A Preliminary Salmonid Reconnaissance of the Kakweiken River System Including Trapping and Coded-Wire Tagging of Wild Coho Juveniles, 1977

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Fisheries and Marine Service

Manuscript Report 1497

March 1979

A PRELIMINARY SALMONID RECONNAISSANCE OF THE KAKWEIKEN RIVER SYSTEM INCLUDING TRAPPING AND CODED-WIRE TAGGING OF WILD COHO JUVENILES, 1977

by

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ABSTRACT

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Over a six week period in April and May of 1977, coho salmon (Oncorhynchus kisutch) smolts from the Kakweiken River system were captured and tagged with binary coded-wire-tags for assessment of ocean migration patterns and fishery contributions. The total number of coho smolts tagged was 2,958, far short of the 40,000 target. Lack of success was due in part to extreme water fluctuations in the river system.

The primary objective of the reconnaissance program, conducted from July through October of 1977, was to obtain adult chinook salmon (O. tshawytsha) for an egg-take and egg incubation to the eyed-out stage. Due to a scarcity of adult chinooks, pink salmon (O. gorbuscha) eggs were taken. Pink eggs (48,000) were successfully incubated to the eyed-out stage (2.6% mortality rate), and then were planted in the main river. Construction cost of the incubation facility was approximately $1,400.

Summer and fall reconnaissance, both ground and aerial, provided new information on the extent of spawning grounds as well as on the distribution of salmonid spawners, in particular pink salmon spawners.

Key words: Coded-wire tagging, life history, salmonids, Kakweiken River, British Columbia.

RÉSUMÉ

Durant six semaines entre avril et mai 1977, des saumons coho (Oncorhynchus kisutch) au stade smolt ont été capturés dans la rivière Kakweiken et marqués par des fils métalliques codés en binaire, pour déterminer leurs mouvements migratoires et l'importance des prises. Avec 2 958 smolts de coho marqués, on était loin des 40 000 prévus. Ces piètres résultats sont attribuables aux variations extrêmes du niveau d l'eau de la rivière.

Le premier objectif de la compagne de reconnaissance, menée de juillet à la fin d'octobre 1977, consistait à capturer des saumons chinook adultes (O. tshawytsha) pour prélever leurs oeufs et les incuber jusqu'à l'apparition des yeux. Étant donné la rareté des adultes chinook, les auteurs ont prélevé des oeufs de saumon rose (O. gorbuscha). Avec un taux de mortalité de 2,6 %, l'incubation des 48,000 oeufs jusqu'au stade prévu s'est révélée un succés. Les oeufs ont ensuite été retournés a la rivière. La construction de l'incubateur a coûté environ 1 400 $.

Grâce aux reconnaissances effectuées l'été et l'automne, a partir du sol et dans les airs, de nouveaux renseignements ont été obtenus concernant l'étendue des frayères et la répartition des salmonidés reproducteurs, en particulier pour ce qui concerne le saumon rose.

Mots clefs: Marquage au fil métallique; cycle évolutif; salmonides; rivière Kakweiken; Colombie-Britannique.

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INTRODUCTION

A two-phase reconnaissance program was conducted on the Kakweiken River in 1977 (Fig. 1). The first phase in April and May, involved locating coho smolt (Oncorhynchus kisutch) trap sites, building and operating traps and capturing and coded-wire tagging (CWT) coho juveniles. It also involved beach seining juvenile chinook salmon (O. tshawytscha) for coded-wire tagging.

The second phase from July through September, involved capturing a sufficient number of adult chinook salmon and summer steelhead (Salmo gairdneri) for an egg take and on site incubation to the eyed-out stage. Eggs were then to be transferred to Quinsam hatchery for rearing and coded-wire tagging prior to spring release in the Kakweiken River. Throughout the summer and fall, field crews collected basic salmonid spawner and juvenile distribution data and described physical aspects of upriver salmonid spawning areas.

This report documents numbers, size, and age of juvenile coho that were trapped and tagged. Salmonid spawner distribution observations are also included. The report concludes with a full description of the egg-take operation. Raw data in tabular form and disease pathology analysis reports are appended.

GENERAL DESCRIPTION OF WATERSHED

"The Kakweiken watershed is located at the head of Thompson Sound and drains about 310 square kilometres (120 square miles) ranging from sea level to 1520 m (5,000 feet). About 20% of this area is sub-alpine (above 760 m; 2,500 feet).

"Bedrock in the watershed appears dominantly igneous-intrusive resulting in relatively coarse-textured cohesionless soils. Post glacial and glacial fluvial processes have resulted in an extensive array of reworked valley bottom silts, sands and gravels. The break in slope between valley side walls and the valley bottom is characterized by coalescing alluvial fans of well-drained gravelly sandy loam. Soil organic layers are deep in protected sites but thin in valley bottom locations, subjected to frequent flooding.

"Rainfall has not been measured in the watershed, but is estimated at 380 cm/yr (150 in/yr) on the basis of nearby stations. Snow contributes a substantial but unknown portion of yearly precipitation. As a result, the spring melt period represents a dominant segment of the yearly hydrograph, with associated problems for the aquatic habitat.

"Drainage patterns in the watershed reflect the high precipitation inputs. Closely spaced sub-parallel valley side wall tributaries join meandering and often braided valley bottom streams, characterized

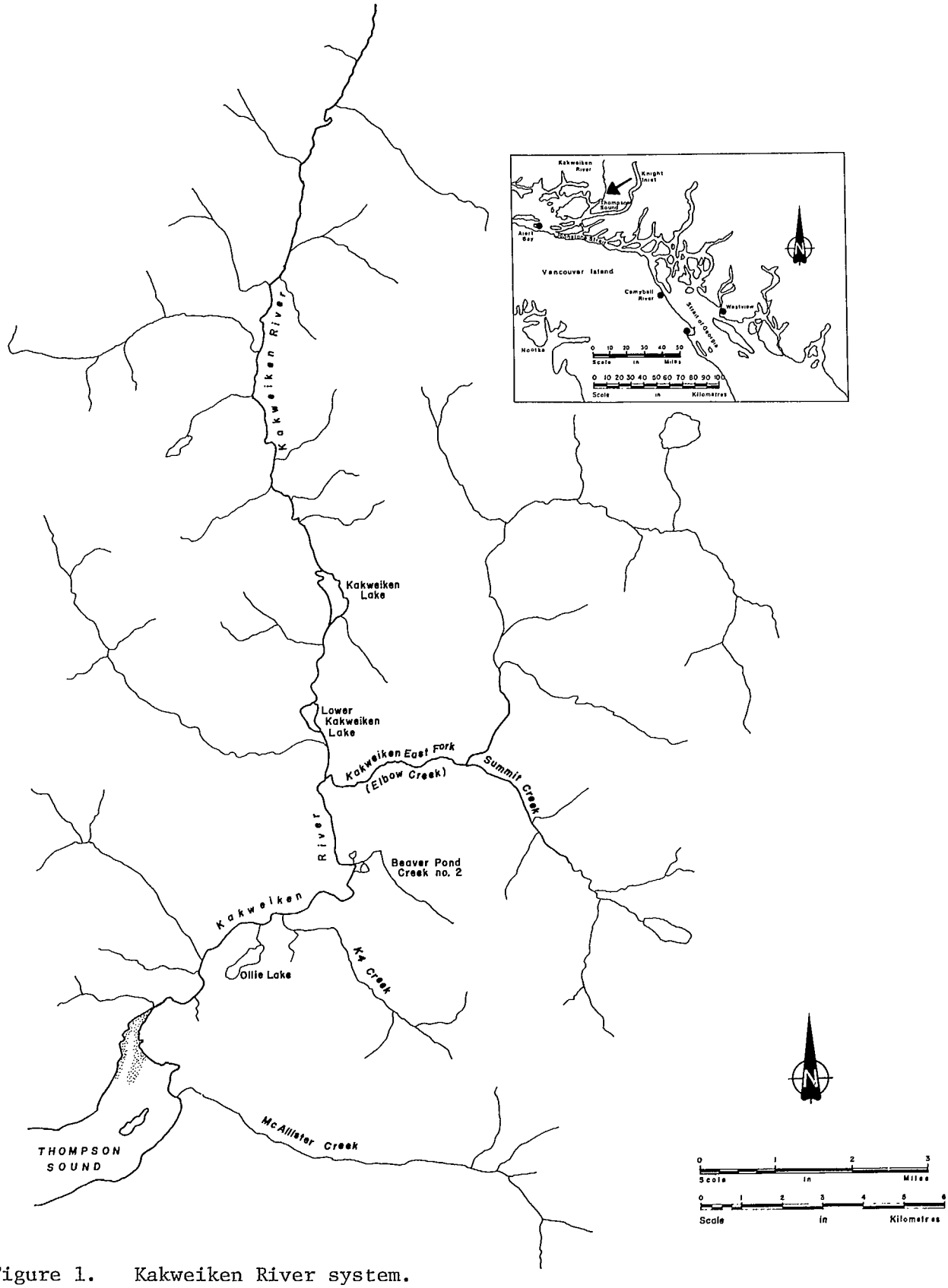

Figure 1. Kakweiken River system.

by extreme flow fluctuations and large volumes of bed and natural debris transport. No measurements on minimum or maximum flows exist.

"Forest tree species include sitka spruce, western red cedar and western hemlock in the valley bottoms and seepage sites while hemlock and balsam (amabilis fir) with some cedar are found on slopes. Devil's club characterizes the wetter areas while Vaccinium species are common on the well-drained slopes. Alder and elderberry are common along tributary and mainstream banks as well as over much of the alluvial flats." (Chamberlain, Slaney and Brownlee, 1973).

"An obstruction existing on the Kakweiken River was first reported in the 1920's to be limiting the production of salmon in that system. Remedial work was undertaken around that time to improve access conditions, however, this was not too successful. In 1961 a recommendation was made to the effect that the obstruction be surveyed with a view to extending the migration of pink and chum salmon into the upper reaches of the river. Biological and engineering surveys were subsequently undertaken and an aluminum steeppass fishway of the Denil type was installed at the upper falls in 1964 to pass salmon above that barrier." (Anon., 1969).

Plans also exist for an improved fishway (Anon., 1969) since the existing steeppass fishway becomes inoperable at low water levels.

Logging has been carried out in the Kakweiken Valley and adjacent valleys by Weldwood of Canada Limited, commencing in 1973 under forest permit #A00615. A spokesman for Weldwood, Mr. D. Thompson, estimated that logging will cease by 1981 (Weldwood removed the married staff facilities during the summer of 1977). Weldwood has attempted to minimize logging practices that disturb salmonids. Increases in pink and coho salmon escapements in recent years suggest that the existing logging operation has not been overly detrimental to spawning activity; however, it may be too early to judge the long term logging effects since some of the improved escapements undoubtedly result from improved access above the obstruction.

STATUS OF THE STOCKS

The Kakweiken River is host to all five species of Pacific salmon, as well as steelhead and cutthroat trout and Dolly Varden; historically, pink salmon have dominated. Odd year escapements of pinks averaged 137,500 from 1951 to 1975 (all pre-1977 figures from Marshall et al., 1976; see Appendix F). However, recent odd year pink salmon escapements have been considerably higher than historic levels, with 800,000 in 1975, compared to a previous high of 300,000 in 1971. Even year pinks averaged 70,000 from 1950 to 1976 with a high of 500,000 in 1976. Again, recent runs show much higher returns than historic levels.

Pink salmon spawning prior to construction of the fishway in 1964 was limited to the lower 4 km (2½ miles) of river by an obstruction caused by the lower falls. The odd year pink salmon run now spawns throughout the entire system. The escapement estimate for 1977 was 75,000 pinks (1977 escapement estimates are as reported by Fishery Officer, R. Scheck, except as noted).

Chum salmon escapements averaged 9,500 since 1950 with a high of 75,000 recorded in 1951. Virtually all chum salmon are reported to spawn below the falls, although 1977 observations indicate limited spawning between the falls and Kakweiken River east fork (Elbow Creek). Chum escapements for 1977 show a decline in the run, with 1,700 spawners reported.

Coho escapements averaged 7,300 since 1950 with a high of 75,000 in 1951, and a low of 750 in a number of years. The 1977 estimate of 5,500 represents an average run. Coho are not impeded by the falls and spawn throughout the entire system.

The average escapement of sockeye since 1950 was 2,400 with a high of 15,000 in 1951 and a low of 25 from 1970 through 1973. The 1977 estimate was 600 spawners. Sockeye, like chinook, coho and steelhead, are not impeded by the falls and spawn in the upper reaches of the system.

Chinook salmon escapements averaged 340 since 1951 with a high of 750 in 1972 and 1974, and a low of 25 in 1971. The 1977 estimate of 130 was below average.

Steelhead trout have only been enumerated since 1973, and have averaged 1,300 spawners per year. Most are thought to be from the winter run. Estimates for 1977 were down; only 100 were estimated on the spawning grounds.

FIELD METHODS

TRAPPING JUVENILES

Coho Trapping and Tagging Sites

The following water sources were chosen for trapping because they were the only small tributaries accessible by river or logging road that were found to contain rearing coho in the early spring (Fig. 2). They are relatively small in size and are either ground water fed or appear to be relatively stable.

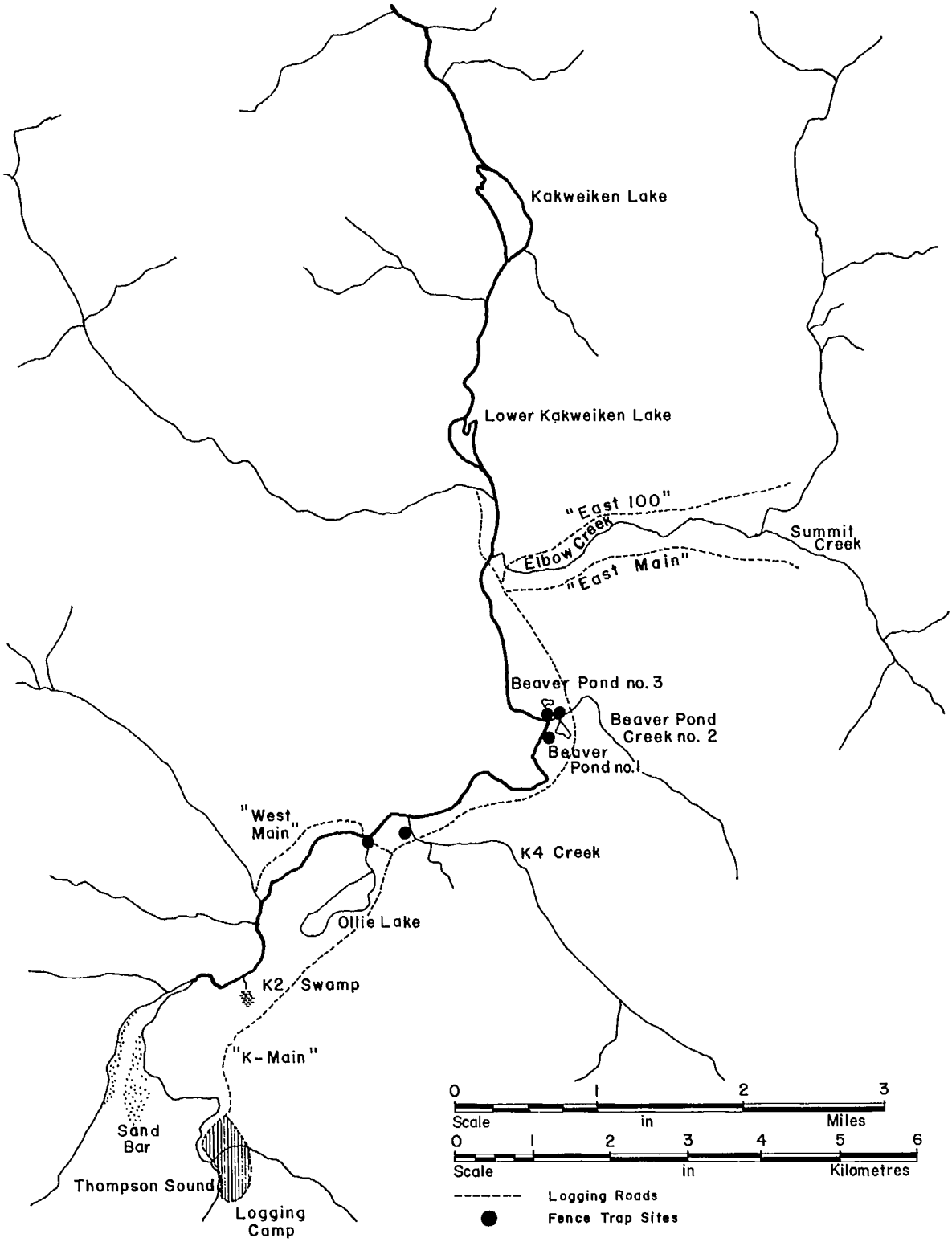

Figure 2. Coho trapping and tagging sites.

Ollie Lake Creek

Ollie Lake Creek is approximately 200 metres long (660 ft.), is slow flowing, deep and mud-bottomed over most of its length (Fig. 3). It enters the Kakweiken River 100 metres (330 ft.) above the falls and fishway. The creek originates from Ollie Lake, a small shallow lake of approximately 1.7 hectares (4.2 acres) surface area. Ollie Lake is bordered by tall grass for half its circumference and by rock and coniferous forest for the remainder. The shoreline alongside the rocky, forested half is littered with windfall debris and many floating logs. The creek flows through a flat logged-off area overgrown with small alders, vines and Devil's club. The trap was installed near the outflow into the Kakweiken River at a site where rocks from logging road construction lined the creek bed.

K-4 Mile Creek

K-4 Mile Creek, an unnamed tributary of the Kakweiken River, flows through a culvert under the "K-Main" logging road close to the road sign denoting four miles from the Thompson Sound logging camp (Fig. 4). This creek is approximately 3 km (1.9 mi.) in length. The major portion is steep and inaccessible to salmon. The lower section above the logging road flows through a swampy area of approximately 50 hectares (120 acres). The vegetation here consists of grasses, moss, Devil's club, ferns, and deciduous and coniferous trees. Below the road the creek flows through a logged off area, with a protective corridor of similar flora. Here the creek bed is composed of gravel and sand. Water flows through alternating pools and riffles created by the occasional log jam. The trap was installed approximately 100 metres (330 ft.) from the outflow into the Kakweiken River.

Beaver Pond

Near the 5-mile road sign a swampy area is visible from the "K-Main" road (Fig. 5). A creek crosses under the road near this point and flows into a swampy area. On closer examination this swamp proved to be the work of industrious beavers, creating a shallow (1-4 m deep) lake of approximately 4 hectares (2.5 acres). The creek is rocky and steep above the road, but flows slowly over a well-gravelled bottom below the road. It breaks up into smaller branches near a corner of the beaver pond with "tributaries" flowing into and out of the pond. The branches rejoin and flow into a side channel of the Kakweiken River about 100 m (330 ft.) below the beaver pond. On this creek, called Beaver Pond Creek #2, the trap was built near the outflow.

Another creek was found flowing from the same beaver pond. About 75 m (250 ft.) in length, this creek flows into another side channel of the Kakweiken River about 100 m (330 ft.) below the beaver pond. The trap on this creek, labelled Beaver Pond Creek #1, was built near the outlfow.

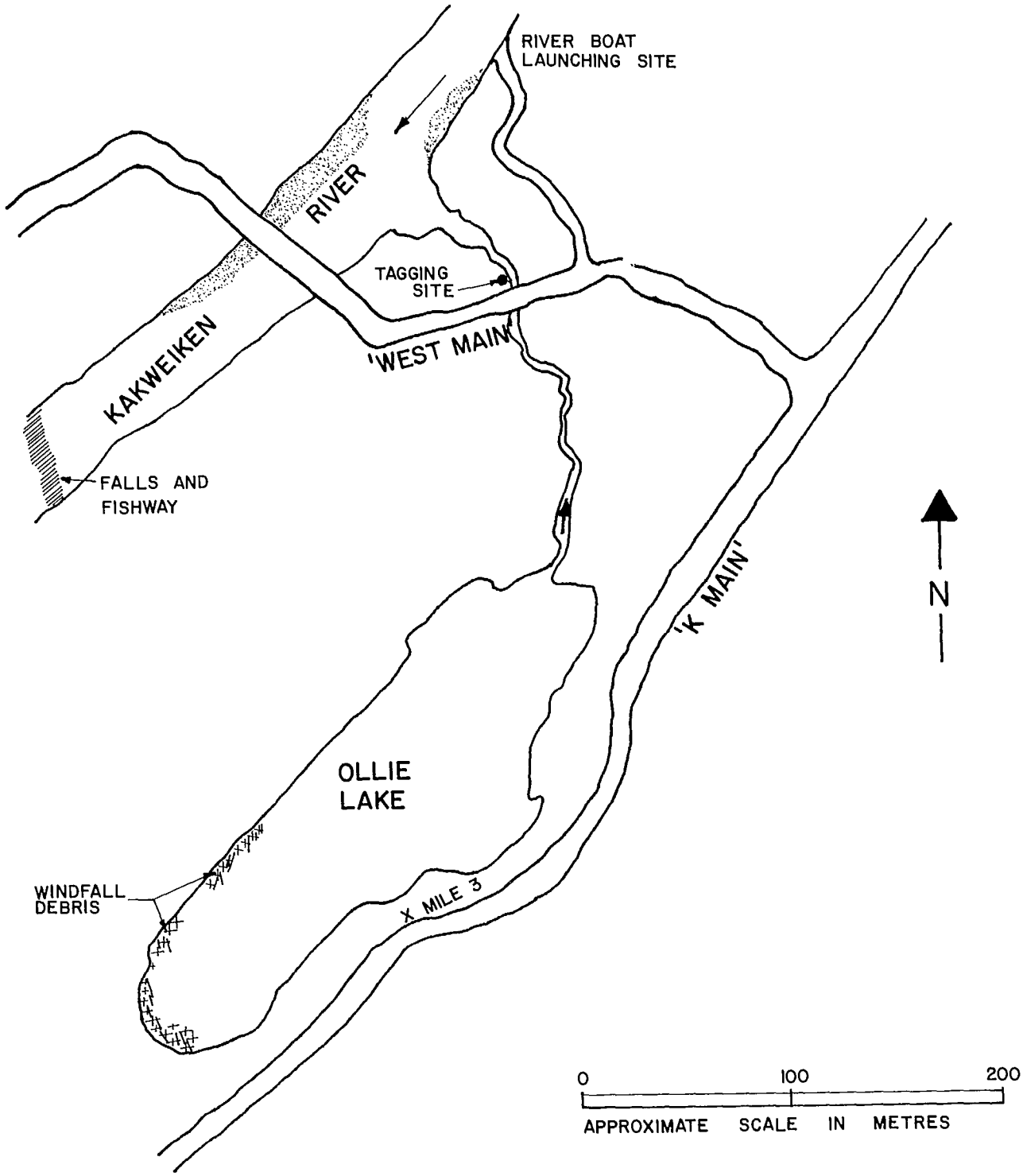

Figure 3. Ollie Lake and Creek sketch map showing the CWT site. Not to scale.

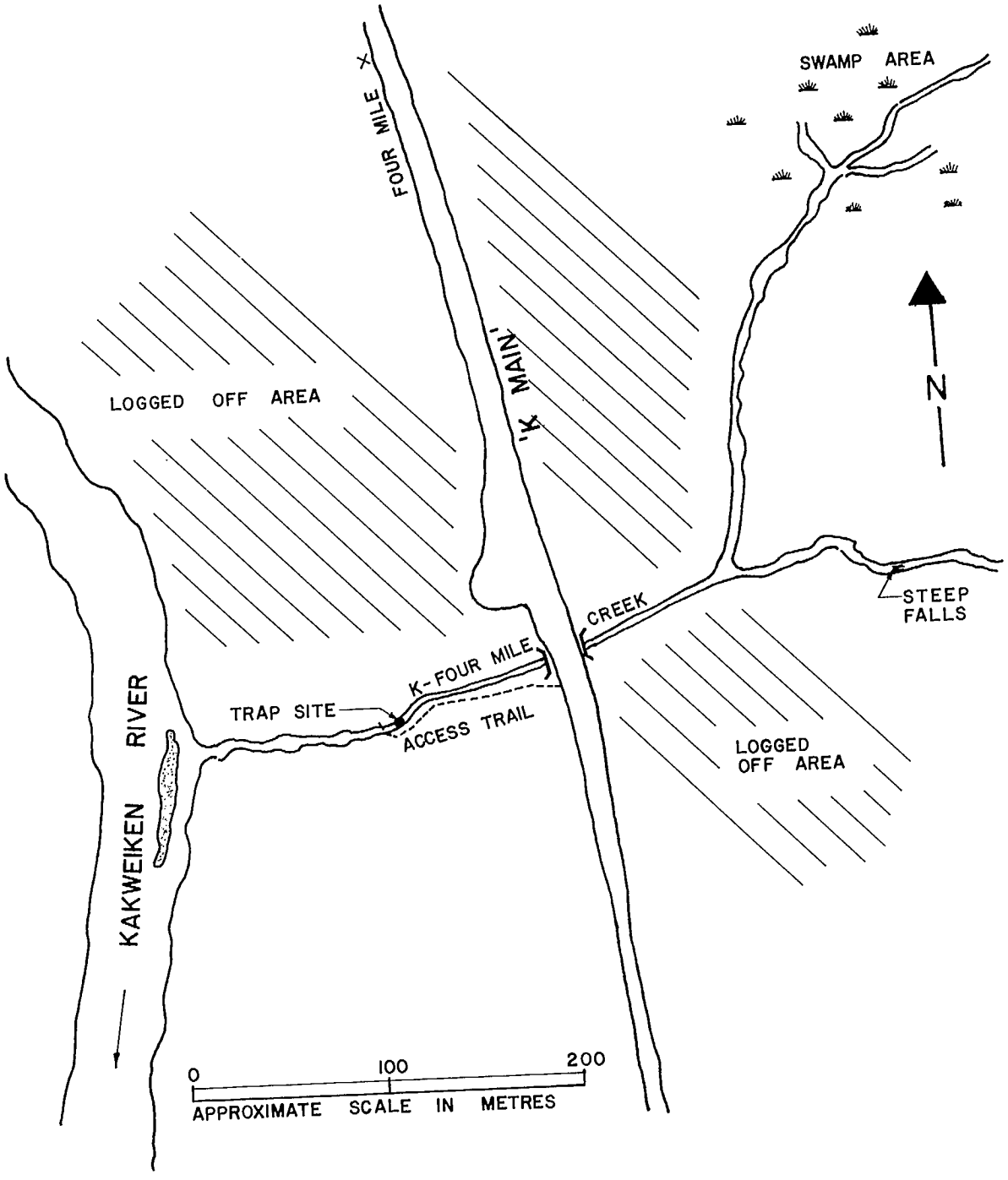

Figure 4. K-4 Mile Creek sketch map showing CWT site. Not to scale.

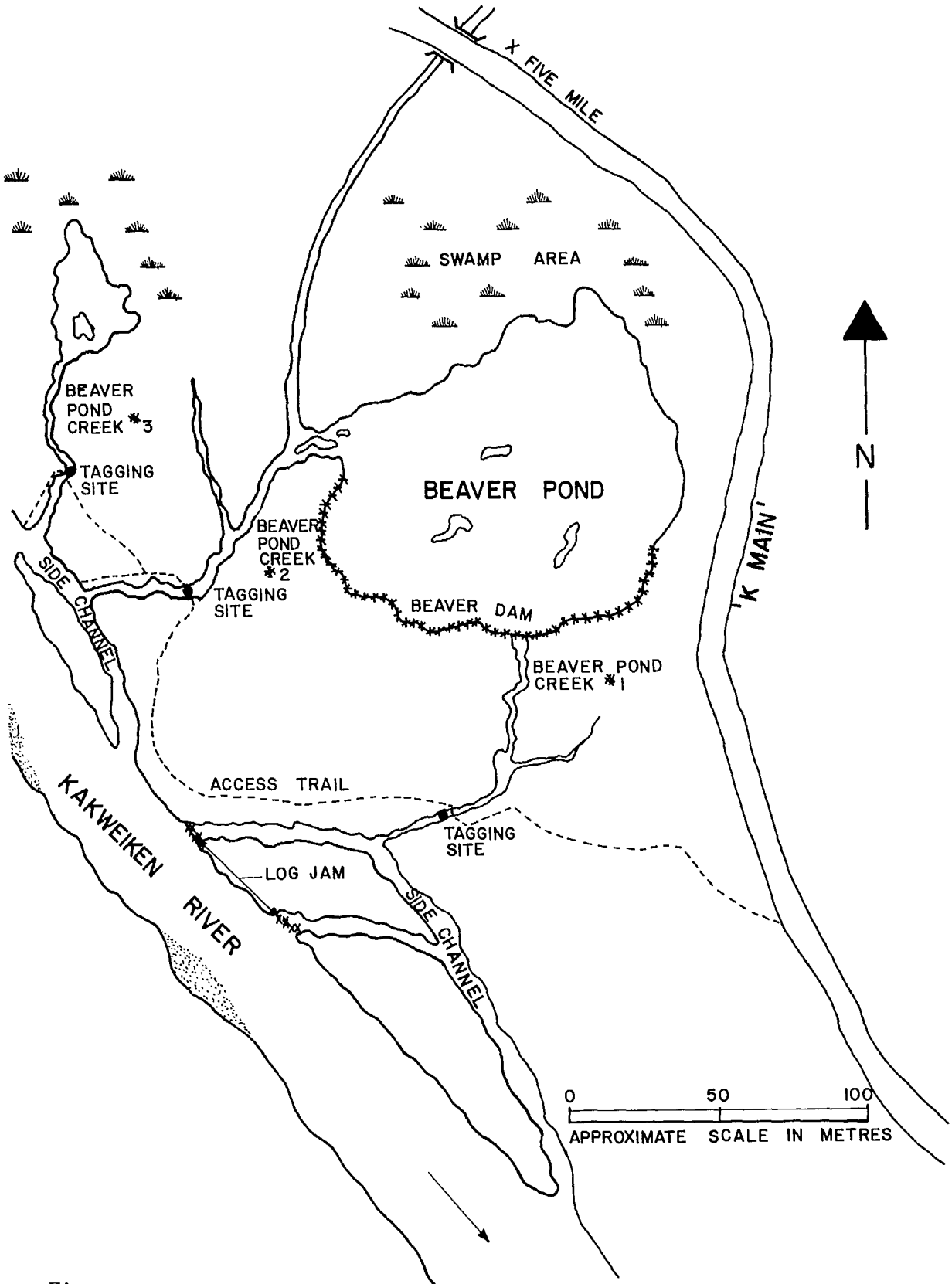

Figure 5. Beaver Pond sketch map showing CWT site. Not to scale.

A third, smaller beaver pond was found just upstream from the outlet of Beaver Pond Creek #2. A trap was built on the small creek (Beaver Pond Creek #3) draining this beaver pond.

The banks surrounding the beaver ponds are overgrown with grass, moss, ferns, alder and an occasional large hemlock. Below the beaver ponds the creeks are overhung with the same ferns, Devil's club and alder, and flow through a stand of very large conifers.

K-2 Mile Swamp

This swamp is ground water fed and slowly drains into the Kakweiken River near mile 2 on the "K-Main" road (Fig. 6). Preliminary engineering drawings have been completed for a pink salmon spawning channel in the vicinity of this swamp (pers. comm., J. Wild, Enh. Serv. Br. engineer). The creek draining the swamp is approximately 300 m (980 ft.) in length with banks lined by grasses and ferns. Creek depth varies from a few centimetres to 4 metres (13 ft.). Minnow traps were used to capture coho smolts which were transferred to a holding box near the confluence of the creek and the Kakweiken River, about 1.5 km (0.9 mi.) from the mouth of the Kakweiken River. The Kakweiken River is under tidal influence at this point.

Test Fishing Methods and Sites

Prior to installing fence traps we checked various sites for availability of coho smolts by test fishing with baited (salmon roe) minnow traps (Fig. 7 lower). Minnow traps were set in Ollie Lake, Beaver Pond, Lower Kakweiken Lake, Lower Kakweiken River and Upper Kakweiken River. To assess whether sufficient fingerling chinooks would be present for a CWT operation in June, we beach seined for chinook fry in May using a 34 x 3 m (112 x 10 ft.) beach seine, as described by Armstrong and Argue (1977). The seine was set from a 5 m (18 ft.) jet-driven river boat; thirty-five sets were made between May 3 and 30 in the Kakweiken River and estuary (Fig. 7 upper). Test fishing records are presented in Appendix A.

Capture and Tagging Methods

The fence traps, minnow traps and beach seines used to capture coho smolts at the Kakweiken River as well as the anaesthetizing methods, tagging equipment, tagging machine maintenance and tagging procedures are fully described by Armstrong and Argue (1977). Fig. 8 presents a typical fence trap design and Fig. 9 pictures fence traps on K-4 Mile and Ollie Creeks.

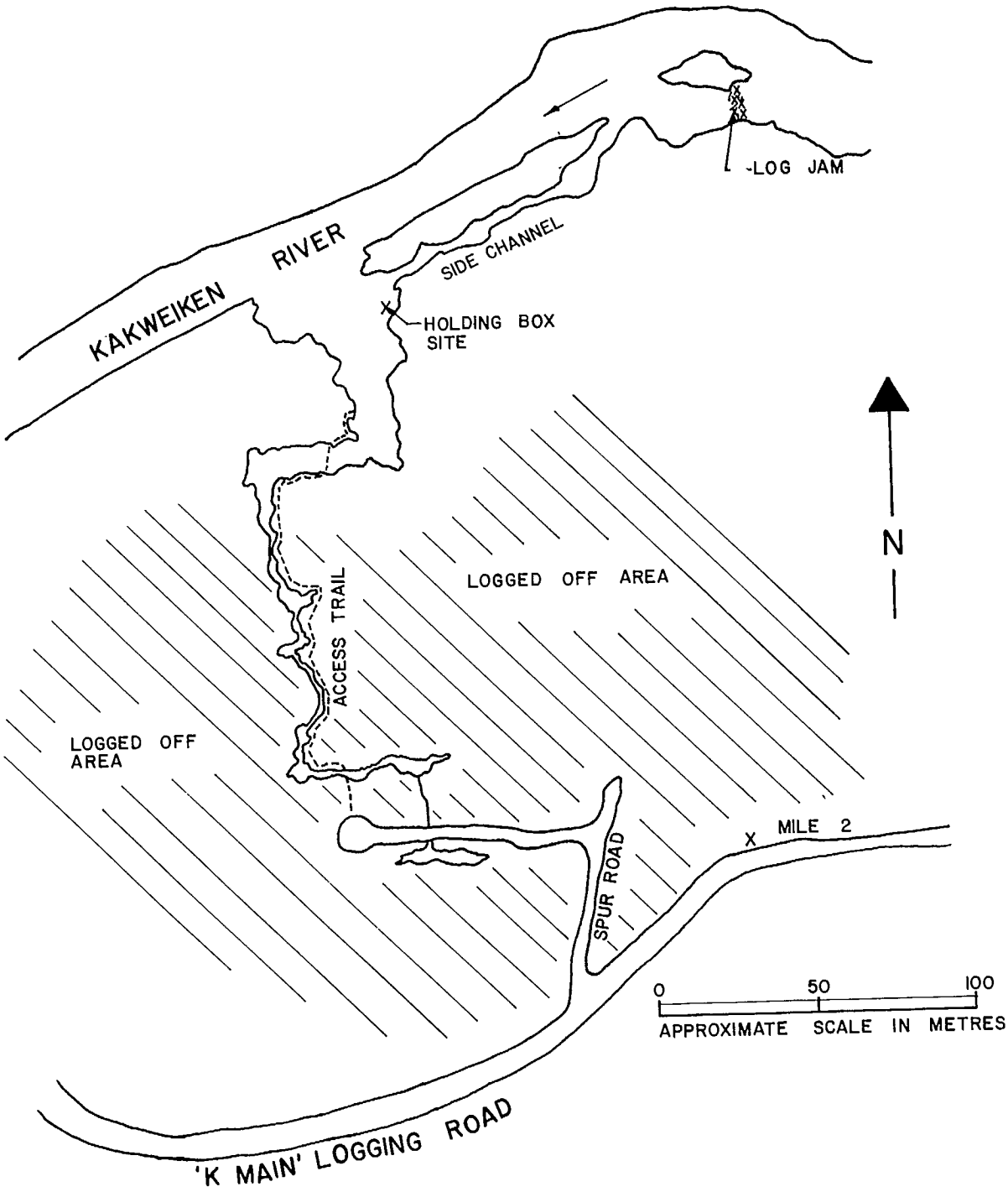

Figure 6. K-2 Mile swamp sketch map. Not to scale.

Figure 7. Test fishing methods showing beach seining (upper) and minnow trap with captured salmonids (lower).

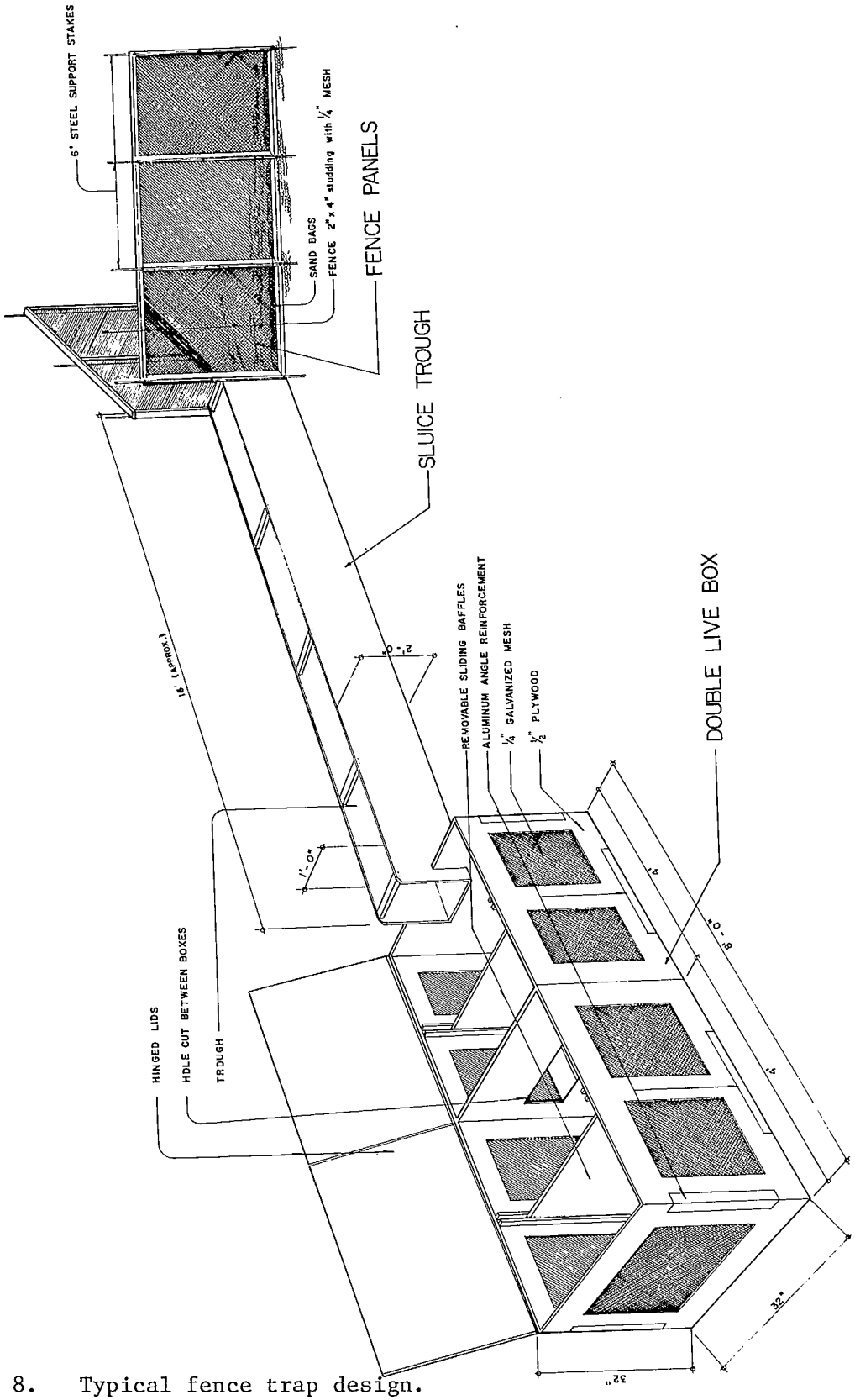

Figure 8. Typical fence trap design.

Figure 9. Fence traps: K-4 mile (upper), Ollie Lake (lower) at low water levels. Both traps submerged at high water level.

Biological Samples

Throughout the program we subsampled approximately 100 coho from each weekly tagging lot for scale samples, fork length, and wet weight. Juvenile coho and sockeye from beach and estuary seining were also sampled. A subsample of the captured salmonids were analysed for prevelance of disease.

Tag Code

The tag code used on coho smolts for all CWT locations and tagging dates was 11/2/7 (Data 1/Agency/Data 2).

Coho Fingerling Tagging

As discussed later, capture of sufficient migrating coho smolts for CWT tagging was difficult. As an experiment we tried to capture coho fry during summer/fall months when water levels were stable and when coho fry were larger and more available to trapping gear. Gee's minnow traps were used with fresh and frozen salmon roe as bait. Three sites were chosen for trapping: a small side channel just below the six mile bridge; the main river at six mile bridge; and K-4 Mile creek (Fig. 10).

SPAWNER OBSERVATIONS

General Reconnaissance

The Kakweiken River, from Lower Kakweiken Lake to the estuary, was thoroughly surveyed in previous years (Anon., 1969; Chamberlain et al., 1973). However, there had been virtually no reconnaissance above the lower Lake; so it was felt that further reconnaissance in this area was required.

With permission of the Provincial Dept. of Lands and Forests (Appendix J) an overland trail was cut from the upper end of the lower lake to the lower end of the upper lake. An inflatable Zodiac and a 9 HP outboard were then back-packed into the upper lake and used to survey part of the river above Upper Kakweiken Lake. A foot survey of 2.4 km (1.5 mi.) was carried out above the farthest point of boat navigation. Distances over these stretches were measured using a Topofil surveyor's string measuring device. Visual assessments of spawning gravel were made where possible. As a final check on the system, a helicopter flight was made (September 9) over the river to a point approximately 8.1 km (5 mi.) above the farthest upstream point of ground reconnaissance. The river below Lower Kakweiken Lake was also floated and measured with the Topofil device. Estimates of average river width and percent of stream bed suitable for salmon spawners were noted for the areas surveyed.

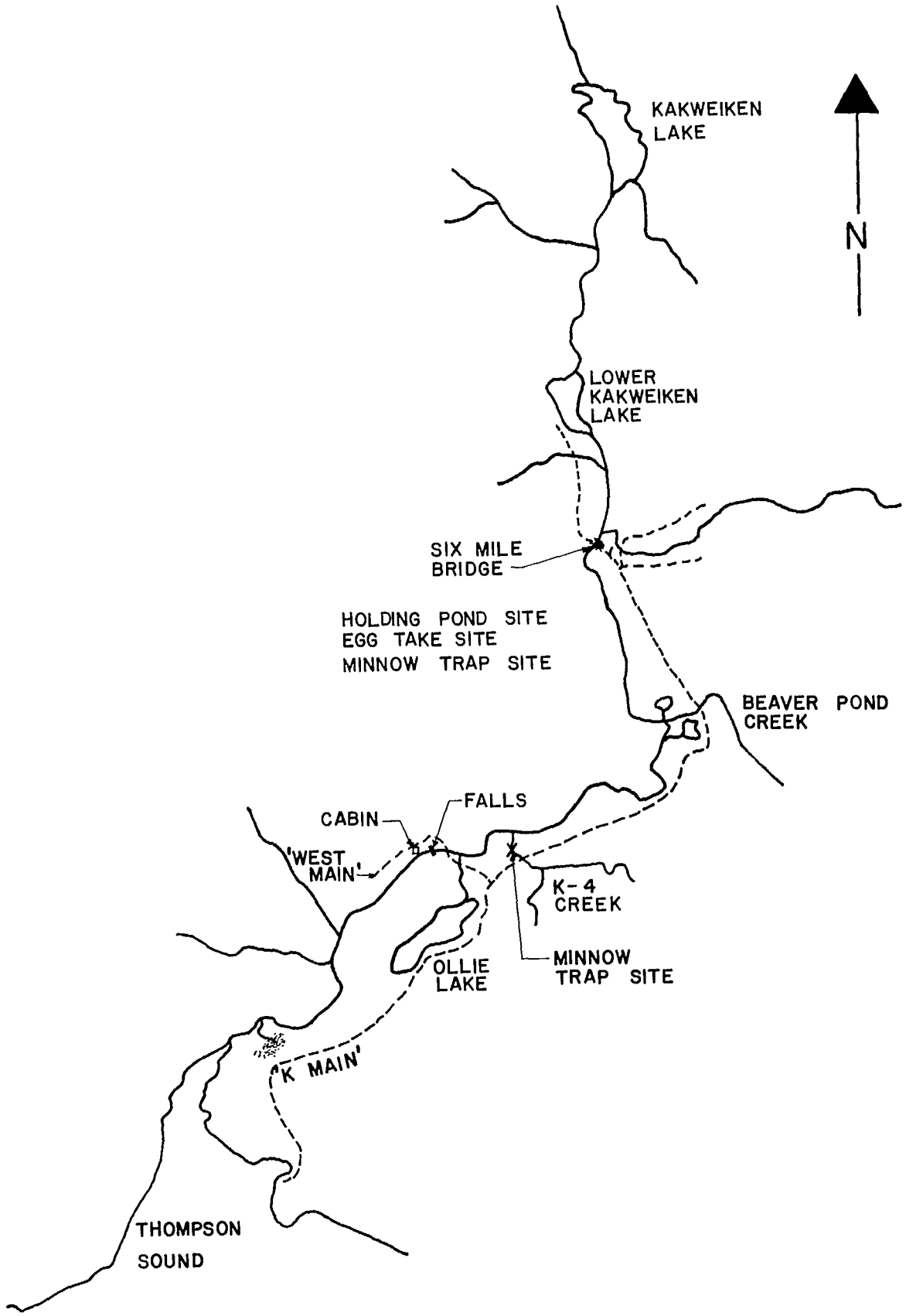

Figure 10. Kakweiken River sketch map showing holding pond site, egg-take site and minnow trap sites. Not to scale.

River Swim

Swimmers surveyed the Kakweiken River from Lower Kakweiken Lake to the river mouth to provide information on the numbers and location of spawning chinook salmon and steelhead trout. The swim involved several swimmers with wet suits and snorkels making visual estimates on numbers and location of salmonids. They were accompanied by one or two people in a rubber raft who recorded the estimates for each section. The river was divided into convenient sections for swimming and record keeping by painted signs nailed to trees. From Lower Kakweiken Lake to the falls below Ollie Lake the river was divided into six sections, while the river from the falls to the mouth was considered one complete section (Fig. 11). The first swim was conducted on July 13. Regular swims were not started until early August, after which they were conducted approximately every two days, river conditions permitting. The final swim was made on September 5. A total of 14 swims were made (Appendix G).

EGG COLLECTION AND ON-SITE INCUBATION

Chinook Salmon Egg Take

Chinook salmon were the target species for an egg take. It was hoped to capture and hold 30 adult chinook salmon until maturity. Mature chinooks were then to be stripped of eggs and milt. The eggs were to be fertilized in buckets, transferred to incubation trays on site, and held until they reached the eyed-out stage. They were then to be transported to the Quinsam Hatchery on Vancouver Island for final incubating, rearing and coded-wire tagging. It was also hoped that sufficient numbers of summer steelhead could be located for an egg-take.

The chinook and steelhead were to be located during river swims and captured either by gillnetting, beach seining or, as a last resort, by sport fishing. Five gill nets with mesh sizes of 11.4, 14, 17, 19 and 22 cm (4.5, 5.5, 6.5, 7.5, 8.5 in.) in 9 m (30 ft.) lengths and 2.4 m (8 ft.) depths were prepared. It was thought that one of these mesh sizes would either capture the adults without gilling them or would capture them in a "roll-up" since the nets were hung on a 4:1 mesh to cork line ratio. Two beach seine nets 30.5 m (100 ft.) and 46 m (150 ft.) in length and 5 m (16 ft.) in depth were used. Gill nets were used at four main river sites (Fig. 11); beach seines were set at the six mile bridge (Fig. 10).

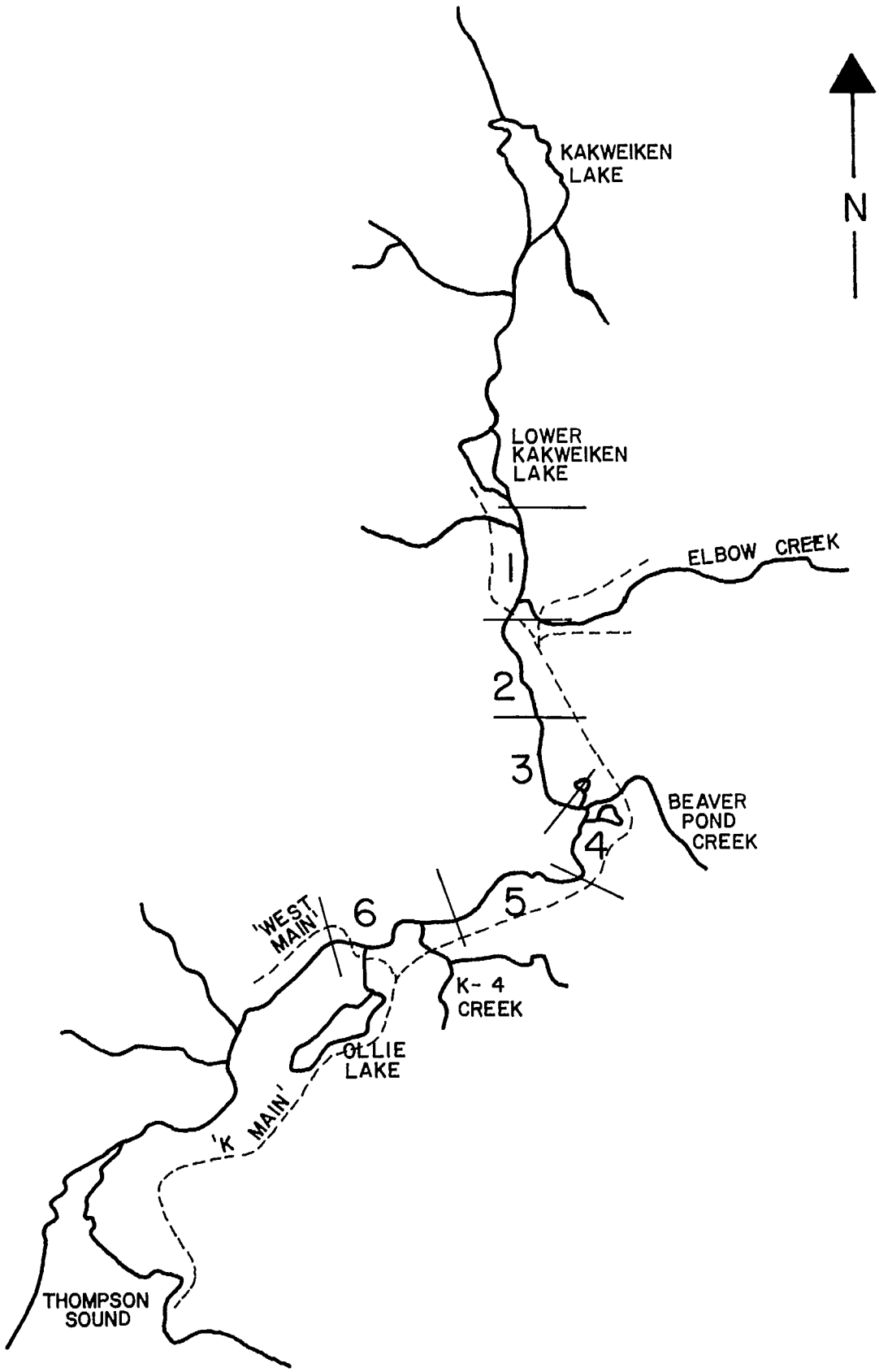

Figure 11. Kakweiken River sketch map showing river swim sections. Upper swim sections are numbered; lower section, from the falls to the estuary, swum as one complete section.

Estuary Purse Seining

In addition to the work carried out on the river to capture adult chinooks, the Fisheries Service research vessel MV Walker Rock purse seined in the estuary in the hopes of capturing incoming chinooks. The seine used was 274 m (150 fathoms) long by 38 m (21 fathoms) deep.

Holding Pond

In anticipation of capturing sufficient chinook salmon and steelhead trout a holding pen (Fig. 12) was constructed, based on a design used on the Harrison River in 1971 (Armstrong, 1973). All necessary equipment and materials were shipped to Thompson Sound by barge and pens were constructed on site.

The site chosen for pen installation was a large back eddy at a point where the logging road crosses the river at the 6 mile bridge. The back eddy provided an adequate flow of water without being overpowering and also provided adequate depth, both at low and high water. The holding pen could be moved in or out from shore as water levels changed (Fig. 13).

Incubation Facility

The egg incubation facility (Figs. 14 and 15) was built on the bank of McAllister Creek, adjacent to the logging camp residences. This site was chosen as it offered two separate water supplies, easy road access to the Kakweiken River for egg transportation, and easy access for egg tending during the incubation period. It was assumed that the McAllister Creek water supply was satisfactory for egg incubation, in terms of water chemistry and pathogen content, since small numbers of chum salmon, pink salmon and cutthroat trout had spawned in the creek in recent years (pers. comm., logging camp personnel).

Three incubation stacks were housed in a 4.3 x 3 x 1.8 m (14 x 10 x 6 ft.) aluminum shed modified to exclude any direct sunlight. Each stack of standard Heath incubation trays (Fig. 16) was supported by a wooden frame and was fed water at a rate of 10 litres (2.2 gal.) per minute through adjustable valves in the bottom of a 900 litre (200 gal.) header tank situated directly above the incubation stacks (Fig. 15 lower). Capacity was approximately 100,000 chinook eggs.

The header tank was supplied by two separate water systems. The main system was a gravity feed 4 cm (1.5 in.) plastic line originating from a screened box placed in a pool in McAllister Creek, approximately 270 metres (886 ft.) upstream from the incubation shed. With 7 metres (23 ft.) of head this line was capable of delivery 50 litres (11 gal.)

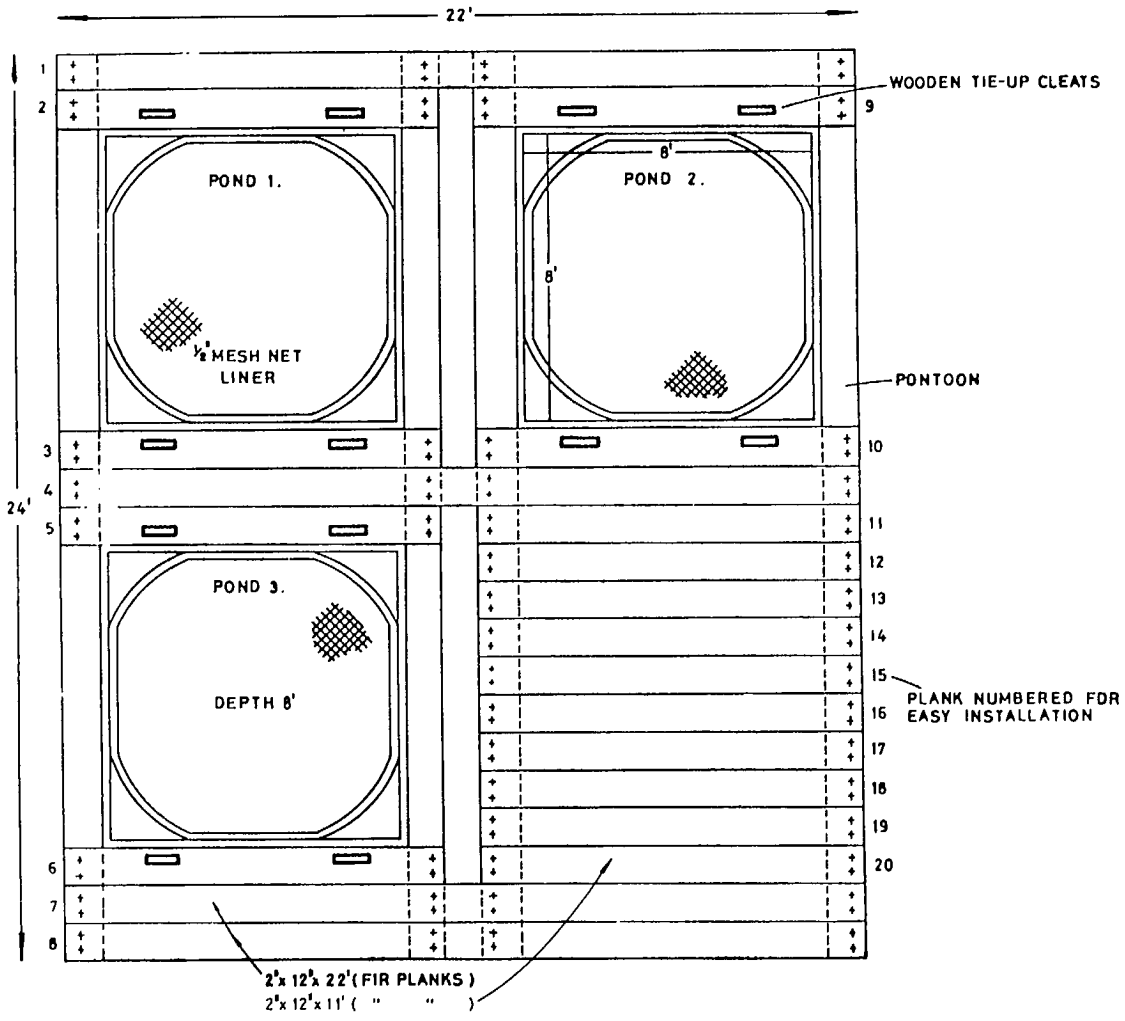

Figure 12. Holding pen design.

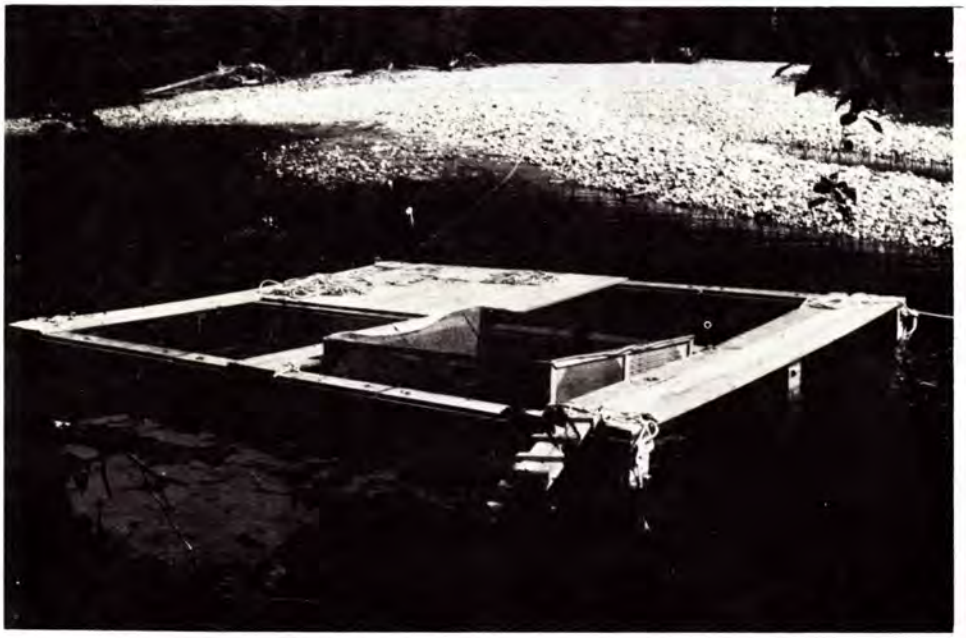

Figure 13. Holding pen in backeddy of the Kakweiken River.

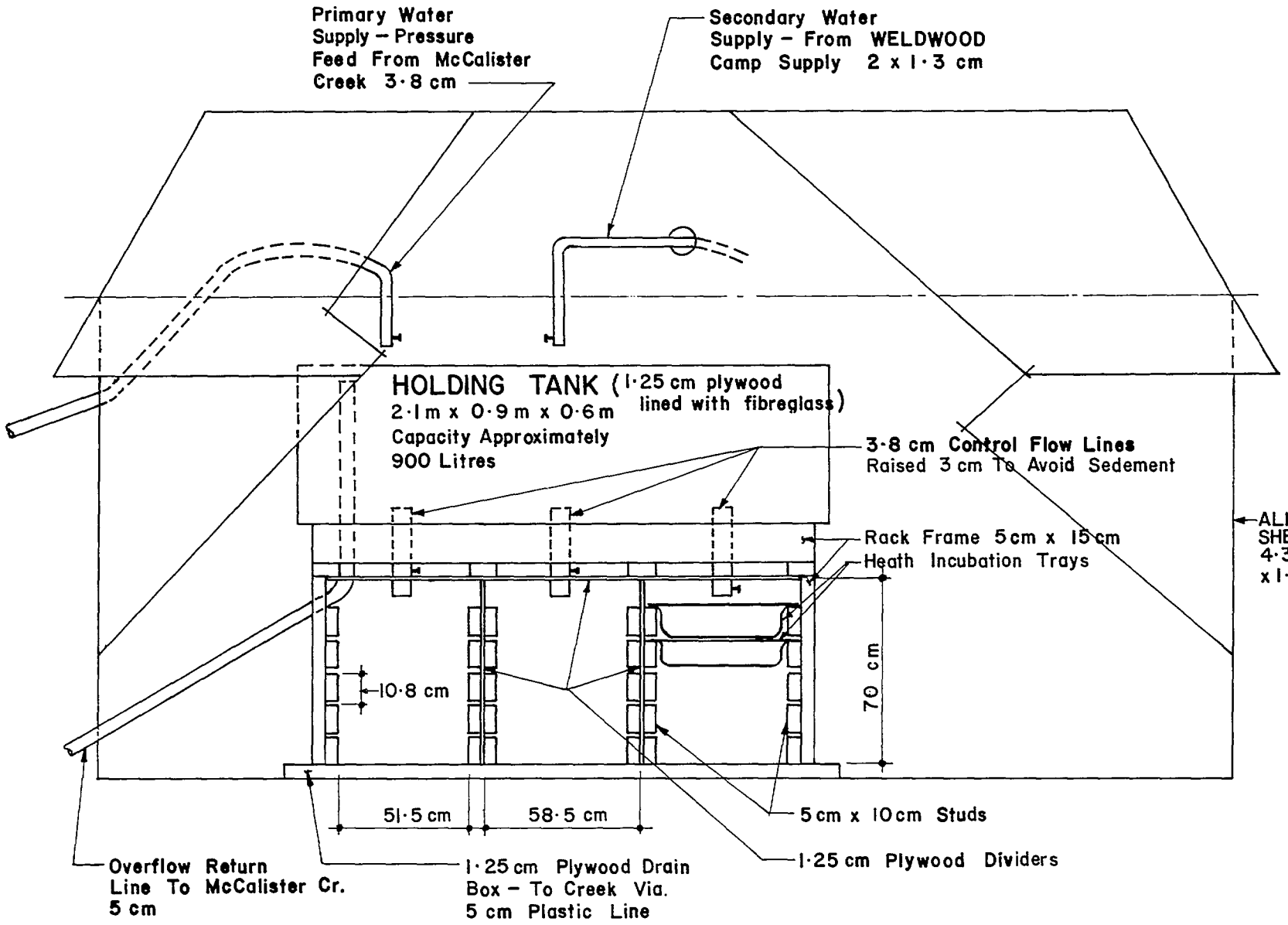

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Figure 14. Kakweiken River incubation shed.

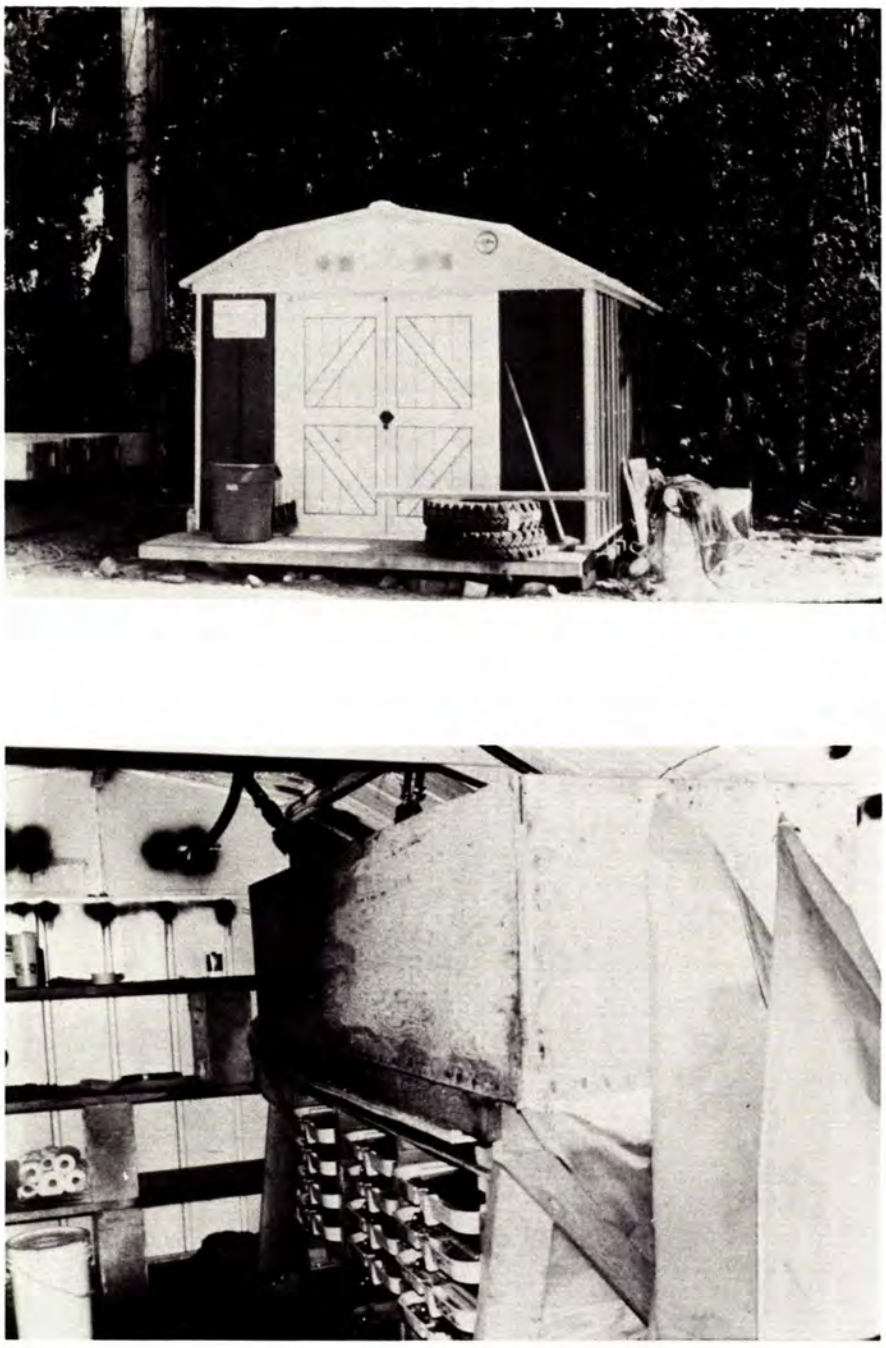

Figure 15. Incubation facility showing aluminum shed (upper) and header tank over heath trays (lower).

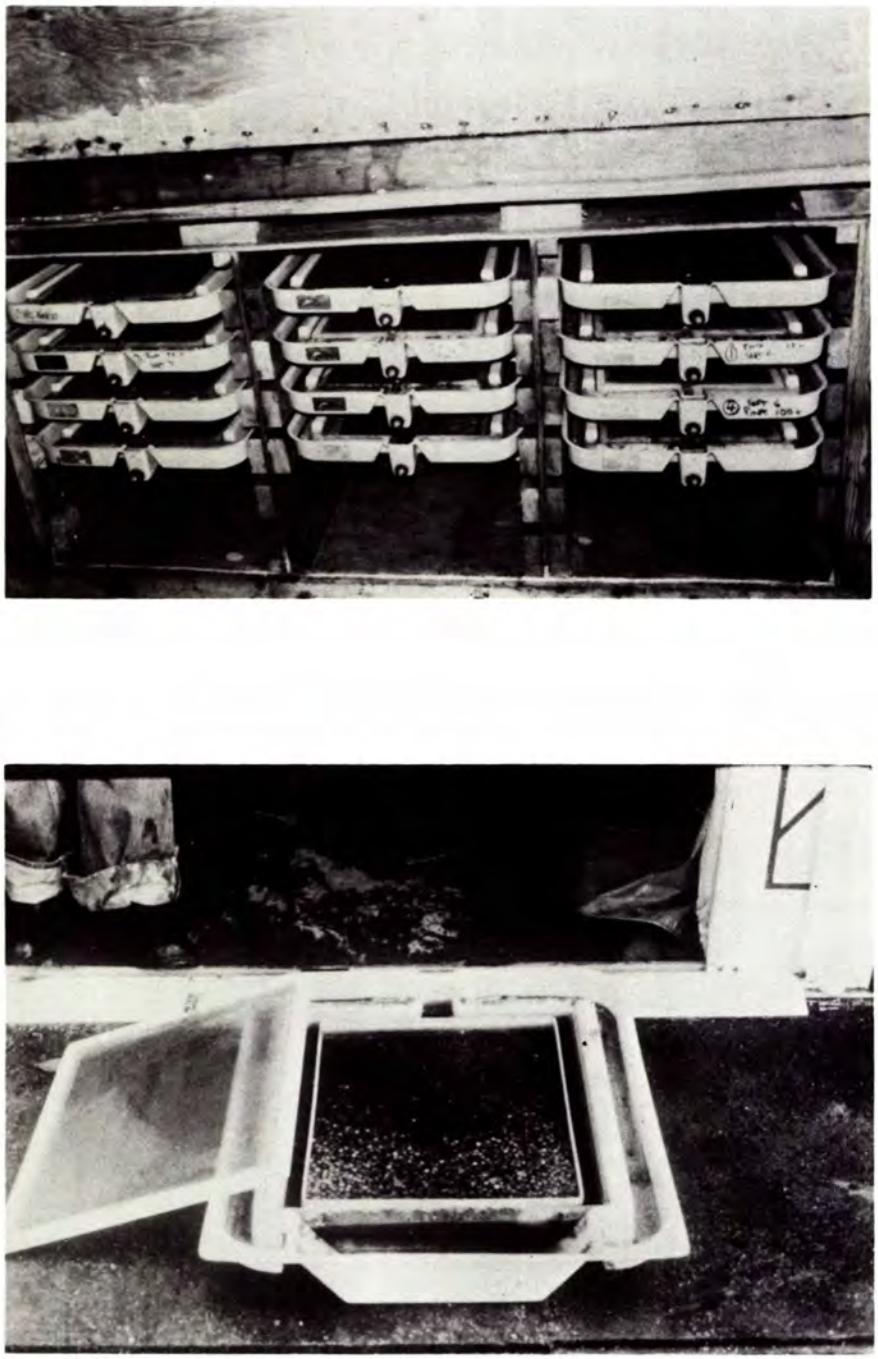

Figure 16. Heath trays in position in incubation rack (upper) and heath tray with eggs (lower).

per minute and was valved to reduce the flow to the necessary 30 litres (6.6 gal.) per minute. The secondary or back-up water source was tapped directly from the logging camp water supply, which consisted of a 23,000 litre (5,000 gallon) reservoir filled by a system of pumps set into a well a few metres from McAllister Creek. From the reservoir the water was gravity fed into the logging camp. The camp water was tested for possible copper, lead, and zinc contamination due to use of copper and galvanized iron piping in the logging camp system; test results showed insignificant traces of these metals (Appendix H).

The secondary water supply for the incubation shed was capable of delivering a constant flow of 45 litres (9.9 gal.) per minute. This also was reduced by valves to supply only the necessary 30 litres/min. (6.6 gal./min.). An alarm system was installed to warn when the water level in the header tank began to drop. All excess and effluent water was piped back into McAllister Creek.

Both water supply systems were tested for dissolved oxygen content (Appendix H). Oxygen levels were found to be satisfactory for incubation. There was no evidence of nitrogen saturation. All equipment used in the incubation facility was thoroughly disinfected with ROCCAL sterilizant before eggs were introduced.

The approximate cost of materials and supplies to build and operate this on-site incubation facility are detailed in Table 1.

Table 1. Approximate cost of the incubation facility.

Material	Approximate Cost
Aluminum storage shed	$ 395
Lumber and plywood	180
Fibreglass materials	60
Plastic piping, fittings, and valves	500
Alarm system (sensor, bell, batteries)	95
Miscellaneous hardware (nails, screws, small tools, etc.)	170
5 - 5 gallon buckets	20
Malchite Green	12
Roccal	12
3 Thermometers	10
TOTAL	$1454

OBSERVATIONS AND DISCUSSION

JUVENILE COHO CODED-WIRE TAGGING

Numbers Caught and Tagged

A total of 3,666[1] coho smolts were trapped at the tagging sites on the Kakweiken River; 2,958 of these were released with coded-wire tags (Table 2); 372 were not tagged because they were too small (<55 mm fork length); approximately 300 escaped untagged from the holding boxes during flooding; 34 died during the tagging period; three were released unclipped and untagged due to injuries; and 52 were released with clips but no CWTs.

Table 2. Coho smolts tagged and released at each tagging site (code 11/2/7).

Tagging Site	No. Tagged	Immediate Tagging Mortality	No. Adipose[2] Clips Released	No. Tags Released
Ollie Lake	820	23	15	782
Beaver Pond Creek #1	607	1	7	599
Beaver Pond Creek #2	331	-	3	328
Beaver Pond Creek #3	891	6	27	858
K-2 Swamp Minnow Traps	395	4	-	391
Total	3,044	34	52	2,958

The total of 2,958 tagged and released coho smolts was well below our tag release goal of 40,000. Two factors likely accounted for the low catches: 1) the number of coho smolts rearing in the study streams was not as high as expected; and 2) all fence traps (with the exception of Beaver Pond Creek #3) were plagued with washouts due to rapid and large fluctuations in water flow with changes in the weather. No smolts were tagged at K-4 Mile Creek as this trap was almost continuously in flood-damage condition. Of interest, daily catches at Ollie Lake Creek were highest as the water level receded from "flooded out" conditions. No estimate can be made of how many smolts escaped the traps during these flood conditions.

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[1] Daily coho smolt counts at the trap sites were made quickly to reduce stress mortality. Thus there are slight differences between totals of the daily catches presented in Appendix A tables, and totals under "No. Tagged" in Table 2.

[2] Coho smolt sub samples were held for extended periods after tagging to determine tag loss rate, from which estimated total tag loss figures were extrapolated.

One coho smolt in a sample of 3,044 had a naturally missing adipose fin. This compares with an incidence of one coho smolt in 1,312 with a naturally missing adipose fin on the Squamish River system (Argue and Armstrong, 1977).

Tables in Appendix A list daily catch records, daily temperature records, comments on trap operation for each fence trap site and K-2 Swamp minnow trap catches. Appendix B details all tagging and release data.

Coho Smolt Migration Timing

Peak migration timing, as measured by the date on which 50% of the smolts had been captured, occurred on May 3 at Beaver Pond Creek #3. This was the only site where trapping was unaffected by flooding. The other traps, although interrupted by flooding and flood damage, showed similar migration timings (Table 3). This peak date compares with May 11 for three Squamish River tributaries (Argue and Armstrong, 1977) and approximately May 20 for several Cowichan River tributaries (Armstrong and Argue, 1977).

Table 3. Coho smolt migration timing at each trap site.

Trap Site	Days Trap Fished	Migration Timing		
		Peak	Peak 50% (days fished)[a]	
Ollie Lake Creek	37	May 5	April 28-May 5	(8)
Beaver Pond Creek #1	26	May 8	May 1-10	(10)
Beaver Pond Creek #2	30	May 8	April 30-May 13	(14)
Beaver Pond Creek #3	31	May 3	May 1-7	(7)

[a] The dates and numbers of days on either side of the peak migration date over which 50% of the total catch occurred.

Coho Smolt Age

Based on scale reading the study streams had a higher percentage of age 2. smolts (Table 4) than is commonly expected based on ocean catch sampling (Milne, 1964). Ollie Lake Creek had the highest percent of age 2. smolts (22.9%). Beaver Pond Creek #1 and Beaver Pond Creek #2 (which are interconnected) had 17.8% and 20.0% age 2. smolts respectively. Beaver Pond Creek #3 and K-2 Swamp had 4.4% and 3.3% age 2. smolts, closer to ocean age compositions for adult coho. Age composition of all trapped coho migrants was 86.1% age 1. and 13.9% age 2. This compares

Table 4. Percent age composition of tagged coho smolts.[a]

Site	April - May 5		May 6 - May 11		May 12 - May 28		Total[a]	
	1.	2.	1.	2.	1.	2.	Catch (% 1.)	Catch (% 2.)
Ollie Lake Creek	88.0	12.0	68.4	31.6	67.9	32.1	603 (77.1)	179 (22.9)
Beaver Pond Crk. #1	77.5	22.5	76.3	23.7	92.3	7.7	484 (82.2)	115 (17.8)
Beaver Pond Crk. #2	75.7	24.3	71.4	28.6	93.5	6.5	264 (80.0)	64 (20.0)
Beaver Pond Crk. #3	95.2	4.8	96.7	3.3	-	-	819 (95.5)	39 (4.5)
K-2 Swamp	-	-	-	-	96.7	3.3	378 (96.7)	13 (3.3)
					Total		2548 (86.1)	410 (13.9)

[a] Age composition weighted by numbers tagged each tagging period.

with age compositions of 92.4% age 1. and 7.6% age 2. over a three year period for three Squamish River tributaries (Argue and Armstrong, 1977), 97.3% age 1. and 2.7% age 2. over a five year period on the Big Qualicum River (Lister and Walker, 1968) and 97.6% age 1. and 2.4% age 2. for a single year's smolt sample from the Cowichan River (Armstrong and Argue, 1977).

Length and Weight of Smolt Migrants

Age 1. coho smolts were significantly longer ($p<0.01$) at Ollie Lake Creek (weighted seasonal mean fork length 92 mm) than at Beaver Pond Creek #1 (88 mm), Beaver Pond Creek #3 (81 mm), Beaver Pond Creek #2 (80 mm) and at K-2 Swamp (71 mm). Also age 1. coho smolts were significantly longer ($p<0.01$) at all three Beaver Pond Creeks than at K-2 Swamp. As mentioned previously, approximately 10% of the coho smolt catch was too small for tagging (<55 mm) and most of these had the dark pigmentation and prominent parr marks of presmolts. Since these fish were excluded from the age/size sample the true average size of age 1. coho smolts would be somewhat smaller than that noted above and illustrated in Figure 17. Age 1. smolts were largest in the early sampling period and decreased in size as the migration progressed.

Age 2. smolts were also significantly longer at Ollie Lake ($p<0.01$) (unweighted seasonal mean length 106 mm) than at Beaver Pond Creek #2 (100 mm) and Beaver Pond Creek #1 (95 mm). Very few age 2. migrant coho were encountered at the other trap sites. It is possible that the larger smolt size at Ollie Lake reflects warmer water temperatures - 10.7°C average morning water temperature during the survey period versus temperatures less than 9°C at the other sites.

Weighted mean fork length for all tagged age 1. coho smolts was 83 mm. Weighted mean fork length for age 1. Cowichan River coho smolts was 94 mm in 1975 (Armstrong and Argue, 1977). The mean fork length for age 1. Squamish River coho smolts was 82 mm between 1973 and 1975 (Argue and Armstrong, 1977). Age 2. smolts averaged 102 mm for all three river systems. Appendix C presents age/length frequency data for each Kakweiken sample site.

Table 5. Number of coho smolts per kilogram (pound) for each tagging site.

Site	Numbers/kg	Numbers/lb
Ollie Lake Creek	113.6	51.5
Beaver Pond Creek #1	154.8	70.2
Beaver Pond Creek #2	166.1	75.3
Beaver Pond Creek #3	174.5	79.1
K-2 Swamp	263.2	119.4
Total	154.1	69.9

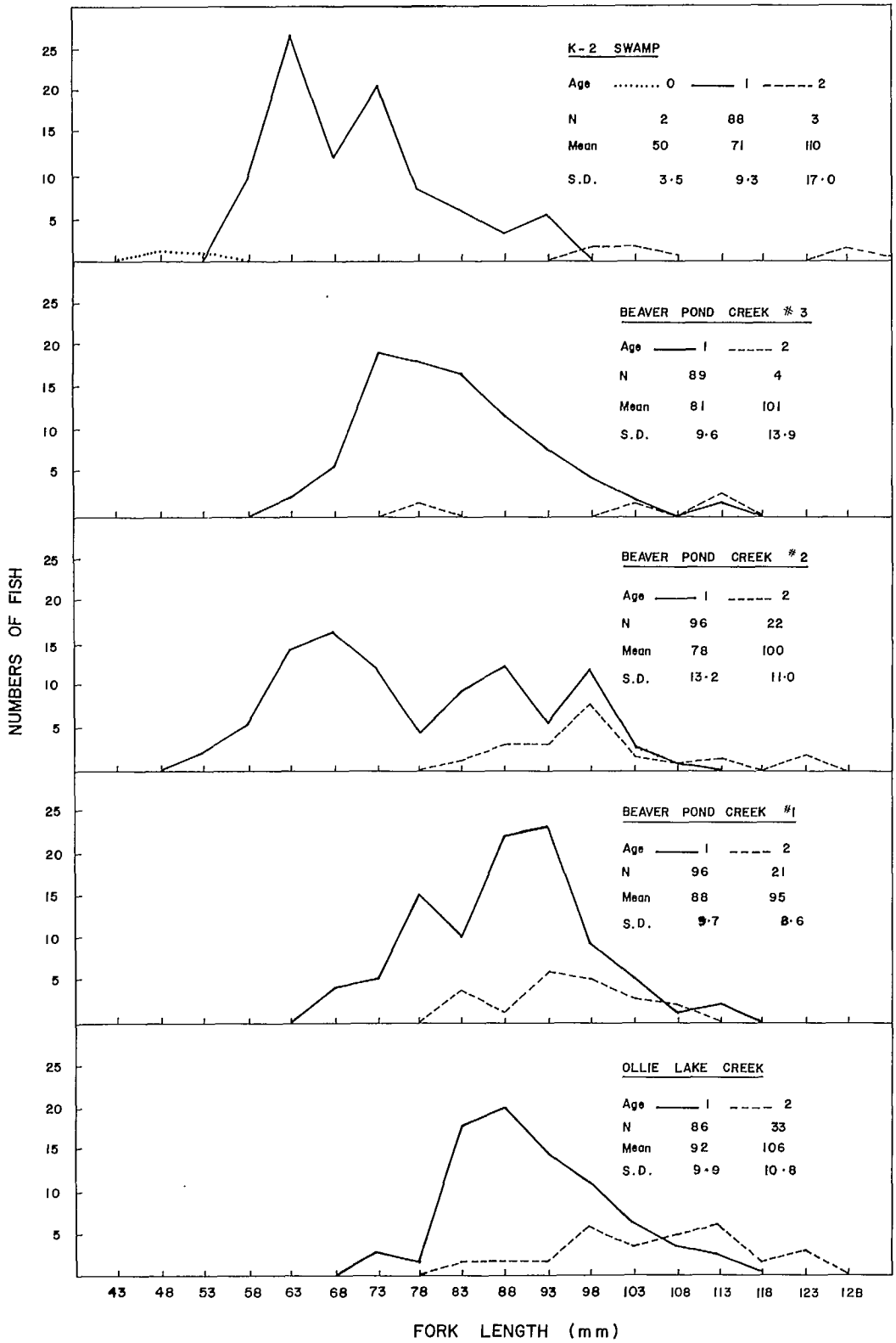

Figure 17. Fork length frequency distributions (unweighted) by age and tagging site.

As expected, the heaviest age 1. smolts (weighted seasonal mean 7.4 g) were captured from Ollie Lake Creek. Beaver Pond Creek #1 age 1. smolt mean weight was 6.0 g, Beaver Pond Creek #2 was 5.0 g, Beaver Pond Creek #3 was 4.9 g, and K-2 Swamp was 3.5 g. Numbers of smolts per kilogram was 154 (70 smolts per pound) for all trap sites and ages combined (Table 5). Appendix D presents age/weight frequency data for each sampling site.

Test Fishing Results

Beach seining for chinook juveniles was unsuccessful. Total salmonid catch from 27 sets in the river and 8 sets in the estuary was 138 coho fry, 54 coho smolts, 33 sockeye smolts, and 23 chinook juveniles. Suitable seining sites were few and the chinook catches were too low to warrant further preparation for chinook coded-wire tagging. Of interest, the average length of all chinook juveniles was 61 mm and all readable scales (9) were aged 1. (see Appendix Table C8). Average length of aged chinook was 74 mm. Possibly stream rearing type juveniles are the dominant freshwater age group for Kakweiken chinook.

Minnow traps set in the Beaver Pond on May 13, and in Ollie Lake on May 20 caught very few coho smolts, in fact the Dolly Varden catch equalled the coho catch. Apparently the majority of coho smolts had migrated from these rearing areas and consequently fence trap catches could not be expected to increase. All fence traps were removed by May 30. Test fishing catches are presented in Appendix E. Disease analysis of captured salmonid juveniles is presented in Appendix I.

Potential for Coho Fingerling Tagging

Since numbers of coho smolts tagged and released during May was well below the 40,000 target, it was decided to minnow trap age 0. coho fingerlings during late summer to determine whether sufficient numbers over 55 mm fork length were available for a tagging operation. Three sites were chosen for minnow trapping: a small side channel just below the six mile bridge, the main river at the six mile bridge, and in K-4 Creek (see Fig. 10).

Based on trap catch results for August 21 and September 5 (Table 6) it was clear that a considerable effort would be necessary to tag 40,000 plus age 0. coho. Most coho exceeded 55 mm in length (Appendix Table C10); however, at an average trap catch rate of only 3.2 coho above 55 mm per trap hour, a trap line of 100 traps, spread over at least 10 productive sites, would have to be fished for at least 125 hours to capture 40,000 taggable coho fingerlings.

Table 6. Minnow trap catches of 1976 brood coho fry.

Date	Location	No. Traps	Time In	Time Out	Catch	Catch per Trap	Catch Per Trap Hour	Avg. Fork Length (mm)	% Taggable (over 55 mm)	Catch Other Species
Aug 21	Side Channel	9	10:40	13:45	324	36.0	11.7	55.6	24	20 Dollies 1 cutthroat
Aug 21	Main River	4	10:40	13:45	23	5.8	1.9	75.6	83	5 steelhead smolts 2 cutthroat 1 sculpin
Aug 21	Four Mile Creek	10	13:30	17:00	219	21.9	6.3	66.4	81	N.A.
Sep 5	Side Channel	10	15:00	17:10	246	24.6	11.4	54.3	31	11 Dollies 2 cutthroat
Sep 5	Four Mile Creek	15	14:30	17:40	186	12.4	3.9	75.6	82	3 Dollies 2 cutthroat 24 sculpins
	Unweighted Averages for Coho >55 mm					9.8	3.2			

SPAWNER OBSERVATIONS

River Swim

The main objective of river swims was to locate chinook salmon in preparation for an egg take. Snorklers began their search on July 23. By the second week of August it was quite apparent that there were insufficient numbers of chinook for an egg take. At that point, the priorities of the river swims changed. While it was still hoped that incoming fish would include some chinooks, more accurate counts were kept on other species in order to estimate spawning escapements. Appendix G details observations for each river swim.

Chinook

Based on previous escapement observations (Appendix F) we hoped to locate 200 to 300 adult chinooks (aged .2 and older) to provide a level of safety for an egg take (30 chinook were required for a successful egg collection). At no time, however, did actual chinook sightings number more than 12, and more often during the period of peak chinook abundance (based on previous years' records) three or less were sighted.

Maximum counts were made on August 5 and 6 when 9 were sighted in the entire system, and on August 9 when 12 were sighted in the upper river above the falls. Although the maximum sighting was only 12 chinook, and visibility was generally good, it must be assumed that the actual escapement was somewhat higher than the number actually seen. Some may have been "hidden" within larger schools of other species, some may have bypassed the swim area to spawn in the upper river, and many jacks may have passed unidentified.

The general scarcity of adult chinooks was further verified by gillnet and sport test fishing. Angling was tried on two occasions when chinooks were the primary target. On August 7 fishing was carried out in the pool at the beaver pond streams; one jack spring was captured and released. On August 9, when 12 chinooks were sighted in the upper river above the falls, fishing was attempted in several nearby pool areas with no catch. Sport fishing attempts in September and October resulted in the capture of numerous coho, but no chinook. Gillnets were used in July and August, as listed in Table 7 but resulted in no chinook captures.

The lack of chinooks may indicate that previous chinook escapement estimates were too high, or that chinook salmon stocks have been seriously depleted in recent years. In 1975, 254 sport caught chinook were taken primarily by logging camp personnel at the head of Thompson Sound, adjacent to the Kakweiken estuary, and, in 1976, 250 were taken from the same location (pers. comm., R. Scheck, Fishery Officer and D. Trudeau, Patrol-woman). In 1977 there were very few chinook caught at this location.

Table 7. Gillnet test fishing results.

Date	Location	Mesh Size	Catch
July 22	Pool below lower Kakweiken Lake	19 cm	2 male coho
30	Pool above lower Kakweiken Lake	"	nil
31	" " " " "	"	"
31	Above six-mile bridge	"	"
Aug. 1	Above lower lake	"	"
1	Six mile bridge	"	1 male coho
2	" " "	"	nil

It is possible that the sport catch in earlier years was composed mainly of transient fish, and not the Kakweiken run, since there are chinook runs into Bond Sound and Knight Inlet and since many sport caught chinook in Thompson Sound were immature and feeding on herring. However, if these fish were from the Kakweiken run, the recorded sport catch would amount to almost half the chinook escapement figures for 1975 and 1976.

Since the 1977 survey could not resolve the status of Kakweiken chinooks, except to point out that they are very scarce, it is clear that continued reconnaissance work is required on this species.

Pinks

Maximum visual sightings of pinks occurred on August 5 and 6 when 16,300 were observed between the falls and lower lake and 17,000 were observed below the falls. It was felt that this was the peak of the pink run. The field crew expanded observed numbers to spawning estimates of 35,000 and 25,000 in the upper and lower rivers respectively. Allowing for post-peak spawners, a total escapement estimate of 70-75,000 pinks was established. This estimate was supported by observations made on the September 9 helicopter survey. At this time 12,000 pinks were sighted below the falls, and 22,000 were sighted from the falls to the top of the system (Table 8), for a total count of 34,000. Approximately one half of the pinks had finished spawning and had been washed downstream by freshets prior to September 9. This was substantiated by large numbers of carcasses on the river banks. Therefore doubling the 34 thousand figure to 68,000 brings it into line with the estimate of 70-75,000 pinks based on the swim survey. This was far below the reported 800,000 spawners in 1975, but it is necessary to keep in mind that extreme flooding during late fall and winter in 1975 likely killed large numbers of eggs (pers. comm., R. Scheck).

One point must be made concerning migration of pink salmon above the obstruction (falls) 2.7 km (1.7 miles) from the estuary. The previous surveys indicated that even year pink runs do not spawn above the falls to any appreciable extent; yet odd year runs do utilize the existing fishway. For example, 15,000 of an escapement of 35,000 pinks spawned above the falls in 1965 (Anon., 1969); approximately 100,000 spawned above the falls in 1967 (no estimate of total escapement available); and based on our September 9, helicopter flight in 1977, twice as many pinks spawned above the falls than spawned below the falls. Clearly odd year runs of pinks are fully utilizing the fishway; however, further reconnaissance is required on even year pink salmon passage through the fishway.

Table 8. Pink salmon spawning estimate from helicopter on September 9, 1977.

Section	Spawner Estimates
Estuary to falls	12,000
Falls to 6 mile bridge	9,000
6 mile bridge to lower lake	4,000
Lower lake to rapids	2,000
Top of rapids to upper lake	1,000
Upper lake to end of recon.	6,000
Total	34,000

Coho-Chum-Sockeye

There were insufficient data to make escapement estimates for these three species. Coho were present, but a large body of coho had yet to arrive since loggers from the Weldwood camp reported catching many "silver-bright" coho in the lower river up to a month after the project ended. Chum salmon spawners were observed between the falls and Elbow Creek. Although some sockeye were sighted in the lower river, and 100 were observed in the extreme upper reaches, most of the run was over before the survey started.

Summer Steelhead

No steelhead were sighted by swimmers at any time in the Kakweiken system. Thus we question whether there is indeed any summer run of that species in this river system. Mr. George Reid, Senior Regional Biologist with the Provincial Fish and Wildlife Branch in Nanaimo, stated that scales sent in by a logging camp employee during the summer months were the only evidence of a possible summer run. However, these scales could have been from late spring arrivals of the winter run. For example several "silver-bright" steelhead were caught during May by our field crew - one, caught on sport gear, was 7.7 kg (17 lb.) and scale age 6_3.

General Reconnaissance

A previous reconnaissance survey provided estimates of 20,000 m^2 (24,000 yd^2) of spawning gravel below the falls, and 210,000 m^2 (250,000 yd^2) for 6 kilometres (4 mi.) of river above the falls. This survey did not include the river above Lower Kakweiken Lake. Reconnaissance carried out during the 1977 project showed that large potential spawning areas exist above the lower lake.

The 1977 estimates for usable salmon spawning area are: 26,000 m^2 (31,000 yd^2) below the falls, 107,000 m^2 (128,000 yd^2) between the falls and Lower Kakweiken Lake, 17,000 m^2 (21,000 yd^2) between Upper and Lower Kakweiken Lakes and potentially 117,000 m^2 (140,000 yd^2) or more above Upper Kakweiken Lake. Measurements and estimates by section are listed in Table 9.

New information was gathered from Lower Kakweiken Lake to a point 16 km (10 mi.) above Kakweiken Lake (Figures 18 and 19). Ground reconnaissance by boat and on foot revealed good spawning gravel and excellent salmonid rearing areas up to 5 km (3 mi.) above the upper lake (Figure 19).

Adult sockeye, pink and coho were all sighted at the upper limit of ground reconnaissance, 5 km (3 mi.) from Kakweiken Lake. This adds 5-6 km (3-4 mi.) of additional spawning grounds over estimates made during previous studies. Based on the combination of foot, boat and helicopter surveys above Lower Kakweiken Lake we estimated that at least 9,000 pink salmon and 100 sockeye spawned this far upstream.

The helicoper flight confirmed that the river valley above the upper lake widens out and includes a large number of side channels, swamps, and bogs which appear to offer excellent salmonid rearing habitat. During the flight, adult salmonids (species unknown) were sighted in the river as far as 8 km (5 mi.) above the upper lake, and the river appeared to be passable to salmonids, with good stretches of spawning gravel, as far as 16 km (10 mi.) above the upper lake. Finally, large numbers of coho and other unidentified salmonid fry were sighted on the shoreline of Kakweiken Lake, indicating that this lake may rear substantial numbers of salmonid juveniles.

Table 9. Kakweiken River estimated potential salmon spawning area from boat, foot, and helicopter surveys.

Description of River Section	Length of River Section (m)	Estimated Average Width (m)	General River-Bottom Type	Estimated % of total area usable by salmon spawners	Estimated Area usable by salmon spawners (m^2)
Estuary to end of tidal influence	670 (90)[a]	24	mud, sand, gravel	80	1728
Tidal influence to Indian graveyard	1340	20	gravel	80	21440
Graveyard to rapids	275	24	gravel, boulders	30	1980
Rapids to falls	365	21	boulders	10	767
TOTAL SPAWNER AREA BELOW FALLS	2650 (2070)[a]				25,915 (30,990 yd^2)
Falls to Ollie Lake outlet	200	21	sand, mud, gravel	30	1260
Ollie Lake outlet to Six Mile Bridge	4570	23	gravel	80	84,088
Six Mile Bridge to Lower Kakweiken Lake	1310	21	gravel	80	22,008
TOTAL, FALLS TO LOWER LAKE	6080				107,356 (128,398 yd^2)
Lower Lake to log jam	490	18	mud, gravel	30	2646
Log jam to rapids	730	18	gravel	80	10,512
Rapids area	730	15	boulders	0	0
Above rapids to Upper Kakweiken Lake outlet	450	15	gravel	60	4050
Upper Kakweiken Lake outlet	150	24	mud	0	0
TOTAL, LOWER LAKE TO UPPER LAKE	2550				17,208 (20,580 yd^2)
Upper lake to end of boat reconnaissance	2600	18	sand, mud, gravel	30	14,040
Foot reconnaissance	2000	15	gravel	70	21,000
Helicopter reconnaissance to end of spawner sightings	3400	12	gravel patches	60	24,000[b]
Helicopter reconnaissances of additional spawning potential	8000	12	gravel patches	60	57,600[b]
TOTAL, SURVEYED AREA ABOVE UPPER LAKE	16,000				116,640 (139,500 yd^2)
TOTAL, SURVEYED AREA KAKWEIKEN RIVER	27,280				267,119 (319,468 yd^2)

[a] Due to tidal waters only the upper 90 m of this section is usable for salmon spawning

[b] The figures from the helicopter flights are estimates only

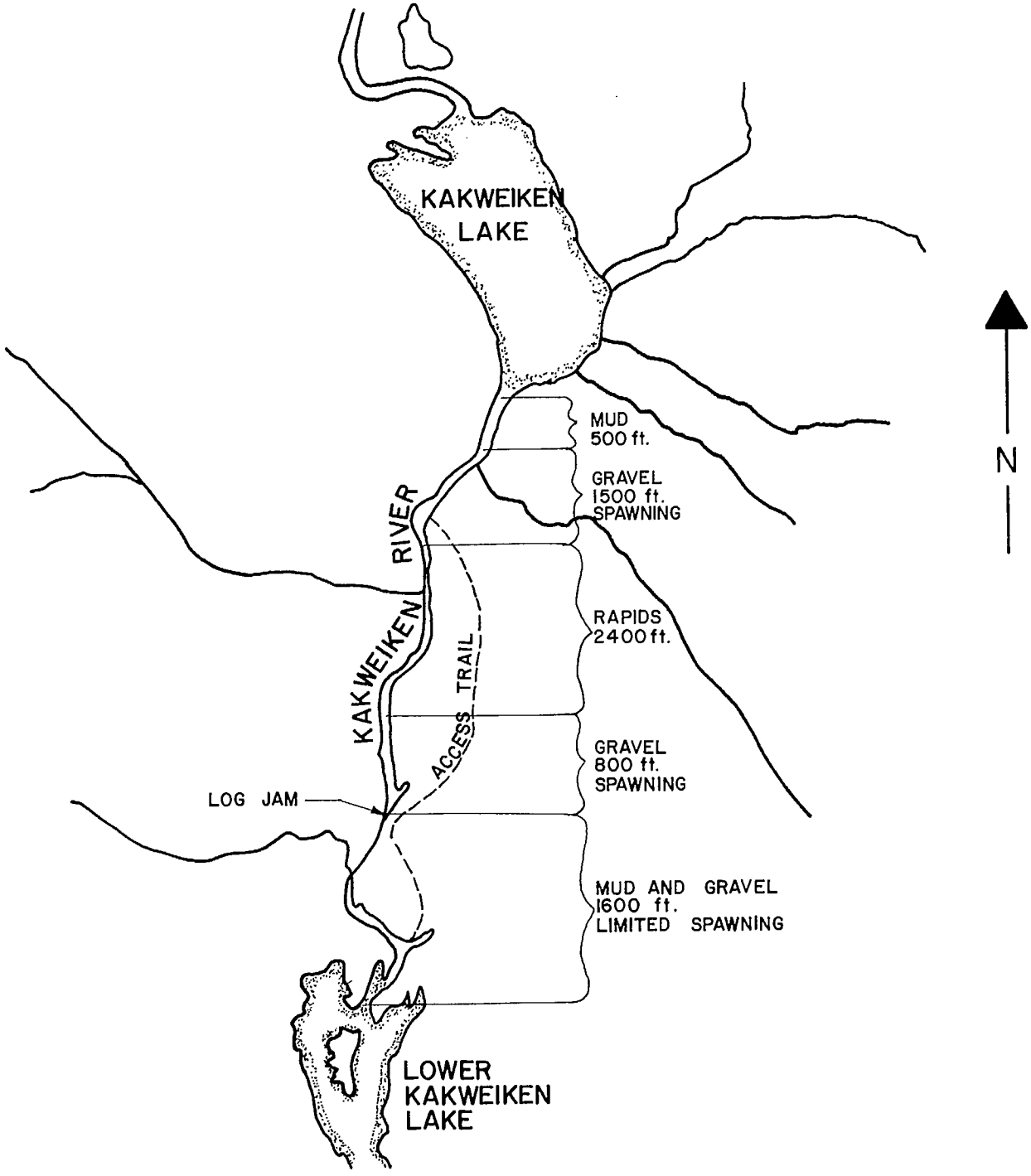

Figure 18. Ground reconnaissance of the Upper Kakweiken River.

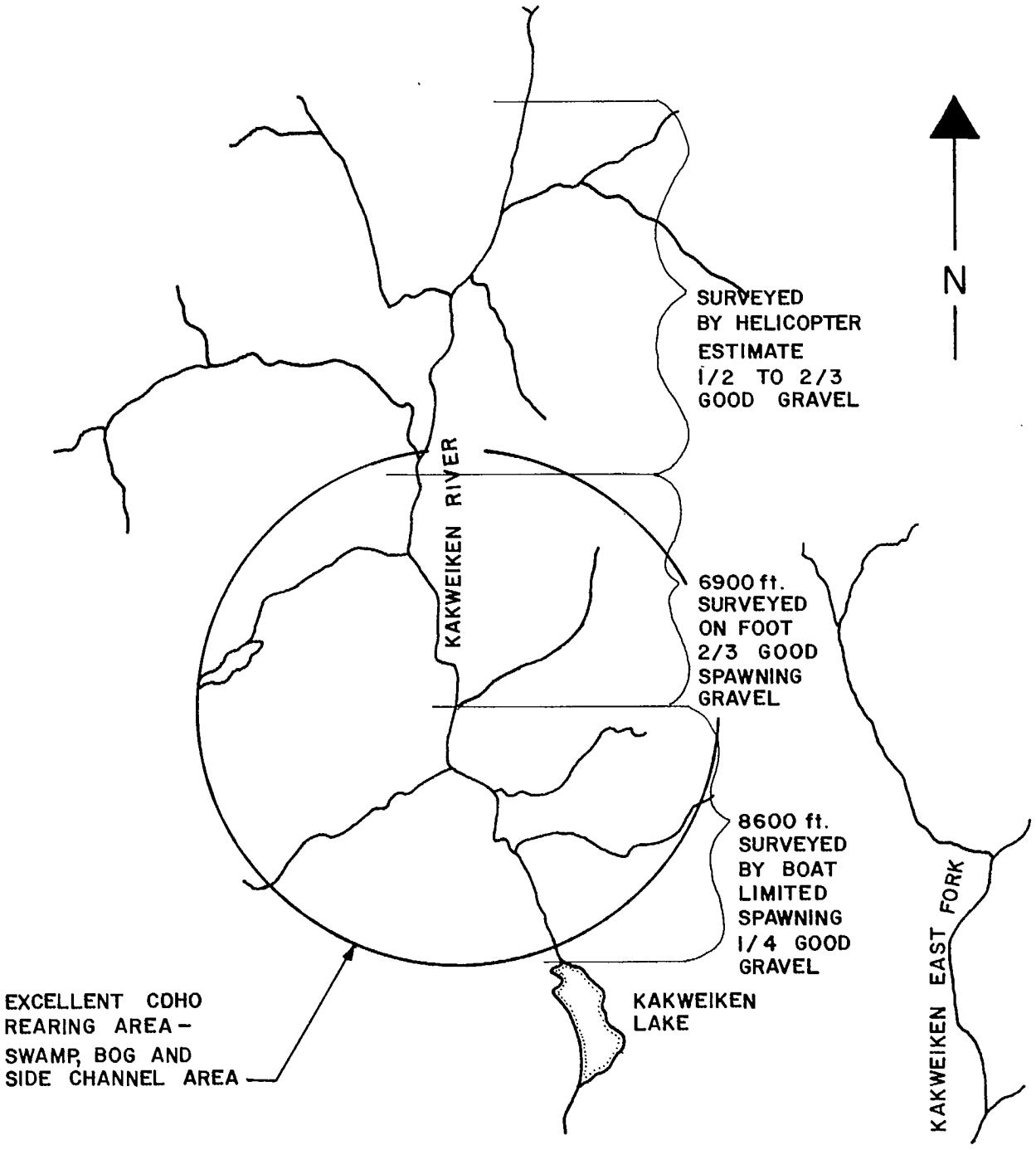

Figure 19. Ground and helicopter reconnaissance of the Upper Kakweiken River.

EGG TAKE AND ON-SITE INCUBATION

Egg-Take

When it became evident that there were insufficient chinook for an egg-take, pink salmon eggs were incubated instead to test the effectiveness of the on-site incubation facilities. Previous beach seine sets had demonstrated that pinks were easy to capture in sufficient numbers for an egg-take.

Four sets were made using the 46 x 5 m (150 x 16 ft.) heavy-leaded beach seine at a site approximately 200 m (650 ft.) downstream from the six mile bridge (Fig. 20). These sets resulted in the capture of 90 female pinks. Forty of these were spawned-out or "green" and were released. Fifty females were killed; and of these, fourteen were found to be either not fully mature or partially spawned-out. The eggs from 36 mature females were put into plastic buckets and fertilized with milt from 20 males. We stripped eggs and used the immediate-fertilization-delayed-washing technique described by Armstrong (1973). All captured males were then released. The buckets were transported to the incubation site by boat (smokercraft) and truck, and placed into hatchery incubation trays. Four trays were used with the following egg volumes (fluid ounces) in each tray: 68, 66, 84, 100 for a total of 318 fluid ounces. Based on later subsampling we estimated that there were 154 eggs per ounce for a total egg-take of 49,094, or 1,364 eggs per female.

The eggs were kept in the incubation facility until October 2. A record was kept of Fahrenheit heat units (Table 10). During the incubation period the eggs were treated for fungus with MALACHITE GREEN every two days in a 60 ml flush of 1:200,000 solution by volume, or 45 grams malachite to 15 litres of water. When cumulative heat units had exceeded 500, the eggs were eyed-out and ready for planting in the river. Total egg mortality was 2.6% (Table 11). The 48,000 eggs were then returned to the spawning bed closest to the adult capture site. A trench approximately 4 m (13 ft.) long by 0.3 m (1 ft.) deep by an average of 0.3 m (1 ft.) wide was dug while the river was partially diverted with sheets of plywood (Fig. 21). The eggs were buried in the gravel in the manner described by MacKinnon (1960). We found that placing a large rock in the trench and pouring eggs around it helped to reduce washout of eggs.

Estuary Purse Seining

Three sets were made with the department vessel MV Walker Rock on September 3. Poor catch results (Table 12) as well as no visual sightings of adult salmonids led to the suspension of estuary seining after only one day.

Figure 20. Egg take showing setting of beach seine (upper) and collecting beached females (lower).

Figure 21. Trench construction for deposition of "eyed" pink salmon eggs.

Table 10. Fahrenheit heat units during pink egg incubation.

Date	Temperature (Fahrenheit)			Daily Heat Units[a]	Cumulative Heat Units
	Morning	Afternoon	Average		
Sep 07	51	52	51.5	19.5	19.5
08	51	53	52	20	39.5
09	52	53	52.5	20.5	60
10	52.0	54.0	53	21	81
11	53.0	55.0	54	22	103
12	52.0	54.5	53.25	21.25	124.25
13	53	54	53.5	21.5	145.75
14	53	55	54	22	167.75
15	52.5	53	52.75	20.75	188.5
16	50.0	55	52.5	20.5	209.0
17	54.0	54.0	54.0	22.0	231.0
18	52.0	54.0	53.0	21.0	252.0
19	52.0	55.0	53.5	21.5	273.5
20	52.0	55.0	53.5	21.5	295.0
21	52.0	54.0	53.0	21.0	316.0
22	51.0	51.0	51.0	19.0	335.0
23	51.0	54.0	52.5	20.5	355.5
24	50.0	53.0	51.5	19.5	375.5
25	49.0	52.0	50.5	18.5	394.0
26	48.0	53.0	50.5	18.5	412.5
27	48.0	53.0	50.5	18.5	431.0
28	48.0	51.0	49.5	17.5	448.5
29	51.0	50.0	50.5	18.5	467.0
30	50.0	51.0	50.5	18.5	485.5
Oct 01	50.0	51.0	50.5	18.5	504.0

[a] Daily Heat Units = (Min. Temp. + Max. Temp./2) - 32.

Table 11. Number of pink eggs per tray and percent survival to the eyed stage of development.

	Ounces Per Tray	Eggs per Ounce	Total Eggs	Mortality	Percent Mortality	Percent Survival
Tray 1	68	146	9,928	443	4.5	95.5
Tray 2	66	159	10,494	405	3.9	96.1
Tray 3	84	158	13,272	360	2.7	97.3
Tray 4	100	154	15,400	88	0.6	99.4
Total	318	617	49,094	1,296	2.6	97.4

Table 12. Estuary purse seining set records.

Set No.	Location	Depth	Catch
1	Cleave Point	25-30 fathoms	2 chinook grilse
2	Right side estuary	35-40 fathoms	2 adult pink
			1 chinook grilse
			12 mixed juveniles
3	Mid estuary	25-30 fathoms	6 coho grilse
			1 juvenile pink
			3 herring

SUMMARY

The 1977 Kakweiken project included several parts: coho smolt trapping and coded-wire tagging; a general reconnaissance of spawning areas and salmonid distribution; and reconnaissance to establish the feasibility of an adult chinook and/or summer steelhead trout egg take and on-site incubation of eggs to the eyed-out stage. A helicopter flight over the entire system concluded the program. Major findings are summarized below:

1. 2,958 coho smolts were tagged and released (code 11/2/7) at five trapping sites over a 5-week period. Holding and immediate tagging mortality were negligible,

2. Rapid and large fluctuations in flows caused flood damage problems to fence traps resulting in much lower than anticipated coho smolt catches (target 40,000 tagged smolts),

3. Minnow trapping was successful at only one location, K-2 Swamp, where 391 coho smolts were tagged and released. Beach seining failed to produce adequate numbers of coho or chinook smolts for tagging,

4. Peak coho smolt migration occurred between May 3 and May 8; 50 percent of each fence trap's catch occurred over an 8 to 14 day period on either side of the peak,

5. Coho smolts (age 1.) from warmer Ollie Lake were significantly longer (mean fork length 92 mm) than smolts from Beaver Pond Creek #3 (81 mm) and Beaver Pond Creek #2 (80 mm). K-2 Swamp smolts averaged 71 mm at the time of tagging. Average length of all tagged smolts (both age classes) was 88 mm. Weight measurements indicated 154 coho smolts per kg (70/lb.),

6. Approximately 86% of all coho smolts were aged 1., the remainder were aged 2.; 9 chinook smolts were aged 1. and averaged 74 mm fork length,

7. Capture of sufficient age 0. coho fry over 55 mm fork length for coded-wire tagging is feasible, but based on minnow trap test fishing in August and September this type of tagging operation could be very time consuming and costly,

8. Based on river swims, ground reconnaissance and a helicopter flight, the pink salmon escapement estimate was between 70,000 and 75,000,

9. Odd year pink salmon appear to be increasing their utilization of the existing fishway at the falls; 1977 estimates showed a 2:1 ratio for spawners above and below the falls.

10. Chinook escapements were very low in 1977. No summer steelhead were observed during 14 river swims, sport test fishing and many hours of ground observation,

11. There were insufficient numbers of chinook salmon or summer run steelhead trout for an egg-take on either species; therefore, eggs were collected from pink salmon to test the incubation facility,

12. A successful incubation facility was constructed at an approximate cost of $1,400; 48,000 pink salmon eggs were successfully incubated to the eyed-out stage (2.6% mortality). The eyed eggs were replanted in the Kakweiken River,

13. Access to the upper river was provided by cutting a trail between the two lakes above the falls. Surveys above Lower Kakweiken Lake showed that there are considerable stretches of river which are not only accessible to salmon, but contain good spawning gravel (perhaps more than 134,00 m^2; 160,000 yd^2). Spawning salmonids were sighted 8 km (5 miles) above the upper lake (i.e. 6000 pinks) and it is very likely that up to 16 km (10 miles) of river above the upper lake are available for spawning. Thus 25 km (15.5 miles) of river above the falls may be accessible to spawning salmonids.

RECOMMENDATIONS

1. Further reconnaissance is necessary to document the abundance and fresh water life history of the Kakweiken chinook stock and the distribution of even year pink salmon spawners, in particular the extent of pink salmon upstream migration,

2. Trapping age 0. coho for coded-wire tagging should be tested further during September and October,

3. Completion of a permanent fishway to replace the Denil fishway is highly recommended in light of the extensive spawning area above Lower Kakweiken Lake.

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APPENDIX A

Coho Smolt Daily Catch Results

A 1. Ollie Lake Creek daily catch results

Date	Time P.S.T.	Water Temp. °C	Coho Smolts	Coho Fry	Chum Fry	Trout		Sculpin	Stickle-back	Other	Stream Flow	Remarks
						Stlhd-Rnbw	Cuthrt					
April 14	0815	7.5	7	-	-	-	-	12	1	1 Lamprey	Stable	
15	0900	6.0	17	-	-	-	-	23	-	-	Stable	
16	0815	7.0	5	-	-	-	-	34	1	-	Stable	
17	0830	7.5	6	-	-	-	-	26	2	-	Dropping	
18	0800	7.0	7	-	-	-	-	21	-	1 Lamprey	Stable	
19	0800	7.0	2	-	-	-	-	12	1	-	Stable	
20	1000	6.5	12	-	-	-	-	19	2	1 Lamprey		
										1 Dolly Varden	Stable	
21	0800	7.0	2	-	-	-	1	4	1	1 Lamprey		
										1 Frog	Dropping	
22	0745	8.0	-	-	-	-	-	-	-	-	Stable	
23	0800	-	-	-	-	-	-	-	-	-	Rising	23rd to 27th no fish due to high water. River depth has caused a reverse flow at the trap site. Trap is completely submerged.
24	0800	-	-	-	-	-	-	-	-	-	Rising	
25	0655	-	-	-	-	-	-	-	-	-	Rising	
26	0730	-	-	-	-	-	-	-	-	-	Stable	
27	0840	-	-	-	-	-	-	-	-	-	Dropping	
28	0800	9.5	207	5	-	-	6	43	1	20 Sockeye	Dropping	
29	0830	11.5	20	5	-	-	-	40	-	10 live Sockeye		*Dead sockeye - due to high turbulence in the trap.
										& 16 dead*	Stable	
30	0700	11.0	23	4	-	-	-	65	-	5 Sockeye		
										3 Frogs	Dropping	
May 1	1200	14.0	28	-	-	-	-	17	-	10 Sockeye	Stable	
2	0945	7.0	5	-	-	-	2	2	-	2 Sockeye	Rising	
3	0700	-	-	-	-	-	-	-	-	-	Rising	Heavy rain last 12 hrs. Flow is again reversed and flowing over the trap.
4	0900	10.0	111	4	-	-	3	75	-	4 Dolly Varden	Dropping	
5	1700	11.0	101	6	-	-	-	160	1	4 Sockeye		
										1 Dolly Varden	Stable	
6	0700	10.0	8	-	-	-	-	65	-	-	Stable	
7	0715	10.5	4	-	-	-	1	118	-	2 Dolly Varden	Stable	
8	0930	13.5	-	-	-	-	-	11	-	1 dead Sockeye	Rising	
9	0945	13.0	14	-	-	-	-	65	-	-	Stable	
10	0700	-	-	-	-	-	-	-	-	-	Stable	Found a hole in fence at mouth of trap, which was made yesterday when adjustments for flow were made.
11	1415	13.0	18	-	-	-	3	150	-	-	Stable	
12	0830	14.0	19	-	-	-	-	120	-	-	Stable	
13	0645	12.0	2	-	-	-	-	70	-	-	Stable	
14	0700	12.0	19	-	-	-	-	50	-	1 dead Sockeye	Stable	
15	1200	17.0	9	-	-	-	-	25	-	-	Dropping	Very little flow into box. Trough lowered.
16	0715	12.0	35	-	-	-	-	100	-	-	Stable	
17	0830	9.0	10	-	-	-	-	70	-	-	Stable	
18	0730	13.0	10	-	-	-	3	68	-	2 Dolly Varden	Stable	
19	0745	14.0	17	-	-	-	-	60	-	2 Sockeye	Stable	
20	1045	-	11	-	-	-	-	86	-	-	Stable	
21	-	-	-	-	-	-	-	-	-	-	Rising	Heavy rain. Water level up and flow reversed.
22	0730	13.0	70	-	-	-	-	53	-	1 Dolly Varden	Dropping	
23	0900	-	47	-	-	-	-	200	-	-	Dropping	
24	0955	12.0	28	-	-	-	-	90	-	-	Dropping	
25	1130	13.0	18	-	-	-	-	150	-	-	Dropping	
26	1030	13.0	10	-	-	-	-	-	-	-	Dropping	
27	0700	13.0	22	-	-	-	3	45	-	2 Dolly Varden	Stable	
28	0900	13.0	12	-	-	-	-	45	-	1 Frog	Stable	
29	-	-	10	-	-	-	-	-	-	-	Stable	
30	-	-	10	-	-	-	-	-	-	-	Stable	Trap removed.
		$\bar{x}$ = 10.7[a]										
		Total	956	24	-	-	22	2194	10	71 sockeye, 13 dolly varden, 4 lamprey, 5 frogs		

[a] Average of morning (≤ 1200 hrs) temperatures

A 2. Beaver Pond Creek #1 daily catch results

Date	Time P.S.T.	Water Temp. °C	Coho Smolts	Coho Fry	Chum Fry	Trout		Sculpin	Stickle-back	Other	Stream Flow	Remarks
						Stlhd-Rnbw	Cuthrt					
April 23	0900	-	-	-	-	-	-	-	-	-	Rising	23rd to 27th trap is in but due
24	0900	-	-	-	-	-	-	-	-	-	Rising	to heavy rain and snow melt the
25	0730	-	-	-	-	-	-	-	-	-	Stable	water level has increased to a
26	0745	-	-	-	-	-	-	-	-	-	Stable	level of submerging most of the
27	0730	-	-	-	-	-	-	-	-	-	Dropping	trap.
28	1230	8.5	69	15	-	-	1	3	-	2 Lamprey		
										2 Frogs	Dropping	
29	0900	8.5	4	3	-	-	-	3	-	1 Frog	Stable	
30	1000	7.5	65	5	-	-	-	5	1	1 Lamprey	Stable	
May 1	0805	8.0	126	20	-	-	-	3	-	-	Rising	
2	0930	7.0	26	8	-	-	4	-	-	1 Lamprey		
										2 Dolly Varden		
										2 Frogs	Rising	
3	0800	-	-	-	-	-	-	-	-	-	Rising	Heavy rain last 12 hrs. Water level up and flowing around the fence.
4	1230	7.5	35	15	-	-	-	-	-	-	Dropping	
5	1400	8.0	37	12	-	-	-	-	-	-	Stable	
6	1430	8.0	-	-	-	-	-	-	-	-	Stable	
7	1400	9.0	33	6	-	-	-	2	-	1 Dolly Varden	Stable	
8	0945	9.0	53	7	-	-	-	3	-	1 Frog		
										2 Lamprey*	Stable	*1 Lamprey was dead.
9	0715	9.0	46	6	-	-	-	3	-	1 Lamprey		
										2 Dolly Varden		
										1 Frog	Stable	
10	0800	9.0	65	7	-	-	-	-	-	1 Lamprey		
										2 Dolly Varden	Stable	
11	1155	8.0	20	5	-	-	-	2	-	3 Frogs	Stable	
12	0730	8.5	22	-	-	-	-	1	-	-	Stable	
13	0700	9.0	10	-	-	-	-	-	-	-	Stable	
14	0700	9.0	14	-	-	-	-	-	-	1 Frog	Stable	
15	1300	9.0	10	-	-	-	-	-	-	-	Dropping	
16	0700	-	30	5	-	-	3	-	-	10 Dolly Varden	Stable	
17	0830	9.0	5	-	-	-	-	-	-	3 Frogs	Stable	
18	0840	8.5	32	-	-	-	-	1	-	1 Frog	Stable	
19	0800	10.0	8	8	-	-	-	1	-	3 Frogs	Stable	
20	0830	10.0	6	-	-	-	-	-	-	1 Lamprey		
										3 Frogs	Rising	
21	-	-	-	-	-	-	-	-	-	-	Rising	Heavy rain, trap overflowing.
22	0755	8.0	25	-	-	-	-	-	-	-	Dropping	
23	0800	8.5	28	6	-	-	-	-	-	-	Dropping	
24	0800	8.5	-	-	-	-	-	-	-	-	Dropping	No flow into trap.
25	1055	8.5	4	-	-	-	-	4	-	-	Stable	Still no flow.
26	1100	8.5	25	-	-	-	1	-	-	1 Frog	Rising	
27	0700	8.0	20	-	-	-	-	-	-	-	Stable	Trap taken out.
		$\bar{x}$ = 8.6[a]										
		Total	818	128	-	-	9	31	1	17 dolly varden 9 lamprey 22 frogs		

[a] Average of morning (≤ 1200 hrs) temperatures

A 3. Beaver Pond Creek #2 daily catch results

Date	Time P.S.T.	Water Temp. °C	Coho Smolts	Coho Fry	Chum Fry	Trout		Sculpin	Stickle-back	Other	Stream Flow	Remarks
						Stlhd-Rnbw	Cuthrt					
April 23	1100	8.0	42	5	-	-	-	-	-	1 Dolly Varden	Rising	
24	0930	5.5	11	3	-	-	3	-	-	2 Dolly Varden	Rising	
25	0800	6.0	3	3	-	-	1	-	-	1 Dolly Varden	Stable	Trap is not in full effect as some flow is bypassing it.
26	0800	6.5	5	-	-	-	-	-	-	1 Lamprey	Stable	
27	0745	5.0	8	-	-	-	1	-	-	-	Dropping	Water down. Trap is fishing to full extent.
28	0915	5.0	15	13	-	-	2	-	-	1 Dolly Varden	Stable	
29	0915	6.5	4	12	-	-	12	-	-	-	Stable	
30	0820	5.5	11	6	-	-	4	-	-	1 Lamprey		
										6 Dolly Varden	Stable	
May 1	0830	5.5	48	16	-	-	6	-	-	1 Lamprey		
										2 Dolly Varden	Stable	
2	0830	9.0	37	2	-	-	-	-	-	-	Rising	
3	0830	-	-	-	-	-	-	-	-	-	Rising	Trap washed out. Repairable when water drops.
4	-	-	-	-	-	-	-	-	-	-	Dropping	
5	0930	-	-	-	-	-	-	-	-	-	Stable	
6	0930	6.0	9	15	-	-	4	-	-	1 Dolly Varden	Stable	Trap is repaired and fishing.
7	1030	7.0	92	12	-	-	4	-	-	1 Dolly Varden	Stable	
8	1015	7.0	22	15	-	-	11	-	-	6 Dolly Varden	Stable	
9	0730	6.0	22	12	-	-	12	-	-	21 Dolly Varden	Stable	
10	0900	6.0	14	28	-	-	11	-	-	1 Lamprey		
										3 Dolly Varden	Stable	
11	0730	5.0	10	18	-	-	-	-	-	2 Dolly Varden	Stable	
12	0800	5.5	11	-	-	-	1	-	-	1 Dolly Varden	Dropping	
13	0730	6.0	7	6	-	-	2	-	-	1 Lamprey		
										2 Dolly Varden	Dropping	
14	0730	6.0	3	6	-	-	1	-	-	2 Dolly Varden	Stable	
15	1300	8.0	4	10	-	-	1	-	-	1 Dolly Varden	Stable	
16	0715	-	4	-	-	-	-	-	-	1 Dolly Varden	Stable	
17	0900	8.0	30	40	-	-	3	-	-	5 Dolly Varden	Stable	
18	0850	6.0	33	1	-	-	9	-	-	1 Dolly Varden	Stable	
19	0815	8.0	31	15	-	-	-	1	-	8 Dolly Varden	Stable	
20	0900	8.0	18	-	-	-	3	-	-	5 Dolly Varden	Rising	
21	-	-	-	-	-	-	-	-	-	-	Rising	Heavy rain. Trap is over-flowing.
22	-	-	-	-	-	-	-	-	-	-	Dropping	
23	0815	6.0	16	10	-	-	4	-	-	3 Dolly Varden	Dropping	
24	0800	6.0	26	-	-	-	2	-	-	4 Dolly Varden	Dropping	
25	1100	7.0	23	2	-	-	3	-	-	1 Lamprey	Rising	
26	1115	6.0	2	-	-	-	4	-	-	-	Rising	Trap overflowing again.
27	0830	6.0	12	-	-	-	-	-	-	-	Dropping	Trap removed.
		$\bar{x}$ = 6.4[a]										
		Total	573	250	-	-	104	1	-	80 dolly varden 6 lamprey		

[a] Average of morning (≤ 1200 hrs) temperatures

A 4. Beaver Pond Creek #3 daily catch results

Date	Time P.S.T.	Water Temp. °C	Coho Smolts	Coho Fry	Chum Fry	Trout		Sculpin	Stickle-back	Other	Stream Flow	Remarks
						Stlhd-Rnbw	Cuthrt					
April 23	1130	11.0	53	28	-	-	2	-	-	3 Dolly Varden		
										2 Frogs	Rising	
24	1030	9.0	9	2	-	-	-	1	-	2 Dolly Varden	Stable	
25	0830	9.5	17	9	-	-	-	-	-	1 Dolly Varden	Stable	
26	0830	10.0	82	21	-	-	-	-	-	2 Dolly Varden		
										3 Frogs	Stable	
27	0800	9.0	42	3	-	-	-	-	-	-	Stable	The variation of flow in this trap is almost nil.
28	1000	8.0	17	8	-	-	-	-	-	-	Stable	
29	1045	9.5	13	6	-	-	-	-	-	-	Stable	
30	0900	8.5	35	12	-	-	-	-	-	-	Stable	
May 1	0900	8.5	30	6	-	-	-	1	-	-	Stable	
2	0900	10.0	76	10	-	-	-	-	-	-	Stable	
3	0930	9.5	112	20	-	-	6	-	-	6 Dolly Varden		
										1 Frog	Rising	Heavy rain last 12 hrs. Level up only a couple inches.
4	1430	9.5	108	18	-	-	-	-	-	-	Stable	
5	1030	9.5	63	20	-	-	-	-	-	-	Stable	
6	0830	8.0	40	16	-	-	-	-	-	3 Dolly Varden	Stable	
7	1045	9.0	55	16	-	-	-	-	-	-	Stable	
8	1030	9.5	43	9	-	-	-	-	-	1 dead Dolly Varden	Stable	
9	0800	9.0	40	14	-	-	-	-	-	3 Dolly Varden	Stable	
10	0830	9.5	23	26	-	-	-	-	-	-	Stable	
11	0830	8.5	5	-	-	-	-	-	-	-	Stable	
12	0815	9.5	8	1	-	-	-	-	-	-	Stable	
13	0800	9.0	1	-	-	-	-	-	-	-	Stable	
14	0730	9.5	1	1	-	-	-	-	-	-	Stable	
15	1315	10.0	-	-	-	-	1	-	-	1 Dolly Varden	Stable	
16	0730	-	2	-	-	-	-	-	-	2 Dolly Varden	Stable	
17	0915	10.5	3	-	-	-	-	-	-	1 Dolly Varden	Stable	
18	0900	9.0	-	1	-	-	1	-	-	2 Dolly Varden	Stable	
19	0825	10.0	2	-	-	-	-	-	-	-	Stable	
20	0930	11.0	5	-	-	-	-	-	-	-	Stable	
21	0830	10.0	4	-	-	-	2	-	-	-	Stable	
22	0910	10.0	15	-	1 dead	-	-	-	-	-	Stable	
23	0825	10.0	-	-	-	-	-	-	-	-	Stable	
24	0825	10.0	3	-	-	-	-	-	-	-	Stable	
25	1110	9.5	3	-	-	-	-	-	-	-	Stable	
26	1130	9.0	2	-	-	-	4	-	-	-	Stable	
27	0845	9.0	-	-	-	-	-	-	-	-	Stable	
28th to 30th		-	-	-	-	-	-	-	-	-	Stable	Trap removed May 31st.
		$\bar{x}$ = 9.4[a]										
		Total	912	247	1	-	16	2	-	27 dolly varden 6 frogs		

[a] Average of morning (≤ 1200 hrs) temperatures.

A 5. K-4 Mile Creek daily catch results

Date	Time P.S.T.	Water Temp. °C	Coho Smolts	Coho Fry	Chum Fry	Trout		Sculpin	Stickle-back	Other	Stream Flow	Remarks
						Stlhd-Rnbw	Cuthrt					
April 17	0900	3.0	2	-	-	-	-	-	-	-	Dropping	
18	0815	3.0	0	-	-	-	-	-	-	2 Dolly Varden	Stable	
19	0815	3.0	1	-	-	-	-	-	-	-	Stable	
20	1015	3.0	15	-	-	-	-	-	-	-	Stable	
21	0830	3.5	10	-	-	-	-	-	-	-	Stable	
22	-	-	-	-	-	-	-	-	-	-	Rising	Heavy rain last 12 hrs. Half the trap was washed out.
23	-	-	-	-	-	-	-	-	-	-	Rising	
24	-	-	-	-	-	-	-	-	-	-	Stable	
25	-	-	-	-	-	-	-	-	-	-	Stable	
26	-	-	-	-	-	-	-	-	-	-	Rising	
27	-	-	-	-	-	-	-	-	-	-	Dropping	
28	-	-	-	-	-	-	-	-	-	-	Dropping	
29	-	-	-	-	-	-	-	-	-	-	Stable	Water level down, trap repaired.
30	0730	4.5	8*	-	-	-	-	-	-	-	Stable	*All smolts were very dark.
May 1	0745	5.0	2	-	-	-	-	-	-	-	Rising	Trap undermined.
2	-	-	-	-	-	-	-	-	-	-	Rising	Holding boxes flooded.
3	-	-	-	-	-	-	-	-	-	-	Rising	Trap flooded over.
4	-	-	-	-	-	-	-	-	-	-	Rising	Trap washed out again.
5	-	-	-	-	-	-	-	-	-	-	Rising	Trap is out. Reluctant to
6	-	-	-	-	-	-	-	-	-	-	Stable	repair as forecast is for
7	-	-	-	-	-	-	-	-	-	-	Stable	more rain (5th to 16th).
8	-	-	-	-	-	-	-	-	-	-	Stable	
9	-	-	-	-	-	-	-	-	-	-	Stable	
10	-	-	-	-	-	-	-	-	-	-	Stable	
11	-	-	-	-	-	-	-	-	-	-	Stable	
12	-	-	-	-	-	-	-	-	-	-	Dropping	
13	-	-	-	-	-	-	-	-	-	-	Dropping	
14	-	-	-	-	-	-	-	-	-	-	Dropping	
15	-	-	-	-	-	-	-	-	-	-	Stable	
16	-	-	-	-	-	-	-	-	-	-	Stable	Trap repaired.
17	0900	9.0	10	-	-	-	-	-	-	-	Stable	
18	0800	-	28	-	-	-	2	-	-	-	Stable	
19	0955	6.5	7	-	-	-	-	-	-	-	Stable	
20	1030	8.0	25	-	-	-	4	86	-	1 Dolly Varden	Stable	
21	-	-	-	-	-	-	-	-	-	-	Rising	Heavy rain overnight. Trap flooded and removed.

APPENDIX B

COHO SMOLT TAGGING DATA

Coho smolt tagging data

Location	Date	Lot #	Holding Time	Total # Tagged	Code	Mortality at Tagging	Mortality After Holding Period	Tag Loss After Holding Period	Number Retagged	Released Clipped/No Tag	Natural Missing Adipose	Corrected Tag Total Released	Remarks
Ollie Lake	May 3	1	24 hours	364	11/2/7	1	0	7.9%	20	9	0	354	
	May 11	2	24	153	11/2/7	0	18	3.3%	5	0	0	135	
	May 28	3	24	303	11/2/7	0	4	4.35%	7	6	0	293	67 released too small, 2 one eye injured
Beaver Pond #1	May 4	1	24	226	11/2/7	0	0	5.8%	13	0	0	226	35 too small
	11	2	24	225	11/2/7	0	0	3.1%	0	7	0	218	
	27	3	24	156	11/2/7	0	1	4.5%	7	0	0	155	80 too small
Beaver Pond #2	May 5	1	24	156	11/2/7	0	0	4.5%	6	1	0	155	
	11	2	24	69	11/2/7	0	0	3.2%	0	2	1	67	
	27	3	24	106	11/2/7	0	0	2.9%	3	0	0	106	over 100 too small
Beaver Pond #3	May 5	1	24	687	11/2/7	3	3	3.8%	4	22	0	659	
	11	2	24	166	11/2/7	0	0	3.0%	0	5	0	161	
	27	3	24	38	11/2/7	0	0	2.6%	1	0	0	38	10 too small
K-2 Swamp	May 28	1	24	395	11/2/7	0	4	2.3%	9	0	0	391	over 80 too small, 2 one eye injured
Total				3044		4	30		75	52	1	2958	

APPENDIX C

LENGTH FREQUENCY DISTRIBUTIONS OF TRAPPED JUVENILE SALMON

C 1. Length Distribution by Age and Tagging Lot - Coho - Ollie Lake, 1977

Tagging Lot	May 2			May 11			May 19			Total (unweighted)		
Age	Total	1.	2.	Total	1.	2.	Total	1.	2.	Total	1.	2.
Length												
51 - 55 mm	-	-	-	-	-	-	-	-	-	-	-	-
56 - 60	-	-	-	-	-	-	-	-	-	-	-	-
61 - 65	1	1	-	-	-	-	-	-	-	1	1	-
66 - 70	-	-	-	1	-	-	-	-	-	1	-	-
71 - 75	-	-	-	2	1	-	2	2	-	4	3	-
76 - 80	-	-	-	-	-	-	2	2	-	2	2	-
81 - 85	9	7	-	6	6	-	9	5	2	24	18	2
86 - 90	3	2	-	6	4	2	16	14	-	25	20	2
91 - 95	5	5	-	10	6	2	5	4	-	20	15	2
96 - 100	3	-	1	12	5	3	12	7	2	27	12	6
101 - 105	8	5	-	4	1	2	5	1	2	17	7	4
106 - 110	3	1	1	2	1	1	6	2	3	11	4	5
111 - 115	2	1	-	4	2	1	8	-	5	14	3	6
116 - 120	3	-	1	2	-	1	3	1	1	8	1	2
121 - 125	-	-	-	1	-	-	7	-	3	8	-	3
126 - 130	1	-	-	-	-	1	1	-	-	2	-	1
N	38	22	3	50	26	12	76	38	18	164	86	33
$\bar{x}$	97	92	108	96	93	101	99	91	108	98	92	106
S.D.	13.1	11.1	9.0	11.4	9.5	9.4	13.9	9.6	11.3	13.0	9.9	10.8

WEIGHTED TOTALS[a]

	TOTAL	AGE 1.
N	782	603
$\bar{x}$	98	92
S.D.	13.2	10.4

[a] Weighted means and standard deviations were calculated by substituting the number of smolts caught and tagged in each sampling period for the number of smolts measured in each subsample. Weighted totals "N" refer to total smolts and total calculated age 1. smolts tagged at each site. (See Table 4, Appendix Table B).

C 2. Length Distribution by Age and Tagging Lot - Coho - Beaver Pond #1, 1977

Tagging Lot	May 4			May 11			May 19			Total (unweighted)		
Age	Total	1.	2.	Total	1.	2.	Total	1.	2.	Total	1.	2.
Length												
51 - 55 mm	-	-	-	-	-	-	-	-	-	-	-	-
56 - 60	-	-	-	-	-	-	-	-	-	-	-	-
61 - 65	-	-	-	-	-	-	-	-	-	-	-	-
66 - 70	-	-	-	2	1	-	3	3	-	5	4	-
71 - 75	2	2	-	1	1	-	3	2	-	6	5	-
76 - 80	2	2	-	10	8	-	5	5	-	17	15	-
81 - 85	9	3	3	6	4	1	4	3	-	19	10	4
86 - 90	3	1	-	9	7	1	20	14	-	32	22	1
91 - 95	14	11	2	12	5	2	10	7	2	36	23	6
96 - 100	7	4	3	6	3	2	4	2	-	17	9	5
101 - 105	6	5	-	3	-	2	1	-	1	10	5	3
106 - 110	3	1	1	1	-	1	-	-	-	4	1	2
111 - 115	3	2	-	-	-	-	-	-	-	3	2	-
116 - 120	-	-	-	-	-	-	-	-	-	-	-	-
121 - 125	-	-	-	-	-	-	-	-	-	-	-	-
126 - 130	-	-	-	-	-	-	-	-	-	-	-	-
N	49	31	9	50	29	9	50	36	3	149	96	21
$\bar{x}$	93	93	93	88	85	97	87	86	96	89	88	95
S.D.	10.1	10.2	9.5	9.6	8.3	9.0	8.2	8.3	5.3	9.7	9.6	8.6

WEIGHTED TOTALS [a]		
	TOTAL	1.
N	599	484
$\bar{X}$	90	88
S.D.	98	9.7

[a] Weighted means and standard deviations were calculated by substituting the number of smolts caught and tagged in each sampling period for the number of smolts measured in each subsample. Weighted totals "N" refer to total smolts and total calculated age 1. smolts tagged at each site. (See Table 4, AppendixTable B).

C 3. Length Distribution by Age and Tagging Lot - Coho - Beaver Pond #2, 1977

Tagging Lot	May 4			May 11			May 19			Total (unweighted)		
Age	Total	1.	2.	Total	1.	2.	Total	1.	2.	Total	1.	2.
Length												
51 - 55 mm	-	-	-	-	-	-	2	2	-	2	2	-
56 - 60	1	-	-	1	1	-	4	4	-	6	5	-
61 - 65	-	-	-	-	-	-	14	14	-	14	14	-
66 - 70	3	3	-	7	7	-	6	6	-	16	16	-
71 - 75	4	3	-	3	3	-	7	6	-	14	12	-
76 - 80	3	2	-	2	-	-	2	2	-	7	4	-
81 - 85	3	2	-	6	4	-	5	3	1	14	9	1
86 - 90	7	4	-	11	6	3	2	2	-	20	12	3
91 - 95	6	3	1	4	1	-	4	2	2	14	6	3
96 - 100	14	7	5	8	3	3	3	2	-	25	12	8
101 - 105	6	3	1	5	-	1	1	-	-	12	3	2
106 - 110	1	1	-	1	-	1	-	-	-	2	1	1
111 - 115	1	-	-	2	-	2	-	-	-	3	-	2
116 - 120	-	-	-	-	-	-	-	-	-	-	-	-
121 - 125	2	-	2	-	-	-	-	-	-	2	-	2
126 - 130	-	-	-	-	-	-	-	-	-	-	-	-
N	51	28	9	50	25	10	50	43	3	151	96	22
$\bar{x}$	92	88	104	87	80	99	73	71	90	84	78	100
S.D.	13.7	12.0	11.8	13.0	11.2	10.1	12.8	11.3	4.6	15.3	13.6	11.0

WEIGHTED TOTAL[a]		
	TOTAL	AGE 1.
N	328	264
$\bar{X}$	85	80
S.D.	15.7	13.9

[a] Weighted means and standard deviations were calculated by substituting the number of smolts caught and tagged in each sampling period fot the number of smolts measured in each subsample. Weighted totals "N" refer to total smolts and total calculated age 1. smolts tagged at each site. (See Table 4, Appendix Table B).

C 4. Length Distribution by Age and Tagging Lot - Coho - Beaver Pond #3, 1977

Tagging Lot	May 5			May 11			Total unweighted		
Age	Total	1.	2.	Total	1.	2.	Total	1.	2.
Length									
46 - 50 mm	-	-	-	1	-	-	1	-	-
51 - 55	-	-	-	-	-	-	-	-	-
56 - 60	-	-	-	-	-	-	-	-	-
61 - 65	1	1	-	2	1	-	3	2	-
66 - 70	4	2	-	6	4	-	10	6	-
71 - 75	16	14	-	8	5	-	24	19	-
76 - 80	13	10	1	9	8	-	22	18	1
81 - 85	17	12	-	9	5	-	26	17	-
86 - 90	10	8	-	5	4	-	15	12	-
91 - 95	17	7	-	6	1	-	23	8	-
96 - 100	7	4	-	-	-	-	7	4	-
101 - 105	6	1	1	2	1	-	8	2	1
106 - 110	2	1	1	-	-	-	2	-	-
111 - 115	4	1	1	2	-	1	6	1	2
116 - 120	2	-	-	-	-	-	2	-	-
121 - 125	1	-	-	-	-	-	1	-	-
126 - 130	-	-	-	-	-	-	-	-	-
N	100	60	3	50	29	1	150	89	4
$\bar{x}$	87	82	97	81	79	111	85	81	101
S.D.	12.6	9.9	14.7	12.0	8.6	-	12.7	9.6	13.9

WEIGHTED TOTALS[a]

	TOTAL	AGE 1
N	858	819
$\bar{x}$	86	81
S.D.	12.7	9.7

[a] Weighted means and standard deviations were calculated by substituting the number of smolts caught and tagged in each sampling period for the number of smolts measured in each subsample. Weighted totals "N" refer to total smolts and total calculated age 1. smolts tagged at each site. (See Table 4, Appendix Table B)

C 5. Length Distribution by Age - Coho - K2 Mile Swamp

Tagging Lot	May 27			
Age	Total	0.	1.	2.
Length				
46 - 50 mm	2	1	-	-
51 - 55	1	1	-	-
56 - 60	9	-	9	-
61 - 65	28	-	26	-
66 - 70	12	-	12	-
71 - 75	21	-	20	-
76 - 80	8	-	8	-
81 - 85	6	-	6	-
86 - 90	4	-	3	-
91 - 95	5	-	5	-
96 - 100	2	-	-	1
101 - 105	1	-	-	1
106 - 110	-	-	-	-
111 - 115	-	-	-	-
116 - 120	-	-	-	-
121 - 125	-	-	-	-
126 - 130	1	-	-	1
N	100	2	88	3
$\bar{x}$	71	50	71	110
S.D.	12.5	3.5	9.3	17.0

WEIGHTED COMBINED TOTAL OF ALL TAGGED COHO, ALL SITES

	TOTAL	AGE 1
N	2958	2548
$\bar{X}$	88	83
S.D.	15.0	12.4

C 6. Length Distribution by Age - Coho - K-4 Mile Creek

Tagging Lot	May 19		
Age	Total	1.	2.
Length			
51 - 55 mm	1	1	-
56 - 60	2	1	-
61 - 65	1	1	-
66 - 70	8	7	-
71 - 75	3	3	-
76 - 80	6	5	-
81 - 85	7	7	-
86 - 90	5	4	-
91 - 95	1	-	-
96 - 100	3	3	-
101 - 105	2	-	-
106 - 110	3	-	2
111 - 115	-	-	-
116 - 120	1	-	-
121 - 125	-	-	-
126 - 130	-	-	-
N	43	32	2
$\bar{x}$	82	77	110
S.D.	15.2	11.1	0.71

C 7. Length Distribution by Age and Sampling Date - Coho

	Kakweiken Main River						Kakweiken Estuary		
Sampling Date	May 20		May 25		Total		May 25		
Age	Total	1.	Total	1.	Total	1.	Total	1.	2.
Length									
51 - 55 mm	-	-	2	2	2	2	-	-	-
56 - 60	2	2	3	3	5	5	-	2	-
61 - 65	5	5	5	5	10	10	-	1	-
66 - 70	2	-	3	2	5	2	1	2	-
71 - 75	5	5	-	-	5	5	-	4	-
76 - 80	-	-	-	-	-	-	-	3	-
81 - 85	1	1	1	1	2	2	-	4	1
86 - 90	-	-	-	-	-	-	-	1	-
91 - 95	-	-	-	-	-	-	-	2	-
96 - 100	-	-	-	-	-	-	-	-	1
101 - 105	-	-	-	-	-	-	-	-	-
106 - 110	-	-	-	-	-	-	-	-	-
111 - 115	-	-	-	-	-	-	-	-	-
116 - 120	-	-	-	-	-	-	-	-	-
121 - 125	-	-	-	-	-	-	-	-	-
126 - 130	-	-	-	-	-	-	-	-	-
N	15	13	14	13	29	26	22	19	2
$\bar{x}$	67	67	63	62	65	65	77	76	90
S.D.	5.8	6.3	7.0	7.0	6.7	7.0	10.9	10.4	9.2

C 8. Length Distribution by Age and Sampling Date
Chinook - Kakweiken Main River

Sampling Date	May 20		May 25		Total	
Age	Total	1.	Total	1.	Total	1.
Length						
36 - 40 mm	-	-	-	-	-	-
41 - 45	2	-	-	-	2	-
46 - 50	5	-	-	-	5	-
51 - 55	2	-	-	-	2	-
56 - 60	-	-	-	-	-	-
61 - 65	1	1	-	-	1	1
66 - 70	1	1	1	1	2	2
71 - 75	3	3	-	-	3	3
76 - 80	1	1	-	-	1	1
81 - 85	1	1	-	-	1	1
86 - 90	1	1	-	-	1	1
N	17	8	1	1	18	9
x	60	75	68	68	61	74
S.D.	15.0	7.8	-	-	14.6	7.6

C 9. Length Distribution by Age - Sockeye

	Kakweiken Estuary			Kakweiken Main River		
Sampling Date	May 25			May 25		
Age	Total	1.	2.	Total	1.	2.
Length						
56 - 60 mm	-	-	-	-	-	-
61 - 65	2	2	-	1	1	-
66 - 70	12	10	2	3	3	-
71 - 75	6	5	1	2	2	-
76 - 80	3	2	1	2	1	1
81 - 85	2	-	2	-	-	-
86 - 90	-	-	-	-	-	-
91 - 95	-	-	-	-	-	-
96 - 100	1	1	-	-	-	-
101 - 105	-	-	-	1	-	1
106 - 110	-	-	-	-	-	-
N	26	20	6	9	7	2
x	72	71	76	75	70	90
S.D.	7.7	7.9	6.4	10.9	4.2	15.6

C 10. Kakweiken River Minnow-Trapped Coho Fry Length Frequency Distribution

	SIDE CHANNEL		MAIN STEM	FOUR MILE CREEK	
	Aug.21	Sept.5	Aug.21	Aug.21	Sept.5
41 - 45	14	9		1	
46 - 50	10	21	2	2	5
54 - 55	12	23	2	12	6
56 - 60	2	10	2	6	13
61 - 65	1	7	2	6	10
66 - 70	1	1	1	2	6
71 - 75	3	2	1		4
76 - 80	2	1	1		
81 - 85	6	2	5	1	4
86 - 90		1	1	1	4
91 - 95			3	3	4
96 - 100			3		1
101 - 105				2	1
106 - 110					3
111 - 115				1	1
116 - 120				1	
N	51	77	23	38	62
$\bar{x}$	55.65	54.30	75.61	66.42	69.94
S.D	13.80	9.54	17.05	19.63	17.52
N 60 mm	13	14	17	17	38
% 60 mm	25	18	74	45	61

APPENDIX D

WEIGHT FREQUENCY DISTRIBUTIONS OF TRAPPED JUVENILE SALMON

D 1. Weight Distribution by Age and Tagging Lot - Coho - Ollie Lake, 1977

Tagging Lot	May 2			May 11			May 19			Total(unweighted)		
Age	Total	1.	2.	Total	1.	2.	Total	1.	2.	Total	1.	2.
Weight												
3.0 - 4.9 g	2	1	-	3	1	-	4	4	-	9	6	-
5.0 - 6.9	12	10	-	7	7	-	21	14	2	40	31	2
7.0 - 8.9	7	4	1	24	10	7	18	13	3	49	27	11
9.0 - 10.9	11	6	1	7	5	2	10	4	2	28	15	5
11.0 - 12.9	2	-	-	3	2	1	8	2	4	13	4	5
13.0 - 14.9	2	-	1	4	1	1	5	-	3	11	1	5
15.0 - 16.9	1	-	-	1	-	1	6	1	3	8	1	4
17.0 - 18.9	-	-	-	-	-	-	3	-	1	3	-	1
19.0 - 20.9	-	-	-	1	-	-	1	-	-	2	-	-
N	37	21	3	50	26	12	76	38	18	163	85	33
$\bar{x}$	8.4	7.2	11.2	8.8	8.1	9.8	9.5	7.5	11.7	9.0	7.6	11.0
S.D.	2.81	1.65	3.06	2.92	2.02	2.59	3.86	2.33	3.58	3.38	2.09	3.25

WEIGHTED TOTAL[a]		
	TOTAL	AGE 1.
N	782	603
$\bar{X}$	8.9	7.4
S.D.	3.29	1.98

a Weighted means and standard deviations were calculated by substituting the number of smolts caught and tagged in each sampling period for the number of smolts measured in each subsample. Weighted totals "N" refer to total smolts and total calculated age 1.smolts tagged at each site. (See Table 4, Appendix Table B).

D 2. Weight Distribution by Age and Tagging Lot - Coho - Beaver Pond #1, 1977

Tagging Lot	May 4			May 11			May 19			Total (unweighted)		
Age	Total	1.	2.	Total	1.	2.	Total	1.	2.	Total	1.	2.
Weight												
1.0 - 2.9 g	1	1	-	1	1	-	1	1	-	3	3	-
3.0 - 4.9	10	7	2	14	11	-	11	9	-	35	27	2
5.0 - 6.9	15	9	3	17	11	2	25	17	1	57	37	6
7.0 - 8.9	15	10	3	12	6	3	10	7	1	37	22	7
9.0 - 10.9	5	3	1	4	-	2	3	2	1	12	5	4
11.0 - 12.9	3	1	-	2	-	2	-	-	-	5	1	2
N	49	31	9	50	29	9	50	36	3	149	96	21
$\bar{x}$	6.8	6.6	6.6	6.3	5.4	8.7	6.2	6.0	8.2	6.4	6.0	7.7
S.D.	2.35	2.38	2.05	2.18	1.73	2.17	1.64	1.65	1.39	2.08	1.98	2.19

WEIGHTED TOTAL[a]		
	TOTAL	1.
N	599	484
$\bar{X}$	6.2	6.0
S.D.	1.64	2.03

a Weighted means and standard deviations were calculated by substituting the number of smolts caught and tagged in each sampling period for the number of smolts measured in each subsample. Weighted totals "N" refer to total smolts and total calculated age 1. smolts tagged at each site. (See Table 4, Appendix Table B).

D 3. Weight Distribution by Age and Tagging Lot - Coho - Beaver Pond #2, 1977

Tagging Lot	May 4			May 11			May 19			Total (unweighted)		
Age	Total	1.	2.	Total	1.	2.	Total	1.	2.	Total	1.	2.
Weight												
1.0 - 2.9 g	1	1	-	1	1	-	25	25	-	27	27	-
3.0 - 4.9	12	9	-	14	11	-	12	11	-	38	31	-
5.0 - 6.9	8	4	-	15	9	3	8	5	2	31	18	5
7.0 - 8.9	20	11	5	11	4	2	4	2	1	35	17	8
9.0 - 10.9	7	3	2	7	-	3	1	-	-	15	3	5
11.0 - 12.9	-	-	-	2	-	2	-	-	-	2	-	2
13.0 - 14.9	1	-	-	-	-	-	-	-	-	1	-	-
15.0 - 16.9	1	-	1	-	-	-	-	-	-	1	-	1
17.0 - 18.9	1	-	1	-	-	-	-	-	-	1	-	1
N	51	28	9	50	25	10	50	43	3	151	96	22
$\bar{x}$	7.3	6.3	10.4	6.4	5.0	8.7	3.9	3.4	6.3	5.9	4.7	9.1
S.D.	3.05	2.23	3.81	2.50	1.75	2.39	2.05	1.76	0.95	2.94	2.25	3.16

WEIGHTED TOTAL[2]		
	TOTAL	1.
N	328	264
$\bar{X}$	6.0	5.0
S.D.	3.04	2.37

a Weighted means and standard deviations were calculated by substituting the number of smolts caught and tagged in each sampling period for the number of smolts measured in each subsample. Weighted totals "N" refer to total smolts and total calculated age 1. smolts tagged at each site. (See Table 4, Appendix Table B).

D 4. Weight Distribution by Age and Tagging Lot - Coho - Beaver Pond #3, 1977

Tagging Lot	May 5			May 11			Total (unweighted)		
Age	Total	1.	2.	Total	1.	2.	Total	1.	2.
Weight									
1.0 - 2.9 g	3	2	-	12	8	-	15	10	-
3.0 - 4.9	35	28	1	20	14	-	55	42	1
5.0 - 6.9	28	19	-	11	6	-	39	25	-
7.0 - 8.9	21	8	-	3	1	-	24	9	-
9.0 - 10.9	7	2	2	2	-	-	9	2	2
11.0 - 12.9	3	1	-	1	-	1	4	1	1
13.0 - 14.9	2	-	-	-	-	-	2	-	-
15.0 - 16.9	1	-	-	-	-	-	1	-	-
N	100	60	3	49	29	1	149	89	4
x	6.1	5.2	7.9	4.5	4.0	11.7	5.6	4.8	8.9
S.D.	2.62	1.86	2.97	2.20	1.47	-	2.59	1.82	3.07

	WEIGHTED TOTAL[a]	
	TOTAL	1.
N	858	819
$\bar{X}$	5.7	4.9
S.D.	2.62	1.85

a Weighted means and standard deviations were calculated by substituting the number of smolts caught and tagged in each sampling period for the number of smolts measured in each subsample. Weighted totals "N" refer to total smolts and total calculated age 1. smolts tagged at each site. (See Table 4, Appendix Table B).

D 5. Weight Distribution by Age and Tagging Lot
Coho - K-2 Mile Swamp, 1977

Tagging Lot	May 27			
Age	Total	0.	1.	2.
Weight				
0.0 - 0.9 g	2	2	-	-
1.0 - 2.9	46	-	43	-
3.0 - 4.9	30	-	28	-
5.0 - 6.9	13	-	12	-
7.0 - 8.9	4	-	3	1
9.0 - 10.9	3	-	1	1
11.0 - 12.9	-	-	-	-
13.0 - 14.9	-	-	-	-
15.0 - 16.9	-	-	-	-
17.0 - 18.9	-	-	-	-
19.0 - 20.9	1	-	-	1
N	99	2	87	3
$\bar{x}$	3.8	0.9	3.5	12.4
S.D.	2.47	0.0	1.63	5.84

WEIGHTED COMBINED TOTALS FOR ALL TAGGED COHO, ALL SITES

	TOTAL	AGE 1.
N	2958	2548
$\bar{X}$	6.5	5.5
S.D.	3.20	2.33

D 6. Weight Distribution by Age and Sampling Date, 1977

	Coho - K-4 Creek			Chinook - Kakweiken Main River			
Sampling Date	May 19			May 20		May 25	
Age	Total	1.	2.	Total	1.	Total	1.
Weight							
0.0 - 0.9 g	-	-	-	2	-	-	-
1.0 - 2.9	5	4	-	8	1	-	-
3.0 - 4.9	14	13	-	5	5	1	1
5.0 - 6.9	11	10	-	2	2	-	-
7.0 - 8.9	4	2	-	-	-	-	-
9.0 - 10.9	5	3	-	-	-	-	-
11.0 - 12.9	2	-	1	-	-	-	-
13.0 - 14.9	1	-	1	-	-	-	-
15.0 - 16.9	1	-	-	-	-	-	-
N	43	32	2	17	8	1	1
$\bar{x}$	6.1	5.0	12.7	2.7	4.1	3.3	3.3
S.D.	3.23	2.02	0.64	1.61	1.16	-	-

D 7. Weight Distribution by Age and Sampling Date - Coho, 1977

	Kakweiken Main River						Kakweiken Estuary		
Sampling Date	May 20		May 25		Total		May 25		
Age	Total	1.	Total	1.	Total	1.	Total	1.	2.
Weight									
1.0 - 2.9 g	7	7	10	10	17	17	4	4	-
3.0 - 4.9	7	5	4	3	11	8	7	7	-
5.0 - 6.9	1	1	-	-	1	1	7	6	1
7.0 - 8.9	-	-	-	-	-	-	2	2	-
9.0 - 10.9	-	-	-	-	-	-	1	-	1
N	15	13	14	13	29	26	21	19	2
$\bar{x}$	3.2	3.3	2.6	2.6	2.9	2.9	5.0	4.8	7.7
S.D.	0.82	0.88	0.88	0.90	0.89	0.94	2.06	1.83	3.04

D 8. Weight Distribution by Age and Sampling Date - Sockeye, 1977

	Kakweiken Estuary			Kakweiken Main River		
Sampling Date	May 25			May 25		
Age	Total	1.	2.	Total	1.	2.
Weight						
1.0 - 2.9 g	3	3	-	3	3	-
3.0 - 4.9	19	16	3	4	4	-
5.0 - 6.9	3	-	3	1	-	1
7.0 - 8.9	-	-	-	-	-	-
9.0 - 10.9	1	1	-	1	-	1
N	26	20	6	9	7	2
$\bar{x}$	4.0	3.7	4.8	4.4	3.4	7.7
S.D.	1.71	1.69	1.64	2.16	0.69	2.62

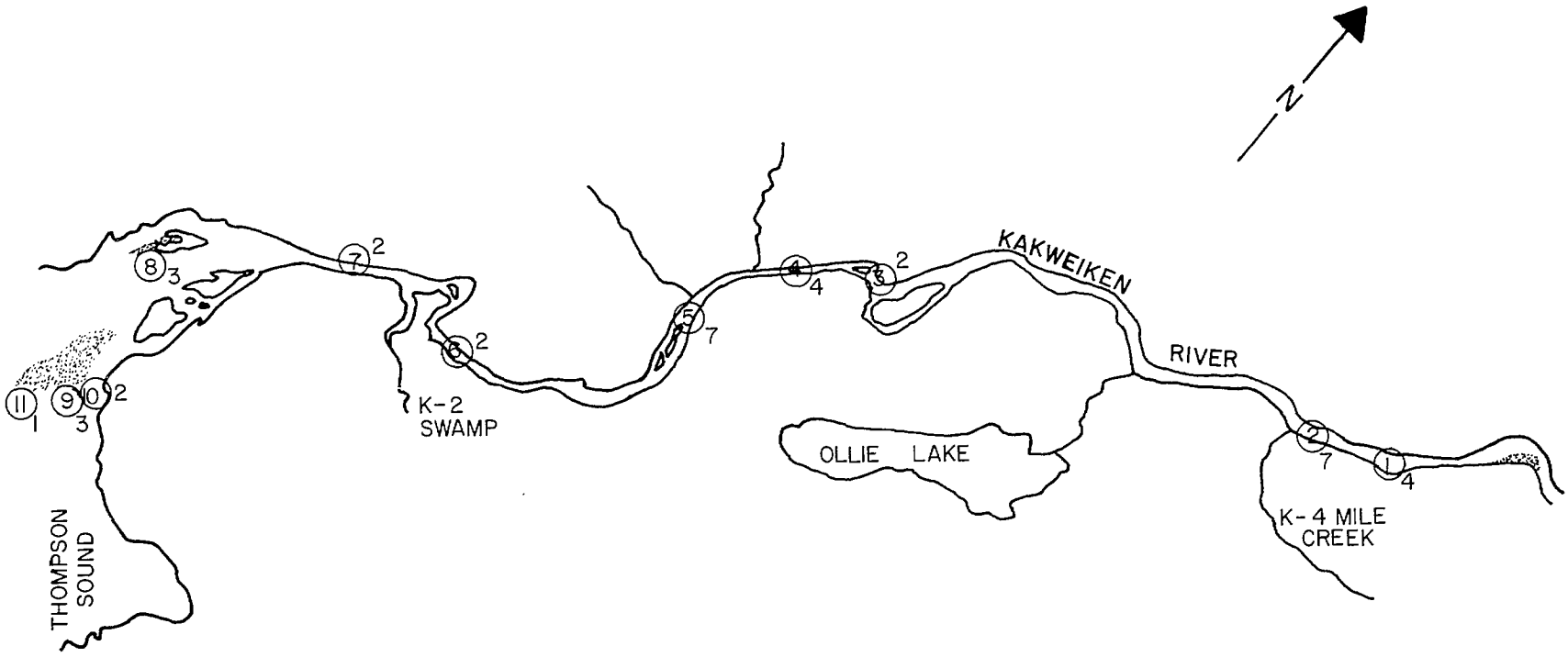
APPENDIX E

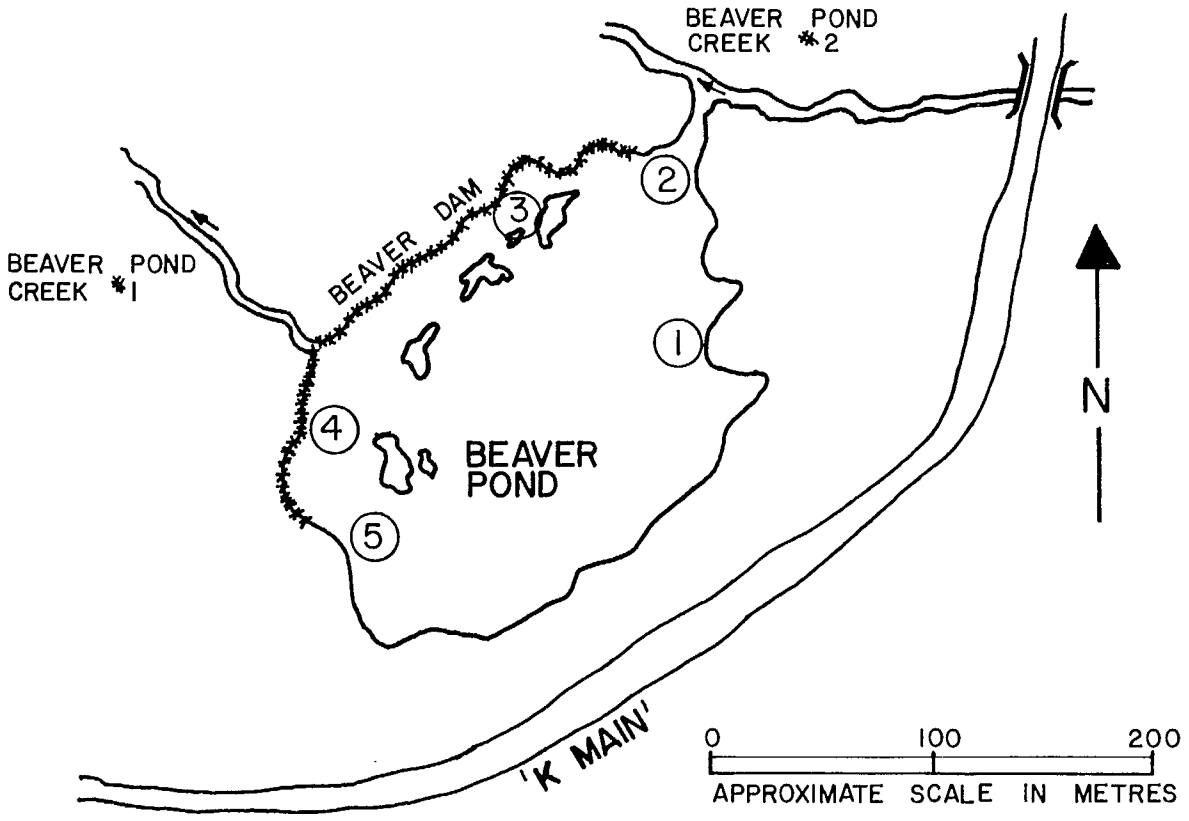
TEST FISHING RESULTS

E 1. JUVENILE BEACH SEINING RECORDS

Date	Site #	Site Description	No. of Sets	Catch			
				Coho Smolts	Coho Fry	Chinook Fry	Others
May 8,9,10	2	¼ mi. above K-4 Creek	6	8	3	3	-
May 12	1	½ mi. above K-4 Creek	3	-	4	-	-
14	8	estuary (high tide)	3	-	-	-	-
	7	lower river	1	1	-	-	2 eulachons
20	3	end of lower river navigation	1	1	-	2	-
	4	just above log jam	4	14	-	11	-
	5	just below rapid area	1	5	10	5	-
	6	above K-2 mile swamp	1	-	-	-	1 dollie varden
May 21	9	estuary - sandbar	1	-	-	1	-
	10	estuary - wharf	2	-	-	-	-
May 25	3	end of navigation	1	1	1	-	1 sockeye smolt 2 sculpins
	5	below rapid area	1	-	-	-	2 sculpins
	6	above K-2	1	9	5	-	26 sculpins
	7	lower river	1	4	-	-	9 sockeye smolts
May 29	5	above rapid area	3	9	29	-	9 sockeye smolts
	1	above K-4 Creek	1	1	6	-	3 sculpins
May 30	5	below rapid area	2	1	80	1	14 sockeye smolts
	9	estuary - sandbar	1	-	-	-	100 yellow shiners 15 sculpins
	11	sandbar point	1	-	-	-	2 flounders 20 sculpins
			35	54	138	23	

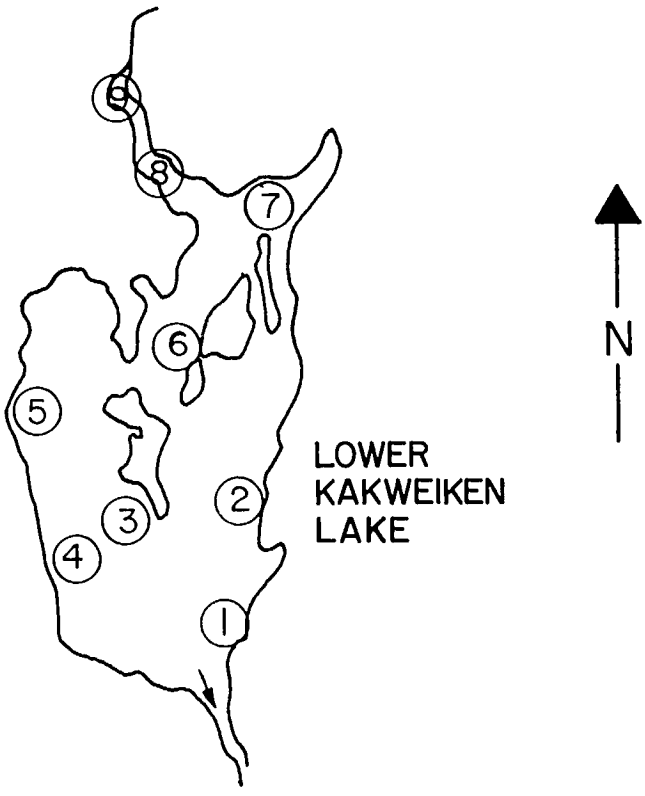
E 2. JUVENILE BEACH SEINING SET LOCATIONS





E 3. BEAVER POND MINNOW TRAP TEST FISHING MAY 13, 1977

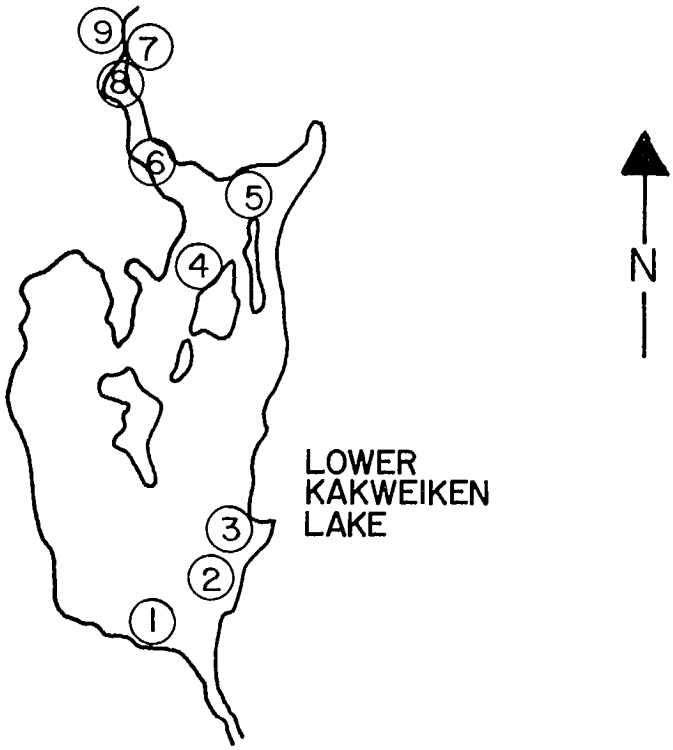
TRAP No.	CATCH	
	COHO SMOLTS	OTHER
1	-	-
2	-	-
3	3	-
4	1	-
5	1	1 Dolly Varden
TOTAL	5	



E 4. LOWER KAKWEIKEN LAKE MINNOW TRAP TEST FISHING MAY 14, 1977 (Soak time 24 hrs.)

TRAP No.	CATCH			
	COHO SMOLTS[a]	COHO FRY	DOLLIE VARDEN	SCULPINS
1	2	-	-	-
2	1	-	-	1
3	1	-	-	2
4	1	-	1	-
5	-	-	-	-
6	20 (small)	-	-	-
7	1	-	4	-
8	1	-	1	2
9	6	1	6	-
TOTAL	33	1	12	5

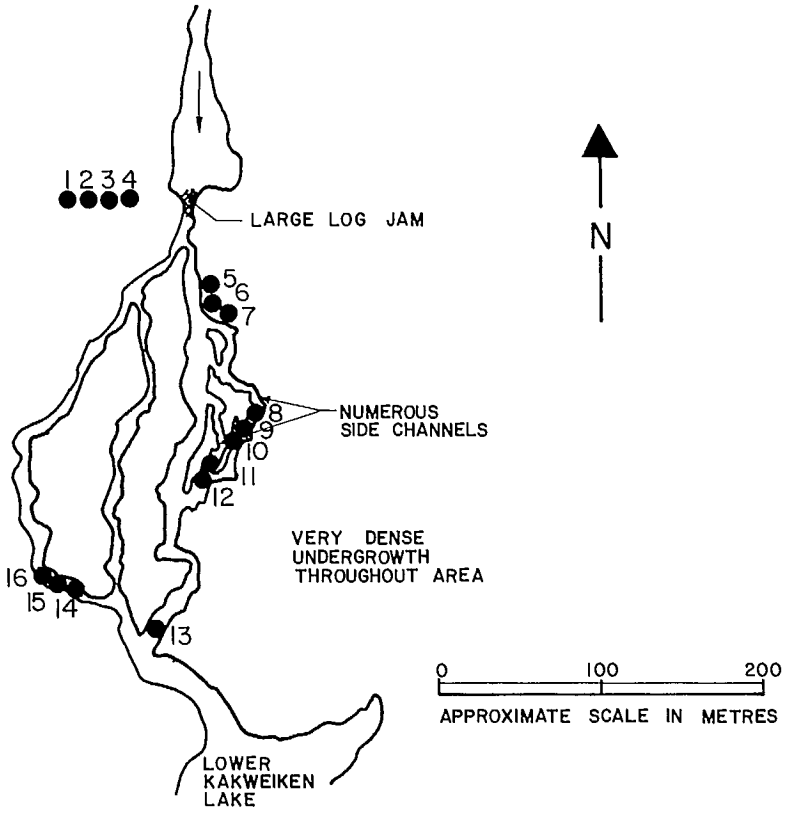
[a] The majority of the trapped coho "smolts" were dark (unsmolted) and small (50-60 mm) but were judged too large to be fry of the year.



E 5. LOWER KAKWEIKEN LAKE MINNOW TRAP TEST FISHING MAY 15, 1977 (Soak time 24 hrs.)

TRAP No.	CATCH				
	COHO SMOLTS[a]	COHO FRY	DOLLIE VARDEN	CUTTHROAT	OTHERS
1	2	-	2	-	-
2	2	-	-	1	1 sculpin,1 stickleback
3	6	-	1	-	-
4	12	-	4	-	-
5	1	-	1	-	-
6	13	-	2	-	1 stickleback
7	18	-	2	-	-
8	11	-	-	-	-
9	7	-	3	1	1 stickleback
TOTAL	72	-	15	2	

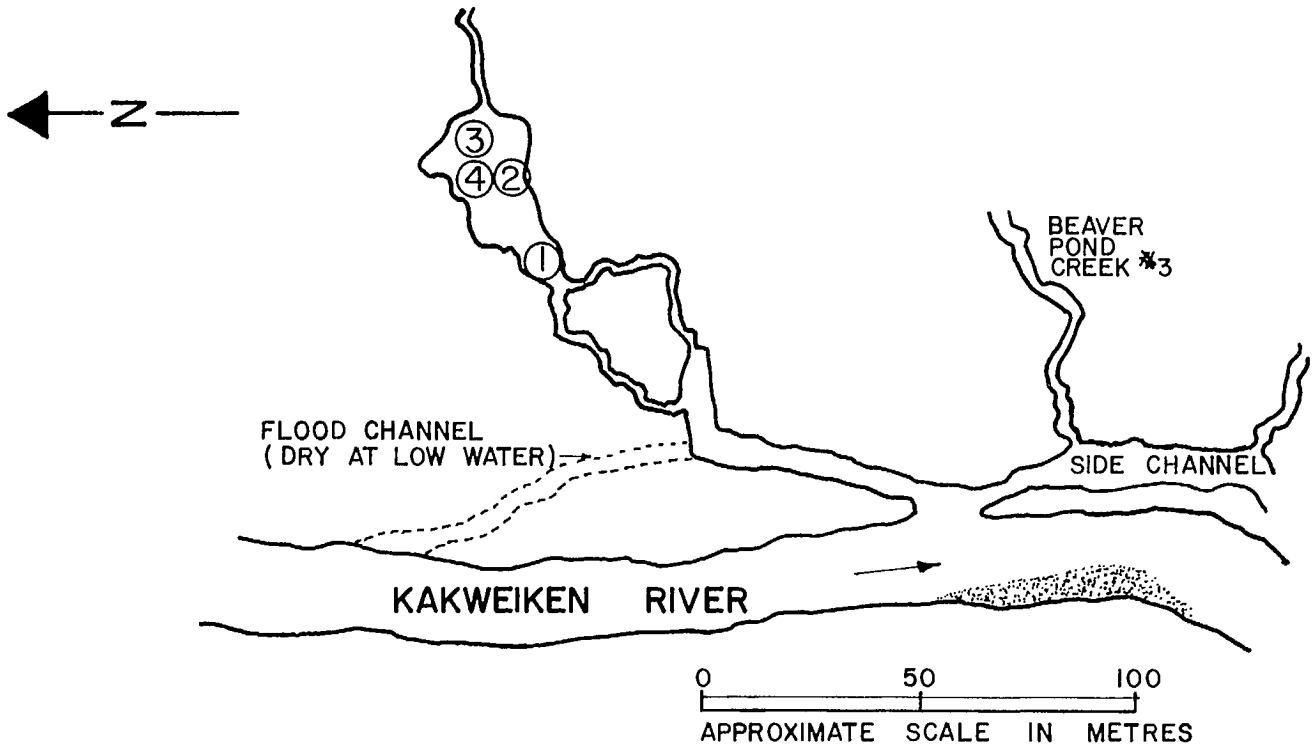
[a] The majority of the trapped coho "smolt" were dark (unsmolted) and small (50-60 mm) but were judged too large to be fry of the year.



E 6. UPPER KAKWEIKEN RIVER MINNOW TRAP TEST FISHING MAY 18, 1977 (Soak time 1½ - 4 hrs.)

TRAP No.	CATCH	
	COHO	TROUT (includes cutthroat, steelhead, Dollie Varden)
1	3	4
2	2	5
3	5	2
4	2	4
5	3	5
6	1	4
7	2	4
8	3	2
9	1	-
10	2	4
11	4	3
12	4	1
13	4	2
14	4	-
15	5	3
16	-	3
TOTAL	45[a]	46

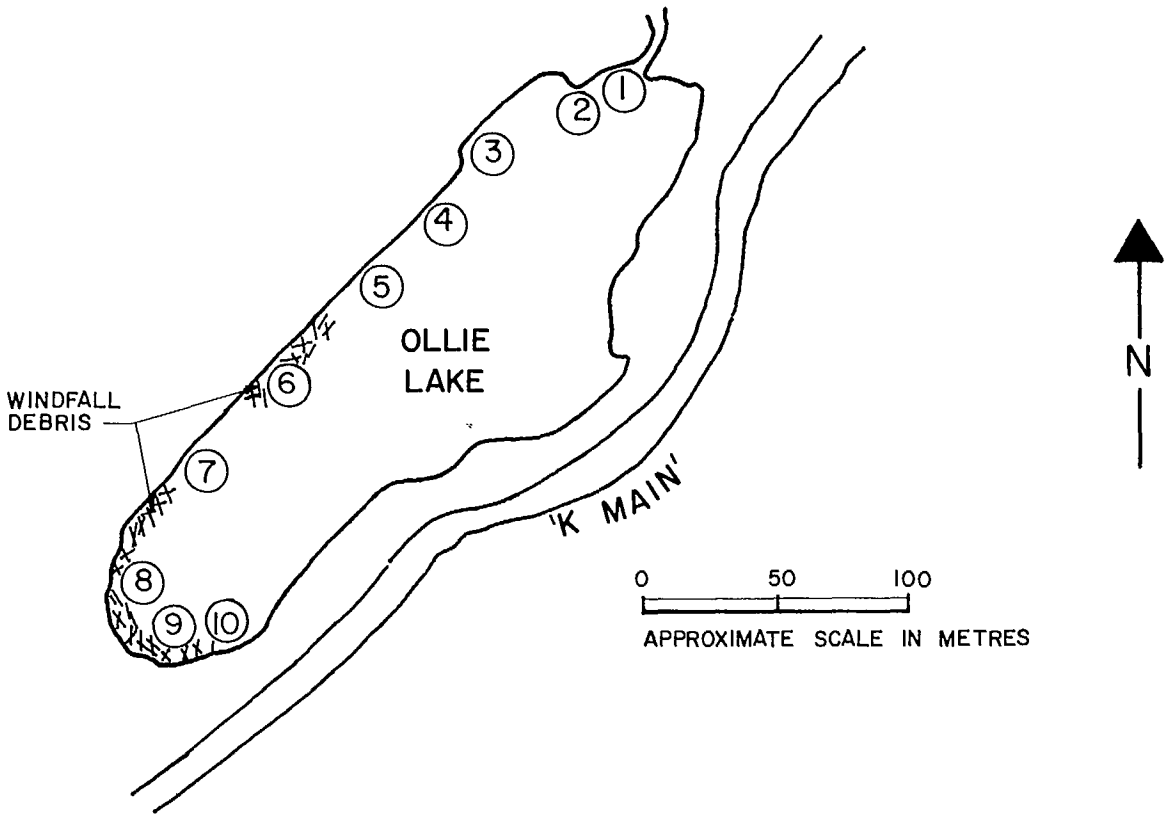
[a] All trapped coho were dark (unsmolted) and small (50-60 mm) but were judged too large to be fry of the year.



E 7. "SIDE CHANNEL POND" MINNOW TRAP TEST FISHING MAY 20, 1977

TRAP No.	COHO CATCH[a]
1	18
2	16
3	-
4	30
TOTAL	64

[a] All trapped coho were dark (unsmolted) and small (50-60 mm) but were judged too large to be fry of the year.



E 8. OLLIE LAKE MINNOW TRAP TEST FISHING MAY 20, 1977 (Soak time 1½ - 4 hrs.)

TRAP No.	CATCH			
	COHO SMOLTS	DOLLIE VARDEN	SCULPINS	STICKLEBACK
1	2	-	12	20
2	1	-	10	36
3	-	-	15	25
4	-	-	8	27
5	-	-	25	31
6	-	-	10	37
7	-	-	13	21
8	-	3	20	19
9	-	4	21	36
10	-	3	17	29
TOTAL	3	10	151	281

APPENDIX F

ESCAPEMENT RECORD FOR KAKWEIKEN RIVER

ESCAPEMENT RECORD FOR KAKWEIKEN RIVER

YEAR	SOCKEYE	CHINOOK	COHO	CHUM	PINK	STEELHEAD
1947	UNK	UNK	UNK	UNK	UNK	
48	UNK	UNK	UNK	UNK	UNK	
49	UNK	UNK	UNK	UNK	UNK	
50	7500	N/O	7500	35000	35000	
51	15000	400	75000	75000	100000+	
52	1500	400	3500	3500	35000	
53	7500	400	15000	3500	35000	
54	1500	200	3500	35000	75000	UNK
55	1500	400	7500	15000	75000	75
56	1500	400	15000	3500	35000	
57	1500	400	3500	1500	30000	
58	7500	400	7500	15000	35000	
59	75	25	1500	400	1500	
60	200	200	1500	7500	7500	
61	1500	400	750	3500	35000	
62	1500	400	3500	1500	35000	
63	1500	200	1500	3500	35000	
64	1500	400	3500	3500	3500	
65	750	400	1500	750	35000	
66	N/O	200	750	750	7500	
67	3500	200	3500	3500	75000	
68	1500	N/O	3500	3500	62500	
69	750	75	2000	3000	45000	
70	25	75	3500	1500	35000	
71	25	25	3500	400	220000	
72	25	750	750	7500	15000	
73	25	500	10000	8000	300000	1000
74	N/O	750	10000	UNK	100000	2000
75	200	200	7500	2000	800000	800
76	1200	650	6500	5000	500000	1500
77						
78						
79						
80						
81						
82						
83						
84						
85						
Time						
Arr.	JULY	JULY	AUG	SEPT	AUG	
Start	SEPT	E AUG	SEPT	SEPT	SEPT	
Peak	L SEPT	AUG	OCT	L SEPT	SEPT	
End		SEPT	NOV	OCT	OCT	

REMARKS

APPENDIX G

KAKWEIKEN RIVER SWIM RESULTS

KAKWEIKEN RIVER SWIM SURVEY

Date	Section	Swimmers	Coho		Chinook		Pink		Chum		Sockeye		Trout dollie/cutt.	
			Seen	Est.	Seen	Est.	Seen	Est.	Seen	Est.	Seen	Est.		
July 23	Above falls	2	104	-	3	4	-	-	-	-	2	-	-	-
27	upper	2	171	-	1	-	36	-	-	-	-	-	-	-
29	lower	2	-	-	-	-	no est.	-	1	-	-	-	-	-
Aug 5	lower	2	104	-	5	12-15	17,000 - 25,000		43/3	-	-	-	-	-
6	upper	3	355	-	4	12-15	16,300 - 35,000		16	100-200	20	-	-	-
9	upper	2	456*	-	12	-	25,945	-	6*	-	2* may be small due to large number pinks		-	
15	upper	1	320+	selected pools	-	-	no est. observing only chinooks	-	12+	-	-	-	-	-
19	upper	N.A.[1?]	15	-	5	-	20-30,000	-	20	-	-	-	-	-
22	upper	N.A.[1?]	N.A.	-	3	-	16,000	-	10	-	-	-	-	-
25	1	3	-	-	-	-	2,000	-	-	-	-	-	-	-
	2	3	10	-	1	-	4,500	-	-	-	-	-	-	-
	3	3	10	-	-	-	500	-	-	-	-	-	-	-
	4	3	50	-	-	-	500	-	-	-	-	-	-	-
	5	3	-	-	-	-	-	-	-	-	-	-	-	-
	6	3	250	-	-	-	1,100	-	-	-	-	-	-	-
26	lower	N.A. [?]	900	-	-	-	7,200	-	160	-	-	-	-	-
31	1	2	10	-	3	-	5,500	-	15	-	-	-	50+	-
	2	?	2	-	-	-	2,500	-	6	-	-	-	-	-
	3	2	4	-	1 spawned out		2,000	-	6	-	-	-	50	-
	4	2	1	-	1 jack		150	-	-	-	-	-	20	-
	5	2	20	-	-	-	650	-	6	-	-	-	-	-
	6	2	250	-	-	-	1,250	-	2	-	-	-	20/3	-
Sept 1	lower	2	510	-	-	-	7,000/20 dead		405/2 dead		2	-	200/20	-
5	1	2	200	-	-	-	5,000/12 dead		3/1	-	-	-	no est.	-
	2	2	100	-	-	-	2,500	-	25	-	-	-	no est.	-
	3	2	30	-	-	-	1,000/5	-	12/2	-	-	-	no est.	-
	4	2	25	-	-	-	400	-	-	-	-	-	no est.	-
	5	2	20	-	-	-	500	-	-	-	-	-	20/2 steelhead	
	6	2	25	-	3	-	150/30	-	2	-	-	-	-	-

APPENDIX H

INCUBATION FACILITY WATER SUPPLY DATA

Incubation Facility Water Supply Data - dissolved oxygen

Date	Water Source	Temperature °C	Dissolved Oxygen (ppm)	Saturation
Aug 7 (A.M.)	McAllister Creek	15.0	10.1	
7 (A.M.)	McAllister Creek	14.7	10.3	
7 (A.M.)	McAllister Creek	15.0	9.8	
7 (A.M.)	McAllister Creek	15.3	10.6	
7 (P.M.)	McAllister Creek	15.2	10.0	
7 (P.M.)	McAllister Creek	15.3	10.4	
7 (P.M.)	McAllister Creek	15.5	9.6	
7 (P.M.)	McAllister Creek	16.1	8.5	
7 (P.M.)	McAllister Creek	16.4	9.6	
7 (P.M.)	McAllister Creek	16.2	10.0	
7 (A.M.)	Camp Supply	15.8	9.4	
7 (A.M.)	Camp Supply	16.0	9.5	
7 (P.M.)	Camp Supply	16.1	9.4	
Aug 12	McAllister Creek		10.1	100%
Aug 12	Camp Water Supply		8.8	90%

McALLISTER CREEK SURVEYING - WATER SUPPLY ELEVATION

STATION	BACK SIGHT	HEIGHT OF INSTRUMENT	FORE SIGHT	TURNING POINT	ELEVATION
Floor of incubation facility					assume 100.00
-	14.53	114.53			
			0.44	114.09	
-	11.72	125.81			
			0.20	125.61	
-	11.99	137.60			
			0.89	136.71	
-	3.89	140.60			
-	3.27	129.90			
			6.58		122.82
Pool above bridge					

APPENDIX I

DISEASE ANALYSIS RESULTS

Diseases found at Kakweiken River, 04/14/1978.

Date	Diagnosis	Species	Case
10/11/1974	Furunculosis	Pink Salmon	740880
10/11/1974	Haplosporidian	Pink Salmon	740880
10/11/1974	Mot. Aero. Sept.	Pink Salmon	740880
06/03/1977	Neoechinorhyn.	Cutthroat Trout	771171
06/03/1977	Chloromyxum	Dolly Varden	771152
06/03/1977	Salmincola	Cutthroat Trout	771171
06/03/1977	Eimeria	Dolly Varden	771152
06/03/1977	Neascus	Sockeye Salmon	771180
06/03/1977	Bulbodacnitis	Cutthroat Trout	771172
06/03/1977	Eubothrium	Cutthroat Trout	771172
06/03/1977	Proteocephalus	Cutthroat Trout	771172
06/03/1977	Trichophrya	Cutthroat Trout	771171
06/03/1977	Trichodina	Dolly Varden	771152
06/03/1977	Healthy	Coho Salmon	771190
06/03/1977	Rhabdochona	Cutthroat Trout	771171
06/03/1977	Neoechinorhyn.	Dolly Varden	771151
06/03/1977	Gyrodactylus	Dolly Varden	771151
06/03/1977	Salmincola	Dolly Varden	771151
06/03/1977	Crepidostomum	Dolly Varden	771151
06/03/1977	Neascus	Cutthroat Trout	771171
06/03/1977	Hexamita	Dolly Varden	771151
06/03/1977	Eustrongylides	Dolly Varden	771151
06/03/1977	Crepidostomum	Cutthroat Trout	771171
06/28/1977	Proteocephalus	Chinook Salmon	771600
06/28/1977	Tetracotyle	Chinook Salmon	771600
06/28/1977	Crepidostomum	Chinook Salmon	771600
06/28/1977	Trichophrya	Chinook Salmon	771600
06/28/1977	Neascus	Chinook Salmon	771600
06/28/1977	Capillaria	Chinook Salmon	771600

Kakweiken River samples.

Date	Case	Species	Age/Stage	Sample	Diagnosis
10/11/1974	740880	Pink Salmon	Ripe Adult	100	Furunculosis* Haplosporidian Mot.Aero.Sept.
06/03/1977	771151& 771152	Dolly Varden	Fing/Smolt	12	Neoechinorhyn Crepidostomum Gyrodactylus* Salmincola Eustrongylides Hexamita Chloromyxum Trichodina* Eimeria
06/03/1977	771171& 771172	Cutthroat Trout	Imm. Adult	6	Neoechinorhyn Salmincola* Rhabdochona Trichophrya Neascus Crepidostonum Bulbodacnitis Eubothrium Proteocephalus
06/03/1977	771180	Sockeye Salmon	Yearling	5	Neascus
06/03/1977	77190	Coho Salmon	Fing/Smolt	9	Healthy
06/28/1977	771600	Chinook Salmon	Fing/Smolt	4	Proteocephalus Tetracotyle Crepidostdmum Trichophrya Neascus Capillaria

* Diseases or disease agents known to be hatchery problem.

Sample = sample size (no. of fish we examined).

Environment Canada | Environnement Canada
Fisheries and Marine | Pêches et Sciences de la mer

April 24, 1978

Your file Votre reference

Our file Notre reference 25-16-1

Mr. R. B. Lewis
Georgia-Johnstone Strait Unit
Fisheries - Pacific Region
1090 West Pender Street
Vancouver, B.C. V6E 2P1

Dear Sir:

Gordon Bell has asked me to answer your letter of April 17, 1978 concerning the Kakweiken River samples.

Lastyear, in June, we received the following from the Kakweiken:

12	Dolly Varden
6	Cutthroat
5	Sockeye
9	Coho
4	Chinook
36	Total

We characterized the above fish according to the approximate age/size stages as shown in the attached printout. In addition, in October, 1974, we examined 100 ripe pinks from this system.

Of the diseases or disease agents listed in the printout, only four are known to cause problems among stocks of cultured fish.

Furunculosis - bacterial disease
Gyrodactylus - monogenetic trematode
Trichodina - protozoan
Salmincola - copepod

..../2

Pacific Biological Station
P.O. Box 100
Nanaimo, B.C.
V9R 5K6

Station de biologie du pacifique
Case postale 100
Nanaimo (C.-B.)
V9R 5K6

And of these four only the furunculosis has caused massive hatchery losses in this region. Except for the motile Aeromonas septicemia (mot. Aero. sept.), a bacterial disease, all the other agents listed are commonly encountered parasites of wild fish. Parasites are seldom found in cultured fish because of the lack of intermediate hosts, etc., in the hatchery environment.

Routinely, we examine all samples received for all diseases known to cause significant losses among both wild and cultured fish. Examination for agents or diseases of lesser importance depends upon the amount of time and help available. The coho (case 771190) are given as "healthy" which indicates only the important diseases were checked for in this case.

Since the adult pinks in the Kakweiken are carriers of furunculosis, there is an excellent chance that adults of other species in this system are also infected. Danger of transmission of furunculosis via the egg can be reduced by egg surface disinfection. However, this is not an absolute safeguard. At least one case has been observed where furunculosis occurred in a stock of coho from disinfected eggs.

I am generally opposed to introducing any fish or eggs into our hatcheries because of the major problems infectious diseases have caused in the past. We can never hope to minimize our disease problems if diseases are continually being re-introduced into the hatcheries. There is also the possibility that Kakweiken fish are carriers of diseases we were not able to detect because of the small sample sizes.

I hope this clears up some of the confusion.

Yours truly,

Gary Hoskins
Biologist

GH/sp

Attach.

APPENDIX J

LETTER OF PERMISSION RE ACCESS TRAIL

Province of
British Columbia

Ministry of
Forests

FOREST SERVICE

345 Quebec Street
Victoria, British Columbia
V8V 1X5

November 23, 1977

Our File: 0345492
Your File: 31-3-K22

Environment Canada
Fisheries and Marine
1090 West Pender Street
Vancouver, British Columbia
V6E 2P1

Attention: Mr. R. W. Armstrong, Senior Biological Technician

Dear Sirs:

With reference to the following application covering disposition of lands within the Kingcome Forest Reserve.

Applicant: Environment Canada - Fisheries

Purpose: Access Trail (Kakweiken River)

Description of Area: As indicated on the attached sketch marked Exhibit "A" dated September 8, 1977.

We concur with the above area as a map notation subject to the prior rights of the holders of Chart 2 of A00615 (Weldwood of Canada Ltd.) insofar as cutting permits and development plans are concerned.

R. D. Miller
Administration Division

Attachment

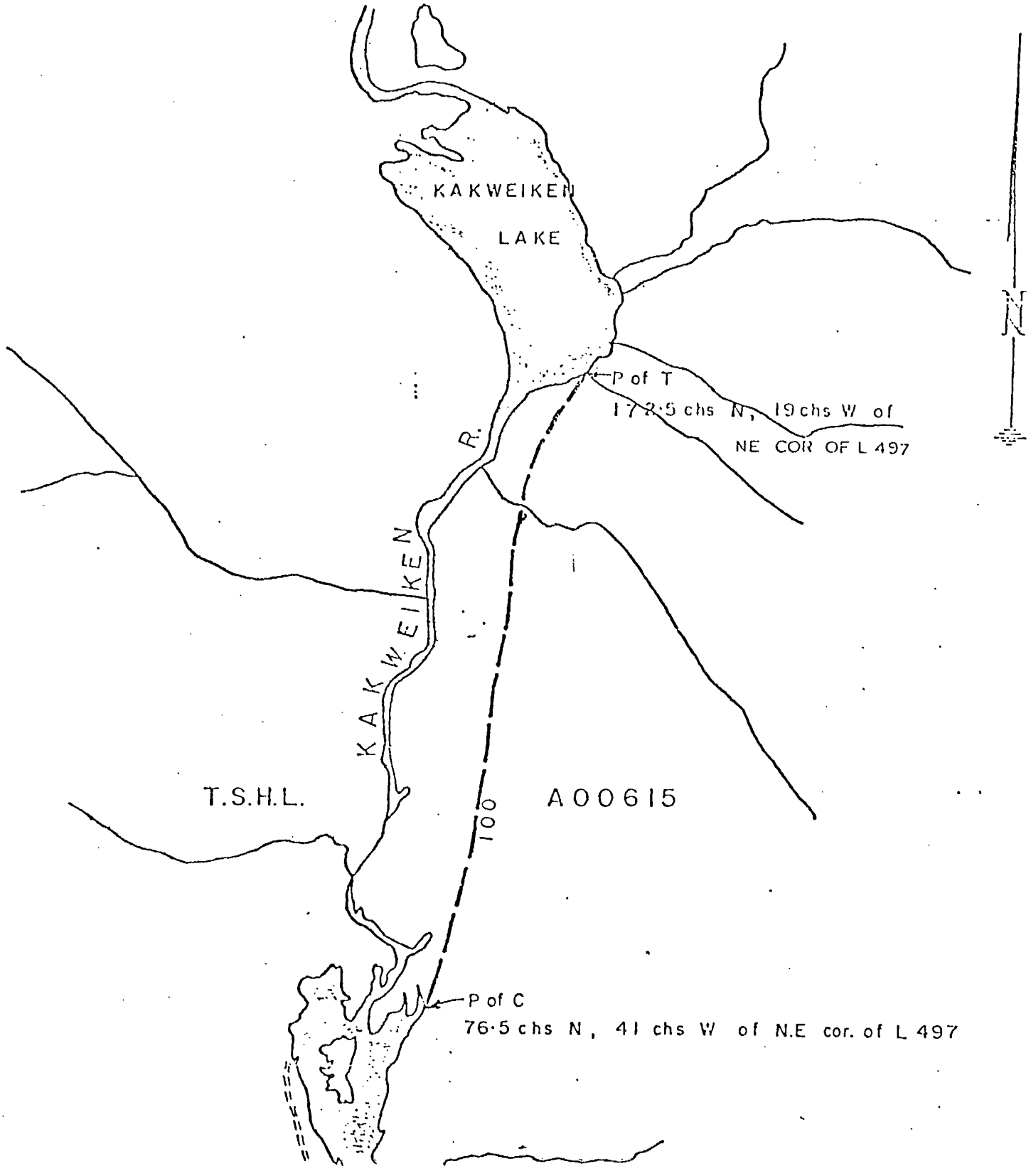
...ion 50 Compt. No. 6
...e 92-K-13-d,e

BRITISH COLUMBIA
FOREST SERVICE

EXHIBIT A
Date SEPT 8, 1977
Atlas Ref. 92-K-13

0345492

...own Acres: R.D. 14 Scale 20 chs



DUE DATE

April 6/20			
	201-6503		Printed in USA