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Summary of Fall 1988 Adult and Juvenile Coho Salmon Sampling Operations on the Lachmach River, British Columbia

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ABSTRACT

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Adult and juvenile coho (Oncorhynchus kisutch) were sampled in the fall of 1988 in the Lachmach River system. Large adult and jack coho were tagged with Peterson disks and Floy anchor tags. In addition 19 large adult coho were tagged with radio transmitters in order to monitor instream movements.

Fresh water age for returning adults and juvenile coho sampled within the system could not be ascertained because the first few growth annuli of the scales could not be determined at this time. The mean length and weight for both large males and females was 690 mm and 4.1 kg respectively. The mean length and weight of jack coho was 316 mm and 0.41 kg. Movement of large adults within the system was minimal due to tagging locations. Major spawning areas were determined throughout the system. Population estimates were not possible due to poor water visibility and a very low mark rate of both large adults and jacks.

Juvenile coho were sampled from several different habitat types including riverine ponds, mainstem sites and off channel areas. Densities of juveniles varied widely between sites as did the mean lengths and weights with the overall mean length and weight being 72.3 mm and 5.46 g.

RÉSUMÉ

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Les saumons cohos (Oncorhynchus kisutch) adultes et juvéniles du bassin de la rivière Lachmach ont été échantillonnés à l'automne de 1988. Les adultes de grande taille et les juvéniles mâles à maturité précoce ont été étiquetés à l'aide de marques Petersen et de marques de type Floy. De plus, dix-neuf grands saumons cohos adultes ont été munis d'un émetteur radio afin de surveiller leurs mouvements dans le cours d'eau.

On n'a pu établir avec certitude l'âge auquel les saumons cohos adultes et juvéniles prélevés dans le bassin retournent en eau douce, parce qu'on ne pouvait pas encore distinguer les premiers anneaux de croissance sur les écailles. La longueur et le poids moyens des mâles et des femelles de grande taille, respectivement, étaient de 690 mm et de 4,1 kg. La longueur et le poids moyens des saumons cohos juvéniles mâles à maturité précoce étaient de 316 mm et de 0,41 kg. Vu le lieu du marquage, le déplacement des adultes de grande taille dans le bassin était négligeable. Des frayères importantes ont été repérées un peu partout dans le bassin. Il est impossible d'évaluer la population à cause de la turbidité de l'eau et du faible taux de marquage des adultes de grande taille et des juvéniles mâles à maturité précoce.

Des saumons cohos juvéniles ont été échantillonnés dans différents types d'habitats, notamment les étangs riverains, l'axe principal et à proximité des chenaux. La densité, la longueur et le poids moyens de juvéniles ont varié considérablement d'un endroit à l'autre, la longueur et le poids moyens pour l'ensemble étant de 72,3 mm et de 5,46 g.

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INTRODUCTION

The Lachmach River is a small coastal stream approximately 8 km in length. It is located 23 km east of Prince Rupert, British Columbia at the head of Work Channel (Fig. 1). It drains a small (42 km_2) watershed typified by steep mountainous sides. The western slope of the watershed was clearcut logged during the 1970's and early 1980's. The river is characterized by sections of moderate gradient in the lower 2 km and areas of riverine ponds especially in the upper reaches. It displays only limited estuarine development and supports populations of coho salmon (Oncorhynchus kisutch), pink salmon (Oncorhynchus gorbuscha), chum salmon (Onchorhynchus keta), steelhead trout (Oncorhynchus mykiss), cutthroat trout (Oncorhynchus clarki clarki), Dolly Varden char (Salvelinus malma), freshwater sculpins (Cottis sp.) and three spine stickleback (Gasterosteus aculeatus).

In 1986 the Lachmach River was chosen by the Department of Fisheries and Oceans (DFO) as a representative north coast watershed suitable for the investigation of productivity and life history of northern British Columbia coho stocks.

The data presented here are the results of an adult and juvenile coho salmon (Oncorhynchus kisutch) study on the Lachmach River conducted in the fall of 1988. The objectives were to enumerate adult coho, identify spawning areas, estimate residence time of spawners, collect basic biological data from adults and juveniles and identify off channel juvenile overwintering areas.

This work was carried out under contract by Aquatic Resources Ltd., Vancouver, British Columbia.

METHODS

Adult coho were captured by angling or with a 30 m beach seine. Angling was done throughout the system during a variety of water levels. The beach seine was used at the 2600 meter pool only. Each coho captured was sexed, weighed measured and examined for an adipose fin clip. Five scales, three from one side, two from the other were taken from each fish for age determination.

Adults, excluding jacks, were tagged with either orange FD-68b Floy anchor tags (Floy Tag Man. Inc. Seatle Wa.) or orange Peterson disk tags and Lotek model FRT-4 radio transmitters (Lotek Engineering Inc. Aurora, Ont.).

The 17 mm wide by 60 mm long radio tags were lubricated with glycerine and inserted into the fishes stomach using a 15 mm rigid plastic tube. The 29 cm long antennae extended out of the fishes mouth about 10 cm. Each tag was wrapped with orange and green flagging tape prior to insertion to increase their visibility as an aid to recovery. Adults with floy tags were marked with a left operculum punch. Adults with radio tags were marked with a right operculum punch. Jacks were tagged with orange Floy tags and a left operculum punch or with a right operculum punch only. Jacks were not radio tagged.

The location of each radio tagged fish was determined daily using a portable Lotek radio receiver. Monitoring was mainly done from a road adjacent to the stream. Each tag was tracked from 16 sites, 0.5 km apart along the road. More precise locations were determined by monitoring tag frequencies during weekly stream walks. Damage to the radio receiver on Oct. 3 prevented any radio tag monitoring until Oct. 7, when a back up receiver was obtained. Because there were no other receivers available should the back up be damaged during use monitoring was not done during stream walks from Oct. 7 until Nov. 4 when the original was returned.

Adult enumeration involved streambank and float counts throughout the system. Float counts were only done during low flow conditions because of poor visibility during high water. The procedure consisted of one person in a dry suit using a mask and snorkel swimming a section of stream, one person in the stream to flush out fish and the other person observing from the stream bank. Standard streamwalks consisted of two to three observers walking a stretch of stream making independent counts. Both streambank and float counts were impossible in the 5000 m to 7000 m pond areas due to deep water and poor visibility. Juvenile sampling was done using 1/4 inch mesh Gee minnow traps baited with salted salmon roe. Soak time was about 24 hours. Population estimates were made at the 5000 m, 7000 m and 3820 m ponds and the 3820 m, 3500 m and the 600 m off channel areas (Fig. 2). These location names refer to the distance upstream from tidal water.

Before sampling all juvenile fish were anaesthetized with 2-phenoxyethanol. All coho were measured for fork length to the nearest mm and 2 fish of every length were sampled for weight when possible. Scales for age determination were taken from the entire size range of fish lengths. The upper lobe of the caudal fin was clipped and the fish were allowed to recover before being released. All other species captured were counted and released.

Recapture for the purpose of population estimation using the Peterson method (Ricker 1975) did not occur for at least three days to reduce trap avoidance by marked fish.

All off channel areas that could be found were surveyed using baited Gee traps. Catches were identified, counted and released back into the area from which they were trapped.

All environmental data was collected at the fence site. Precipitation was measured daily using a 127 mm capacity rectangular rain gauge. Air temperatures were measured using a minimum-maximum thermometer. Water temperature was measured daily using a hand held alcohol thermometer. Water level was measured at a staff gauge on the fence abutment located at the tidal boundary.

RESULTS AND DISCUSSION

WEATHER AND PHYSICAL OBSERVATIONS

Total precipitation for the period of Sept. 15 to Nov. 11 was 913 mm. Peak daily precipitation occurred on Sept. 28 and Oct. 21, with 123 mm and 127 mm respectively (Fig.3). Daily water height on Lachmach River ranged from a low of 0.45 m on Oct. 11, to a high of 1.68 m on Oct. 21. Rising water levels closely followed daily precipitation. Peak water levels of 1.6 m and 1.68 m occurred the day after the peak precipitation days of Sept. 28 and Oct. 21 respectively.

Daily mean water temperatures declined gradually over the study period. The range was 11.2°C - 6.0°C (Fig. 4), the average for the study period was 8.6°C. The rate of decline of water temperatures was arrested during periods of high precipitation (Fig. 3 and 4). A similar decrease in the daily ranges and overall mean of air temperatures also occurred (Fig. 5).

ADULT COHO

Mark and recovery samples were too small to produce a reliable population estimate using simple mark recapture methodology Streambank and float counts (Table 7) were also not sufficient to get a population estimate. However these counts were useful in locating spawning and holding areas.

A total of 58 large adult coho and 40 jacks were caught and sampled. Summary statistics for adults are given in Table 1 and Figures 6 and 7. Of the large coho 35 were males and 23 were females. There were no statistically discernable differences between the mean lengths and weights of large male and female coho. Both groups had a mean length of about 69 cm and a mean weight of about 4.1 kg. The range of lengths and weights in large males was more variable than in females. This greater variability in male sizes has also been observed in adult coho from the Cowichan River system (J. Taylor, 1987) and other systems (K. Simpson pers. comm.). Jack coho had a mean length of 31.6 +- 0.8 cm. and a mean weight of 0.41 +-0.04 kg.

Regression of $\log_{10}$ weight on $\log_{10}$ length for adults and jacks shows a strong relationship between length and weight over the values sampled (Table 2 and Figs. 8-10).

The number of fish missing an adipose fin (indicating the possible presence of a CWT) was very low. Of the 98 fish examined, only 1 large male and 7 jacks had a missing adipose fin (Table 1). The low mark rate of adults is not surprising given that only 1,790 smolts were tagged in 1987 (Finnegan, Dunbrack and Simpson unpubl. data). However, 9,192 smolts were tagged in the spring of 1988 (Finnegan, unpubl. data) and a higher mark rate on jacks was expected. The low mark rate suggests that a large number of smolts left the system untagged in 1987 and 1988.

The Ageing Lab at the Pacific Biological Station was unable to resolve ages from any of the scale samples submitted. The problems were primarily due to an inability to determine the start of the first few growth annuli in the juvenile life stages. An intensive juvenile marking program planned for the spring and summer of 1989 will address this problem and these scales may be reexamined.

Tagging commenced on September 13 and ended on November 9. Twenty three of the 40 jacks and 55 of the 58 adults were tagged with orange floy anchor tags. Of the adults tagged, 32 were males and 23 were females. Within this group, 12 of the males and 7 of the females were also tagged with radio transmitters. Table 1 shows the sampling and tagging data.

Movement of the radio tagged fish was minimal (Table 8). This is probably a result of capturing the fish once they had established themselves within the system. Eleven of the tagged fish moved less than 1 km upstream or downstream from where they were tagged, 5 fish moved 1-2 km and 3 fish moved 2-3 km.

Predation on spawning adults appeared to be high throughout the system. A larger number of radio tagged adults in the future should help to provide a reasonable estimate of pre-spawning predation.

Major spawning areas were mapped using the combination of radio tracking, stream walks and float surveys (Fig. 11). Spawning in the lower reaches appeared to be restricted to the 600 m area. Other major spawning sites were just below a falls at 2000 m and above the falls between 2400 and 2600 m. Coho also spawned at 3390 and at the confluence of the Lachmach Lake outlet stream and the Lachmach mainstem at 3820 m. The Lachmach Lake outlet stream is accessible to adults for the first 200 m, but no spawning has been observed beyond its mouth. Heavy spawning was observed from 3500 m to the outlet of the 5000 m pond. No spawning was observed in the mainstem from the 5000 m to 7000 m. This is due to the lack of suitable spawning substrate. All observed spawning above 5000 m occurred in three small tributaries (Fig. 11).

JUVENILE COHO

Juvenile sampling was conducted from Sept. 11 to Dec. 7. Sampling was primarily concentrated in off channel areas from 600 m to 3820 m. The off channel areas are mostly located on the west bank in the flood plain of the mainstem (Fig. 2). These areas are for the most part, inaccessible to adults and usually only accessible to juveniles during flooding. Mainstem ponds at 3820 m and above were also sampled.

SITE DESCRIPTIONS

600 m off channel area. This area was created by beaver dams. It is characterized by small shallow ponds (<2 m depth, <5 m width) connected by a series of narrow, shallow (<0.2 m depth, <0.5 m width) channels. The pond and channels are accessible to juveniles during flooding.

3390,3500 and 3820 m off channel areas. These areas were created primarily by the damming of tributaries by beavers forming several shallow ponds and channels that may be interconnected during high water events. These could be accessible to adults during flooding, but none have been observed to date.

3820 m mainstem area. A large shallow (<3 m) riverine pond created by a landslide in the early 1970's. It is typified by logjams, large volumes of large wood debris and standing spars.

5000 m pond. A large shallow (<3 m) riverine pond surrounded by peat bog meadows on the east bank and a strip of mature spruce forest on the west bank.

7000 m pond. An inter-connected series of shallow (<2 m) elongated riverine ponds formed by beaver damming activity. It is characterized by moderate meanders and swampy low lying peat bog meadows.

POPULATION ESTIMATES

Population estimates for the sample sites are presented in Table 3. The greatest number of juvenile coho (4526) were found in the 3820 m mainstem area. The lowest number (167) were in the 600 m off channel area. Density estimates for juvenile coho ranged from 0.3 fish M^{-2} at the 5000 m pond to 5.5 fish m^{-2} in the 3500 m off channel area. The density estimates for the 600 m, 3500 m and 3820 m off channel areas are based on estimated surface area for the sites. Therefore it is possible that the density estimates for these sites could be misleading. The population and the density estimate for the 5000 m pond site may be in error also. During the recapture phase the water conditions in the pond were very poor. About 4 - 5 cm of ice formed on the pond surface after the traps had been set. The traps could not be recovered for 48 hours and the numbers of juvenile coho caught was considered low in comparison to the marking phase and other sampling times. The low catch numbers were probably due to a decrease in fish activity at the low water temperatures.

Summary statistics for juvenile coho are presented in table 4. The overall mean length and weight (+- 95% C.I.) for the system was 72.3 +- 0.42 mm and 5.45 +- 0.302 g respectively. Separating by site, there appears to be 4 distinct mean length groups (Fig. 12).

1. 88 mm at 600 m
2. 68-70 mm at 3390 m, 3500 m, 3820 m off channel areas and the 3820 m mainstem area.
3. 103 mm at the 5000 m pond
4. 64 mm at the 7000 m pond

There are also 3 distinct mean weight groups of juvenile coho (Fig. 13).

1. 6.8 g at 600 m
2. 3.0 - 5.5 g at 3390 m, 3500 m, 3820 m, off channel areas, the 3820 m mainstem and the 7000 m pond area
3. 9.6 g at the 5000 m pond

In comparison to other sites, juvenile coho at the 3820 m off channel area were unusually light and those in the 7000 m pond were unusually heavy for their respective lengths. The length weight relationships for the system and by sites are presented in Table 4 and Fig. 14.

These different size fish between sampling areas are reflected in the length frequency distributions. The length frequency distribution for the entire system is nearly normal with a skewness to the right (Fig. 15). This skewness is to be expected from a population of coho sampled after a summer growing season. In comparison the length frequency distributions for the sample sites show bimodal length - frequency distributions for all but the 3500 m off channel area (Figs. 16 - 22). The modes are:

1. 600 m - 72 and 93 mm
2. 3390 m - 56 and 75 mm
3. 3500 m off channel - 70 mm
4. 3820 m off channel - 50 and 78 mm
5. 3820 m mainstem - 55 and 84 mm
6. 5000 m pond - 57 and 106 mm
7. 7000 m pond - 48, 78 and 88 mm

Presumably these varying fish sizes represent different age classes of juvenile coho. Unfortunately the problems in determining the first few growth annuli in the scales (as with the adults) prevented the determination of age structure.

The bimodal length - frequency distributions and the dissimilar mean lengths and weights of juvenile coho between sites, suggests that the size differences observed could be a result of different age classes and/or different growth rates of fish between sites. It is apparent that there are two age classes in the 5000 m pond and probably in the 7000 m pond and 3820 m mainstem area and off channel area. The different sizes of fish in the other areas could be from age or growth rate factors such as water temperature, food availability and fish densities. Future work on juvenile coho in the Lachmach River will concentrate on discerning age classes and site specific growth characteristics.

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Ricker, W. E. 1975. Computation and Interpretation of Biological Statistics of Fish Populations. Fish. Res. Bd. Can. Bull. 191. 382 pp.

Taylor, J. E. 1987. Southern coho population unit - adult fence 1986 - 1987; Mesachie Creek. Data Report prepared by L.G.L. Limited for the Department of Fisheries and Oceans. 50 pp.

Table 1. Sampling data from Lachmach River adult coho, fall 1988.

Date	Length (cm)	Weight (kg)	Sex	Cond.	Tag No.	Scale No.	Adip. Clip
SEPT. 13	33.8	0.6	JACK	B	F08301	B1-1	N
SEPT. 13	33.2	0.45	JACK	B	F08302	B1-2	N
SEPT. 13	33.8	0.45	JACK	B	F08303	B1-3	N
SEPT. 13	35.7	0.7	JACK	B	F08304	B1-4	N
SEPT. 13	33.8	0.5	JACK	B	F08306	B1-5	N
SEPT. 15	30.9	0.5	JACK	B	F08307	B1-6	N
SEPT. 15	72.5	4.6	MALE	T	F08308	B1-7	N
SEPT. 15	52.8	2	FEMALE	T	F08309	B1-8	N
SEPT. 16	30.9	0.45	JACK	B	F08310	B1-9	N
SEPT. 16	28.8	0.35	JACK	B	F08311	B1-10	N
SEPT. 16	33.9	0.525	JACK	B	F08312	B2-1	N
SEPT. 18	64	3.1	MALE	T	RADIO F088	B2-2	N
SEPT. 18	70.8	5.25	MALE	T	F08313	B2-3	N
SEPT. 18	29	0.275	JACK	M	F08314	B2-4	N
SEPT. 18	73	4.4	MALE	T	F08315	B2-5	N
SEPT. 19	31.8	0.3	JACK	T	F08316	B2-6	N
SEPT. 20	28.1	0.3	JACK	B	F08317	B2-7	Y
SEPT. 20	32.5	0.45	JACK	B	F08318	B2-8	N
SEPT. 20	33.8	0.55	JACK	B	F08319	B2-9	N
SEPT. 20	32.8	0.55	JACK	B	F08320	B2-10	N
SEPT. 20	35	0.6	JACK	B	F08321	B3-1	N
SEPT. 20	27.7	0.325	JACK	B	F08322	B3-2	N
SEPT. 20	29	0.275	JACK	B	F08323	B3-3	N
SEPT. 20	29.5	0.325	JACK	B	F08342	B3-4	N
SEPT. 21	64.3	3.5	MALE	B	RADIO F078	B3-5	N
SEPT. 21	70.5	4.45	MALE	T	RADIO F096	B3-6	N
SEPT. 23	31.4	0.4	JACK	B	F08351	B3-7	N
SEPT. 23	72.9	4.95	MALE	T	RADIO F017	B3-8	N
SEPT. 23	65.2	4.35	FEMALE	T	F08352	B3-9	N
SEPT. 23	29.4	0.375	JACK	T	F08353	B3-10	N
SEPT. 25	30.2	0.375	JACK	B	F08354	B6-1	Y
SEPT. 25	70.8	4.3	FEMALE	T	RADIO F043	B6-2	N
SEPT. 25	73.8	5.6	FEMALE	B	RADIO F023	B6-3	N
SEPT. 25	31.4	0.35	JACK	B	F08355	B6-4	N
SEPT. 26	32.3	0.425	JACK	T	F08356	B6-5	N
SEPT. 26	34.4		JACK	T	F08357	B6-6	N
SEPT. 28	30.5	0.325	JACK	T	NO TAG	B6-7	N
SEPT. 28	33.8	0.475	JACK	M	NO TAG	B6-8	Y
SEPT. 29	80.5	5.85	MALE	T	F08359	B6-9	N
SEPT. 29	67.8	3.8	FEMALE	T	F08360	B6-10	N
SEPT. 30	70.5	4.35	MALE	T	RADIO F018	B7-1	N
OCT. 1	28.5	0.325	JACK	B	NO TAG	B7-2	N
OCT. 1	73.6	5.75	MALE	T	F08361	B7-3	N
OCT. 3	70.8	4.65	FEMALE	T	F08362	B7-4	N
OCT. 4	30.4	0.3	JACK	M	NO TAG	B7-5	N
OCT. 4	55.8	1.875	MALE	M	F08363	B7-6	N

Table 1 (cont'd)

Date	Length (cm)	Weight (kg)	Sex	Cond.	Tag No.	Scale No.	Adip. Clip
OCT. 4	32.5	0.45	JACK	M	NO TAG	B7-7	N
OCT. 4	38.3	0.725	JACK	M	NO TAG	B7-8	Y
OCT. 4	32.3	0.4	JACK	B	NO TAG	B7-9	N
OCT. 6	80		MALE	M	RADIO F028	B7-10	N
OCT. 6	26.8	0.25	JACK	M		B9-1	N
OCT. 6	72.9	5.4	FEMALE	T	F08364	B9-2	N
OCT. 6	67	3.55	FEMALE	T	F08365	B9-3	N
OCT. 6	65.8	3.55	MALE	M	F08366	B9-4	N
OCT. 6	67.8	3.6	FEMALE	T	F08367	B9-5	N
OCT. 6	28.5	0.25	JACK	M		B9-6	Y
OCT. 6	68.1	3.4	MALE	M	F08368	B9-7	N
OCT. 6	65.9	3.7	FEMALE	T	F08370	B9-8	N
OCT. 7	66	3.3	FEMALE	T	RADIO F049	B9-9	N
OCT. 7	74.9	5.2	FEMALE	T	RADIO F091	B9-10	N
OCT. 7	71.3	3.95	FEMALE	T	F08369	B10-1	N
OCT. 7	68.2	3.85	FEMALE	S	RADIO F045	B10-2	N
OCT. 7	70	5	MALE	M	RADIO F044	B10-3	N
OCT. 7	69.8	4.3	FEMALE	T	F08371	B10-4	N
OCT. 7	67.7	3.4	MALE	M	F08372	B10-5	N
OCT. 7	74.3	5.375	FEMALE	T	F08373	B10-6	N
OCT. 7	68.2	4.35	FEMALE	B	F08374	B10-7	N
OCT. 7	74.6	4.95	MALE	M	F08375	B10-8	N
OCT. 7	65.5	3.55	FEMALE	T	F08476	B10-9	N
OCT. 7	79.2	6.1	MALE	M	F08477	B10-10	N
OCT. 7	67.8	4.2	FEMALE	T	F08478	B11-1	N
OCT. 8	68.9	5.05	FEMALE	T	RADIO F046	B11-2	N
OCT. 11	59.8	1.95	MALE	T	F08480	B11-3	N
OCT. 11	64.7	3.25	MALE	T	RADIO F042	B11-4	N
OCT. 12	56.8	2.025	MALE	M	F08483	B11-5	N
OCT. 13	33.3	0.5	JACK	M	NO TAG	B11-6	N
OCT. 14	82.3	6.4	MALE	M	RADIO F020	B11-7	N
OCT. 14	72.2	4.4	MALE	T	F08482	B11-8	N
OCT. 14	67.8	3.55	FEMALE	T	F08485	B11-9	Y
OCT. 18	33.3	0.45	JACK	M	NO TAG	B11-10	Y
OCT. 20	78.2	6	MALE	M	RADIO F043	B12-1	N
OCT. 20	73.6	4.25	MALE	M	F08486	B12-2	N
OCT. 21	78.8	6.4	MALE	M	F08487	B12-3	N
OCT. 21	59.9	2.35	MALE	M	F08488	B12-4	N
OCT. 21	73.8	4.3	MALE	T	F08489	B12-5	N
OCT. 21	72.5	4.25	MALE	M	F08490	B12-6	N
OCT. 23	56.5	2.2	MALE	M	F08491	B12-7	N
OCT. 29	74.5	4.85	MALE	M	F08492	B12-8	N
OCT. 29	64.6	2.9	MALE	S	F08493	B12-9	N
OCT. 29	31.1	0.25	JACK	M	HEAD SAMPLE	B12-10	Y
OCT. 29	34.9	0.45	JACK	M	HEAD SAMPLE	B13-1	N
NOV. 1	69	3.65	FEMALE	M	RADIO F064	B13-2	N
NOV. 1	70.6	4.3	FEMALE	T	F08494	B13-3	N
NOV. 3	29.9	0.275	JACK	M	HEAD SAMPLE	B13-4	N
NOV. 4	60.9	2.475	MALE	M	F08495	B13-5	N
NOV. 4	73.6	5.15	MALE	M	RADIO F02	B13-6	N
NOV. 8	31.1	0.3	JACK	M	HEAD SAMPLE	B13-7	N
NOV. 9	66.3	2.95	MALE	M	RADIO F031	B13-8	N

Table 2. Length-weight summary statistics for adult and jack coho from the Lachmach River. Fall 1988.

	Males	Females	Jacks
Mean Length:	69.5+-2.4 cm	68.6+-1.9 cm	31.6+-0.8 cm
Min.	55.8 cm	52.8 cm	26.8 cm
Max.	80.5 cm	74.9 cm	38.3 cm
SD.	7.02	4.42	2.49
N	35	23	40
Mean Weight:	4.13+-0.45 kg	4.16+-0.36 kg	0.41+-0.04 kg
Min.	1.87 kg	2.00 kg	0.25 kg
Max.	6.40 kg	5.6 kg	0.72 kg
SD.	1.34	0.82	0.12
N	34	23	39

Table 3. Length - weight summary statistics for juvenile coho from sites on the Lachmach River, fall 1988.

Location	Length N	Mean	+/- 95% C.I.	Min.	Max.	SD.	Weight N	Mean	+/- 95% C.I.	Min.	Max.	S.D.
600 m	223	87.9	1.4	52	110	10.99	77	6.78	0.69	1.09	13.5	3.08
3390 m	338	69.3	0.2	48	113	11.71	50	4.64	0.81	1.15	15.00	2.93
3500 m	1064	70.0	0.6	43	107	10.14	84	4.56	0.49	1.30	13.30	2.31
3820 m offchan.	84	68.7	3.4	45	107	15.87	71	3.91	0.64	0.90	13.30	2.74
3820 m main	1474	68.1	0.9	41	117	16.60	100	4.80	0.63	0.75	16.15	3.20
5000 m pond	289	102.7	1.3	49	121	11.11	67	9.55	0.84	1.10	16.15	3.51
7000 m pond	421	64.0	1.8	41	107	18.37	82	5.67	0.71	0.70	13.30	3.28
combined	3893	72.3	0.40	41	121	13.6	551	5.46	0.30	0.70	16.15	3.54

Table 4. Regression equations for log weight vs. log fork length for juvenile coho from the Lachmach River, fall 1988.

Location	Equation	r^2 adjusted	p	N	S.E.
600 m	-5.08+3.05(log length)	0.997	<0.001	47	0.02
3390 m	-5.08+3.05(log length)	0.997	<0.001	50	0.02
3500 m	-5.18+2.98(log length)	0.997	<0.001	48	0.02
3820B m	-5.18+3.10(log length)	0.998	<0.001	47	0.02
3820M m	-5.07+3.03(log length)	0.999	<0.001	62	0.02
5000 Pond	-5.36+3.18(log length)	0.951	<0.001	41	0.11
7000 Pond	-5.10+3.05(log length)	0.997	<0.001	60	0.03
Overall	-5.11+3.06(log length)	0.992	<0.001	355	0.04

Table 5. Mark recapture population estimates with 95% confidence intervals for juvenile coho from sites on the Lachmach River, fall 1988.

Location	No. Marked	No. Recap.	Marks Recap.	Area Trapped	Popn. Est.	Density (m^{-2})	95% C.I. (m^{-2})	95% C.I. (m^2)
600 m offchannel	146	134	52	158[1]	374	2.4	287,488	1.8,3.1
3500 m offchannel	741	667	329	275[1]	1502	5.5	1349,1679	4.9,6.1
3820 m offchannel	50	48	14	200[1]	167	0.8	287,488	1.4,2.4
3820 m mainstem	960	550	116	2310	4526	2.0	3780,5420	1.6,2.3
5000 m pond	180	117	7	9500	2670	0.3	1379,5621	0.2,0.6
7000 m pond	209	269	56	660	995	1.5	769,1286	1.2,1.9

[1]Estimated area

Table 6. Regression equations for $\log_{(10)}$ weight vs. $\log_{(10)}$ length for coho adults and jacks from Lachmach River, Fall 1988.

	Equation	r^2 adjusted	p	N	S.E.
Males:	-5.54+3.34(log length)	0.92	<0.001	34	0.04
Females:	-4.61+2.85(log length)	0.80	<0.001	23	0.04
Jacks:	-5.14+3.15(log length)	0.72	<0.01	39	0.07

Table 7. Adult coho float survey data, Lachmach River fall 1988.

Date	Location	Tagged Adults	Untagged Adults	Tagged Jacks	Untagged Jacks	Water Level
Oct. 4	0 - 4500	3	75	7	40	low
Oct. 6	6000 - 6500	0	0	0	0	low[1]
Oct. 6	2800 - 2000	2	47	2	11	low
Oct. 12	500 - 0	1	1	0	0	low
Oct. 27	5000 - 3000	4	45	0	12	low
Oct. 29	3000 - 2000	3	14	0	2	moderate

1. There was poor visibility in this part of the stream.

Table 8. Radio tracking data from the Lachmach River, fall 1988.

Tag No/ Sex	Date Tagged	Location	Tracking Dates	Tag Location	Tag Recovered/ Location
F02/M	Nov. 4	5000	Nov. 5-11	5500	
			Nov. 21	6900	no
F031/M	Nov. 9	6300	Nov. 10-23	5500 - 6000	
			Nov. 23	6500	yes 6500
F064/F	Nov. 1	6300	Nov. 2 - 22	6000	yes 6300
F020/M	Oct. 14	5000	Oct.15 - 23	5000	
			Oct. 24 - Nov.2	4700	
			Nov. 4 - Dec. 5	3800	no
F042/M	Oct. 11	3820	Oct. 12 - Nov. 1	3500 - 4000	
			Nov. 2	3000	
			Nov.4 - 7	2500	yes 2650
F018/M	Oct. 1	3820	Oct. 8 - Oct. 11	3500 - 4000	
			Oct. 12 - Nov. 11	4500	no
F023/F	Sept. 25	2000	Sept. 26 - Oct. 1	2000 - 2500	
			Oct. 11 - Oct. 16	0 - 500	no
F043/F	Sept. 25	2000	Sept. 27 - Oct. 1	3000 - 3500	
			Oct. 14 - 18	5000	yes 5000
F078/M	Sept. 21	0	Sept. 22	0	
			Sept. 23	2000	
			Sept. 27 - Oct.8	2000 - 2500	
			Oct. 10 - Oct. 28	1500 - 2000	
			Oct. 29- Nov. 18	2000	yes 2000
F091/F	Oct. 7	2600	Oct. 8 - Nov. 11	2500 - 3000	yes 2600
F088/M	Sept. 18	3820	Sept. 20 - Oct. 1	3500 - 4000	
			Oct. 8	2500 - 3000	
			Oct. 9	3500 - 4000	
			Oct. 10	2000 - 2500	
			Oct. 11 - Nov. 11	2000 - 2500	no
F049/F	Oct. 7	2600	Oct. 8 - Nov. 9	2500 - 3000	yes 3000
F028/M	Oct. 6	6300	Oct. 8 - 17	6000 - 6500	
			Oct. 18	6750	
			Oct. 20	6200 Trib[1]	
			Oct. 22 - 24	6500 - 7000	
			Oct. 24	7000 Trib[2]	yes 7000

Table 8. (cont'd)

Tag No.	Date Tagged	Location	Tracking Dates	Tag Location	Tag Recovered/ Location
F017/M	Sept. 23	3820	Sept. 26 - Nov. 2	3500 - 4000	
			Nov. 3	3820	yes 3820
F043/M	Oct. 20	6300	Oct. 21 - Oct. 23	6000 - 6500	
			Oct. 24 - Oct. 31	5000 - 6000	
			Oct. 31 - Nov. 11	6000 - 6500	
			Nov. 22	6300	yes 6300
F044/M	Oct. 7	2600	Oct. 8 - Oct. 18	2500 - 3000	
			Oct. 19 - Nov. 11	0 - 500	no
F096/M	Sept. 21	5000	Sept. 23 - Oct. 1	5000 - 5500	
			Oct. 17 - Nov. 2	4500 - 5000	
			Nov. 4	4760	yes 4760
F046/F	Oct. 8	6300	Oct. 9 - 15	6000 - 6500	
			Oct. 16 - 19	6500 - 7000	
			Oct. 20 - 23	7000 Trib[2]	
			Oct. 24 - Nov. 11	6500 - 7000	
			Nov. 21	6900	yes 6900
F045/F	Oct. 7	2600	Oct. 8 Nov. 6	2000 - 3000	
			Nov. 7	2550	yes 2550

[1] Tributary entering mainstem pond at 6200 m from fence site.
[2] Tributary entering mainstem pond at 7000 m from fence site.

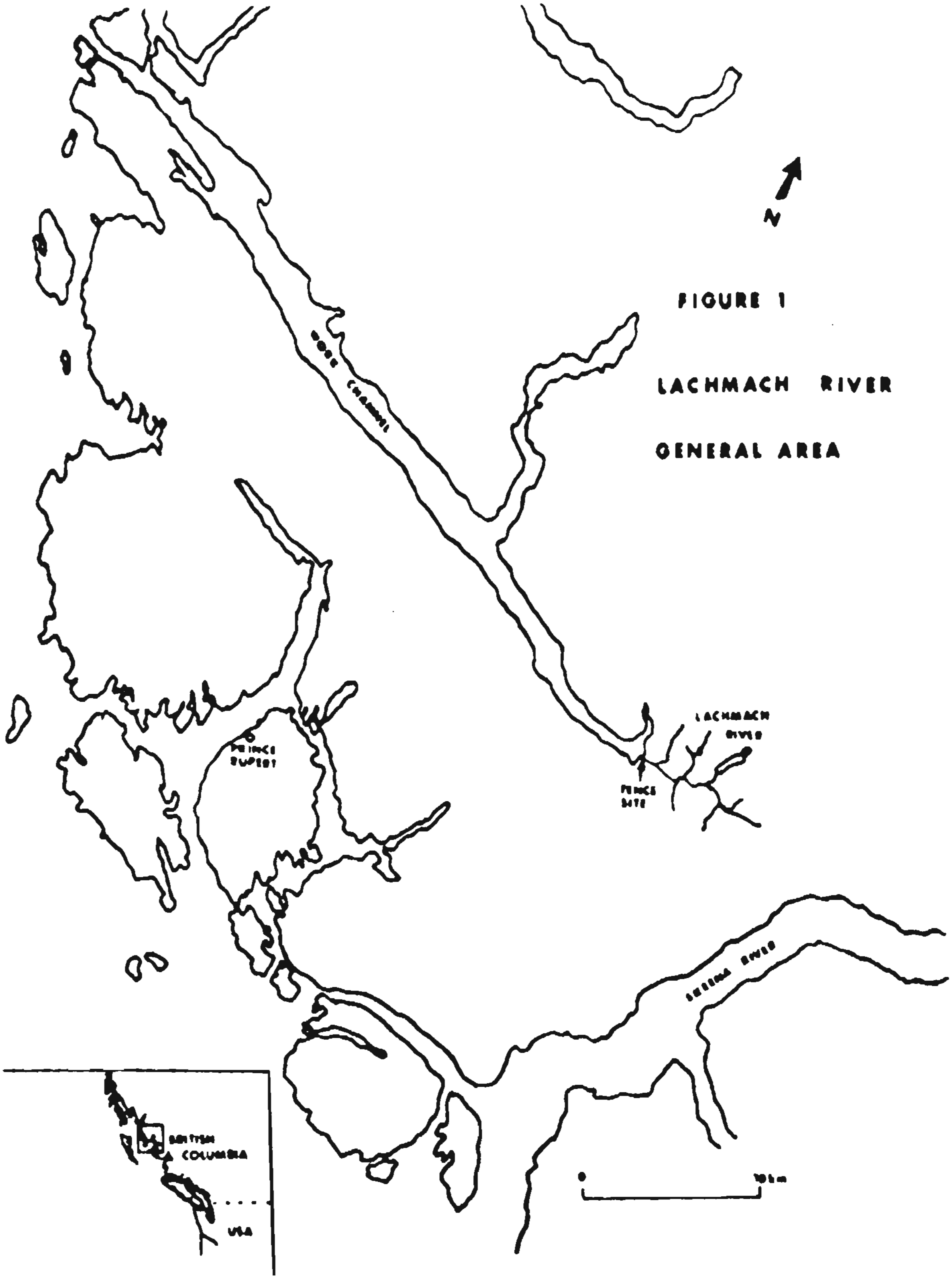


FIGURE 1

LACHMACH RIVER

GENERAL AREA

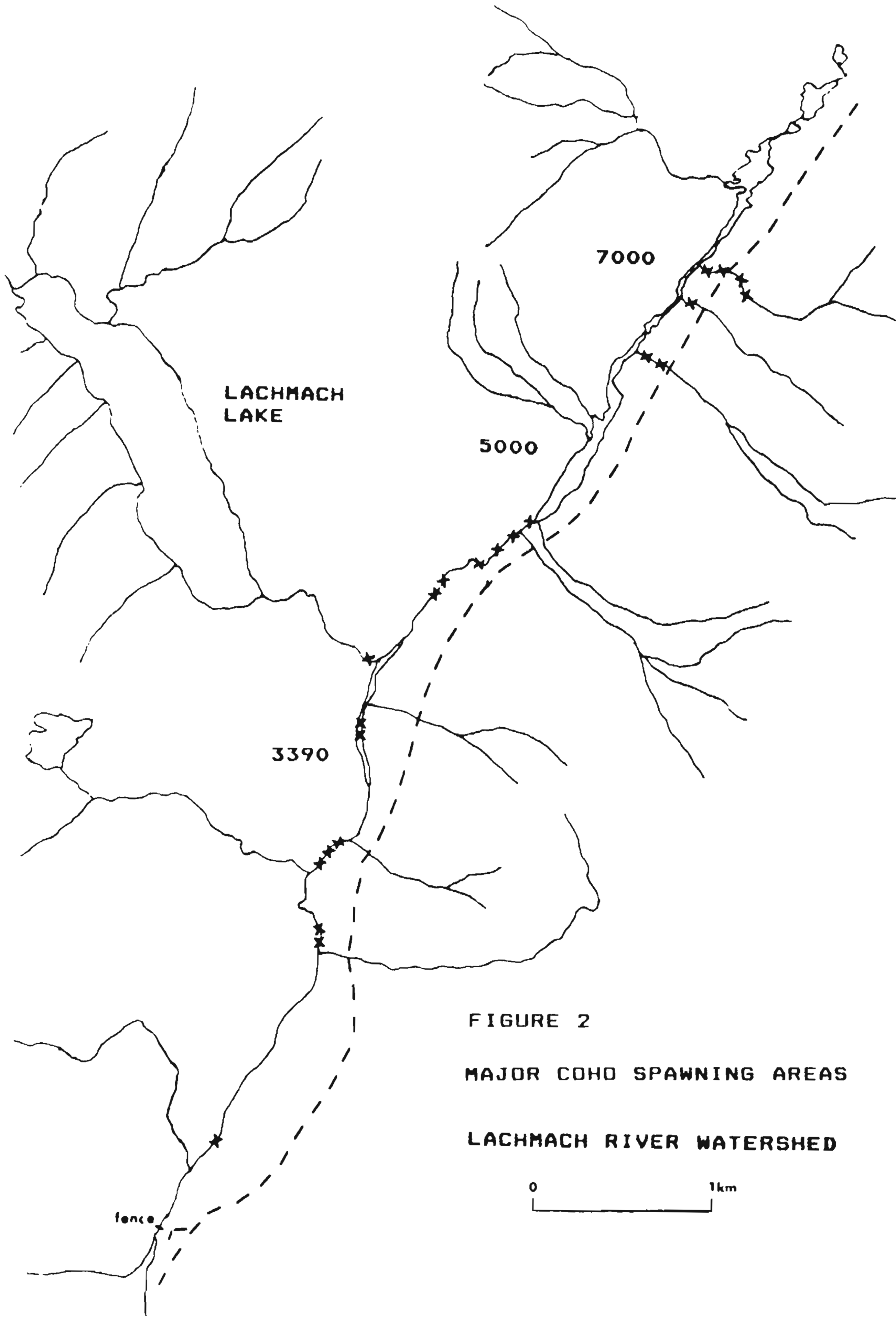


FIGURE 2

MAJOR COHO SPAWNING AREAS

LACHMACH RIVER WATERSHED

Figure 3. Daily precipitation and water height at the Lachmach River fence site, fall 1988.

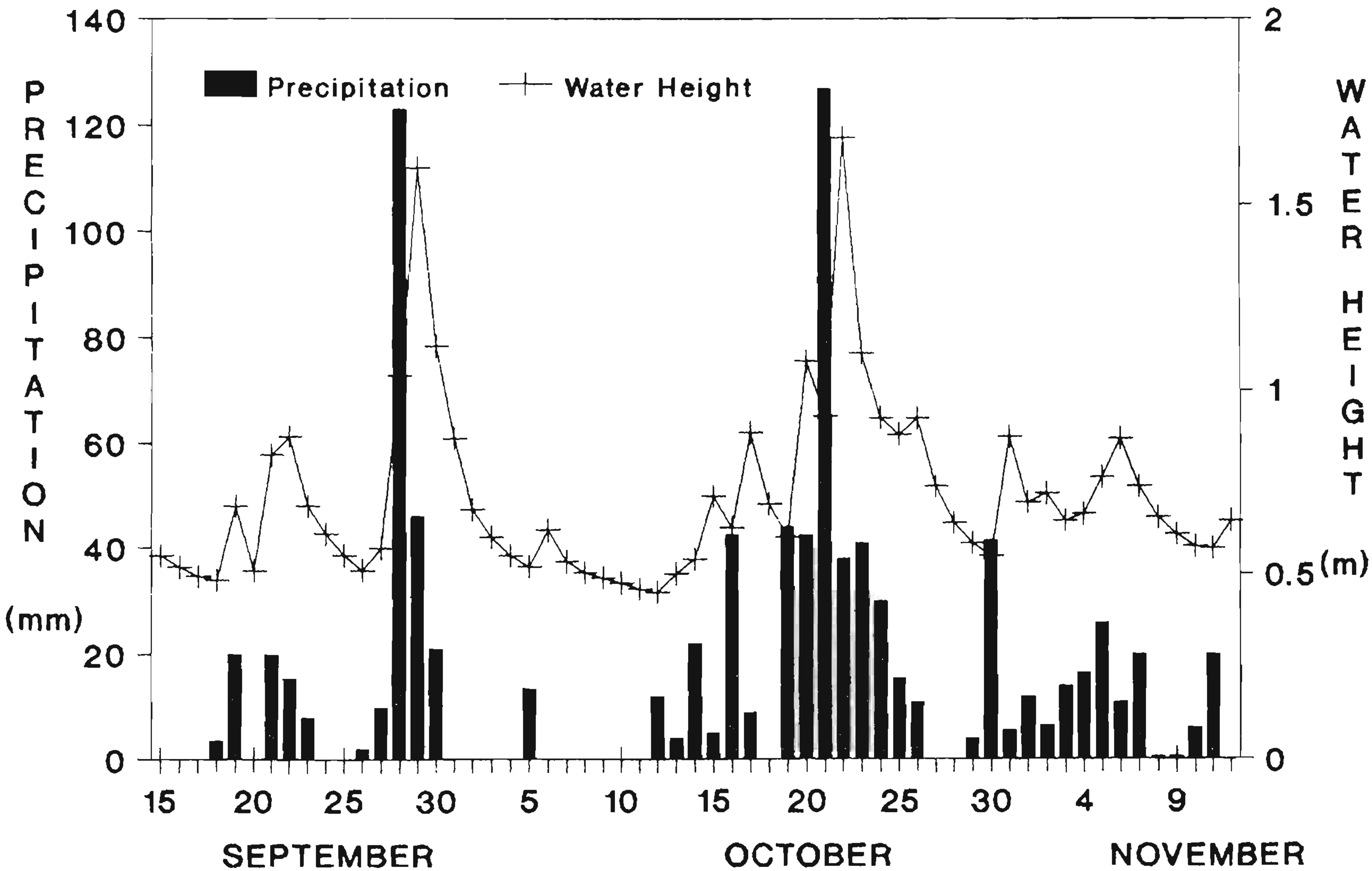


Figure 4. Mean daily water temperatures at the Lachmach River fence site, fall 1988.

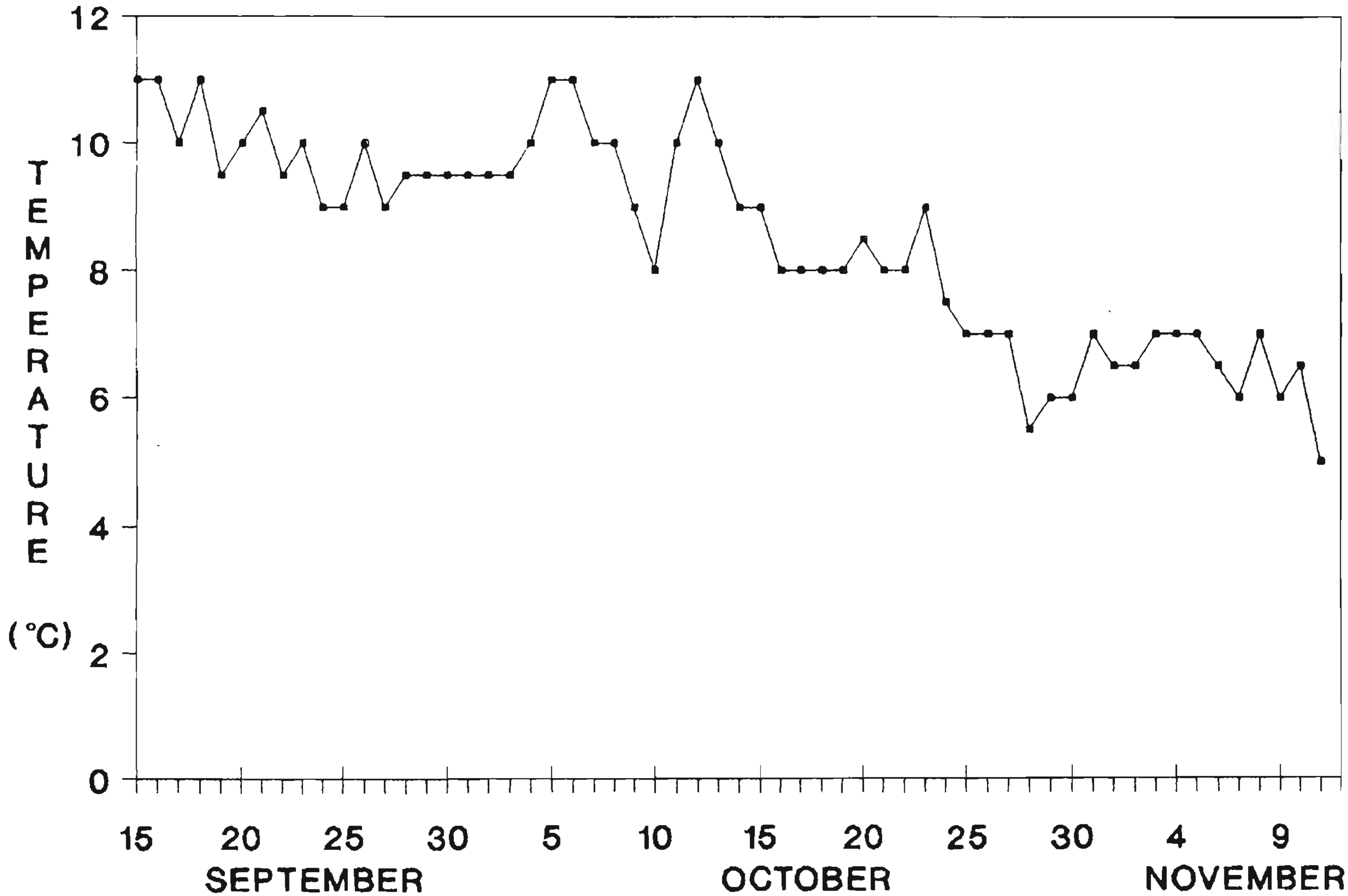
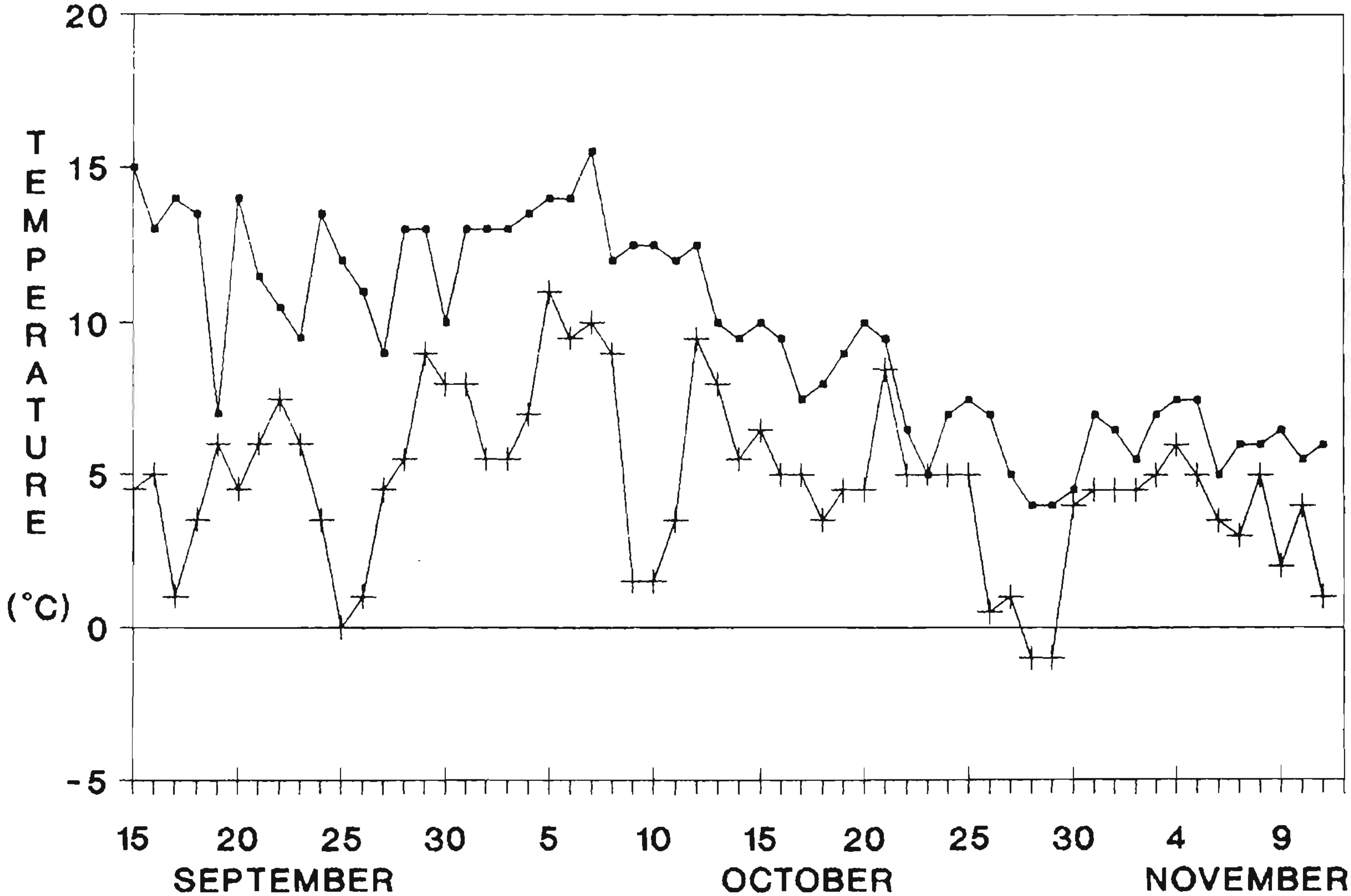


Figure 5. Daily maximum and minimum air temperatures at the Lachmach River fence site, fall 1988.



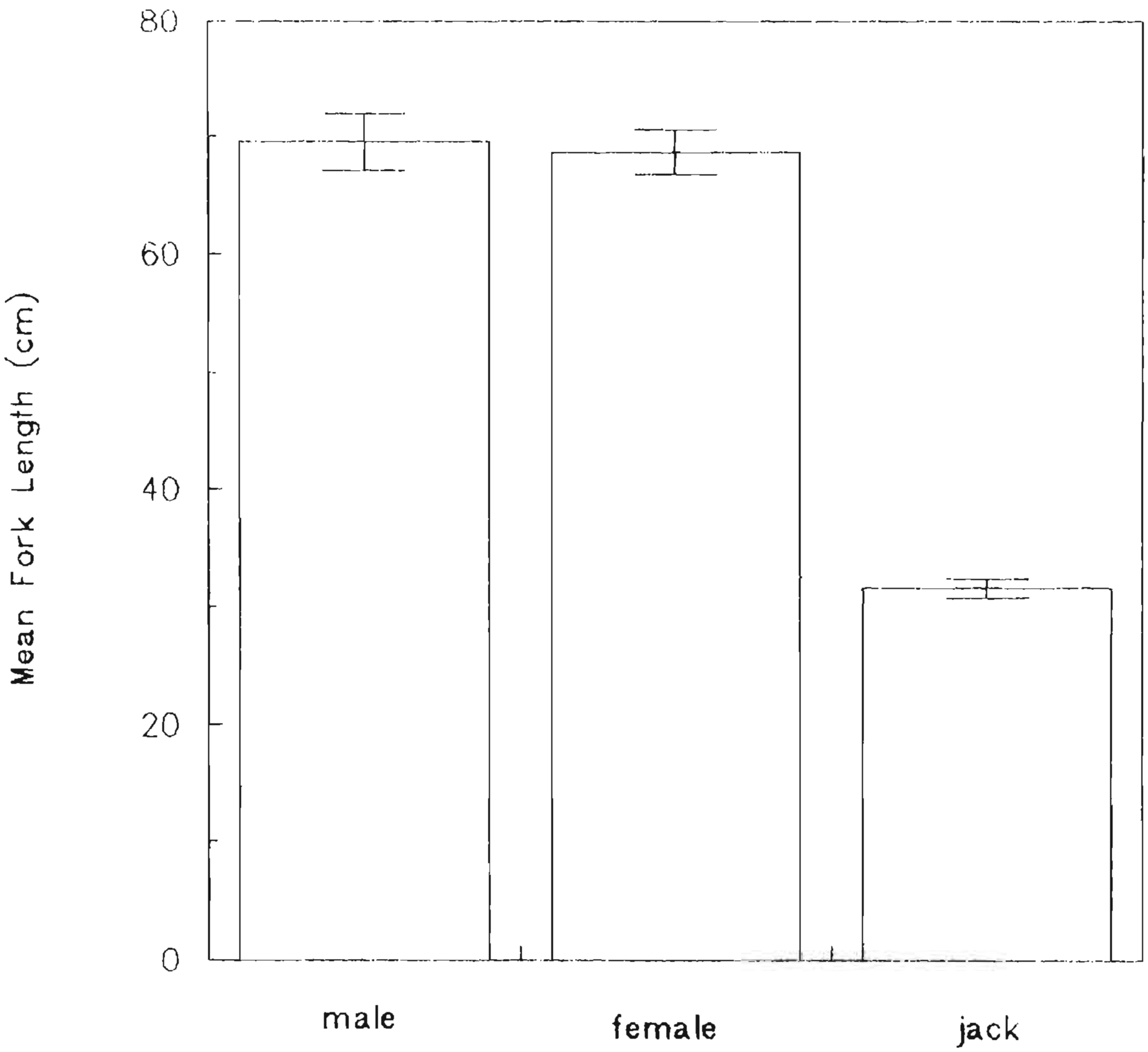


Figure 6. Mean fork lengths with 95% confidence intervals of adult coho from the Lachmach River, fall 1988.

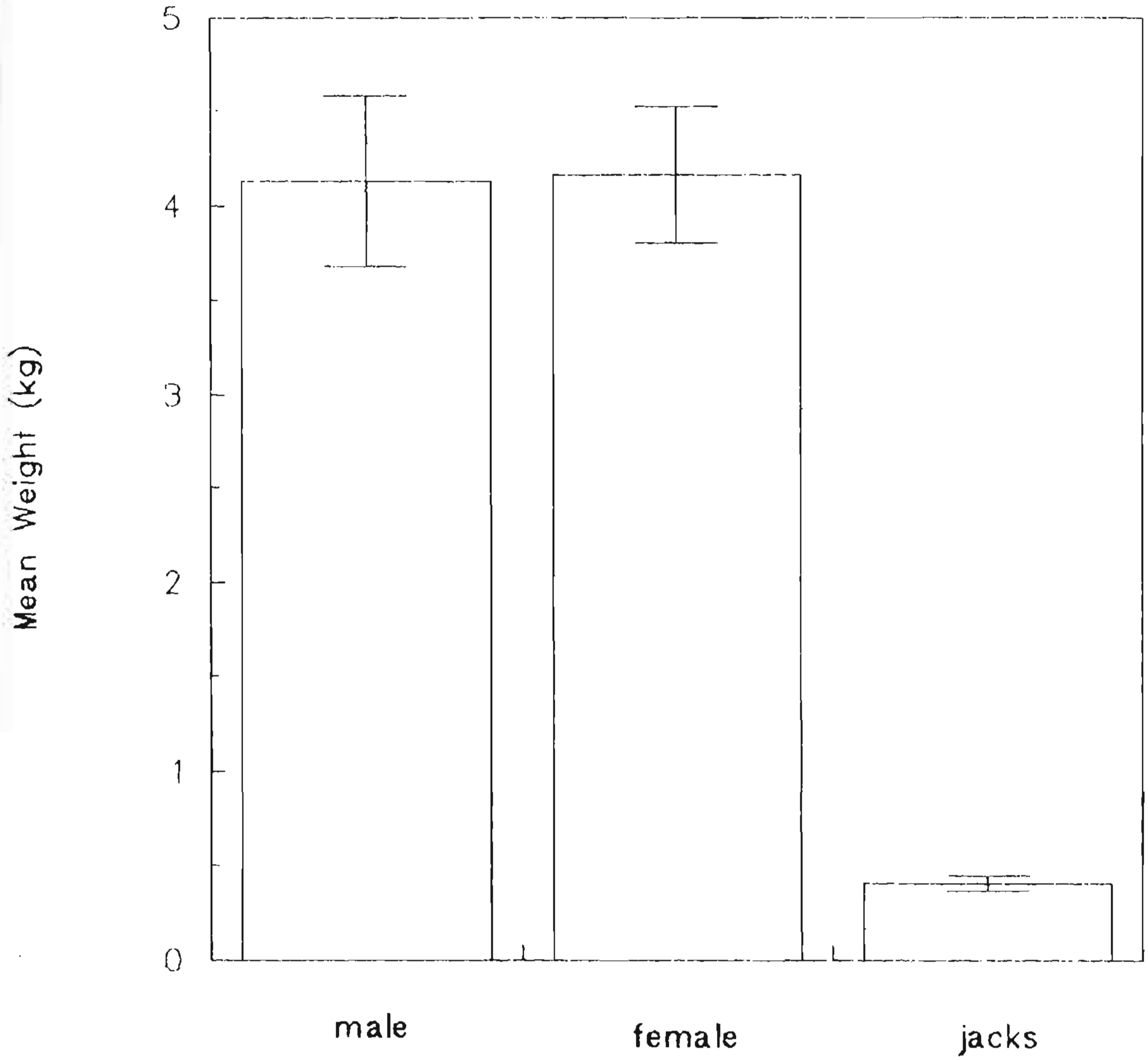


Figure 7. Mean weights with 95% confidence intervals of adult and jack coho from the Lachmach River, fall 1988.

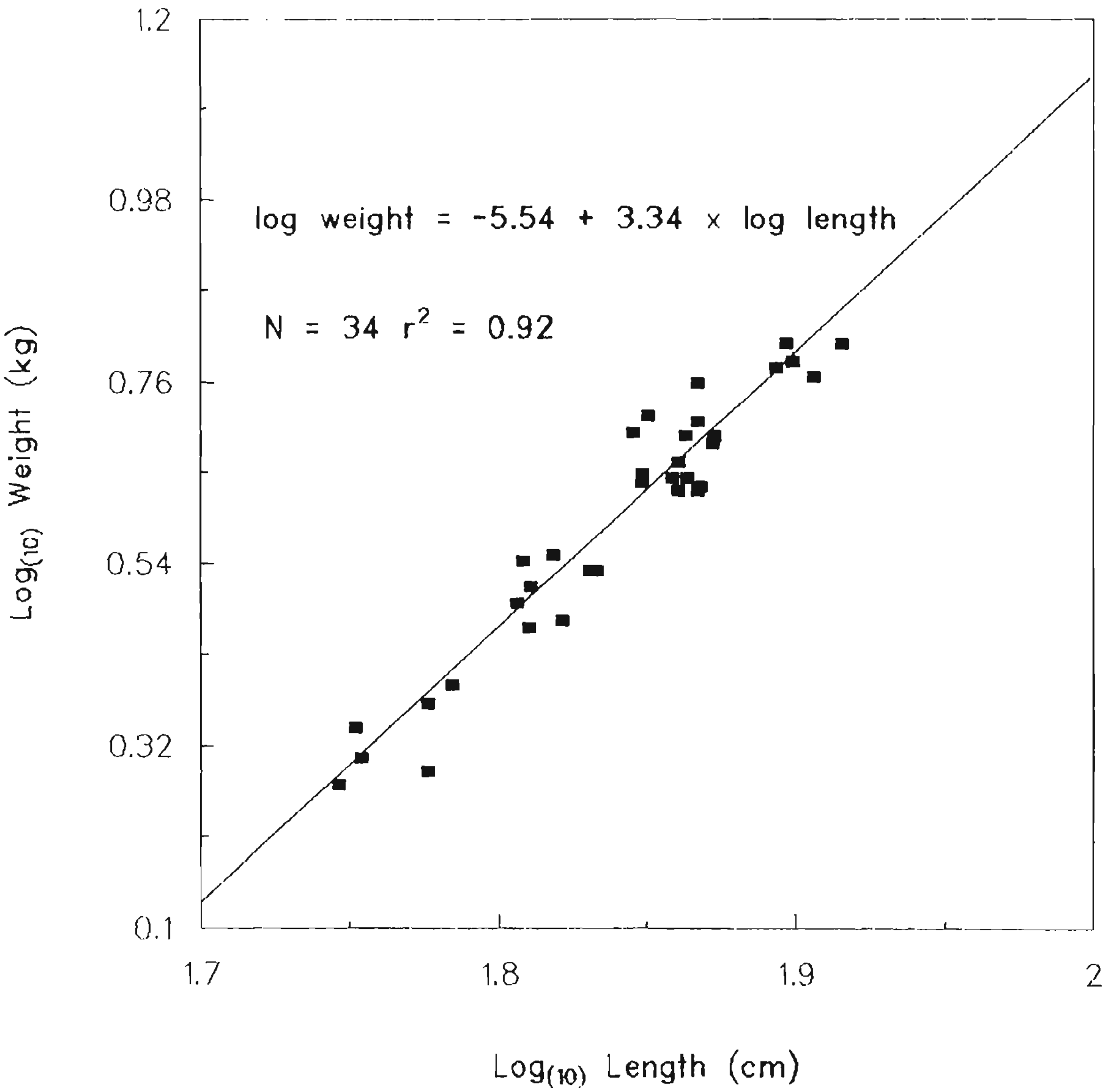


Figure 8. $Log_{(10)}$ - $Log_{(10)}$ regression of weight and length of adult male coho from the Lachmach River, fall 1988.

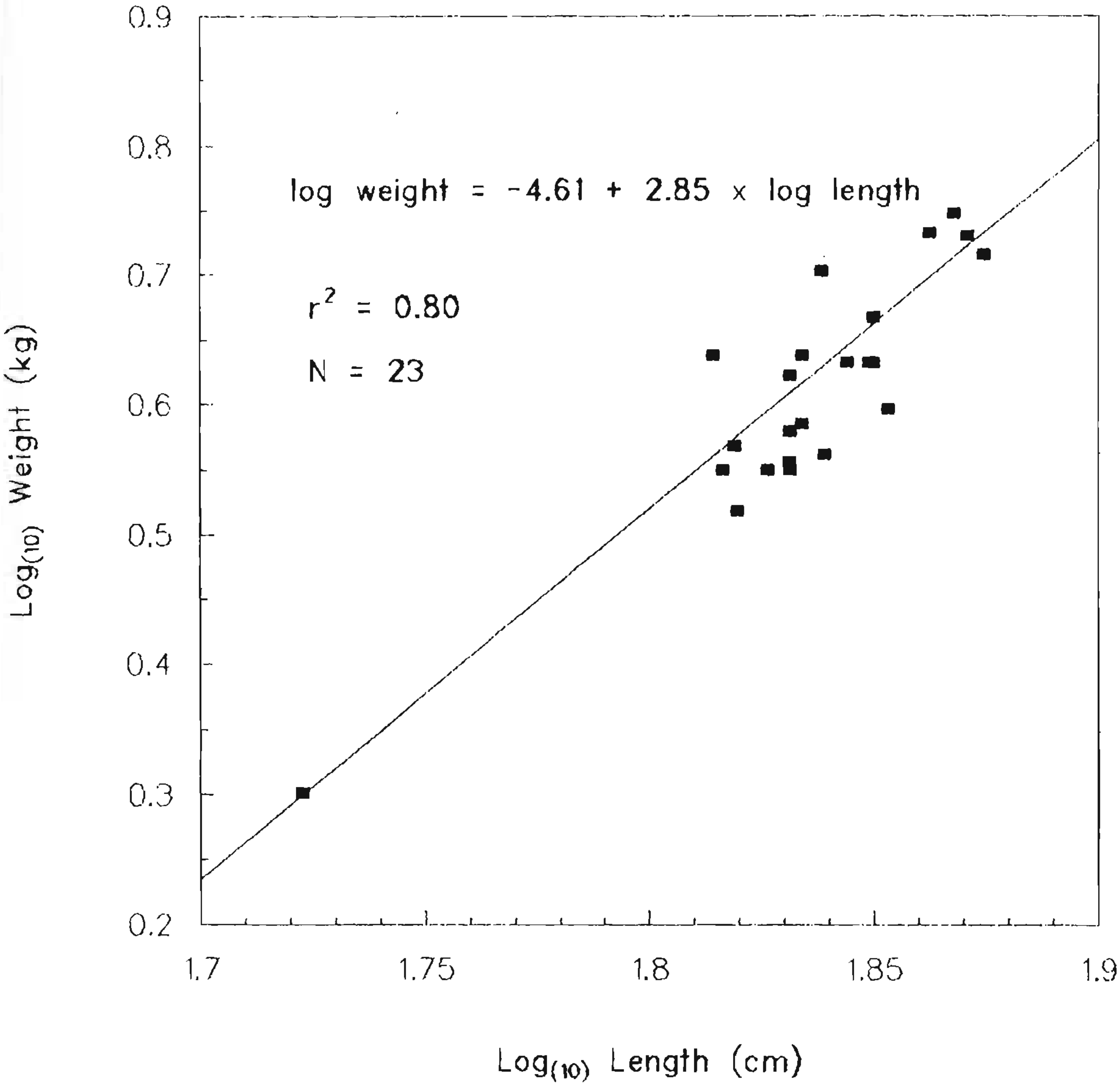


Figure 9. $Log_{(10)}$ - $Log_{(10)}$ regression of weight and length of adult female coho from the Lachmach River, fall 1988.

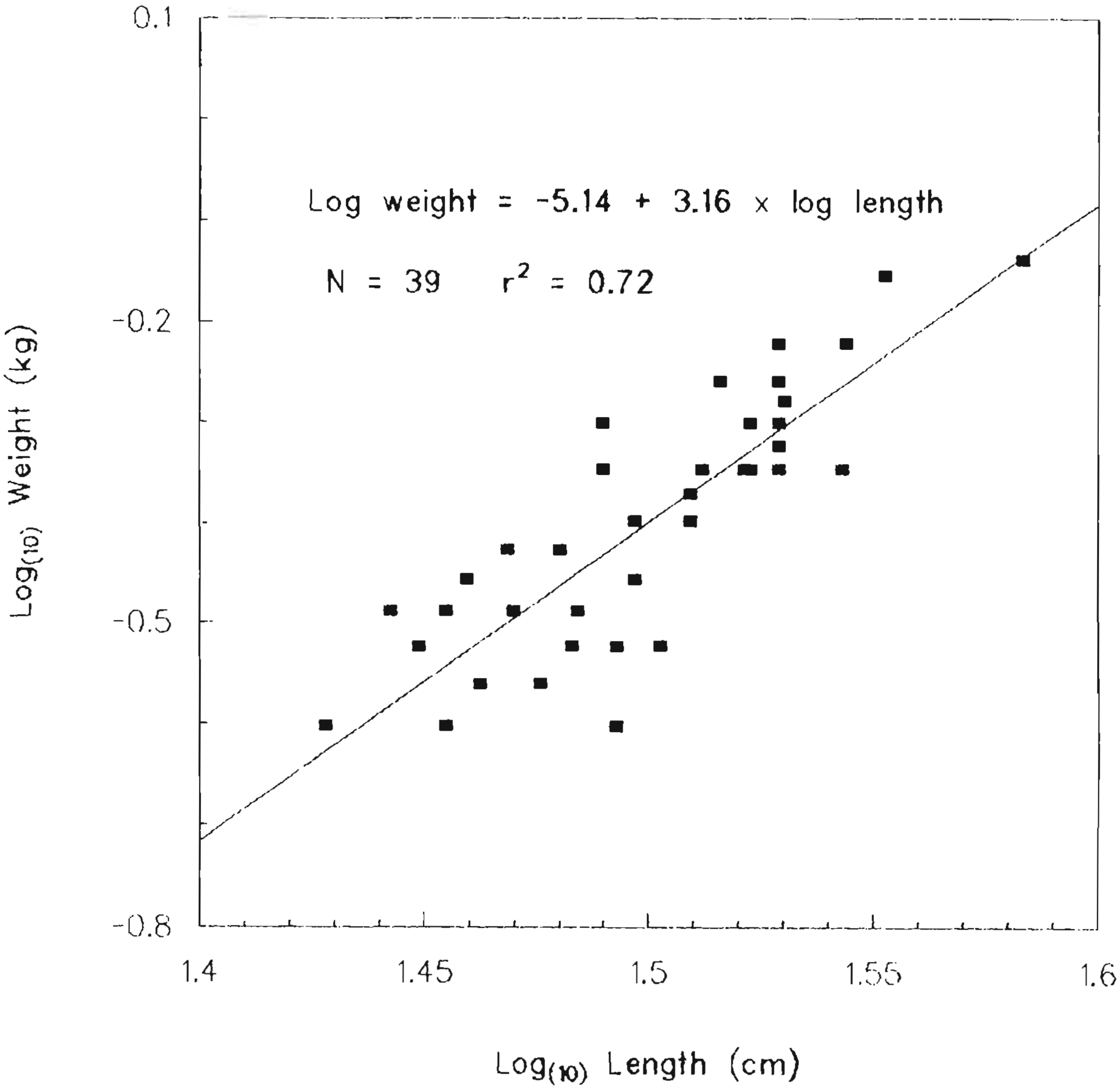


Figure 10. $Log_{(10)}$ - $Log_{(10)}$ regression of weight and length for jack coho from the Lachmach River, fall 1988.

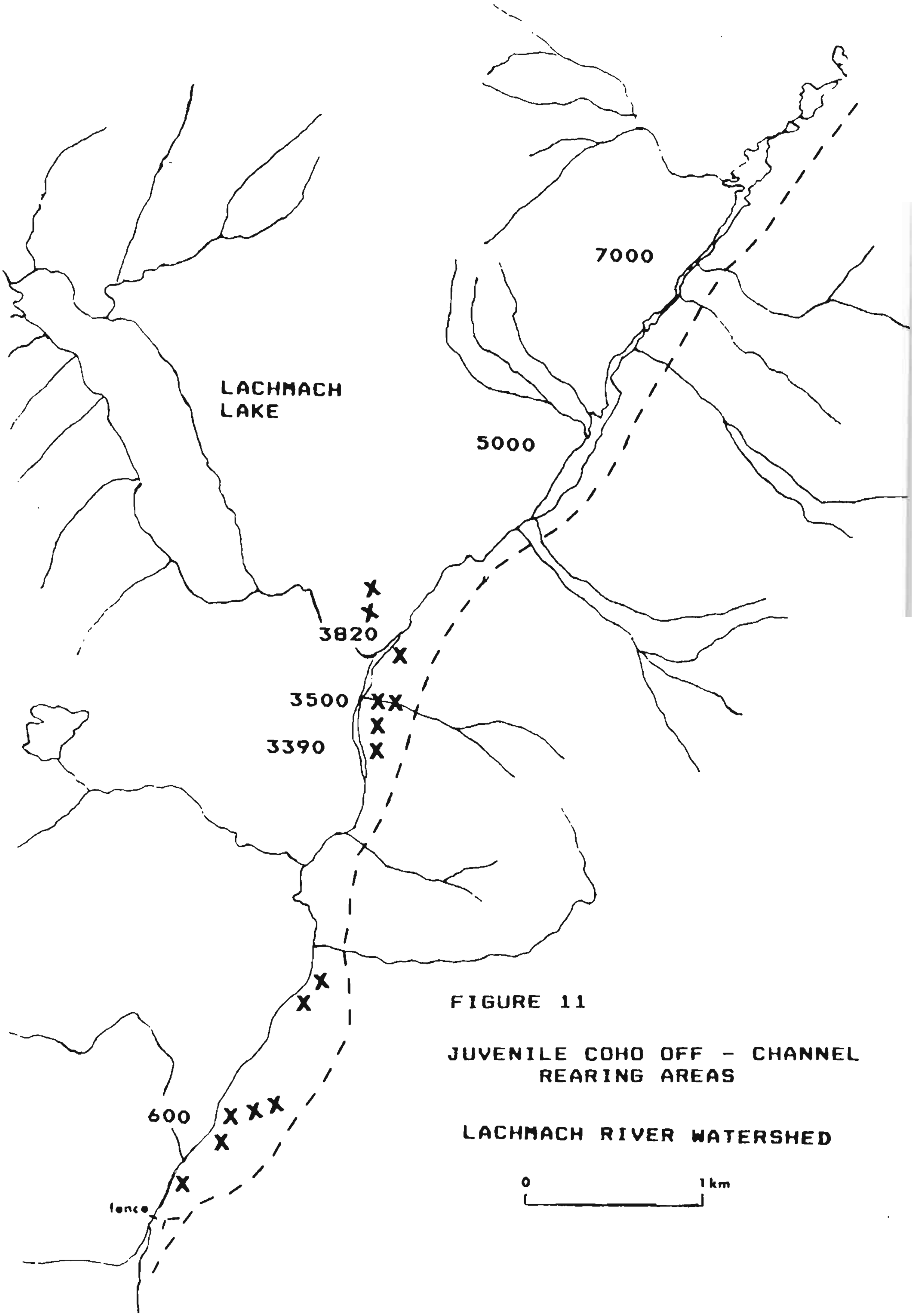


FIGURE 11

JUVENILE COHO OFF - CHANNEL
REARING AREAS

LACHMACH RIVER WATERSHED

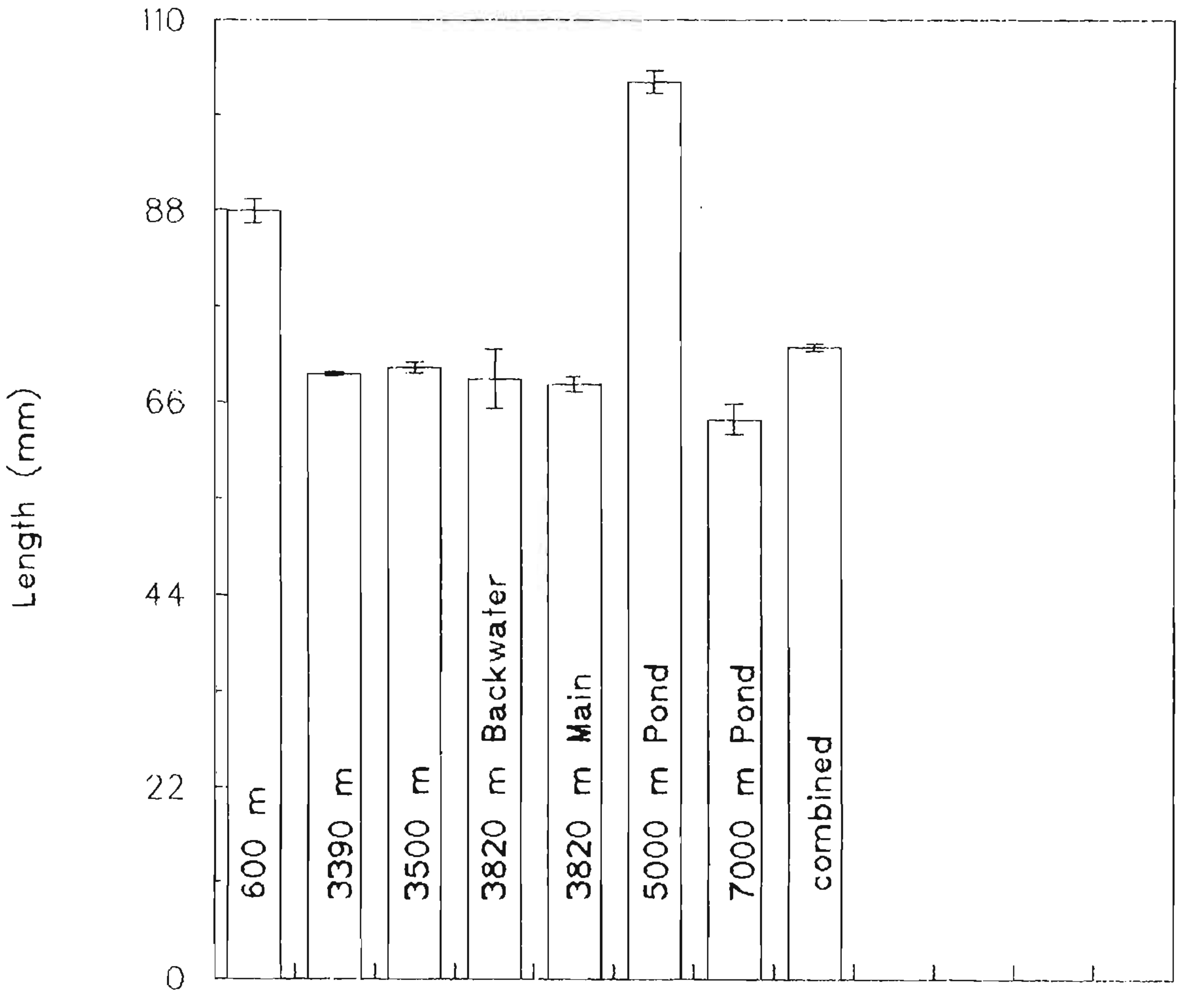


Figure 12. **Mean** lengths with 95% confidence intervals for juvenile coho from the Lachmach River, fall 1988.

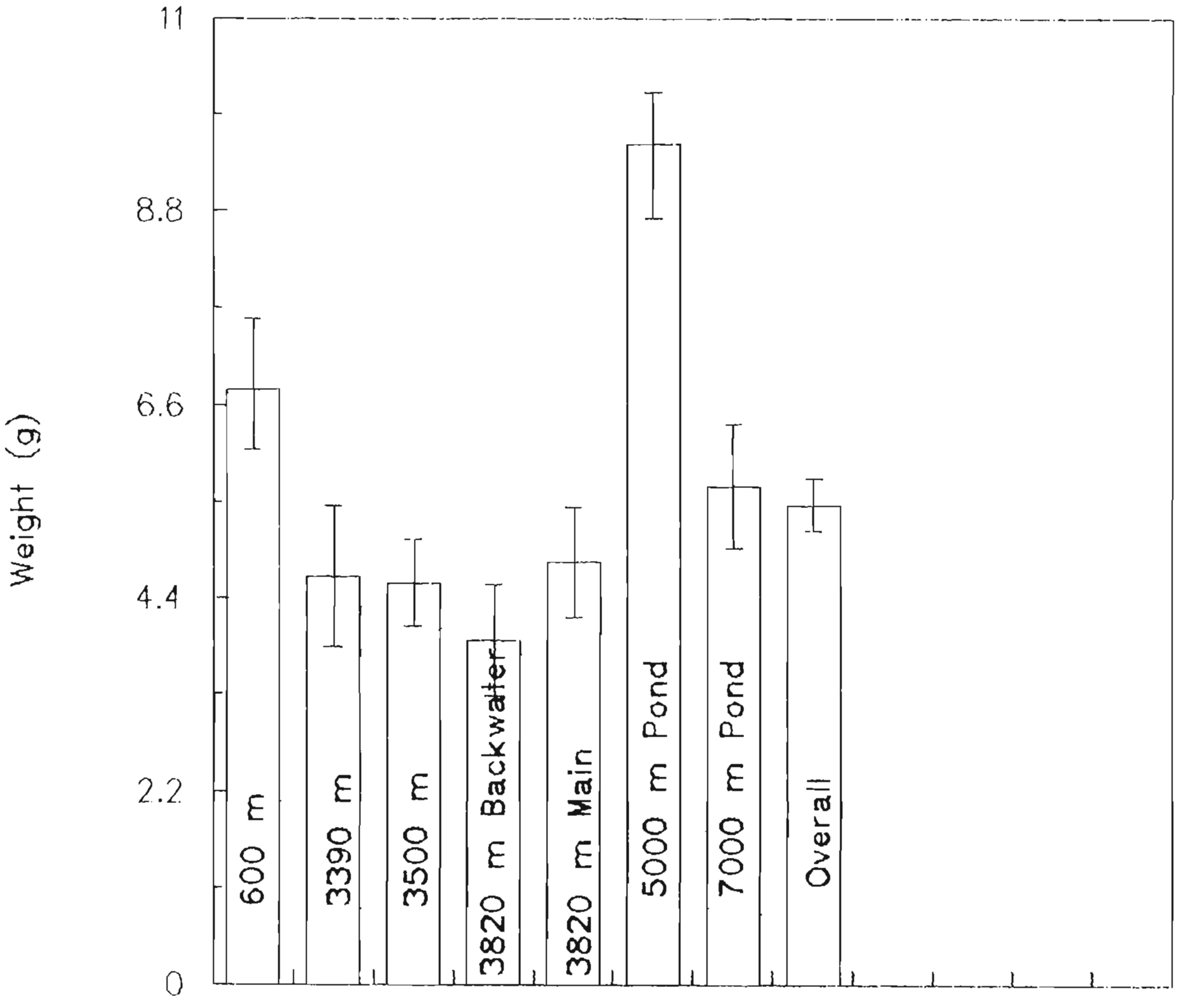


Figure 13. Mean weights with 95% confidence intervals for juvenile coho from the Lachmach River, fall 1988.

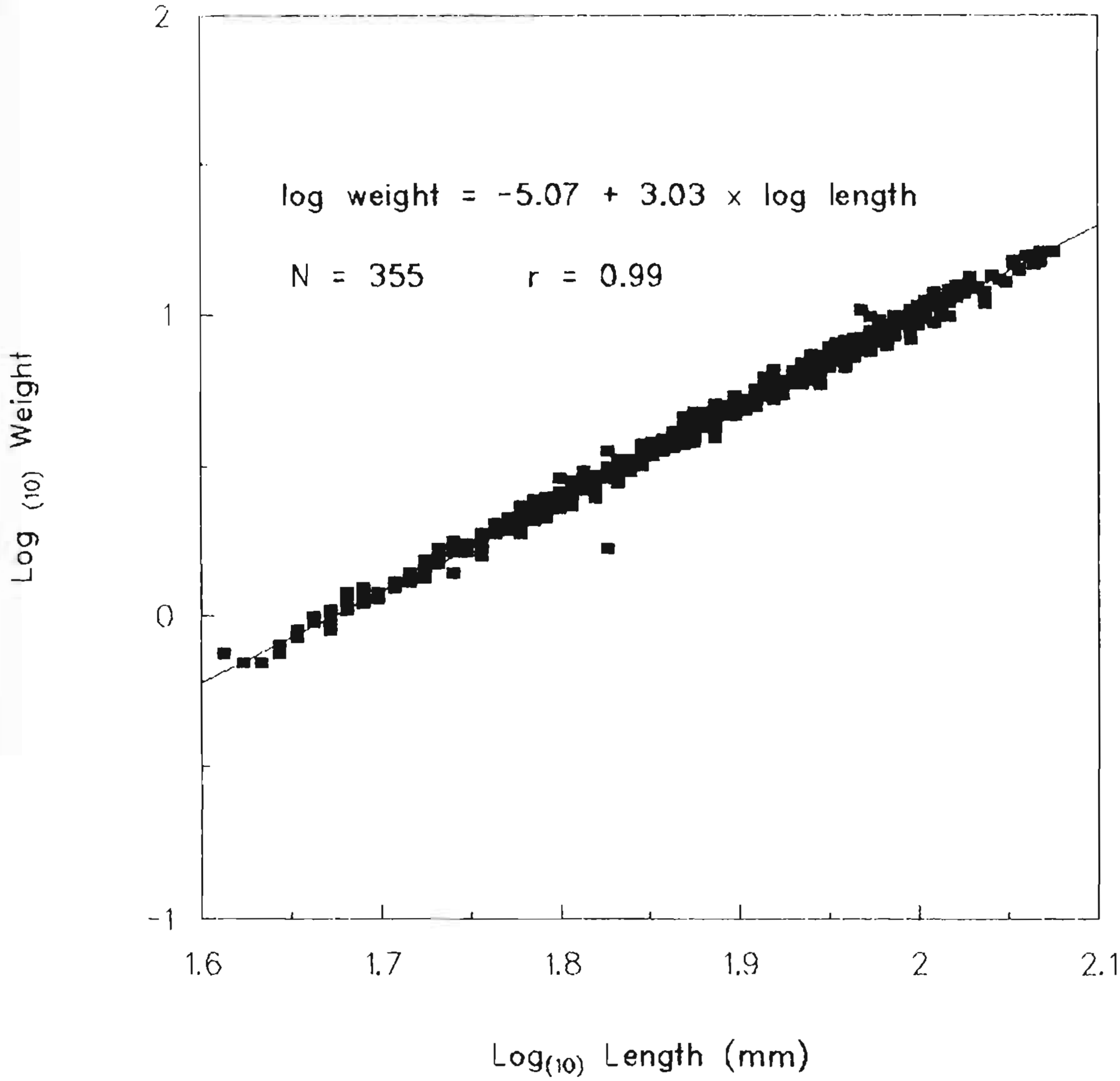


Figure 14. $Log_{(10)}$-$Log_{(10)}$ regression of weight and length of juvenile coho from the Lachmach River, fall 1988.

Figure 15. Length frequencies of juvenile coho from the Lachmach River system, fall 1988.

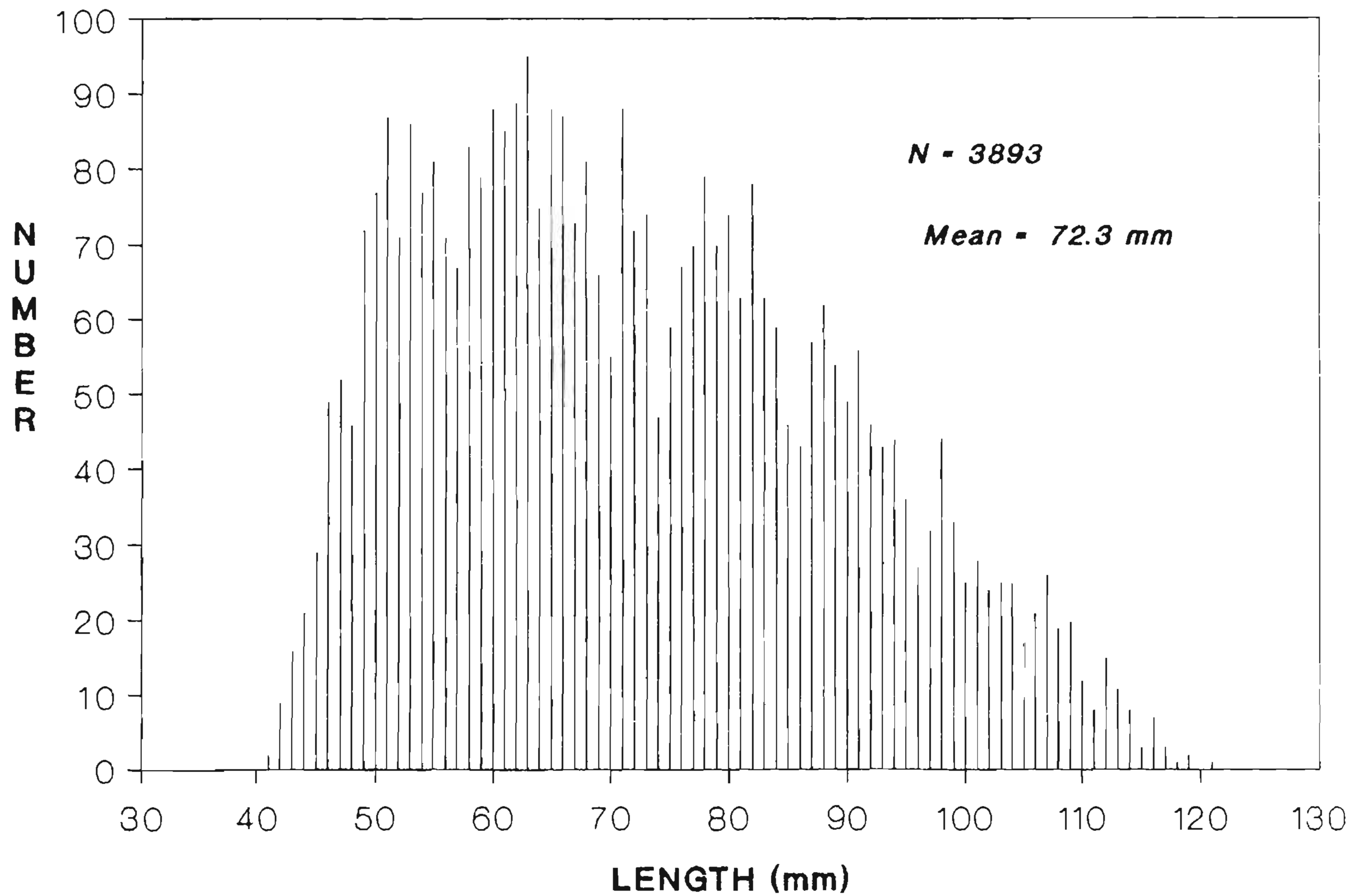


Figure 16. Length frequencies of juvenile coho from the 600m off channel area of the Lachmach River, fall 1988.

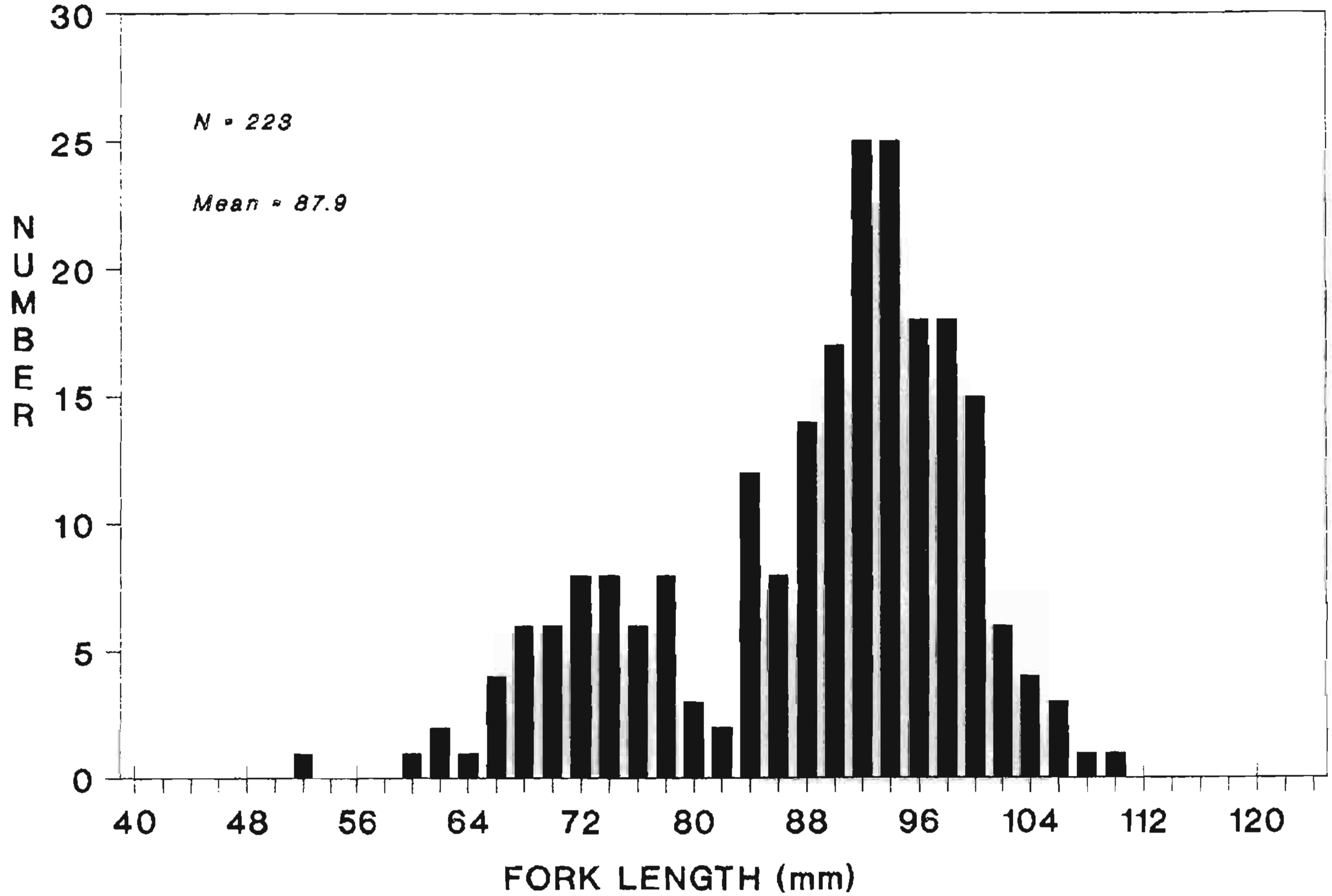


Figure 17. Length frequencies of juvenile coho from the 3390 m off channel area of the Lachmach River, fall 1988.

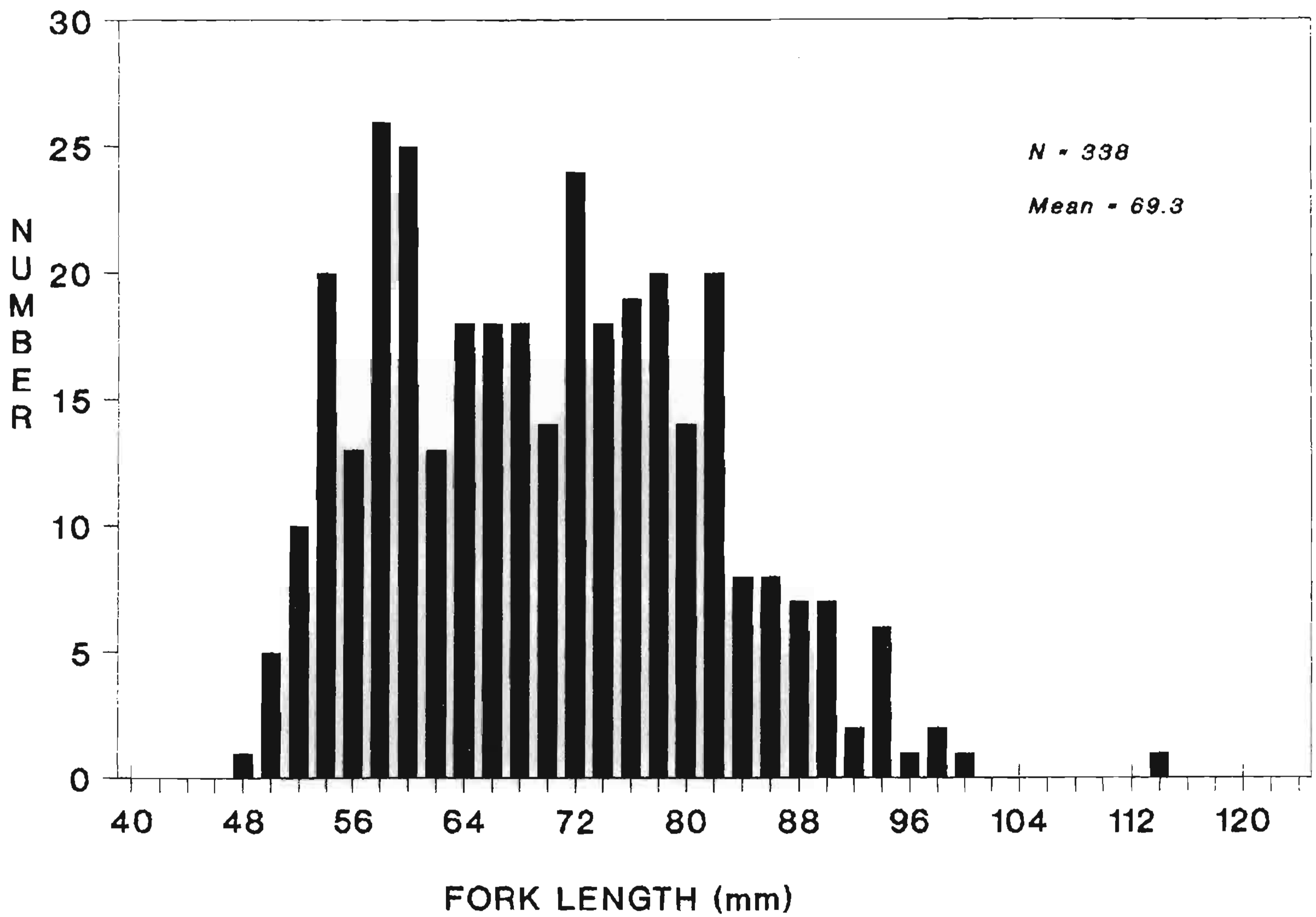


Figure 18. Length frequencies of juvenile coho from the

3500 m off channel area of the Lachmach River, fall 1988.

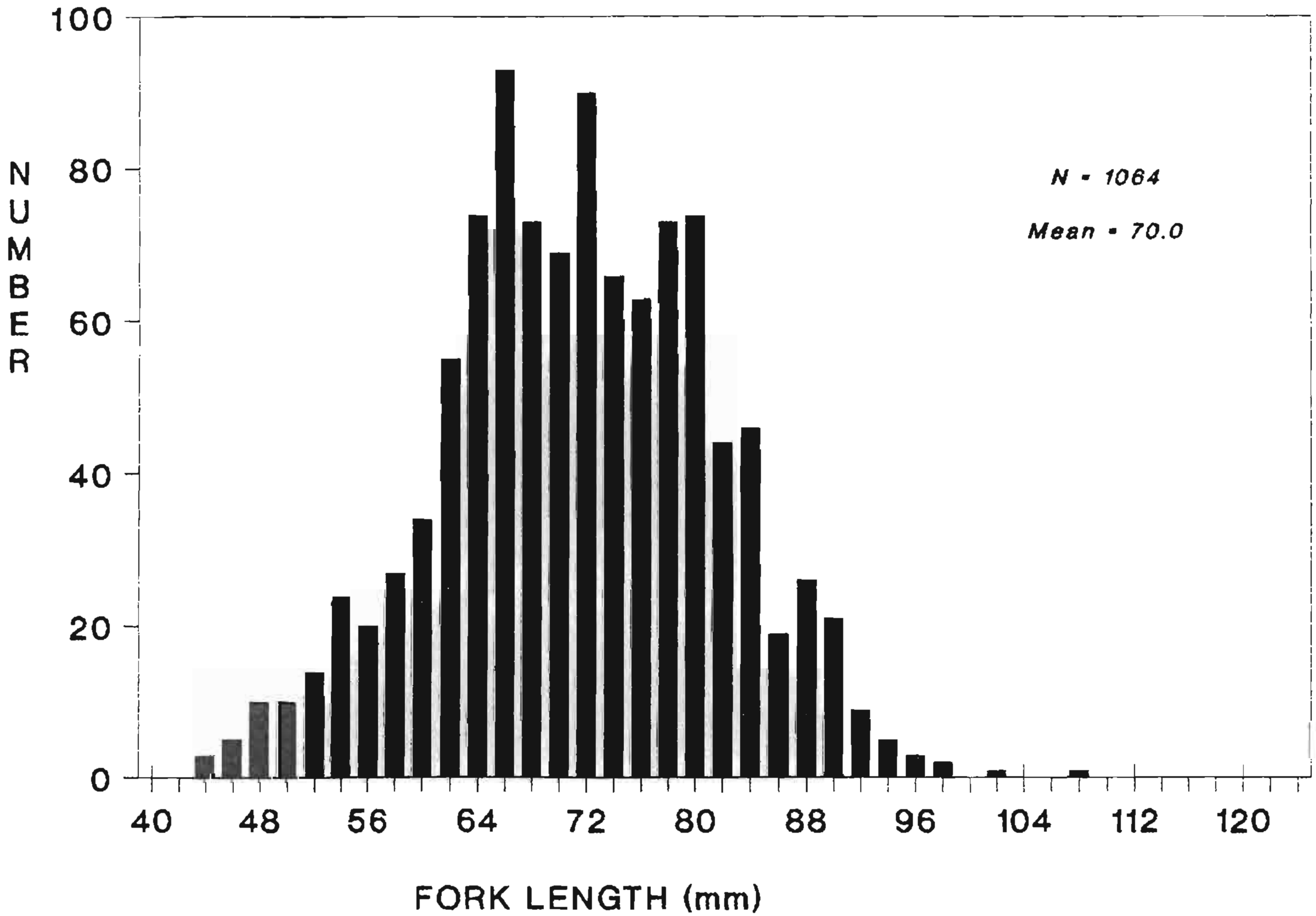


Figure 19. Length frequencies of juvenile coho from the 3820 m off channel area of the Lachmach River, fall 1988.

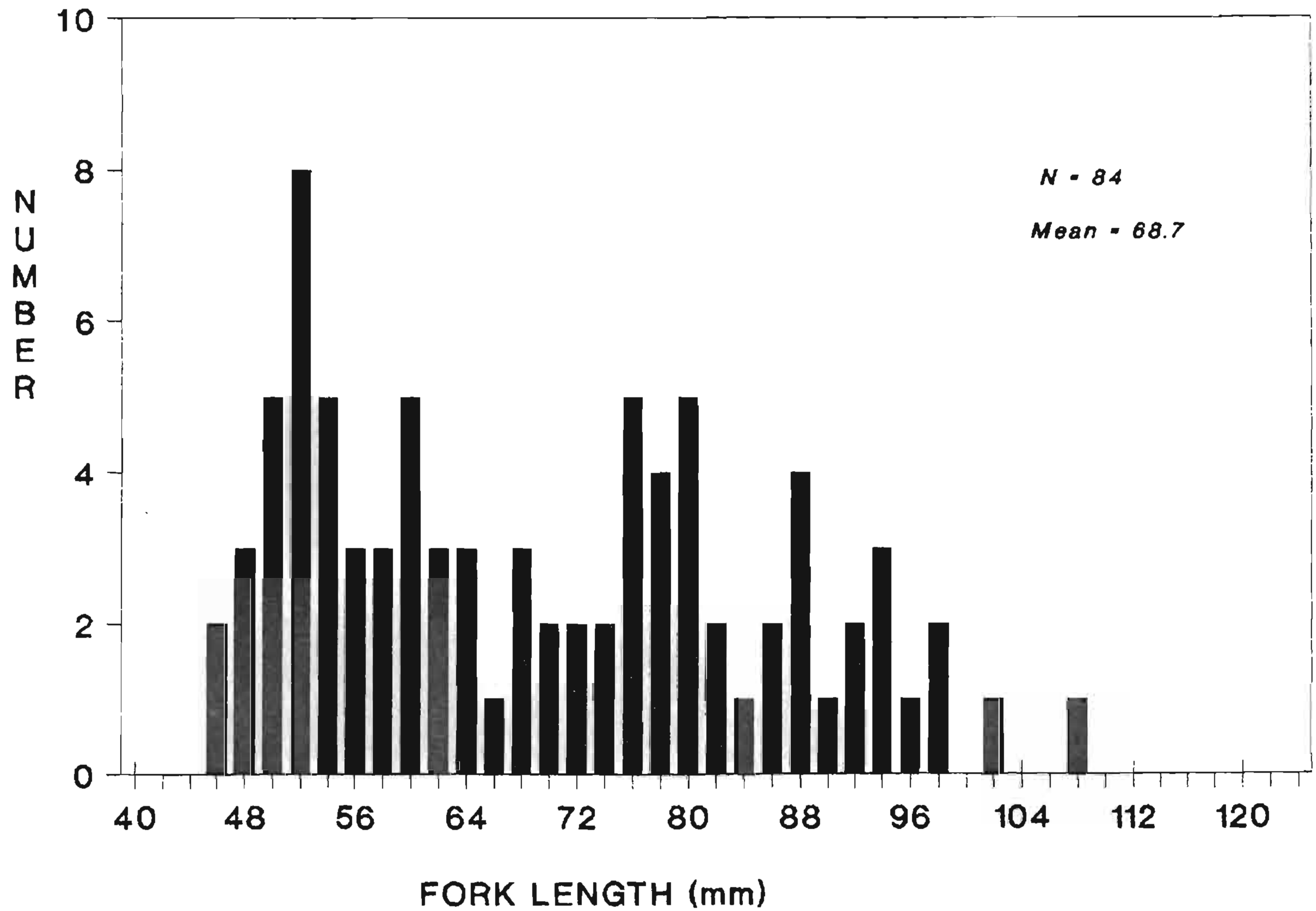


Figure 20. Length frequencies of juvenile coho from the 3820 m area of the Lachmach River, fall 1988.

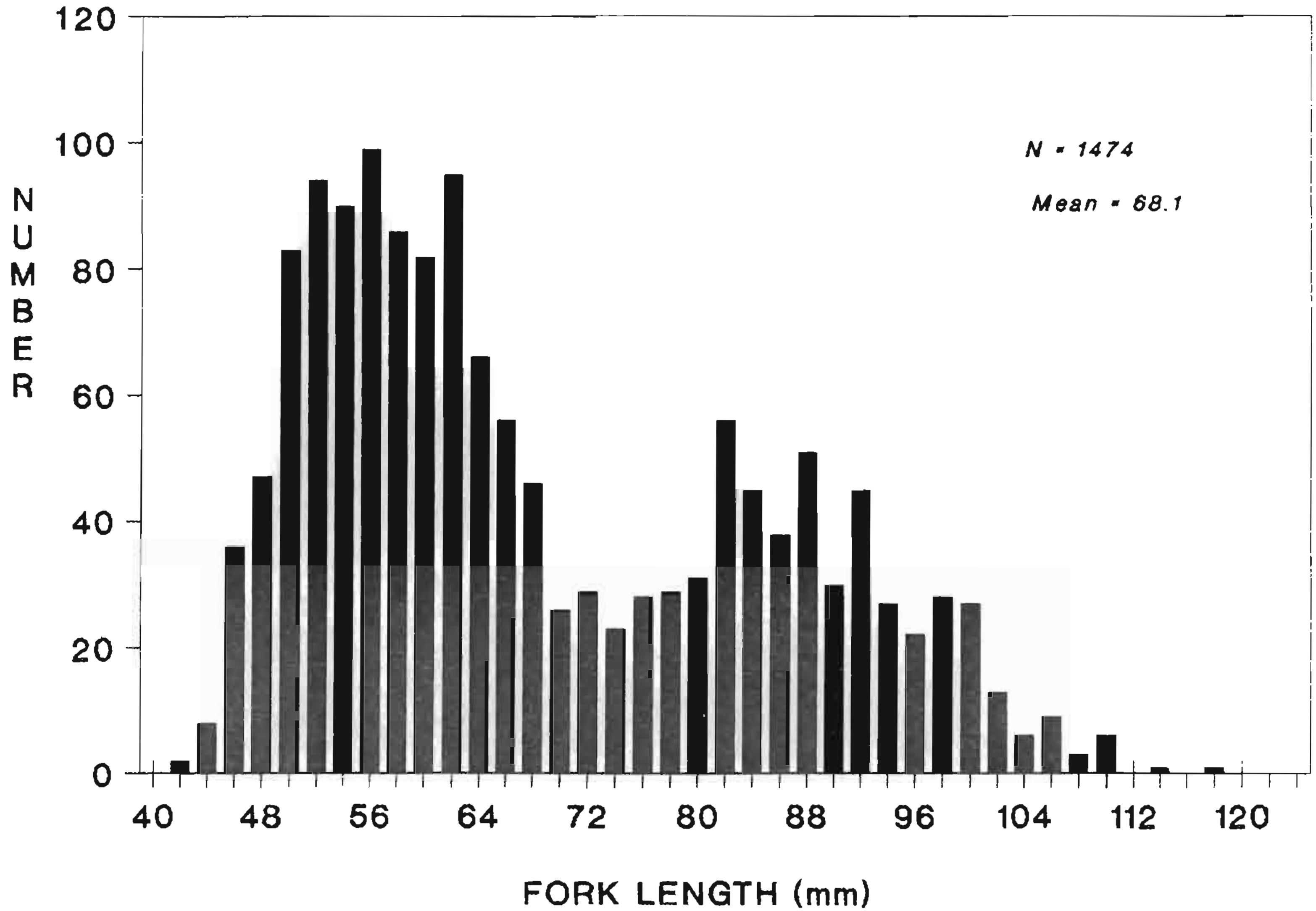


Figure 21. Length frequencies of juvenile coho from the 5000 m pond area of the Lachmach River, fall 1988.

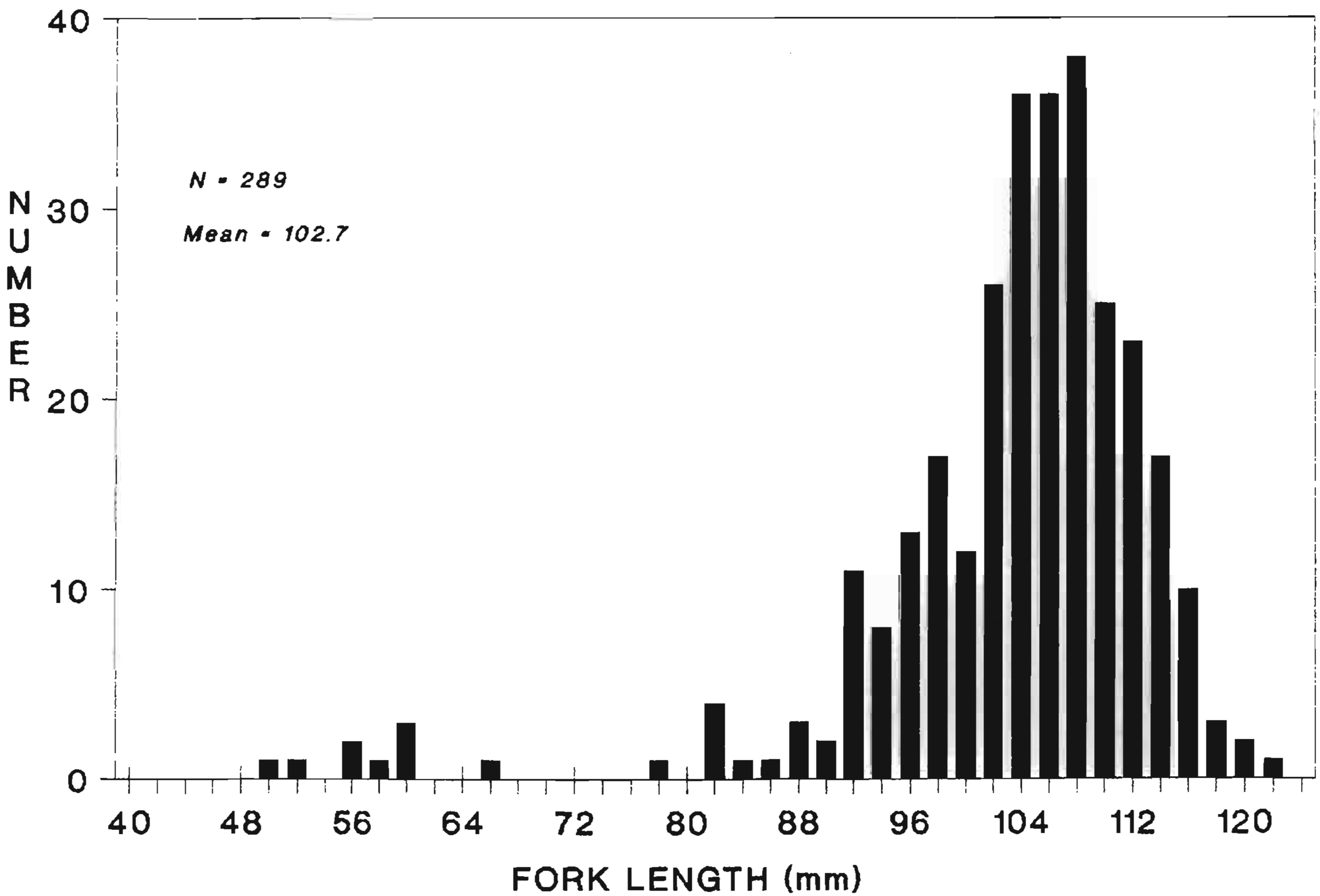


Figure 22. Length frequencies of juvenile coho from the 7000 m pond area of the Lachmach River, fall 1988.