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Enumeration and Biological Data on Arctic Charr (*Salvelinus alpinus*) from Cache Creek, Northwest Territories, 1988

by

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INTRODUCTION

The arctic charr (*Salvelinus alpinus*) population of Cache Creek, Northwest Territories, is anadramous, descending the river in spring to feed in the Beaufort Sea, and returning in August to spawn and over-winter. This charr population is an important traditional food resource for the community of Aklavik, Northwest Territories. Charr are harvested at points along the coast as they migrate east to the MacKenzie Delta, at the mouth of Big Fish River, and later at Fish Hole, in the headwaters of Cache Creek.

Concern by Aklavik residents and the Department of Fisheries and Oceans (DFO) for the charr population, led to the closure of the Big Fish River charr fishery in June 1987 and to the initiation of population surveys. North/South Consultants conducted a census of upstream migrating charr in August and September of 1987. They concluded that the population may have declined by 25 to 50% since 1972, attributable primarily to over-harvesting (MacDonell 1988).

To obtain a second estimate, a stock assessment was conducted in 1988. The objectives were two-fold: 1) census the Cache Creek charr population, and 2) collect basic biological data. This report includes the results and conclusions from the 1988 study.

STUDY AREA

The Big Fish River watershed originates in the Richardson Mountains and enters the MacKenzie Delta 40 km northwest of Aklavik, Northwest Territories. Cache Creek joins Fish River to form Big Fish River (Figure 1). Cache Creek is the only tributary used by arctic charr.

Cache Creek is fed by perennial thermal springs of the mineral type (McCart 1980); consequently the upper reaches stay open relatively late in the year and do not freeze to the bottom. The spawning and over-wintering site, known locally as "Fish Hole", is located in the upper reaches of Cache Creek, below a waterfall impassable to charr. Fish Hole consists of a series of deep pools, separated by shallower riffles.

Cache Creek is a single channel, flowing through a narrow, steep-walled gorge at the falls. Downstream, the creek follows a broad, flat valley through hilly terrain and breaks into numerous channels. Creek substrate is primarily gravel. Surface flow into the creek ends about mid-October, after which only spring flow occurs.

The braided channels are usually dry, except during highwater in spring, or after summer precipitation in the headwaters. Like most mountain streams in the Richardson Mountains, Cache Creek is susceptible to significant fluctuations in water level and reductions in clarity in a short period of time. High water levels carry large amounts of sediment and vegetative debris.

Willow (*Salix* spp.) and alder (*Alnus* sp.) grow along the creek banks. Trees, such as black spruce (*Picea mariana*) and balsam poplar (*Populus balsamifera*), grow rarely, and only in sheltered locations.

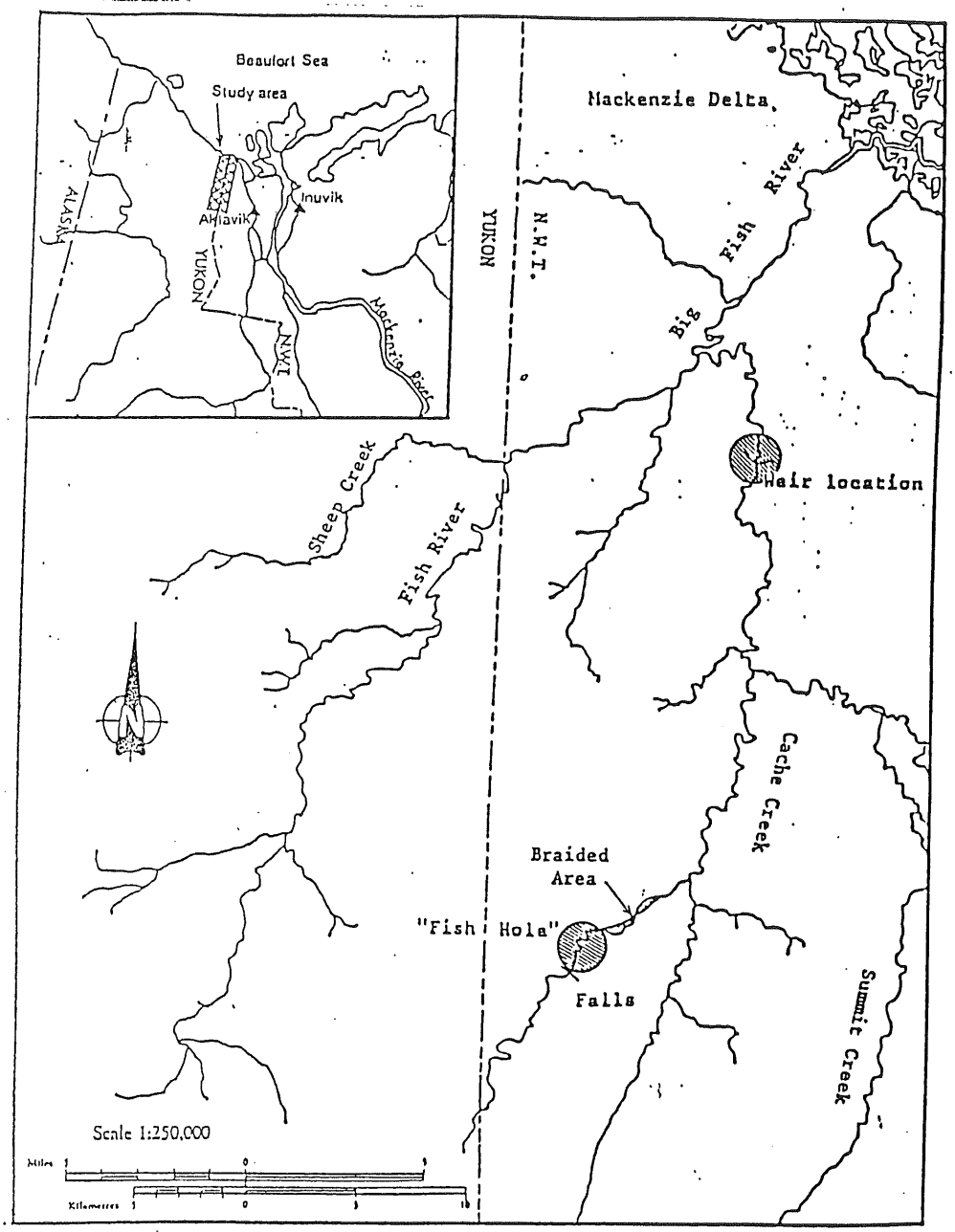

Figure 1. Map of the Big Fish River watershed showing the 1987 and 1988 weir location, and "Fish Hole" on Cache Creek. (From MacDonell 1988)

HISTORY OF THE BIG FISH RIVER CHARR FISHERY

Aklavik residents fish domestically for arctic charr from both the Rat River and Cache Creek populations. The Rat River population is fished in August and September in the West, Peel, and Husky Channels of the MacKenzie Delta.

The Cache Creek population was primarily fished at the mouth of the Big Fish River, using 2" to 4" gillnets. The charr were also heavily fished with seine or small mesh gillnets at Fish Hole. Fish Hole was seined from the beach in October and November, after freeze-up. Fish Hole is a traditional fishing location for Aklavik residents, whereas fishing at the river mouth apparently began in the 1960's. Charr from the Cache Creek population are also taken at points along the coast, such as Shingle Point and Running River, while they migrate east to Big Fish River. Currently, fishing of Cache Creek charr is restricted to coastal areas.

Arctic charr have been commercially fished north of Aklavik; however, the last commercial quota was set in 1986, at which time the quota was 900 kg round weight.

PREVIOUS STUDIES

The Cache Creek charr population was studied in 1972 as part of an investigation into the effects of a northern pipeline on the Delta fishery (Stein et al. 1973). Tag-recapture studies were conducted on the lower reaches of Big Fish River and at Fish Hole (Table 1). A Petersen estimate, conducted prior to fishing, indicated a population between 12 000 and 17 000 fish ($\geq$ 150 mm) at Fish Hole (Stein et al. 1973).

Harvest levels in the early 1970's were considered intense. The catch in 1972 was calculated to be between 8000 and 12 000 fish: 3000 to 5000 from the Big Fish River and 5000 to 7000 from Fish Hole (Stein et al. 1973). The exploitation rate was calculated at 38% for Fish Hole, considered heavy for arctic charr, and 19% for the lower reaches of Big Fish River.

In 1973, the domestic catch was considered poor and the fish of small size (Kristofferson 1986). About 2500 charr were taken from the lower reaches, and 1200 from Fish Hole.

In August of 1980 and 1984, DFO, with assistance from Aklavik fishermen, sampled the catch from Big Fish River (Tables 1 and 2). In 1984, 467 charr were tagged, the majority at Fish Hole (Gillman et al. 1985), measurements of size and age were made. Mortality of fishes aged 7 to 11 years was estimated to be 47% in 1984.

Based on harvest data collected by Aklavik residents, 489 charr were caught between August 21 and 28, 1985 near

the river mouth (Kristofferson 1986). DFO estimated an additional 400 to 600 charr were caught at Fish Hole. A number of fish tagged in 1984 were recaptured in 1985 (Table 1). The 1985 Petersen estimate, based on the 1984 data adjusted for mortality, was calculated to be 3000 to 5000 fish (Kristofferson 1986). The exploitation rate was estimated at 20%, with an annual catch of about 1000 charr. Kristofferson (1986) concluded there was a reduction in population size from the early 1970's to mid 1980's but the extent was unknown.

In 1986, the domestic charr catch from Big Fish River was sampled (Sparling and Stewart 1986) (Table 2). Between August 10 and September 20, 1298 charr were caught between Shingle Point and Destruction City, with at least 201 coming from the Cache Creek population. Between October 4 and 27, 1660 charr were taken from Fish Hole. Fishing in the Delta was hindered in 1986 because of high water.

Most recently, August and September of 1987, a stock assessment was conducted by North/South Consultants Inc. of Winnipeg (MacDonell 1988). Their primary objective was an absolute count of the upstream migrating charr using a portable weir and fish trap. The Schaefer method for stratified populations was run simultaneously.

High water inundated the weir in 1987 and prevented an absolute count; however, the tag-recapture effort (Table 1) produced a Petersen Estimate of 9076 charr (> 200 mm fork

length). The results of the investigation are presented in Tables 1 and 2.

The author concluded that the population has dropped by 25 to 50% since 1972, despite reduced fishing pressure (MacDonell 1988). Kristofferson (1988) concurs with this conclusion, and considers the fishing closure as the fastest way to recovery. MacDonell (1988) recommended against permitting a TAC (total allowable catch), and a population size between 15 000 and 20 000 charr was suggested as the objective. He also recommended that charr fishing be severely restricted until the status of the population is more clearly understood, and that charr population dynamics and movements be researched. The 1987 results are discussed further in connection with the 1988 results.

MacDonell (1988) found the effectiveness of the Schaefer method to be 83% of the weir count. He recommended its use for studies of arctic charr on rivers subject to large, rapid fluctuations in water level and, consequently, where weirs are susceptible to wash outs. Kristofferson (1988) also recommended the Schaefer method over a weir operation.

LIFE HISTORY OF ARCTIC CHARR

McCart (1980) reviewed the systematics and ecology of arctic charr in the western Arctic. An outline and key to the life history types and stages was prepared by Reist (1988). The following section is a summary of the two publications.

Arctic charr in Canada are divided into the eastern form, which occurs only in association with lakes, and the western form, which has a variety of life history types: 1) lake residents, 2) isolated (stream) residents, 3) anadramous charr, and 4) stream residents. Lake residents are confined to lakes, and isolated stream residents are isolated from the main anadramous population by barriers, such as waterfalls. For example, an isolated stream population lives above the falls in Cache Creek. Anadramous charr summer in the Beaufort Sea and spawn and over-winter in freshwater, in association with perennial groundwater springs. Stream residents, or residuals, are primarily male and are associated with the anadramous population. As the name implies stream residents do not searun. Anadramous and residual charr inhabit Cache Creek below the falls.

Cache Creek anadramous charr spawn and over-winter below the falls in the pools and riffles referred to earlier as "Fish Hole". In the spring, during breakup, mature charr migrate to the Beaufort Sea for the summer to feed in inshore waters. The percentage of spawners, if any, that

actually enter the sea is unknown. They may only go as far as the estuary; however, the timing and distribution of spawners likely varies between years and geographical locations.

In August, charr return to Cache Creek, and by mid September they have reached Fish Hole and begun to spawn. Spawning is believed to be complete by late October (Kristofferson 1986). Spawners precede non-spawners upstream and, as the upstream run continues, the proportion of immature charr in the run increases and mean daily fork length decreases.

Fry emerge from the spawning gravels in May and June and spend the first growing season nearby. Juveniles disperse more widely throughout the watershed, often in association with residuals. Charr first migrate to the sea at 3 or 4 years of age. MacDonell (1988) recorded only one 3 year old out of 55 charr aged. Seven of 55 were 4 years old, with the remainder (85%) being $\geq$ 5 years old (See Appendix 4).

METHODS

Three methods were used in 1988 to assess the size of the charr population: 1) a conduit weir and fishtrap was constructed to obtain an absolute charr count, 2) a tag-recapture program, using hoopnets, was employed as a backup to the weir to calculate a Schaefer stratified population estimate, and 3) in the event that neither the weir nor hoopnets were successful, a Petersen population estimate was planned.

An aerial survey of the creek in late July, 1988, found the water levels sufficiently low to permit construction of the weir and placement of the hoopnets. Subsequently, a field camp was established on Cache Creek, July 30, 1988. High water levels in the creek prevented an earlier start.

WEIR AND HOOPNETS

Construction of the weir and fish trap was completed and operational on August 2, 1988. Although other locations were considered, the 1987 site was selected because the improvements in water level or velocity did not merit the considerable effort involved in moving the weir.

Weir design and construction follows Anderson and McDonald (1978)(Figure 2). The weir is comprised of 3 m sections of conduit fence. Each section is constructed from 2 channel irons and conduit pipe (1.5 cm by 1.6 m), which is vertically placed through holes drilled in the channel iron. The conduit pipe is spaced 1.5 cm apart. The sections

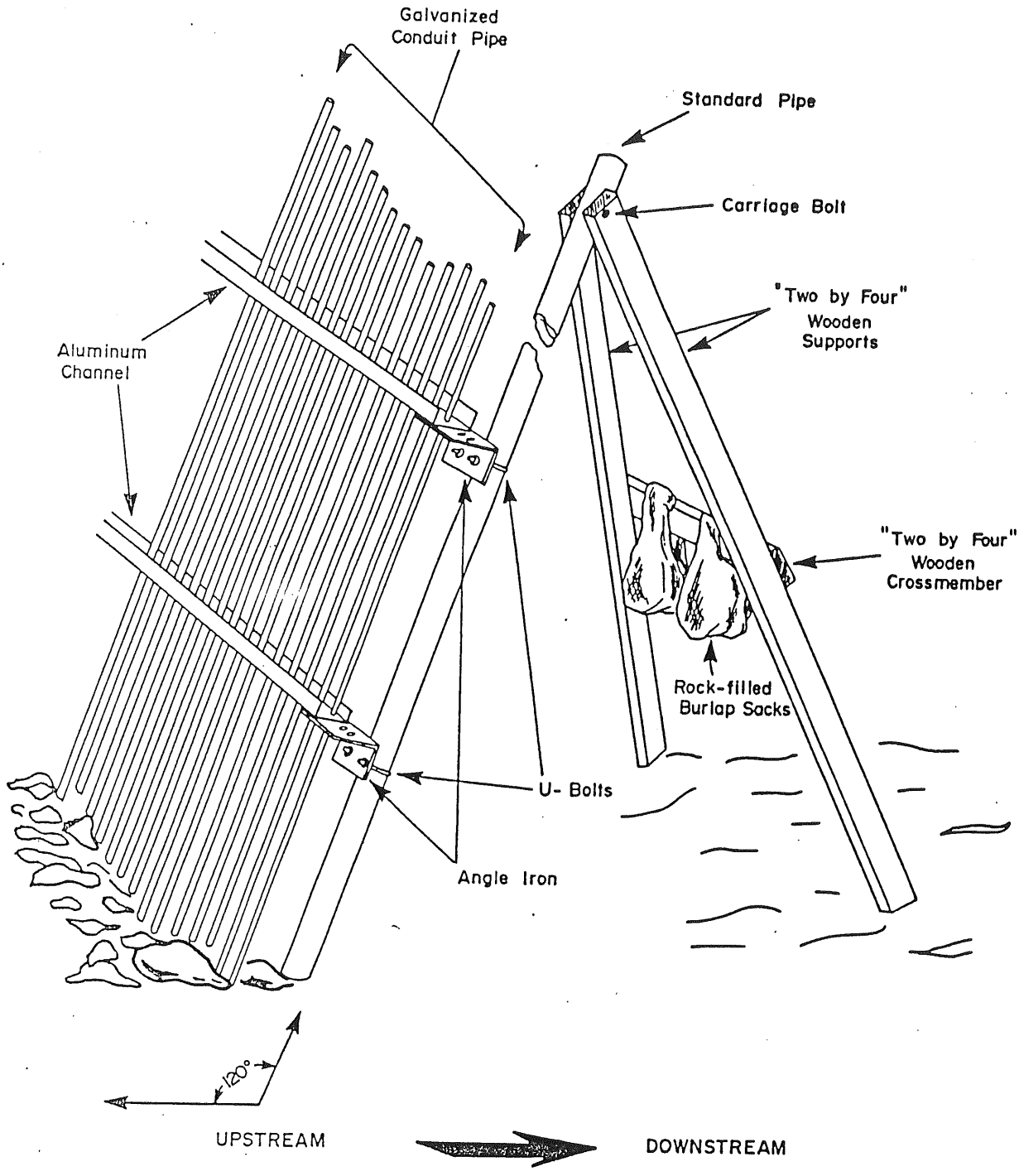

Figure 2. Construction details of wings of conduit pipe weirs. (From Kristofferson et al. 1986)

connect on angle iron brackets which are bolted to 2" steel pipes. Wooden A-frames (2" by 4" lumber) bolted to the pipes support the fence. The A-frames are weighed down by burlap rock bags. The west wing was 10 m in length and the east wing 26 m.

The trap was constructed on a 4' by 8' plywood sheet, with a frame of wood (2" by 4" lumber) and aluminum channel, and sides of conduit pipe. The trap was located in the deepest part of the channel (about 0.6 m at low water) with the open end (10 cm opening) facing downstream. Sand and rock bags on the trap floor held the trap in place. Chicken wire (1" mesh) and rocks closed the gaps between the wings and trap, and other holes in the weir.

The trap was checked every two to four hours. All charr entering the trap were captured with a dipnet, enumerated, and either released, tagged, live-sampled or killed for biological investigations. Other fish species were enumerated and released. Each day the water level was recorded at the trap and the surface water temperature measured (Table 3).

Two 4' hoopnets operated intermittently between the dates August 9 and 25, 1988 (Table 4). The downstream hoopnet was set 1.5 km below the weir for a total of 7 1/2 days. The upstream hoopnet, set 1 km above the weir, operated 11 days. The hoopnets were set to provide data for a Schaefer estimate.

TAGGING AND BIOLOGICAL SAMPLING

Approximately half of the charr were released from the trap without any measurements. These individuals were recorded as "count" or "release". Live-sampled charr were externally sexed, measured for fork length and released. When possible, 50 charr per day were live sampled.

Fourteen percent of the charr enumerated were tagged using a Denison tagging gun. A green, plastic Floy tag was inserted under the posterior half of the dorsal fin and anchored behind the basal pterygiophores. The goal of 400 tagged charr was not achieved because the weir washed out. Tagged fish were also sexed, measured for length and released.

Eighty-one charr were killed for aging, and genetic and fecundity sampling. Fifty of the 81 were used for genetic sampling by DFO. These fish were kept whole and flown out immediately for freezing. The remaining sample of 31 charr was stratified over 50 mm size intervals. These charr were measured for fork length and round weight, and the sagittal otoliths removed for aging. Some otoliths were damaged when the fish were killed, so only 62 charr were aged. The stratified dead sample was used to obtain a length-weight relationship. Fecundity sampling consisted of egg counts of each ovary in ten fish, and the determination of mean egg size.

DATA ANALYSIS

Relationships between weight and length, and fecundity and length were determined with regression analysis. Logarithmic transformations were performed on the response and predictor variables.

Relative body condition (K) was calculated with the following equation:

$$K = (W * 10^5)/L^3$$

where W is round weight (g) and L is fork length (mm).

All data analyses were performed with the Lotus 123 spreadsheet on an IBM compatible microcomputer.

PETERSEN POPULATION ESTIMATE

Data for a Petersen population estimate was collected in mid September, 1988. Four field workers, including the two authors, flew into Fish Hole, Cache Creek on September 15, 1988. The following morning, beginning just above the "braided area" (Figure 1), pools and riffles were seined for charr with a monofilament gill net. Captured charr were marked by clipping their adipose fins, although tagged fish were released after the number was recorded. The total number of marked (clipped and tagged) fish was recorded. Unfortunately, inconsistencies in classifying the fish as spawners and silvers (resting or immature searun charr) makes these data unreliable.

On September 16, working upstream from the braided area, 12 areas were seined. On September 17, 16 more areas

were seined. Seining stopped at the waterfall. Occasionally an area was seined twice. Although recaptures of clipped fish in a second seine were low, total captures were also low, making the second seine inefficient, as well as inappropriate.

On September 18, 1988, all areas previously seined were re-seined once. The total number of charr captured and the number marked and unmarked was recorded for use in a Petersen population estimate. Fish tagged in 1988 and those tagged in 1987, but recaptured at the weir in 1988, were used, along with the clipped fish to calculate a second Petersen estimate. The following formula was used:

$$(C+1)(T+1)/(R+1) = P$$

where C is the number of marked fish, T is the total captured, and R the number of marked fish recaptured (Ricker 1975).

On September 19, 1988, 14 male and 3 female arctic charr were seined and killed for genetic sampling by DFO.

RESULTS AND DISCUSSION

POPULATION ESTIMATES

1. Weir Operation

The intermittent operation of the weir prevented an absolute charr count. High water inundated the weir on three occasions (Tables 3 and 4). High water levels place pressure on the fence, eventually collapsing it, even after conduit pipe has been removed to reduce the pressure. Weir wash-outs, resulting from rapid increases in water level, are a common problem on rivers in the western Arctic, including the Hornaday and Rat Rivers (Gillman and Sparling 1985). Plant debris piling on the fence was insignificant in 1988, although the weir was cleaned whenever necessary. On at least one occasion, a section of weir washed out because a wooden A-frame leg broke.

The catch results are discussed below under biological investigations. A total of 1244 arctic charr were enumerated at the weir (Table 5).

The weir operated 12 1/2 days during August, beginning the afternoon of August 2, 1988 (Table 4). On August 10 at 0400 h, every second conduit pipe was pulled; however, at 0930 h high water washed out 5 sections of fence. The weir operated again from the evening (2000 h) of August 16 to 0900 h, August 20. It operated a final time, with half the conduit, from 2000 h, August 26 to 2330 h, August 27, when all the pipe was pulled from the middle sections of fence.

The weir was finally pulled out on August 28. The weir materials were moved to the east bank, above the high water level, for future use or removal.

2. Hoopnet Operation

High water also hindered hoopnet operation, making it difficult to set, check and maintain them in the creek (Table 4). Additionally, in 18 1/2 hoopnet days, only 5 charr were captured (Table 5), consequently, a Schaefer population estimate could not be calculated. These hoopnets appear to be an unsuitable size (4') and design (square-fronted) for Cache Creek conditions. Repositioning the hoopnets in the river did not improve success.

Similar problems with this type of hoopnet were experienced on the Babbage River in 1988 (Patricia Lewis, pers. comm.). On the Babbage River, two hoopnets were used: a square-fronted 4' net and a round-fronted 3' net. The 3' net caught over 200 charr in 3 days, whereas the 4' net caught only one.

3. Petersen Method

In two days of seining at Fish Hole, 496 charr were marked, including clipped fish and tagged recaptures (Table 6). Re-seining the area produced a total catch of 468 charr, of which 39 were marked recaptures. Using these data, a Petersen population estimate of 5827 charr was calculated. The 95% confidence limits are 4293 and 8122 charr.

A second Petersen estimate was obtained by using the total number of fish seined over 3 days (964), the total charr tagged or recaptured in 1988 at the weir (228), and the number of these tagged fish recaptured at Fish Hole (25)(Table 6). The population estimate is 8499 charr with 95% confidence limits of 5846 and 12 848 charr. Although the two Petersen estimates are widespread, the wide confidence intervals overlap considerably.

The Petersen Method was also used in 1987 to get a population estimate. High water in 1987, like 1988, prevented both an absolute count and a Schaefer estimate (MacDonell 1988). MacDonell (1988) discusses the assumptions behind the Petersen Method and its application to Cache Creek. Whereas in 1988 we treated the charr population as a whole, MacDonell (1988) stratified the population into silvers (nonspawning searun charr) and spawners and estimated the population of each group. The 1987 population estimate was 9076 charr, comprised of 1504 spawners and 7572 silvers. Macdonell (1988) considered his estimate of spawners to be an underestimate because of the difficulty in separating silvers and spawners at the weir location. The confidence limits (95%) for the combined population estimate were 6332 and 13790 charr.

The three population estimates from 1987 and 1988 overlap considerably, thus precluding specific and conclusive statements about population size (Table 1). In general, the population of Cache Creek charr (> 200 mm) is

between 6000 and 10 000 fish; with no significant change from 1987 to 1988. A substantial increase in the population is unlikely, even with continued closure of the fishery, until the progeny of the current spawners reach a larger size (> 200 mm or 3 years old). The 1987 and 1988 estimates are down considerably from the 1972 estimate of 12 000 to 17 000 charr (≥ 150 mm)(Stein (1973); however, they appear equivalent to the 1985 estimate of 3000 to 5000 catchable (≥ 350 mm) charr (Kristofferson 1986).

Separation of the spawners and silvers in 1988 was inconsistent, thus preventing its use in the analysis. Whether the spawning population has increased is not known; however, the charr have not been harvested since 1987 so the trend should be upwards.

ENUMERATION AND MIGRATION

The fishtrap operated 12 1/2 days between August 2 and 27, 1988 (Table 4). During this period, 1244 arctic charr were counted, including 582 released, , 356 live sampled, 178 tagged, 80 dead sampled and 48 recaptured (Table 5). Appendices 1 and 2 list the tagging and recapture data. By comparison, in 1987, in 8 1/2 operational days between August 13 and 23, 3107 charr were counted.

Charr were captured immediately on completion of the weir. On August 2, 1988, 53 charr were captured (Table 7). The timing of charr migrations is poorly documented, but the 1988 results suggest that the upstream migration begins

sometime in mid to late July. In 1987 also, weir operation apparently began after the run had begun.

Prior to August 7, 1988, the daily catch was usually under 100 charr (Table 7). Subsequently, the daily catch increased until high water inundated the weir on August 10. On August 9, 329 charr were captured. This was the greatest daily catch in 1988. When weir operation resumed August 16, the daily catch was again less than 100. These data suggest that peak migration occurred between August 10 and 16. In 1987, however, the weir appears to have operated through peak upstream migration. On August 17, 1987, 1071 charr were enumerated; subsequently the daily catch declined (MacDonell 1988). Had the weir not washed out in 1988, it seems likely that the peak count would have occurred within a few days of the 1987 peak date, August 17.

The duration of charr migrations is also poorly documented, but the Cache Creek migration is believed complete by early September. In August 1988, the weir operated only one day (August 26) in the last week (Table 4), but no fish were counted. In 1987, August 23 was the last operational day of the weir and 103 charr were captured. MacDonell (1988) continued to catch charr in hoopnets until September 2, but the fish were small in size and number. He concluded, based on an aerial survey, that the run was over by September 10, 1987. The domestic fishery is generally complete by early September (Sparling and Stewart 1986; Gillman et al. 1985). This suggests that

the run, at least for the larger, mature fish, is complete in early September.

Mature charr are believed to begin the upstream migration first, with spawners preceding the non-spawners (McCart 1980). Although spawning condition was not consistently recorded in 1988, numerous observations were made of charr with well developed secondary sexual characteristics, including bright spawning colouration and kype development. In 1987, the proportion of spawners dropped daily, immediately after commencement of the enumeration. This suggests that many current year spawners had passed upstream prior to installation of the weir on August 13 (MacDonell 1988). He also observed a decline in mean daily fork length, thus supporting McCart's (1980) assertion that the larger fish migrate first. MacDonell (1988) also recorded a preponderance of charr in the 300 to 349 mm length interval.

The 1988 results appear complementary to the 1987 results. The length data and catch dates suggest that the early part of the run was recorded in 1988, while in 1987 the latter part was documented. Most charr were caught prior to August 10 in 1988, compared to after August 13 in 1987. Prior to August 10, 1988, rather than dropping, mean daily fork length remained at or above 400 mm, and the modal length interval was 400 to 449 mm.

The difference between the 1987 and 1988 modal length interval may also be attributable to the fishing closure,

not just the time of sampling. The 400 to 449 mm interval is commonly harvested by domestic fishermen; however, the fishery was closed in 1987 and 1988 so this size class may just represent an unharvested cohort.

The extent of the seaward migration by mature charr is unclear. Downstream migration is believed to coincide with spring breakup (McCart 1980). Cache Creek spawners go at least as far as the MacKenzie Delta, as the majority of the domestic catch at the mouth of the Big Fish River is comprised of this group (Sparling and Stewart 1986; Gillman et al. 1985). In both 1987 and 1988, current year spawners were captured at the weir. If spawners move seaward in late May or early June and reach the weir during their upstream migration by August 2, only two months are available for summer feeding and migration both ways. Whether the current year spawners actually enter the Beaufort Sea is not known.

Spawning is believed to occur primarily during September and October. Two of 3 females collected at Fish Hole on September 19, 1988 were spent. They were aged 6 and 11 years. The third female was a virgin of unknown age.

BIOLOGICAL INVESTIGATIONS

Mean fork length was 413 mm, ranging from 295 to 575 mm (Tables 2, 7 and 8), and modal length was 400 to 449 mm (Figure 3). Mean round weight was 934 g, ranging from 425 to 2100 g. By comparison, mean length in 1987 was only 338 mm (135 to 550 mm) and the modal length interval was 300 to 349 mm (Table 2). Further, only 2% of the charr were

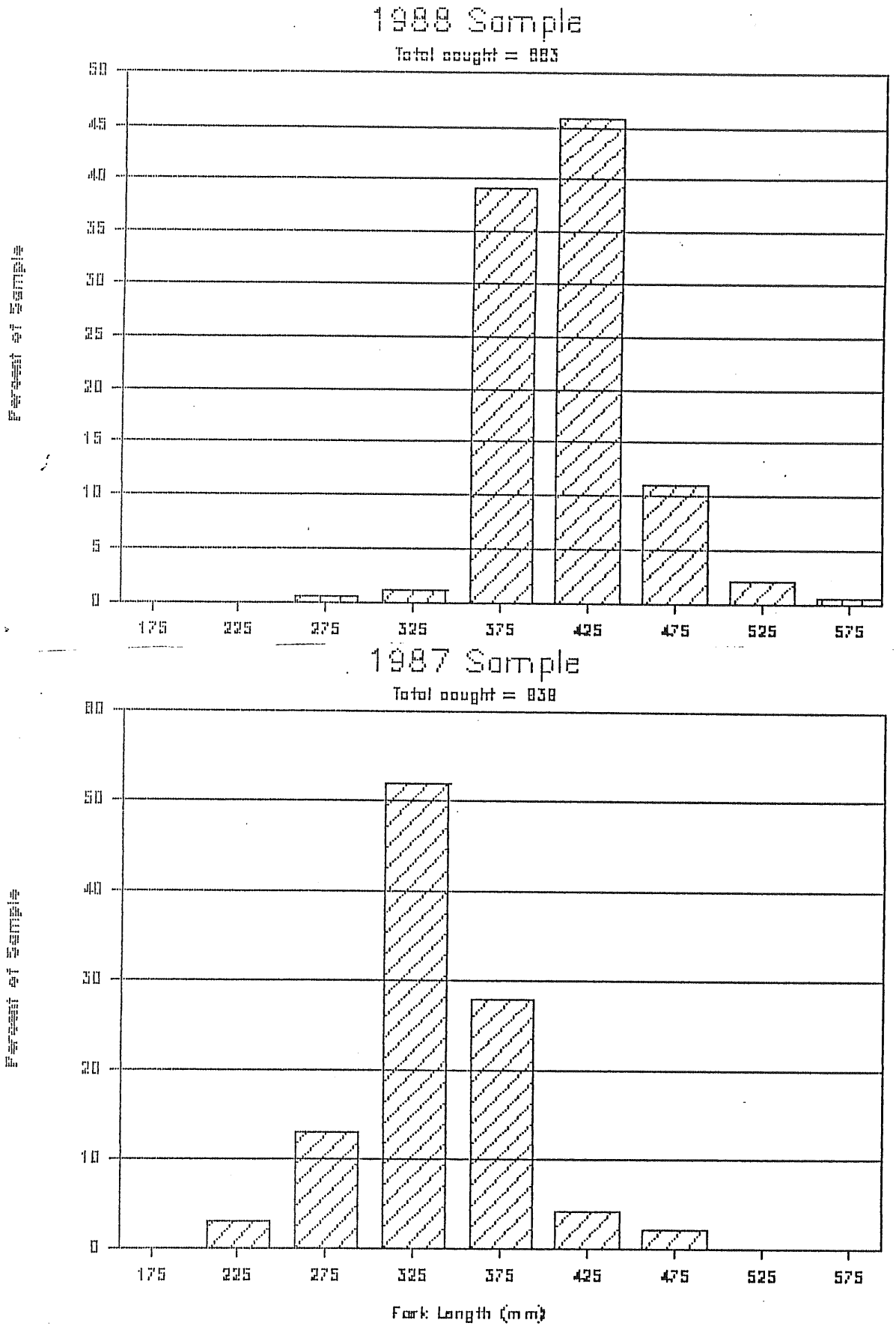

Figure 3. Length - frequency distribution of arctic charr sampled at Cache Creek, August 2 to 26, 1988.

greater than 450 mm in length in 1987 compared to 14% in 1988. Table 8 summarizes the 1988 biological data by age group.

The 1988 length - frequency distribution (Figure 3) is likely not representative of the entire population because the size classes which migrate later in August and in early September are not represented. MacDonell (1988) and McCart (1980) state that mean fork length decreases during the later stages of the migration because juvenile charr and residuals form a greater proportion of the sample. In 1987, modal length dropped from the 300 to 349 mm class to the 200 to 250 mm class, and residuals accounted for 60% of the catch by September 1 (MacDonell 1988). In contrast, the weir in 1988 was inoperable by August 20, (except for August 26), and the smallest fish caught was only 295 mm long. No residuals were captured at the weir in 1988. Throughout the operation of the weir, daily mean fork length was relatively stable between 400 and 420 mm (Table 7).

Although the smaller size classes are not represented in 1988, most larger sizes are represented. In two years of sampling (1987 and 1988) and over 4000 measurements, the largest fish captured was 575 mm (captured August 18, 1988). Larger fish may be present, but undoubtedly they are few in number. In 1986, the longest fish measured 539 mm (Sparling and Stewart 1986), and in 1984, only two fish greater than 600 mm were sampled (Table 2 and Figure 3)(Gillman et al. 1985).

Charr age averaged 6.9 years, ranging from 4 to 13 years (n=62) (Tables 2 and 8). Modal age was 5 and 7 years. Five charr (8%) were 10 years or older, and 2 (3%) were 4 years old. MacDonell (1988) caught one three year old (135 mm) in a hoopnet upstream from the weir and concluded three year olds were making it through the weir. The contribution 3 year olds make to the upstream migration at Cache Creek is unknown, but in the western Arctic, charr generally migrate for the first time at either 3 or 4 years of age (McCart 1980).

Most charr populations in the western Arctic, mature at 5 years of age or older (McCart 1980). Mature arctic charr aged 5 years were recorded in 1987 and 1988. One 4 year old female, internally sampled in 1988, was a current year spawner. Neither of 2, 4 year old males was mature. All 5 year old females (n=8) were current year spawners, as were 90% of the females examined (n=40). The remaining 10% were virgins of unknown age. In contrast, 74% (n=27) of the males were current year spawners. One hundred percent of the males seven years and over (n=11), 75% of the 6 year olds (n=4) and 50% of the 5 year olds (n=2) were spawners.

Mature charr, sampled in 1987 at Cache Creek, averaged 7 years of age and 398 mm in length (Macdonell 1988); however, these statistics are probably biased towards the latter half of the charr migration (Table 2).

The domestic catch at the mouth of Big Fish River was sampled in 1986 (Sparling and Stewart 1986). About 25%

(n=89) of the charr captured were 10 years or older (10 to 14 years) and none were under the age of 5. The average age of the catch was 8.6 years (Mode = 9 years). Two (4%) fish aged 10 (n=55) were recorded in 1987 (MacDonell 1988). In 1984, 9% (n=160) of the domestic catch sampled at the mouth of the Big Fish River was $\geq$ 10 years (10 - 11), and 2% was 5 years old (Gillman et al. 1985). The sample mean was 7.7 years. Table 2 summarizes the age data.

A total of 617 arctic charr were externally sexed, with the sex ratio favouring females 3:1. Females comprised greater than 70% of all size classes under 450 mm. The sex ratio was closer to 1:1 for the classes greater than 450 mm. Males comprised 69% of the 500 to 549 class (Table 8). In 1986 at Cache Creek, the female to male ratio was 5.2 (Sparling and Stewart 1986), and at Rat River the ratio was 4.0 (Gillman and Sparling 1985). McCart (1980) states that, among anadramous charr, females predominate, averaging 68% of the populations.

A significant relationship ($P<0.01$) exists between fork length and weight for Cache Creek charr ($r=0.95$, $n=76$). It can be expressed as:

$$\text{Log}W = 2.78\text{Log}L - 4.33$$

where W refers to round weight (g), and L is fork length (mm). This relationship indicates that 90% of the body weight is explained by body length. The equation compares favourably to regression equations calculated previously for Cache Creek charr (Table 9).

The condition of the fish, as expressed by the condition factor "K", averaged 1.19, ranging from 0.91 to 1.40 (Table 2). In 1986, the average condition was 1.14 (Sparling and Stewart 1986), and in 1987 body condition averaged 1.25 (Table 2). Its unknown whether these values are significantly different, or are reflections of sampling differences and natural annual variation.

Average annual growth was 69 mm, the maximum being 164 mm and the minimum 28 mm. Annual growth rate did not vary substantially between sexes. These growth rates are based on measurements of 47 charr tagged in 1987 and recaptured in 1988 (Table 10). The relationship between age and length is presented in Figure 4 for Cache Creek charr and two other western Arctic charr populations.

One recaptured female (Pink tag, No. 00348) measured 408 mm long when tagged by DFO in 1984. In 1987 it was recaptured and measured 485 mm (MacDonell 1988). Recaptured again in 1988, it measured 480 mm. The 5 mm difference between the 1987 and 1988 measurements is negligible and attributable to sampling error. Using the figures from 1984 and 1987, a growth rate of 26 mm/year was calculated. A second fish, tagged in 1984 and recaptured in 1987 (WB00241; Fork length = 550 mm in 1987) grew at a rate of 17 mm/year. These rates are much lower than the rate calculated for 1988 charr; however, both fish were close to 500 mm long so their growth may have slowed.

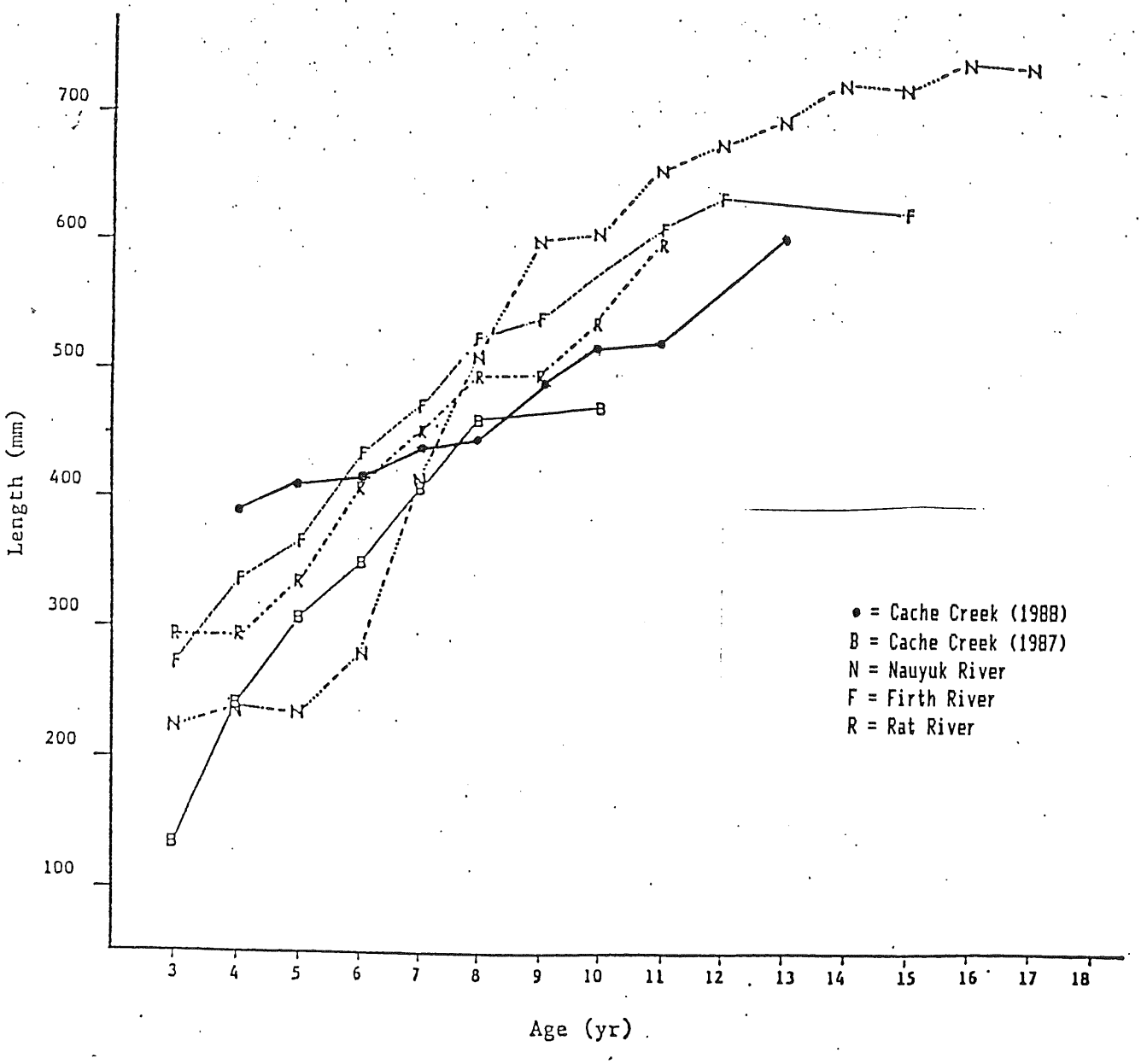

Figure 4. Growth rates of arctic charr from Cache Creek and three other locations in the western Arctic. (From MacDonell 1988)

Fecundity data collected in mid August, 1988, are presented in Table 11. Mean egg count was 2233 (1377 to 3919). Mean egg size was 3.7 mm (3.2 to 4.4 mm). The charr sampled for fecundity averaged 437 mm in length and 6.9 years of age. The 1987 data are similar (MacDonell 1988), although the average length of the sampled charr was 435 mm (Table 11). Mean egg count was 2186 and egg size averaged 4.0 mm. Ovary weight in 1987 was 10.1% of the total body weight.

Fecundity is positively correlated with both body length and weight; however, fecundity to length data are more common (McCart 1980). In 1988, Cache Creek charr fecundity was positively correlated ($P<0.05$) with fork length ($r=0.92$, $n=9$):

$$LogF = 2.56LogL - 3.44$$

where F equals the total egg count and L is fork length (mm). According to these data, 85% of the variation in egg count data is explained by the length of the fish. Table 11, which lists fecundity data from other charr populations, provides further evidence that fecundity is related to body length. Figure 5 compares mean length to fecundity graphically. MacDonell (1988) suggested that Cache Creek charr may have lower fecundity at a given length than do other populations.

The relationship between age and fecundity is much weaker than fecundity and length. Age is positively correlated ($P<0.05$, $r=0.73$, $n=9$) with length, but only about

Deleted

Figure 5. Fecundity - length relationships of arctic charr from western Arctic populations, including Cache Creek, NWT.

50% of the variation in egg count data is attributable to age. The equation,

$$LogF = 3.01Age + 0.05$$

where F equals fecundity, summarizes the relationship.

OTHER FISH SPECIES

Other species captured and released include round whitefish (*Prosopium cylindraceum*), broad whitefish (*Coregonus nasus*), and arctic grayling (*Thymallus arcticus*). Table 12 summarizes the capture data for these species. The large numbers of arctic grayling and, to a lesser degree, round whitefish caught in mid August, 1987 (MacDonell 1988) were not duplicated in 1988. Apparently these species also ran when the weir was out in mid to late August, 1988.

SUMMARY

1. A population census of the Cache Creek arctic charr was conducted in August and September of 1988.
2. High water inundations of the conduit pipe weir prevented an absolute count. Hoopnet operation was also severely affected.
3. The Petersen Method was conducted in mid-September, 1988. The two estimates indicate a population between 6000 and 9000 charr (> 200 mm in length). The 1987 estimate is not significantly different.
4. The weir was first operational and catching fish on August 2, 1988. The last operational day was August 26, 1988. The largest daily catch was on August 9 when 329 charr were captured.
5. A total of 1244 charr were enumerated at the weir, including 582 released, 48 recaptured, 356 live sampled, 80 dead sampled and 178 tagged.
6. Mean fork length was 413 mm, and modal length 400 to 449 mm. Mean round weight was 934 g. Maximum length and weight was 575 mm and 2100 g, respectively. Mean daily length was at or above 400 mm throughout August.

7. Charr age averaged 6.9 years (4-13 years). The female to male ratio was 3:1. Average growth rate was 69 mm/year, based on the 1988 recaptures. Mean egg count was 2233. Ninety percent (90%) of the females internally examined were current year spawners, compared to 74% of the males. The youngest spawner was a female aged 4 years.
8. Arctic grayling, round whitefish and broad whitefish were caught in small numbers in the weir and in hoopnets.

CONCLUSIONS AND MANAGEMENT RECOMMENDATIONS

Large fluctuations in water level plague efforts to count arctic charr in the western Arctic. The attempt to get an absolute count of the charr migrating up Cache Creek failed in 1988 as it did in 1987. In both years the contingency plan, a Petersen estimate, was invoked.

The three Petersen estimates (two in 1988: 5800 and 8500 charr, and one in 1987: 9100 charr) are relatively close and the 95% confidence intervals overlap widely. This situation makes specific and conclusive statements about population trend and size impossible. In general, these data suggest that the population of arctic charr (> 200 mm) is between 6000 and 10 000, and that there is no significant difference between the 1987 and 1988 estimates. In comparison to one estimate made in the early 1970's, the population has declined by at least 25-50% The status of the spawning sub-population was not addressed in 1988.

Compared to the 1987 sample, the 1988 charr had a greater mean and mode fork length (338 mm in 1987 vs. 412 mm in 1988) and 14% were greater than 450 mm in 1988, versus 2% in 1987. Age and fecundity showed little change.

There are a number of explanations for the differences in charr length. First, it may just be an artifact of sampling, as sampling was conducted at an earlier date in 1988 than 1987.

Secondly, the increase in size may be attributable to growth and the fact that there was no harvest in 1988.

Given the mean growth rate of 69 mm/year and the 1987 mean fork length of 338 mm, the fork length predicted for 1988 would be 407 mm - close to the actual mean of 413 mm. If the latter explanation is the correct one then the population estimate should have increased in 1988. That the estimate did not increase may be attributable to the poor resolution and inaccuracy of the census method.

More likely, a combination of the two scenarios is correct. Since there was no harvest and there obviously was body growth, an increase in average body size is expected; however, the magnitude of the increase may be exaggerated because of sampling time differences. Further, a significant increase in population size is unlikely to be noticed until the progeny of the 1987 spawners reach a catchable size, which appears to be about 4 years of age and greater than 250 mm in length..

Based on the 1988 study and our review of the arctic charr literature, a number of recommendations are presented:

1) Maintain closure on the Big Fish River fishery for at least 2 or 3 more years (when the 1987 cohort matures), or until a stock assessment indicates a recovery acceptable to DFO, the Fisheries Joint Management Committee, Inuvik, and the Aklavik HTC,
2) Permanently close, or place strong fishing restrictions, on the spawning grounds (Fish Hole),
3) Establish a minimum gillnet mesh size for use on Big Fish River,

4) Set quotas for the lower reaches of Big Fish River,

5) Open the watershed to controlled sports fishing,

6) Continue research on arctic charr biology, particularly their seasonal movements and population dynamics, and

7) Continue stock assessments, using either small hoopnets, or a weir at a location above the Summit Creek and Cache Creek confluence. To determine population trend, the Petersen estimate should be conducted every year for the next several years, until the trend is established or it is deemed unnecessary. The more intensive assessment should be conducted every two years.

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TABLES

Table 1. Population estimates from tag-recapture studies of the Cache Creek charr, 1972 to 1980.

Date*	Tagged(Recaptured)	Location	Population Estimate
1972	273 (53) 265 (69 L) (117 FH)	Lower Fish Hole	12 000 to 17 000 ($\geq$ 150 mm)
1984	13 --- 454 (3)	Lower Fish Hole	No estimate
1985	0 (23) 0 (33)	Lower Fish Hole	3000 to 5000 ($\geq$ 350 mm)
1987	597 (49)	Weir	9076 (> 200 mm)
1988	228 (25) 496 (39)	Fish Hole Fish Hole	5827 8499 (> 200 mm)

* References: 1972 - Stein et al. (1973), 1984 - Gillman et al. (1985), 1985 - Kristofferson (1986), 1987 - MacDonell (1988), 1988 - this study.

Table 2. Summary of biological investigations of arctic charr from Cache Creek, 1980 to 1988.

Date*	Fork Length (mm) Mean	Modal Class	Range	Weight (g)** Mean	Range
1980	430	400 - 449	250 - 550	---	
1984	439	450 - 499	250 - 660	951	
1986	424	400 - 449	305 - 539	894	325 - 1725
1987	338	300 - 349	135 - 550	619	60 - 1575
1988	412	400 - 449	295 - 575	934	425 - 2100
	Age (years)			Body Condition (K)	
1980	7.0	6 - 7	5 - 10	---	
1984	7.7	7	5 - 11	1.10	
1986	8.6	9	---	1.14	0.97 - 1.46
1987	6.0	-	3 - 10	1.25	
1988	6.9	5 & 7	4 - 13	1.19	0.91 - 1.40

* References: 1980 - Kristofferson (1986), 1984 - Gillman et al. (1985), 1986 - Sparling and Stewart (1986), 1987 - MacDonell (1988), 1988 - this study.
** Round weight.

Table 3. Daily water levels, recorded at the mouth of the fishtrap, and water temperatures, Cache Creek, NWT, 1988.

Date	Depth (cm)	Temperature (°C)	Date	Depth (cm)	Temperature (°C)
July 30	60	--	August 14	105	--
31	60	13	15	94	--
August 1	61	12	16	76	14
2	62	14	17	70	13
3	62	13	18	64	13
4	79	6	19	63	11
5	92	6	20	95*	--
6	77	13	21	>100	--
7	69	14	22	>100	--
8	64	9	23	96	--
9	67	5	24	96	9
10	100	6	25	91	--
11	96	--	26	71	10
12	80	--	27	>100	--
13	95	--	28	>100	--

* Approximate.

Table 4. Operating dates of the fishtrap and hoopnets on Cache Creek, NWT, August 1988.

Fishtrap		Downstream Hoopnet		Upstream Hoopnet	
Dates Operational	No. of Days	Dates Operational	No. of Days	Dates Operational	No. of Days
August		August		August	
2 - 10	8	9 - 10	1	11 - 14	3
16 - 20	3 1/2	11 - 12	1	17 - 25	8
26 - 27	1	12 - 14	1 1/2		
		16 - 20	4		
Total	12 1/2	Total	7 1/2	Total	11

Table 5. Summary of arctic charr captured and sampled at Cache Creek, NWT, August 1988.

Sample	Fishtrap	Downstream Hoopnet	Upstream Hoopnet
Count	582	1	0
Recaptures	48	0	1
Live Samples	356	1	0
Dead Samples	80	0	1
Tagged	178	1	0
TOTAL	1244	3	2

Table 6. Summary of the Petersen Method data collected September 16 to 18, 1988, at Fish Hole on Cache Creek, NWT.

Estimate No. 1		Estimate No. 2	
Marked Fish* (Sept. 16 & 17)	496	Total tagged at weir	228
Total captures (Sept. 18)	468	Total captures	964
Marked recaptures**	39	Tagged fish***	25
Population estimates:	5827		8499
95% Confidence Intervals:			
Lower	4293		5846
Upper	8122		12,848

* Includes tagged and clipped fish.
** Includes 36 clipped and 3 tagged recaptures.
*** Fish tagged (1988) or recaptured (1987 tags) at the weir and captured again at Fish Hole.

Table 7. Daily catches and mean fork length of arctic charr captured in the fishtrap on Cache Creek, NWT, 1988.

Date	Daily Capture	N	Mean Fork Length (mm)
August			
2	53	33	399
3	138	67	412
4	68	56	411
5	29	16	440
6	54	50	410
7	199	110	420
8	122	63	400
9	329	108	413
10	89	4	400
16	6	3	426
17	34	31	405
18	79	79	418
19	44	42	417
26	0	0	---
Total	1244	662	413

Table 8. Biological data summarized by age for the stratified dead sample of arctic charr from Cache Creek, NWT, August 1988.

Age	Fork Length (mm)		Round Weight (g)		K		Age
	N*	Mean	N	Mean	N	Mean	Mean
			Combined				
4	2	395	2	800	2	1.29	
5	14	405	13	808	13	1.26	
6	13	409	12	771	12	1.18	
7	14	431	13	960	13	1.19	
8	9	444	9	1014	9	1.14	
9	5	489	5	1440	5	1.19	
10	3	507	2	1400	2	1.03	
11	1	505	1	1450	1	1.13	
12	0		0		0		
13	1	575	1	2100	1	1.10	
Total*	81	426	76	934	76	1.19	6.9
			Males				
4	0		0		0		
5	2	448	1	900	1	1.10	
6	3	415	2	562	2	1.13	
7	4	454	4	1062	4	1.13	
8	2	468	2	1250	2	1.12	
9	2	529	2	1800	2	1.21	
10	1	489	0		0		
Total	17	453	14	1091	14	1.18	7.1
			Females				
4	2	396	2	800	2	1.29	
5	12	398	12	800	12	1.27	
6	10	408	10	812	10	1.20	
7	10	423	9	914	9	1.21	
8	7	438	7	946	7	1.12	
9	3	462	3	1200	3	1.18	
10	2	516	2	1400	2	1.03	
11	1	505	1	1450	1	1.13	
13	1	575	1	2100	1	1.10	
Total	64	419	62	899	62	1.20	6.8

* The total number of aged fish equals 62 (14 male and 48 females). The total dead sample is 81.

Table 9. Summary of weight - length regression equations ($P<0.05$) calculated for arctic charr from Cache Creek, NWT, 1980 to 1988.

Equation*	N	r	Date	Reference
LogW = 2.78LogL - 4.33	76	0.95	1988	This study
LogW = 3.12LogL - 5.22	55**	0.96	1987	MacDonell (1988)
LogW = 2.77LogL - 4.35	105	0.96	1986	Sparling & Stewart (1986)
LogW = 2.69LogL - 4.19	18	0.92	1980***	McCart (1980)

* W = round weight (g) and L = fork length (mm).
** The number of dead samples in the published table summarizing the biological data.
*** Date published.

Table 10. Growth rates of Cache Creek arctic charr based on the 1988 recapture of charr tagged in 1987.

	N	Growth Rate (mm/year)		
		Mean	Maximum	Minimum
Males	8	72	101	42
Females	37	69	164	28
Total	47*	69	164	28

* Does not equal 45 because two charr were not sexed.

Table 11. Summary of fecundity - length relationships ($P<0.05$) for studies of arctic charr, 1980 to 1988. Fecundity was measured by counting the number of eggs in the ovaries.

Location*	N	Mean FL (mm)	Egg Size (mm)	Fecundity Mean	r	Equation
1. Cache	9	437	3.7	2233	.92	LogF = 2.56LogL - 3.44
2. Cache	19	435	4.0	2186	.75	LogF = 1.67LogL - 1.08
3. Cache	7	491	---	1493	.76	LogF = 3.07LogL - 4.80
4. Firth	20	530	---	4955	.84	LogF = 2.82LogL - 4.01
5. Rat	21	---	3.7	4221	--	--------
6. Rat	27	---	---	3468	.69	LogF = 1.74LogL - 1.12

* Location - References: 1) Cache Creek - This study, 2) Cache Creek - MacDonell (1988), 3) Cache Creek - McCart (1980), 4) Firth River - Glova and McCart (1974), 5) Rat River - Gillman et al. (1985), and 6) Rat River - Bain (1974), in McCart (1980).

Table 12. Summary of other fish species captured in Cache Creek, NWT, August 1988.

Method	Round Whitefish	Broad Whitefish	Grayling
Fishtrap	4	1	1
Downstream Hoopnet	9	0	5
Upstream Hoopnet	7	0	2
Total	20	1	8

APPENDICES

Appendix 1. A list of the arctic charr tagged at the weir site, Cache Creek, August 1988. All tags were green in colour.

Tag Number	Date	Length (mm)	Sex	Comments
62601	August 3			Tag lost.
62602	3	---		No measurements.
62603	3	418	-	
62604	3	408	-	
62605	3	365	M	
62606	3	450	F	
62607	3	385	-	
62608	4	404	M	
62609	4	376	F	
62610	4	372	F	
62611	4	417	F	
62612	4	432	F	
62613	4	336	F	
62614	5	371	F	
62615	5	435	F	
62616	5	442	F	
62617	5	496	M	
62618	5	437	F	
61619	5	422	F	
62620	5	450	M	
62621	5	451	F	
62622	6	368	F	
62623	6	386	F	
62624	6	375	M	
62625	6	419	M	
62626	6	404	M	
62627	6	446	F	
62628	6	384	F	
62629	6	430	M	
62630	6	399	F	
62631	6	404	F	
62632	6	420	F	
62633	6	360	F	
62634	6	392	F	
62635	7	379	F	
62636	7	455	F	
62637	7	422	F	
62638	7	425	F	
62639	7	384	F	
62640	7	419	F	
62641	7	393	F	
62642	7	449	M	
62643	8	376	F	
62644	7	385	F	
62645	7	385	F	
62646	7	459	M	

62647	7	515	M	
62648	8	391	F	
62649	8	431	M	
62650	8	404	F	
62651	8	415	F	
62652	8	416	F	
62653	8	420	F	
62654	8	414	F	
62655	8	394	F	
62656	8	393	F	
62657	8	427	M	
62658	8	424	M	
62659	8	425	F	
62660	8	455	M	
62661	8	426	F	
62662	9	428	F	
62663	9	441	F	
62664	9	367	M	
62665	9	421	F	
62666	9	404	F	
62667	9	410	F	
62668	9	411	F	
62669	9	445	F	
62670	9	376	F	
62671	9	399	F	
62672	9	382	F	
62673	9	---	-	Tag destroyed.
62674	9	419	F	
62675	9	393	F	
62676	9	425	F	
62677	9	422	F	
62678	9	430	M	
62679	9	398	F	
62680	9	434	M	
62681	9	416	M	
62682	9	439	M	
62683	9	410	F	
62684	9	409	F	
62685	9	372	F	
62686	9	362	F	
62687	9	409	M	
62688	9	394	F	
62689	9	411	M	
62690	9	369	F	
62691	9	395	F	
62692	9	361	F	
61693	9	390	F	
62694	9	400	F	
62695	9	395	F	
62696	9	360	F	
62697	9	430	F	
62698	9	436	M	
62699	9	448	F	
62700	9	404	F	

62701	9	470	M	Downstream hoopnet
62702	9	404	F	
62703	9	405	F	
62704	9	442	F	
62705	9	371	F	
62706	9	454	F	
62707	9	397	M	
62708	9	375	M	
62709	9	420	F	
62710	9	405	F	
62711	9	398	F	
61712	9	428	F	
62713	9	403	F	
62714	9	413	F	
62715	9	536	F	
62716	9	391	F	
62717	16			Tag destroyed.
62718	16	410	F	
62719	17	451	M	
62720	17	402	F	
62721	17	410	M	
62722	17	359	F	
62723	17	383	F	
62724	17	387	F	
62725	9	422	F	
62726	17	433	M	
62727	17	395	F	
62728	17	370	F	
62729	17	435	F	
62730	17	390	F	
62731	17	399	F	
62732	17	396	F	
62733	17	414	F	
62734	17	388	F	
62735	17	372	F	
62736	17	405	M	
62737	17	406	F	
62738	17	412	F	
62739	17	396	F	
62740	17	395	F	
62741	17	422	M	
62742	17	455	F	
62743	17	513	M	
62744	17	423	F	
62745	17	378	F	
62746	17	385	F	
62747	18	444	F	
62748	18	495	F	
62749	18	424	F	
62750	18	380	F	
62751	18	443	M	
62752	18	456	M	
62753	18	378	F	
62754	18	359	M	

62755	18	395	F
62756	18	392	F
62757	18	363	F
62758	18	426	F
62759	18	392	F
62760	18	394	F
62761	19	455	M
62762	19	360	F
62763	19	411	M
62764	19	405	F
62765	19	430	F
62766	19	480	M
62767	19	377	F
62768	19	444	M
62769	19	518	M
62770	19	370	F
62771	19	380	F
62772	19	445	F
62773	19	463	M
62774	19	453	M
62775	19	360	F
62776	19	446	F
62777	19	426	F
62778	19	441	F
62779	19	424	F
62780	19	411	F
62781	19	377	F
62782	19	428	F

Appendix 2. A list of tagged arctic charr recaptured at the Cache Creek weir site in August 1988. All recaptured fish were tagged in 1987, except pink tag, No. 00348, which was tagged in 1984 and caught August 7.

Tag Number	Tag Colour	Date	Length (mm)	Sex	Comments
62113	Blue	August 3	407	-	
62274	Blue	3	364	F	
62237	Blue	3	419	-	
62429	Blue	3	400	M	
62310	Blue	3	386	F	
62449	Blue	3	513	M	
62185	Blue	3	364	M	
62417	Blue	3	367	F	
62385	Blue	4	396	F	
62131	Blue	4	362	F	
62085	Blue	4	407	F	
62219	Blue	4	427	F	
62140	Blue	4	427	F	
62500	Blue	4	422	F	
62070	Blue	6	417	F	
62381	Blue	6	394	F	
62414	Blue	6	405	F	
00348	Pink	7	480	F	
62115	Blue	7	403	F	
62080	Blue	7	426	F	
62141	Blue	8	384	F	
62008	Blue	8	442	M	
62103	Blue	9	No measurements.		
62486	Blue	9	390	F	
62373	Blue	9	384	F	
62095	Blue	9	405	M	
62366	Blue	9	393	F	
62233	Blue	9	410	F	
62196	Blue	9	415	F	
62227	Blue	9	370	M	
62325	Blue	9	485	F	
62330	Blue	9	393	F	
62357	Blue	9	377	F	
62112	Blue	9	378	F	
62121	Blue	9	393	F	
62145	Blue	9	356	M	
62106	Blue	10	394	F	
62513	Blue	10	370	F	
62232	Blue	10	434	F	
62413	Blue	16	390	F	
62353	Blue	18	399	F	
62401	Blue	18	390	F	
62450	Blue	18	394	F	
62108	Blue	18	474	F	

62218	Blue	18	434	M
62104	Blue	18	439	F*
62159	Blue	19	388	F
62555	Green	19	380	F
62532	Green	19	372	F

* Captured in upstream hoopnet.

Appendix 3. Summary of biological data for arctic charr collected during the Petersen sampling at Fish Hole on Cache Creek, NWT, September 1988.

	N	Mean	Range	N	Mean	Range
	Fork Length (mm)			Weight (g)		
Male*	14	412	256 - 536	14	844	175 - 1672
Female	3	405	305 - 493	3	796	322 - 1303
Combined	17	411	256 - 536	17	835	175 - 1672
	Age			Maturity		
Male	10	6.9	4 - 11	14	8.1	6 - 9
Female	2	8.5	6 - 11	3	2.3	1 - 3
Combined	12	7.2	4 - 11	17	7.1	1 - 9

* Includes one residual male (256 mm fork length, 175 g, 5 years, and maturity level 5).

Appendix 4. Summary of biological data for arctic charr electroshocked on September 22, 1988 below the falls at Cache Creek, NWT. These data were collected by J.D. Reist of DFO, Winnipeg, Manitoba.

	N	Mean	Range	N	Mean	Range	
	Fork Length (mm)			Weight (g)			Age*
< 50 g	39	84	51 - 100	41	5.9	1 - 11	0
> 50 g	1	162	---	1	50.0	---	0
Combined	40	86	51 - 162	42	6.9	1 - 50	0

* All otoliths were aged "0"; no bands were seen.

This sample may contain young-of-the-year, and one and two year old charr. Young-of-the-year (YOY) from the Babbage River, Yukon, reached 58 mm, whereas one and two year olds reached 94 and 115 mm, respectively (Bain 1974: Arctic Gas Biol. Rep. Ser. 18(1)). YOY from the Firth River, Yukon, measured 53 to 63 mm, fork length, and weighed 2.0 g by September (Glova and McCart 1974). One year olds averaged 110 mm (80 to 150 mm). The Fish Hole sample which ranged from 51 to 100 mm could be just one year olds or a mixture of YOY and one year olds.

The larger fish, 162 mm, is probably two, although bands could not be seen when it was aged. Confusing the situation further, MacDonell (1988) recorded a three year old charr that measured only 135 mm long and weighed 60 g.