, June Creek, Panguinque Creek, and Lost Slough are tributaries where spawning coho salmon have been reported and sporadic sport fishing occurs. In the big Delta area, coho salmon escapements have been observed in the Richardson Clearwater River, Blue Creek, Bluff Cabin Slough, and Delta River near the confluence of the Tanana river (Buklis and Wilcock 1985). Sporadic sport fishing for coho salmon occurs in the Richardson Clearwater River (RCR). The Toklat River in the Kantishna River drainage has a record of spawning coho salmon but no sport harvest has been documented or observed.

Sport fishing effort for Arctic grayling (which is the principal fishery on the DCR) typically declines by the end of August (Merritt et al. 1990), and does not overlap the time frame during which the coho salmon sport fishery occurs.

Anglers fish for coho salmon along a 1 km stretch of shore located from the state campground to Clearwater Lodge. In addition, boats are launched at the campground or at Clearwater Lake to fish for coho salmon in the main river. Aggressive spawning behavior causes coho salmon of both sexes to strike at large colored fishing lures. This aggressive behavior is in part responsible for the quality of the sport fishing experience, which is highly regarded. Another attraction of the DCR coho salmon sport fishery is its timing - it is the last ice-free fishery of the year in the Tanana Valley. However, quality of the fish flesh is fair to poor.

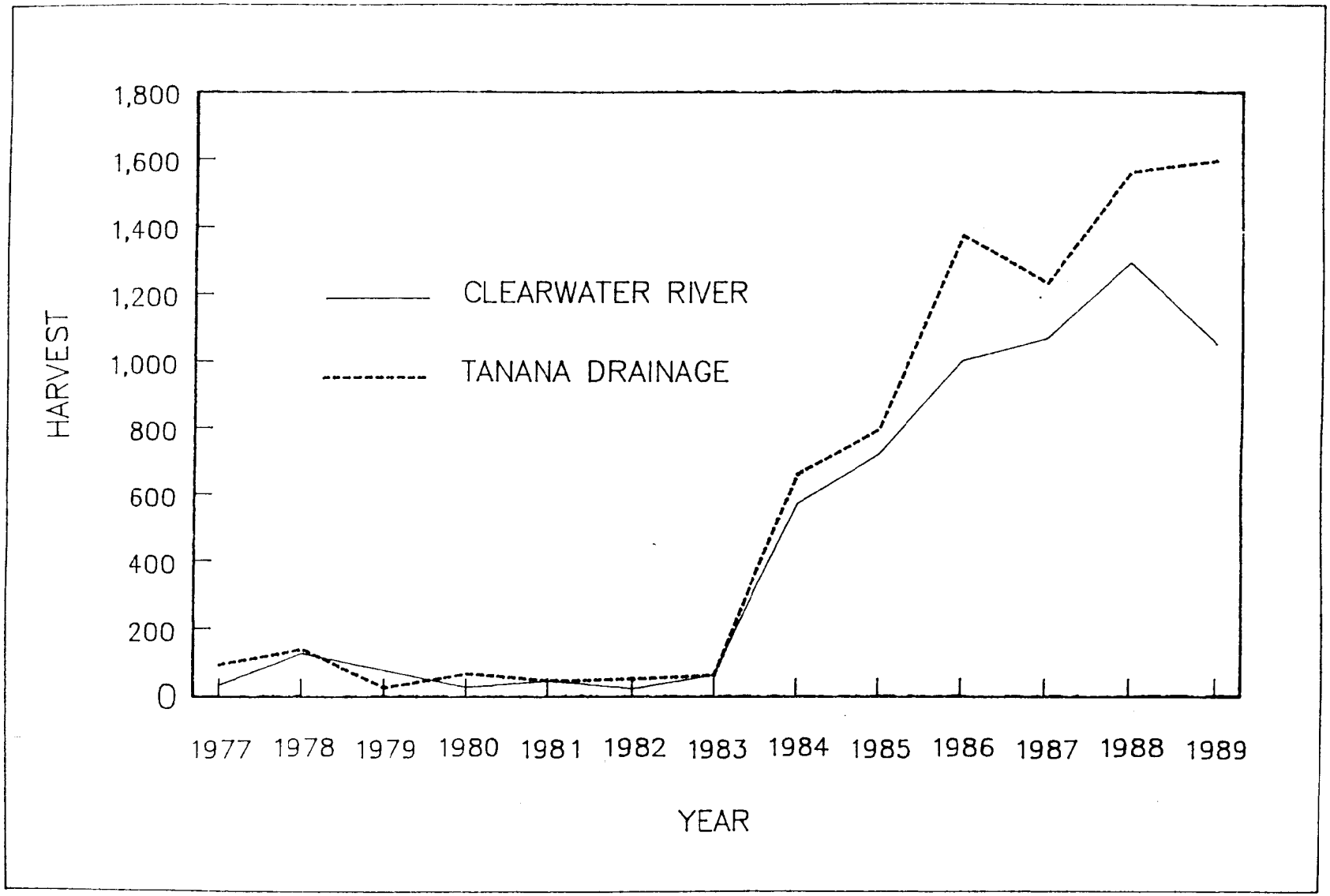

Figure 4. Estimated sport harvest for coho salmon in the Delta Clearwater River and Tanana River drainage, 1977-1989.

Table 2. Estimated sport harvest of anadromous coho salmon in the Tanana River drainage, 1977 - 1989[a].

Year	Location		
	Delta Clearwater River	Nenana Drainage	Other Streams[b]
1977	31	..	63
1978	126	..	13
1979	0	..	25
1980	25	..	42
1981	45	..	0
1982	21	..	31
1983	63	..	0
1984	571	..	91
1985	722	..	74
1986	1,002	0	347
1987	1,068	0	163
1988	1,291	255	272
1989	1,049	192	336
Average	463	223	112

[a] Mills 1978 - 1990

[b] Generally streams of the Nenana drainage.

Changing trends in recreational use of the river has brought new concerns. The popularity of the coho salmon fishery has concentrated angling in a limited area and increased boat activity takes place when coho salmon are spawning. In addition to increased boat activity, use of larger displacement type boats is becoming more common. Larger displacement type boats have a tendency to displace plant growth, organic material, and even gravel from shallower waters. It is unknown if this disturbance affects incubating eggs.

Commercial Fisheries

Coho salmon have been commercially harvested in the Alaska portion of the Yukon River from 1918 - 1921, from 1952 to 1954, and since 1961 (Whitmore et al. 1990). Coho salmon enter the Yukon River from late July through mid September and average 3.2 kg (7 lbs) (Whitmore, et al. 1990). Yukon and Tanana River commercial catches of coho salmon averaged 58,063 fish from 1985 to 1989 (ADFG 1991).

Lower Yukon River commercial fisheries (districts 1-3, Figure 5) are regulated by emergency order openings. Run strength and timing are monitored by test fishing and commercial catch. A sonar project has been operated on the Yukon River near Pilot Station to enumerate passage of salmon, but the project terminates prior to the conclusion of coho salmon passage, so counts of coho salmon are incomplete (Eggers et al. 1989).

In 1990 several short openings of six hours each (down from 12 hours in 1978-1988 and 24 hours 1982-1986) were allowed to fill quotas or to evaluate the run strength (ADFG 1991). In 1988, consistent daily test net catches of coho salmon did not begin until August 5, with no significant catches occurring until August 8 (Whitmore et al. 1990). Peak of the coho salmon run is approximately two weeks later than that of the fall chum salmon, and with tightly regulated commercial openings, more coho salmon escape the lower Yukon River fishery. Lower Yukon River catches averaged 46,319 coho from 1985 to 1989 (ADFG 1991)

In the Upper Yukon fishery, a majority of the commercial coho salmon catches occur in the Lower Tanana River. Harvest of coho salmon in district 6 (Figure 5) has dramatically increased in recent years (Table 3) largely due to increased catches in the fall chum fishery (Holder pers. comm.[4]). In 1989, the Board of Fisheries regulated openings to two 42 hour periods a week and established quotas for district 6 at 2,750-20,500 chum and coho salmon combined. In 1990, 12,464 coho salmon were taken in district 6 in the Upper Yukon River. In addition, 178 kg (3,800 lbs; total Yukon River sales) of coho salmon roe and 3,133 coho salmon in the round was sold (ADFG 1991). Upper Yukon River catches averaged 11,744 coho salmon from 1985 to 1989 (ADFG 1991). An average of $0.37 per pound was paid in 1988 for upper Yukon River coho salmon. Commercial uses of coho salmon consist of buyers processing and selling roe as well as fresh frozen and smoked fish flesh. Fishermen operate fish wheels and set gill nets in the upper Yukon River to capture salmon.

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[4] Holder, Russ. 1991. Personal Communication. ADFG, Division of Commercial Fish, 1300 College Road, Fairbanks, Alaska 99701.

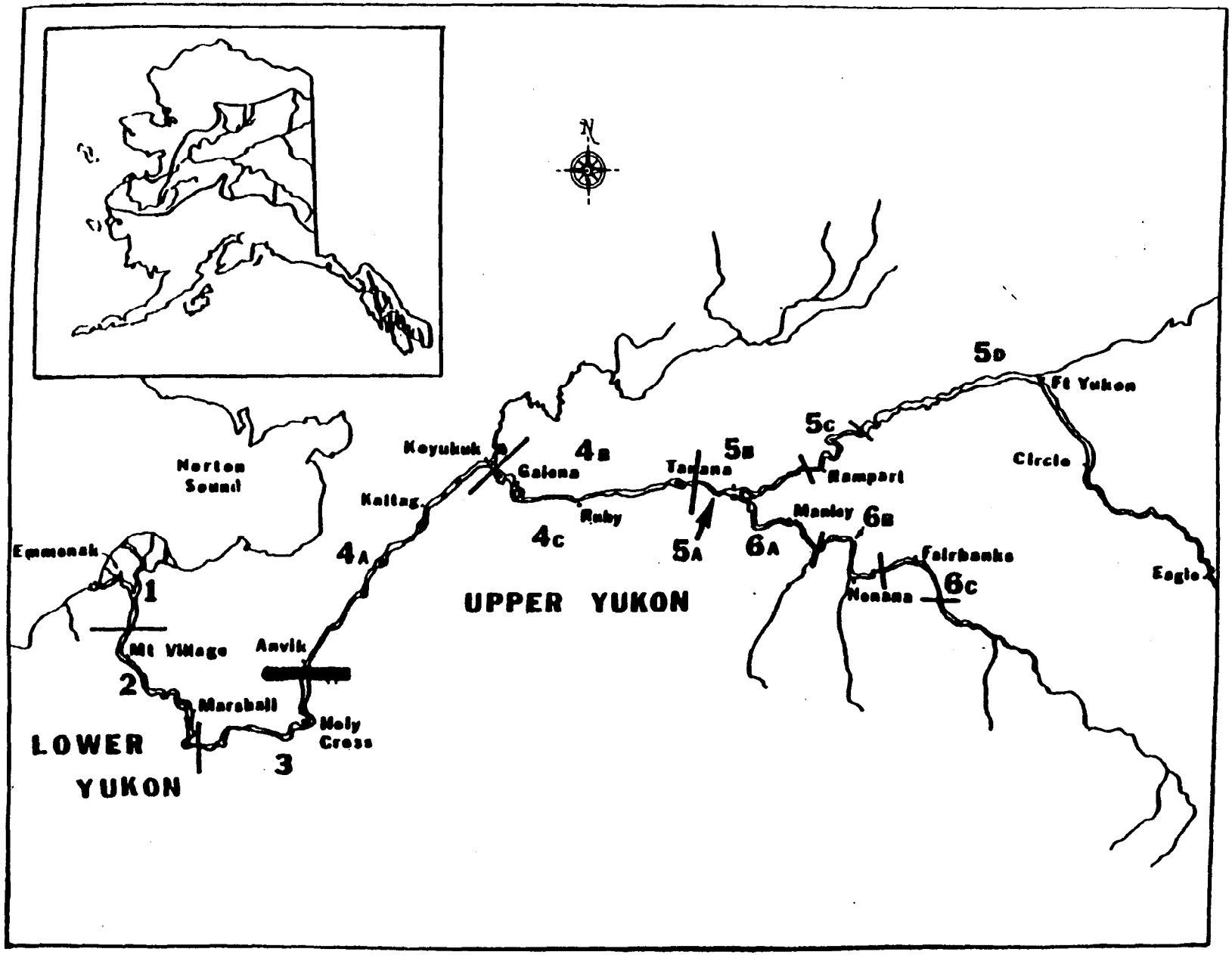

Figure 5. Yukon River drainage with location of Commercial districts 1-6.

Table 3. Commercial coho salmon harvest by district, lower and upper Yukon area, 1978 - 1990[a].

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
LOWER YUKON DRAINAGE													
District 1	16,460	11,369	4,829	13,129	15,115	4,595	29,472	27,676	24,824	0	36,435	24,672	13,354
District 2	5,835	2,850	2,660	7,848	14,179	2,557	43,064	17,125	21,197	0	34,776	38,522	16,435
District 3	758	0	0	419	87	0	621	171	793	0	1,419	3,988	918
Subtotal	23,053	14,219	7,489	21,396	29,381	7,152	73,157	44,972	46,814	0	72,630	67,182	30,707
UPPER YUKON DRAINAGE													
District 4	32	155	30	0	15	0	1,095	938	0	0	2	3	0
District 5	1	0	0	0	0	0	0	0	0	0	8	84	0
District 6	3,066	2,791	1,226	2,284	7,780	6,168	7,688	11,762	441	0	27,267	18,224	12,464
Subtotal	3,099	2,946	1,256	2,284	7,795	6,168	8,783	12,700	441	0	27,277	18,311	12,464
Area Total	26,152	17,165	8,745	23,680	37,176	13,320	81,940	57,672	47,255	0	99,907	85,493	43,171

[a] Data taken from Whitmore (1990).

Distribution of North American and Asian coho salmon on the high seas has been documented since 1956 with a tag recovery program (Myers et al. 1990). Coded-wire tags were incorporated into the tag recovery program in 1980. Recovery of tagged fish is reported to the International North Pacific Fisheries Commission (INPFC). Distribution of North American coho salmon recovered on the high seas is confined primarily to the north Pacific Ocean (Figure 6). Only four coho salmon tagged in the Yukon River have been recovered from the high seas (Myers et al. 1990).

In 1952 the Japanese established two large high seas fisheries: land-based and mother-ship drift net fisheries for salmonids. Concern over the interception of North American and Russian stocks led to restrictions of both fisheries beginning in 1977, through negotiations and treaties. The Fishery Conservation and Management Act of 1976 (Magnuson Act) established a 322 km (200 mi) coastal management zone. The North Pacific Treaty of 1952 was revised in 1978 to annex new regulations such as closed waters southeast of 56°N, 175°E, and fleet and seasonal restrictions. The USSR established quotas in 1956, and implemented a 322 km (200 mi) coastal management zone in 1977. A U.S.-Japan bilateral agreement in 1985 and 1986 featured a gradual phasing out of mother-ship fishing in the central Bering Sea (north of 56°N) through 1994 after which the area north of 56°N will be closed. High seas Japanese interception of coho salmon of Alaskan origin has been reduced since 1978 due to the enforcement of the Magnuson Act (Harris 1988).

Walker (1990) was able to differentiate Asian stocks from North American stocks of coho salmon through scale pattern analysis. Walker estimated that the interception of predominantly Alaskan age 2.1 coho in the landbased Japanese drift-net fisheries at 18% or 87,000 fish in 1986. As a result of the declining land-based fishery, harvest of coho salmon declined to at 50,000 fish by 1988 (Walker 1990). It is unknown what proportion, if any, of this catch is comprised of coho salmon from the Yukon River.

Subsistence Fisheries

ADFG has monitored subsistence catches of Yukon River salmon since 1961. Subsistence fishing occurs from May to October. Fishing activities are generally based from a fish camp or the home village. Due to the difficulty of sampling subsistence users in some 43 Yukon drainage villages, ADFG has distributed catch calendars and conducted personal interviews to collect harvest data since 1988. In 1988, 2,536 households were identified in 40 communities in which 59% or 1,495 households participated in subsistence fishing for salmon (Whitmore et al. 1990). Set and drift gill nets, beach seines, and fish wheels are legal gear for subsistence fishing in the Yukon River area.

During the fishing season more fishing time is allowed for subsistence than for commercial purposes. During closures of the commercial fishing season, subsistence fishing is allowed from five to seven days per week in districts 1-5, and for two 42-hour periods per week in district 6. Subsistence fishing permits are required in the Tanana River drainage (ADFG 1991). Average

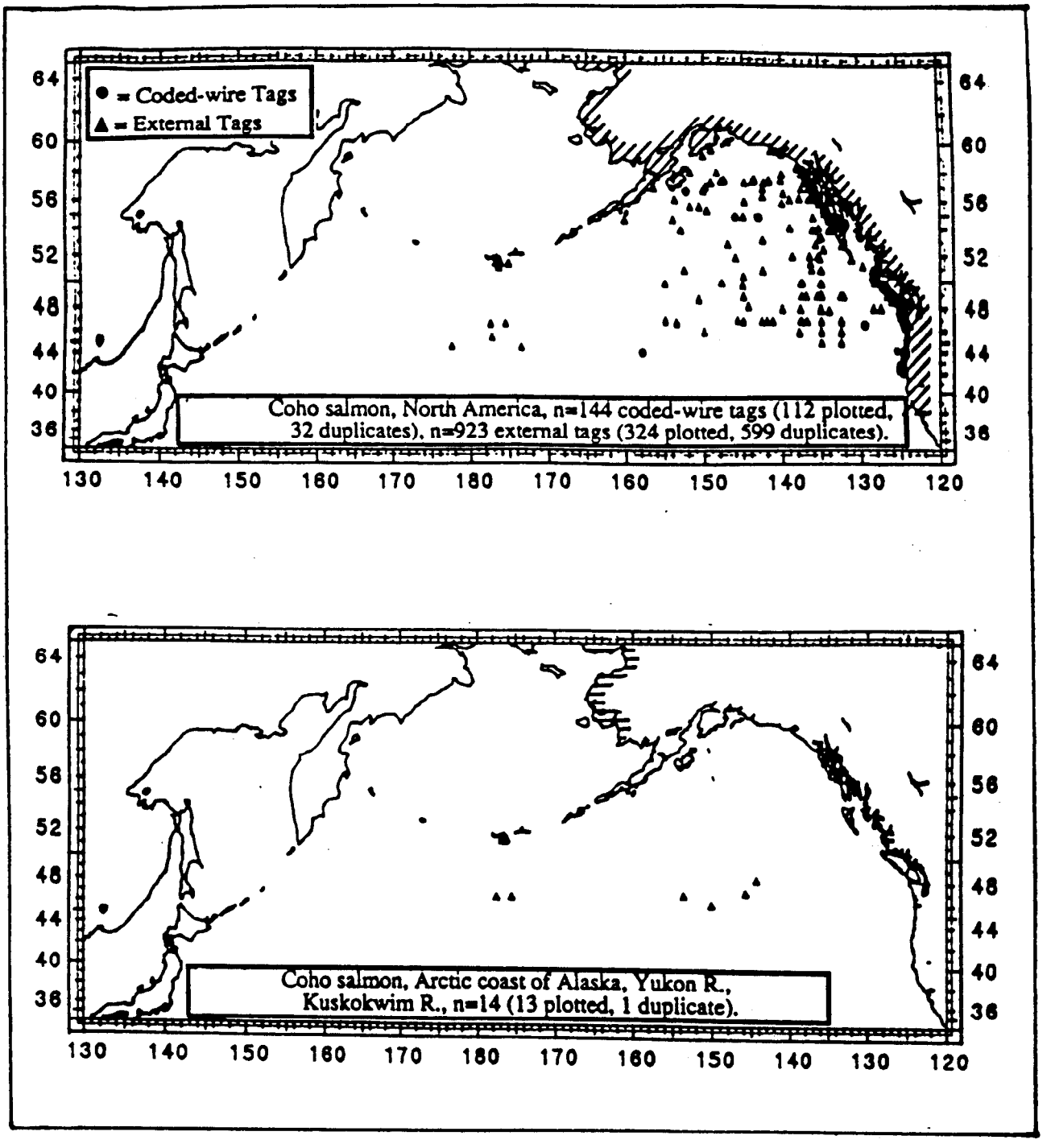

Figure 6. Distribution of tagged coho salmon from North America and from the Yukon and Kuskokwim Rivers (Myers et al. 1990).

subsistence harvest on the Yukon River from 1978 to 1989 was 35,709 coho salmon (Table 4).

Personal Use Fisheries

In the Tanana River drainage, personal use and subsistence harvest limits for coho salmon are as follows: in subdistricts 6A and 6B 2,000 fall chum and coho salmon combined; in subdistrict 6C 5,200 fall chum and coho salmon combined (Holder pers. comm.[5]). Set nets, beach seines, and fish wheels are legal gear for this fishery. Personal use harvest of coho salmon in 1988 was 1,308 fish and in 1989 was 966 coho salmon (ADFG 1991; Table 5).

COHO SALMON ESCAPEMENT

Due to the extensive length of the Yukon River (3,700 km from its' headwaters in British Columbia to the Bering Sea) and concentration of effort to monitor chinook and chum salmon escapements, assessments of coho salmon escapement has centered upon major known concentrations. Sonar counts since 1986 at Pilot Station (river kilometer 196 of the Yukon River), and escapement counts in major spawning streams of the Tanana River drainage are presented in Table 6. Other rivers in the Yukon River drainage having coho salmon escapements documented in 1988 by aerial surveys are the Anvik River (1,203) Atchuelinguk River (176), and the Andreafsky River (2,743) (Whitmore et al. 1990).

The largest coho salmon escapements occur in the DCR. An average of 8,046 coho salmon per year has been counted since 1972. In recent years, escapements have increased and in 1988 22,300 coho salmon were counted. Escapement counts are conducted by boat with an individual counting from a 1.6 m elevated platform. Twenty eight kilometers of mainstream river and 1.6 km of Clearwater Lake is surveyed, and counts recorded for each 1.6 kilometer section (Table 7). Counts occur after the peak of the run which is approximately mid October.

COHO SALMON AGE, LENGTH, AND SEX

The majority of coho salmon entering the Yukon River are four years of age. Four year olds in the commercial and subsistence harvests averaged 83.8% of the sample, and ranged from 73.7 to 91.7% (Table 8) from 1982 to 1988. In 1988 commercially caught coho salmon averaged 3.3 kg (7.3 lbs) in the lower Yukon area, and 3.0 kg (6.6 lbs) in the upper Yukon area (Whitmore et al. 1990).

Since 1984, carcass samples have been collected in the DCR to document age, length, and sex composition. An average of 79% of the returning coho salmon (Table 9) to the DCR from 1984 to 1990 were four years of age. An average of 14% of returning adults were three years of age, and 7% were five years of age. Age of a four year old coho salmon is denoted in the European notation

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[5] Holder, Russ. 1991. Personal Communication. ADFG, Division of Commercial Fish, 1300 College Road, Fairbanks, Alaska 99701.

Table 4. Subsistence coho salmon harvest by district, lower and upper Yukon area, 1978 - 1989[a].

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
						LOWER YUKON DRAINAGE						
District 1	1,142	3,184	1,808	3,769	11,192	3,590	6,095	3,246	2,725	6,396	4,389	5,144
District 2	598	1,132	4,801	3,736	10,229	6,072	7,066	4,834	9,140	6,894	7,104	5,039
District 3	223	12	91	490	675	917	740	376	781	682	1,539	537
Subtotal	1,963	4,328	6,700	7,995	22,096	10,579	13,901	8,456	12,646	13,972	13,032	10,720
						UPPER YUKON DRAINAGE						
District 4	145	259	7,734	2,359	2,952	3,946	2,867	3,949	2,631	3,551	4,842	4,030
District 5	970	595	561	1,713	3,428	2,448	17,467	8,098	5,870	11,900	19,755	7,110
District 6	4,709	4,612	5,163	9,261	7,418	6,922	14,785	11,761	13,321	55,471	31,509	19,117
Subtotal	5,824	5,466	13,458	13,233	13,798	13,316	35,119	23,808	21,822	70,922	56,106	30,257
Area Total:												
Subsistence	7,787	9,794	20,158	21,228	35,894	23,895	49,020	32,264	34,468	84,894	69,138	40,977
Commercial	26,152	17,165	8,745	23,680	37,176	13,320	81,940	57,672	47,255	0	99,907	85,493
Total	33,939	26,959	28,903	44,908	73,070	37,215	130,960	89,936	81,723	84,894	169,045	126,470

[a] Data taken from Whitmore (1990).

Table 5. Personal use coho salmon harvest by area and year, Yukon River, 1988 - 1989.

Permit type	Year	Permits issued	Reported Harvest[a]			
			Chinook	Summer Chums	Fall Chums	Coho
Lower Yukon River						
	1988	17	82	505	7	0
	1989	26	338	450	21	70
Upper Yukon River (Haul Road Bridge area)						
	1988	39	2,044	1,327	2,653	0
	1989	45	2,011	316	3,529	88
Tanana River (Subdistricts a-c)						
Sub district 6(a-b):						
	1988	2	56	224	0	0
Sub district 6(c):						
	1988	114	557	1,715	2,230	1,308
Sub district 6(a-c):						
	1989	116	439	1,096	1,958	809
All Yukon						
	1988	172	2,739	3,771	4,890	1,308
	1989	248	2,788	1,862	5,508	967

[a] Data taken from Whitmore (1990).

Table 6. Coho salmon escapements for selected areas in the Yukon River drainage[a].

Year	Yukon River Drainage		Nenana River Drainage				
	Kilometer 122 Sonar	Andreafsky River	Lost Slough	Clear Creek	Wood Creek[b]	17mile Slough	Richardson Clearwater
1972							454[e]
1973							375
1974			1,388			27	652
1975			943			956	4[e]
1976			118	13		281	80[e]
1977			524		310	1,167	327
1978			350		300	466	
1979			227			1,987	372
1980			499		1,603	592	611
1981			274		849[g]	1,005	550
1982					1,436[g]		
1983			766		1,044[g]	103	88
1984			2,677	2,600[b,d]	8,805[g]		428
1985			1,584		3,775[g]	2,081	
1986	200,000		794	605[b,d]	1,664[g]	218[b,d]	146[e]
1987	241,000		2,511		2,450[g]	3,902	
1988	264,000	2,743	348		2,046[g]		
1989	181,000				412[g]	824[e]	483
1990	230,000		688			15[e]	

[a] Only peak counts presented, survey rating is fair to good unless otherwise stated (ADFG 1991).
[b] Survey by Fisheries Research Enhancement Division.
[c] Survey by Sport fisheries Division.
[d] Boat survey.
[e] Poor survey.
[f] Foot survey.
[g] Weir count.

Table 7. Coho salmon escapement into the Delta Clearwater River and Clearwater Lake Outlet from 1972 to 1990[a].

Year	Date of Survey	Delta Clearwater River[b]				Clearwater Lake Outlet[b]
		Lower River[c]	Upper River[d]	Total	Sport Harvest[e]	
1972	11/9			632		417[f]
1973	10/20			3,322		551
1974				3,954[f]		560[f]
1975	10/24			5,100		1,575
1976	10/22			1,920		1,500
1977	10/25	2,331	2,462	4,793	31	730
1978	10/26	2,470	2,328	4,798	126	570
1979	10/23	3,407	5,563	8,970	0	1,015
1980	10/28	2,206	1,740	3,946	25	1,545
1981	10/21	4,110	4,453	8,563[g]	45	459
1982	11/3	4,015	4,350	8,365[g]	21	
1983	10/25	3,849	4,170	8,019[g]	63	253[f]
1984	11/6	5,434	5,627	11,061	571	1,368[f]
1985	11/13			5,358[f]	722	750[f]
1986	10/21	5,490	5,367	10,857	1,002	1,800
1987	10/27	11,700	10,600	22,300	1,068	4,225
1988	10/28	5,300	16,300	21,600	1,291	825
1989	10/25	5,400	7,200	12,600	1,049	1,600
1990	10/26	4,525	3,800	8,325		2,375

[a] Only peak counts presented, survey rating is fair to good, unless otherwise noted.
[b] Survey by Sport Fish Division, boat survey.
[c] Mile 0 - 7.
[d] Mile 8 - 17.5.
[e] Data taken from Mills (1978-1990).
[f] Survey by Commercial Fisheries Division.
[g] Population estimate.

Table 8. Age composition of coho salmon harvested in Yukon River commercial and subsistence fisheries combined, 1982 - 1988[a].

Year	Sample Size	Percent of harvest by age: Age 1.1	Age 2.1	Age 3.1	All Ages
1982	320	4.1	87.3	8.6	100.0
1983	121	4.1	91.7	4.1	100.0
1984	619	12.9	73.7	13.4	100.0
1985	462	14.1	76.3	9.6	100.0
1986	491	2.2	88.6	9.2	100.0
1987	0[b]				0.0
1988	1,091	12.2	85.5	2.3	100.0
Average		8.4	83.8	7.8	100.0

[a] Age composition estimated from samples collected from each gear type, by district and fishery, or from samples from adjacent fisheries of the same gear type (Whitmore et al. 1990).

[b] No commercial harvest occurred, no subsistence samples taken.

Table 9. Age distribution of the coho salmon escapement, Delta Clearwater River 1984 - 1990.

Return Year	Sample Size	Percent in Age Class		
		1.1	2.1	3.1
1984	250	4.0	75.2	20.8
1985	299	3.0	88.3	8.7
1986	219	8.7	84.5	6.8
1987	221	27.6	69.7	2.7
1988	225	10.2	89.8	0
1989	172	17.4	77.3	5.2
1990	325	28.9	67.4	3.7
Total	1,711	14.3	78.9	6.8

as 2.1. The first digit in the European method is number of freshwater years but does not include the gravel year and the second digit is number of years in the ocean. Average length of male and female coho salmon from 1984 to 1990 varied slightly between sexes and age groups (Table 10). Appendices (A3-A9) provide annual statistics for coho salmon age, sex, and length compositions.

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Table 10. Age, sex, and length composition of the coho salmon escapement, Delta Clearwater River, 1984 - 1990.

Year	Sample Dates	Mean Length (mm)[a] Age 1.1	Age 2.1	Age 3.1	Sample Size	Composition of Sample
Females:						
1984	11/5-11	534	536	541	120	48.0
1985	11/13-18	596	573	574	116	38.8
1986	12/4	528	540	538	98	44.8
1987	12/4	533	554	557	106	48.0
1988	11/11	543	550	...	121	53.8
1989	11/22	539	548	570	92	53.5
1990	11/21	549	556	556	146	44.9
Average		546	551	556		47.7
Males:						
1984	11/5-11	517	525	538	130	52.0
1985	11/13-18	580	567	572	183	61.2
1986	12/4	559	528	524	121	55.2
1987	12/4	541	556	553	115	52.0
1988	11/11	558	560	...	104	46.2
1989	11/22	537	552	578	80	46.5
1990	11/21	541	549	535	179	55.1
Average		548	548	550		52.3

[a] Length measured from mid-orbit to fork of tail.

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APPENDIX A

Appendix A1. Number of coho salmon released, number returned by sex, and percent age and sex of the escapement at Wood Creek weir, Clear air Force Station Hatchery near Nenana, 1981 -1988[a].

Year	Number Released[b] (1,000)	Number Marked (1,000)	Actual Return[c]		Percent Age 4	Marine Age 5	Average Survival[d]	Fecundity	Total Run		Temperature Units[e]		
			Males	Females					Males	Females	Eyed	Hatch	Pond
1981	125.9	25.10						4,120	1,103	943	210	445	619
1982	167.7	18.10						4,089	1,318	1,118	220	468	750
1983	164.9	25.00						3,791	839	825	230	510	700
1984	83.0	26.38	1,248	1,489	99.6	0.4	4.35	4,553	2,422	2,398	215	452	700
1985	160.0	30.19	50	135	94.1	5.9	0.22	4,136	4,312	4,514	220	470	670
1986	159.8	27.50	100	74	100.0	0.0	0.21	3,746	551	493	220	510	720
1987	165.0	0.00	272	273	100.0	0.0	0.66	3,951	784	610	210	473	673
1988	165.0	0.00	423	412	90.2	9.8	1.04	4,168	427	385	210	490	675
Average					97.0	3.0	1.30	4,069	1.469	1,411	217	477	688

[a] Unpublished data from Dave Parks, Hatchery Manager.
[b] Fingerling fry.
[c] Calculated from number of fingerling fry released with marks, coded wire and fin clips.
[d] Fingerling fry to adult return to Wood Creek weir.
[e] One temperature unit is one degree centigrade accumulated per day.

Appendix A2. Catch of coho salmon in fyke traps at Mile One Slough, 1976 - 1985, by date.

	Year and Beginning and Ending Dates of Test Fishing								
	1976	1977	1978	1979	1980	1981	1982	1984	1985
	4/20	4/21	4/18	4/18	4/14	4/15	4/19	4/16	4/23
Date	5/1	5/5	5/5	5/3	5/2	5/1	5/7	5/11	5/8
4/14					31				
4/15									
4/16					24				
4/17						10		18	
4/18			23	27	10				
4/19			153						
4/20			13	65		56		33	
4/21	12	96	20		5	67			
4/22	6	74							
4/23	6			100	40		11	225	
4/24	11			97	18	680			28
4/25			33	102	8			120	
4/26		85	41	134			7		37
4/27	114	20	100	140		1,274			
4/28		154	20		147		1	182	
4/29		100			179	564			67
4/30					88		9	303	
5/1	169			287		157		108	438
5/2			84	425	62				
5/3			76	367			49	681	64
5/4			74					603	
5/5		152	61						
5/6							18		286
5/7							258	303	
5/8									
5/9								577	
5/10									
5/11								411	
Totals	318	681	698	1,744	612	2,808	353	3,563	920

Appendix A3. Length (mm) of coho salmon by age and sex, Delta Clearwater River, 1984[a].

		Brood year and Age Group			
		1981 (1.1)	1980 (2.1)	1979 (3.1)	Total
FEMALE:	Sample Size	6	85	29	120
	Percent	2.4	34.0	11.6	48.0
	Length	534	536	541	
	Std Error	7.1	2.7	3.8	
MALE:					
	Sample Size	4	103	23	130
	Percent	1.6	41.2	9.2	52.0
	Length	517	525	538	
	Std Error	22.7	3.9	8.1	
Total:	Sample Size	10	188	52	250
	Percent	4.0	75.2	20.8	100.0

[a] Samples collected by carcass survey during period 11/05-11/15, length measured from mid-orbit to fork of tail.

Appendix A4. Length (mm) of coho salmon by age and sex, Delta Clearwater River, 1985[a].

		Brood year and Age Group			
		1982 (1.1)	1981 (2.1)	1980 (3.1)	Total
FEMALE:	Sample Size	4	101	11	116
	Percent	1.3	33.8	3.7	38.8
	Length	596	573	574	
	Std Error	15.6	3.7	6.3	
MALE:					
	Sample Size	5	163	15	183
	Percent	1.7	54.5	5.0	61.2
	Length	580	567	572	
	Std Error	13.3	3.7	11.6	
Total	Sample Size	9	264	26	299
	Percent	3.0	88.3	8.7	100.0

[a] Samples collected by carcass survey during period 11/13-11/18, length measured from mid-orbit to fork of tail.

Appendix A5. Length (mm) of coho salmon by age and sex, Delta Clearwater River, 1986[a].

		Brood year and Age Group			
		1983 (1.1)	1982 (2.1)	1981 (3.1)	Total
FEMALE:	Sample Size	10	81	7	98
	Percent	4.6	37.0	3.2	44.8
	Length	528	540	538	
	Std Error	8.5	3.5	8.7	
MALE:					
	Sample Size	9	104	8	121
	Percent	4.1	47.5	3.6	55.2
	Length	559	528	524	
	Std Error	9.5	4.0	12.1	
Total:	Sample Size	19	185	15	219
	Percent	8.7	84.5	6.8	100.0

[a] Samples collected by carcass survey on 12/4, length measured from mid-orbit to fork of tail.

Appendix A6. Length (mm) of coho salmon by age and sex, Delta Clearwater River, 1987[a].

		Brood year and Age Group			
		1984 (1.1)	1983 (2.1)	1982 (3.1)	Total
FEMALE:	Sample Size	33	70	3	106
	Percent	14.9	32.7	1.4	48.0
	Length	533	554	557	
	Std Error	5.0	3.0	9.0	
MALE:					
	Sample Size	28	84	3	115
	Percent	12.7	38.0	1.4	52.0
	Length	541	556	553	
	Std Error	7.0	4.0	9.0	
Total:	Sample Size	61	154	6	221
	Percent	27.6	69.7	2.7	100.0
	Std. Error	3.0	3.1	1.1	

[a] Samples collected by carcass survey on 12/4, length measured from mid-orbit to fork of tail.

Appendix A7. Length (mm) of coho salmon by age and sex, Delta Clearwater River, 1988[a].

		Brood year and Age Group			
		1985 (1.1)	1986 (2.1)	1983 (3.1)	Total
FEMALE:	Sample Size	9	112	0	121
	Percent	4.0	49.8		53.8
	Length	543	550		
	Std Error	12.2	2.9		
MALE:					
	Sample Size	14	90	0	104
	Percent	6.2	40.0		46.2
	Length	558	560		
	Std Error	7.3	3.4		
Total:	Sample Size	23	202	0	225
	Percent	10.2	89.8		100.0
	Std. Error	2.0	2.0		

[a] Samples collected by carcass survey on 11/11, length measured from mid-orbit to fork of tail.

Appendix A8. Length (mm) of coho salmon by age and sex, Delta Clearwater River, 1989[a].

		Brood year and Age Group			
		1986 (1.1)	1985 (2.1)	1984 (3.1)	Total
FEMALE:	Sample Size	18	70	4	92
	Percent	10.5	40.7	2.3	53.5
	Length	539	548	570	
	Std Error	9	5	11	
MALE:					
	Sample Size	12	63	5	80
	Percent	7.0	36.6	2.9	46.5
	Length	537	552	578	
	Std Error	13	6	14	
Total:	Sample Size	30	133	9	172
	Percent	17.4	77.3	5.2	100.0
	Std. Error	3.8	4.2	2.2	

[a] Samples collected by carcass survey on 11/22, length measured from mid-orbit to fork of tail.

Appendix A9. Length (mm) of coho salmon by age and sex, Delta Clearwater River, 1990[a].

		Brood year and Age Group			
		1987 (1.1)	1986 (2.1)	1985 (3.1)	Total
FEMALE:	Sample Size	40	98	8	146
	Percent	12.3	30.2	2.5	44.9
	Length	549	556	556	
	Std Error	4.6	2.9	7.4	
MALE:					
	Sample Size	54	121	4	179
	Percent	28.9	67.4	3.7	55.1
	Length	541	549	535	
	Std Error	5.3	3.8	27.2	
Total:	Sample Size	94	219	12	325
	Percent	28.9	67.4	3.7	100.0
	Std. Error	2.5	2.6	1.0	

[a] Samples collected by carcass survey on 11/21, length measured from mid-orbit to fork of tail.