Data on Rearing, Tagging, and Release of Accelerated and Normally Reared Coho Salmon from Rosewall Creek, 1974

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DATA ON REARING, TAGGING, AND RELEASE OF ACCELERATED AND NORMALLY REARED COHO SALMON FROM ROSEWALL CREEK, 1974

by

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ABSTRACT

Bilton, H. T., R. M. Humphreys, D. W. Jenkinson, and G. Johnston. 1979. Data on rearing, tagging, and release of accelerated and normally reared coho salmon from Rosewall Creek, 1974. Can. Data Rep. Fish. Aquat. Sci. 169: 17 p.

An experiment is currently in progress to compare the survival, growth, age at maturity and distribution of accelerated (6 mo+) with normally reared (14 mo+) juvenile coho salmon (Oncorhynchus kiscutch). In the spring of 1974 (June 10) approximately 10,000 accelerated smolts and 12,000 normally reared (14 mo+) smolts were released from Rosewall Creek, B.C.. In the fall of 1974 (November 6) a second group of approximately 11,000 accelerated coho was released. The present report provides, in readily accessible form, background information required to assess the results of this experiment. Specific information on their growth histories, lengths, weights and sex composition, and the cost of rearing, tagging, etc. is provided.

Key words: Spring, fall releases, accelerated, normal coho.

RÉSUMÉ

Bilton, H. T., R. M. Humphreys, D. W. Jenkinson, and G. Johnston. 1979. Data on rearing, tagging, and release of accelerated and normally reared coho salmon from Rosewall Creek, 1974. Can Data Rep. Fish. Aquat. Sci. 169: 17 p.

On mène actuellement une expérience visant à comparer les taux de survie et de croissance, l'âge à la maturité et la distribution de jeunes saumons cohos (Oncorhynchus kisutch) à croissance accélérée (6 mo +) et à croissance normale (14 mo +). Au printemps 1974 (10 juin), on a libéré environ 10,000 saumoneaux à croissance accélérée et 12,000 saumoneaux à croissance normale (14 mo +) de l'élevage du ruisseau Rosewall (C.-B.). A l'automne 1974 (6 novembre), un second groupe d'environ 11,000 saumons à croissance accélérée a été libéré. Le rapport présente, sous une forme facile à consulter, les renseignements de base permettant d'évaluer les résultats de cette expérience. Des informations précises sur l'évolution de la croissance, la longueur, le poids et le rapport des sexes des saumons, ainsi que sur le coût de l'élevage, du marquage, etc., sont présentées dans le rapport.

Mots clés: libération au printemps et à l'automne, saumon coho à croissance accélérée ou normale.

INTRODUCTION

This report provides the background data to an experiment whose objectives were (1) to rear juvenile coho salmon (Oncorhynchus kisutch) to the smolt stage in 6 months through control of temperature, food, and light; and (2) to compare the distribution, growth, survival, age at maturity, and homing of these fish with a control, comprising a group reared at ambient temperatures for the normal 14 mo. A spring and a fall release of accelerated coho was made from the Resource Services Branch Rosewall Creek facility 80 km north of Nanaimo; the first release was made on June 10, 1974, and the second on November 6, 1974. The control group of coho was liberated with the first group of accelerated fish (June 10).

SPRING RELEASE

A. History of accelerated coho

1. Donor stocks

Coho eggs were collected from the Big Qualicum River (approximately 24 km south of Rosewall Creek) on November 21 and December 1, 1973, and from Robertson River, a tributary of the Cowichan River system, 128 km south of Rosewall Creek on November 14 and 30, 1973. A total of approximately 7,000 Big Qualicum River and 13,000 Robertson River coho eggs were taken, fertilized, and transferred to Heath-type hatchery trays at the Rosewall Creek hatchery.

2. Incubation

Well water was used for egg incubation. Electric immersion heaters provided heated water, and the eggs were incubated at 10-12°C. Mortality to the "eyed" stage (December 27) was 9.7% (692 dead) and 5.5% (742 dead) among the Big Qualicum River and Robertson River coho eggs, respectively.

3. Fry

All eggs had hatched by January 7, 1974, after accumulated thermal experience of 473.4 degree days. A total of 4,499, Big Qualicum River coho fry and 8,827 Robertson River coho fry were transferred into three 2.44 m diameter circular fiberglass tanks on February 7, 1974. The Big Qualicum fry were placed in one tank and the Robertson River fry were divided equally between two other tanks. For the first 4 days (February 7-11) the fry were held at 9°C then the temperature was increased to 16°C.

Between December 27 and February 7, mortality among alevins and fry was 29.7% (1,905 dead) and 30.4% (3,853 dead) among the Big Qualicum River and Robertson River coho, respectively (Table 1). Because of this high mortality, additional spare fry originating from each stock were transferred into the tanks on February 11. On that date, 1,496 additional fry were added to the Big Qualicum River group and 4,025 fry were added to the Robertson River group. The spare fry up to the time of transfer had had the same temperature and rearing history as the fry in the experimental tanks.

During February, high mortality continued (average of 13.4%), (Table 1). It was suspected this mortality was associated with a late start of initial feeding, resulting in loss from starvation. Examinations of dead fry (February 13) indicated they were advanced and many were "buttoned up." High mortality continued until the end of the first week in March and then ultimately to a very low level. From February 12–May 30, fish were reared at mean water temperatures ranging between 14.8 and 16.0°C. On May 31, we began gradually decreasing the water temperature until June 3 when it reached the ambient well water temperature of 7.0°C. Between February 7 and March 4, the water flow to each tank was held at 18 L/min. On March 4, the flow to each tank was increased to 29 L/min and held at that rate until May 30. To supplement the oxygen supply in the water, we began on April 3 to bubble compressed air into each tank and this was continued until June 3. During the rearing period, oxygen and ammonia concentrations were monitored daily (Table 1). Fish were reared under fluorescent light and the photoperiod was increased throughout the period of rearing, timed to coincide with that of normal day length.

4. Feeding

Initially, fry were fed Oregon Moist Pellet (OMP) starter mash and subsequently, various-sized pellets as prescribed in the OMP feeding chart. Fish were offered food every 15 min, dawn to dusk, from automatic feeders.

5. Rearing and release facilities

Three circular fiberglass tanks (2.44 m diameter × 0.9 m depth) were used to rear the fish. These were located inside a building to prevent undue loss of heat from the water. The incoming well water was passed first through two domestic type oil-fired water heaters. From there it passed through a coiled aluminum heat exchanger (213 m) set in an effluent trough into which water from the three tanks drained. In this manner sufficient heat was recovered from the effluent to raise the final temperature of the heated inflowing water by a further 2–3°C. The heated water then passed from the heat exchangers to an open head tank. From the head tank it flowed by gravity into the three rearing tanks, and finally into the effluent trough and to waste.

Prior to the release, the fish were held in a release pond to allow a period of adjustment to a more natural environment. The release pond was constructed by placing a polyethylene liner in an excavation and covering it with a layer of sand and gravel. The pond was approximately

18.3 m long × 6.1 m wide at the bottom, with sloping sides and a total depth of 0.9-1.2 m. Fish were released from the pond, through an outflow pipe leading directly to Rosewall Creek.

6. Sampling

Every 14 days, 50 fish from each tank were sampled, anesthetized, and measured for individual lengths and weights. Sampled fish were returned to the tanks. In addition a bulk sample was weighed, representing approximately 10% of the total estimated weight of fish in each tank 2 wk earlier. The number of fish in each bulk sample was counted and the estimated number of fish per pound was calculated. On June 4, a final sample of 158 Big Qualicum River and 169 Robertson River fry were removed, killed, and frozen. In the laboratory, the lengths and weights of these fish were measured and a scale sample was obtained from each fish.

Scale samples were obtained to estimate scale diameter and number of circuli. Scale impressions were made, and scale diameters and circuli counts were obtained.

In the laboratory, fish from the final sample were thawed and the second vertebra posterior from the head of each fish was dissected out for examination. Each vertebra was examined with a binocular microscope (magnification × 25). The total diameter across the end of each vertebra was measured with an optic micrometer located in the eyepiece of the microscope.

B. History of normal coho

1. Donor stock

Coho eggs from the Big Qualicum and Robertson rivers were collected on November 23 and December 22, 1972, respectively. A total of approximately 6,000 Big Qualicum River and 11,000 Robertson River coho eggs were taken, fertilized, and transferred to Heath-type hatchery trays. The Robertson River eggs were transferred immediately to the Rosewall Creek hatchery. The Big Qualicum eggs were held at the Big Qualicum hatchery until they were "eyed," on January 12, 1973 approximately 5,300 of these eggs were transferred to the Rosewall Creek hatchery.

2. Incubation

Well water was used for incubation. Eggs were incubated at temperatures ranging between 7 and 8°C.

3. Fry

All eggs had hatched after accumulated thermal experience of 792.6 degree days. A total of 5,137 Big Qualicum River fry were transferred into

one 2.44-m diameter circular fiberglass tank on April 3, 1973. Similarly, after accumulated thermal experience of 813.7 degree days, 10,432 Robertson River fry were transferred to two 2.44-m diameter circular fiberglass tanks (Table 2) on April 5 and 6, 1973.

On May 15, 1973, 1,924 Big Qualicum River fry were marked by removal of the adipose fin so that these fish could be identified later. The two stocks were then mixed together among the three tanks. On July 12, 1973, all the fish were transferred into three Burrows ponds. On March 21, 1974, the fish were moved into the release pond where they remained until release. All normally reared fry were raised at ambient temperatures throughout the entire period up to release; during this period water temperatures ranged from 3.1 to 16.1°C.

4. Feeding

Initially, fry were fed OMP starter mash; subsequently they were offered various sized of pellet feed as prescribed. Throughout the rearing period the fish were fed every 15 min, dawn to dusk, from automatic feeders.

5. Rearing facilities

Initially, three 2.44-m diameter circular fiberglass tanks were used to rear the fry. Later, the fry were transferred into three Burrows ponds and then again into one Burrows pond. Both well and river water were used to rear the fry to the smolt stage. Prior to liberation, the juveniles were transferred to the release pond. There they were tagged, marked, and held until they were released along with the accelerated smolts.

6. Sampling

Starting May 30, 1973, and every 14 days thereafter, 50 fish from each tank or pond were sampled, anesthetized, measured for individual length and weight, and returned to the tanks or ponds. In addition, a bulk sample of fish was weighed; this sample represented approximately 10% of the total weight of fish estimated in each tank or pond 2 wk earlier. The sample was counted and the estimated number of fish per pound was calculated. On June 4, a final sample of 268 fish was removed and the fish were killed and frozen. These were processed in the laboratory in the same way as were the accelerated fish.

C. Marking, nose-tagging, and release of accelerated and normal coho smolts

Starting April 17-22, 1974, normally reared coho were removed from the release pond, anesthetized, the adipose fin was removed, and the fish were divided into three size categories according to fork length (mm): < 102, 102-121, > 121 mm. The fish tagged with binary tags, were coded to indicate the agency, group and size category, and then were returned to the release pond. On May 30, 1974, 1,511 fish from the release pond were passed

through the quality control unit to check for the presence of tags. Of these, 104 fish (6.9%) did not have a tag.

From June 5-7, 1974, accelerated coho were subjected to similar treatment and divided into three size categories according to fork length (mm): < 82, 82-92, > 92 mm. The fish were tagged as before, using binary tags coded to indicate the agency, group and size category, and transferred to the release pond.

Following tagging (May 21), fish in the accelerated and normally reared groups were offered medicated diet including 3% TM50D (a mixture of 5 g of terramycin per pound in a sucrose-kaolin base) at a rate of 5% of body weight per day for 14 days. This procedure was carried out primarily to induce a mark on the vertebra of the fish prior to release, which subsequently could be measured under ultraviolet light when the fish returned as jacks or adults. Vertebral diameter is positively correlated with size of the fish. Hence, the diameter of the induced mark laid down on the bone prior to the fish's release should provide a means of estimating their length at the time the fluorescent mark was laid down.

D. Release of fish into Rosewall Creek

On June 10, 1974, all fish were liberated into Rosewall Creek. Access to Rosewall Creek was provided at 2200 hr and all fish had moved out by 2315 hr. Twelve hours later, the creek was surveyed from the outflow pipe to the creek mouth and into the ocean; no fish were observed.

E. Initial data

The pertinent growth data for fish in the accelerated and normal groups during the period of rearing are given in Tables 1 and 2. The numbers of fish tagged and the estimated number of tagged fish released for the two groups are shown in Tables 3 and 4. Table 5 provides estimates, based on release samples, of mean length, weight and freshwater scale characters of smolts by sex and size category in both groups. A total of 10,603 accelerated fish were tagged of which 9,861 were estimated to have a tag. A total of 12,665 normally reared fish were tagged of which 11,778 were estimated to have a tag.

The relationship between vertebral diameter and smolt length was determined from the samples from each group. The correlation coefficient (r) and regression relation between fork length (y, mm) and vertebral diameter (x, mm) were:

Accelerated Big Qualicum River: $y = 14.9094 + 60.5945\ x$
$r = 0.924;\ n = 69$

Accelerated Robertson River: $y = 7.3808 + 64.8713\ x$
$r = 0.925;\ n = 115$

Normal Big Qualicum River and Robertson River mixed: $y = 32.8143 + 53.1272\ x$, $r = 0.914$; $n = 63$

Costs of spawning, rearing, marking, and tagging of accelerated and normally reared coho smolts are given in Table 6.

FALL RELEASE

A. History of accelerated coho

1. Donor stock

The coho smolts released in the fall of 1974 originated from Big Qualicum River eggs of the same brood year (1973) as the accelerated smolts released in the spring of 1974. Both the eggs and the resultant fry for the fall release were reared at ambient temperatures. When the fry were ready to feed they were distributed equally among six Burrows ponds. On June 27, 1974, approximately 12,000 were selected from the ponds (approximately 2,000 from each of the six ponds) to provide the stock for the accelerated fall release (details on incubation and rearing of fry up to this time are given in Data Record 7, 1976).

2. Rearing, feeding, and sampling

The fry were reared in heated water in the same tanks used to accelerate the coho smolts released in the spring. Fish were fed and sampled in the same manner as that described for the earlier accelerated smolts.

B. Marking and nose-tagging

From October 7-11, 1974, the accelerated coho were anesthetized, marked, and tagged as before. The fish were divided into three size categories according to fork length (mm): < 89, 89-103, > 103 mm. The binary tags used were coded as before to indicate the agency, group, and size category. The fish were then transferred to the release pond. Beginning on September 20, the fish were offered a medicated diet containing 3% TM50D at a rate of 5% of body weight per day for 14 days.

C. Release of fish into Rosewall Creek

On November 6, 1974, beginning at 1800 hr all fish were liberated into Rosewall Creek from the release pond. Twelve hours later the creek was surveyed from the outflow pipe of the release pond to the creek mouth and into the ocean. A number of marked fish were observed in the creek.

D. Initial data

The pertinent growth data during the period of rearing are given in Table 7. The numbers of fish tagged, and the estimated number of tagged fish released, are given in Table 8. Table 9 provides estimates, based on the release sample, of mean length, weight, and freshwater scale characters of smolts by sex and size category. A total of 12,064 fish were tagged of which 10,881 were estimated to have a tag.

At the time of marking and tagging the coho were silvery, suggesting they were "smolting" and therefore would be able to adapt to the change from fresh water to salt water after release. Hence, we planned to release the fish very shortly after tagging. Unfortunately, low water conditions in Rosewall Creek forced us to delay release for several weeks. During that period we suspected that many of the smolts had reverted from the smolting stage back to the non-smolting type. There was a noticeable decline in the number of fish having a silvery appearance during this period, suggesting that there may have been a concurrent change in their ability to adapt to salt water after release. A major difference in photoperiod occurred between the rearing period and that following tagging while the fish were in the release pond. This difference may have been instrumental in influencing apparent smolt reversion. Up to the time of tagging and marking, the fish had been reared under an increasing photoperiod similar to that occurring in the spring; after they were transferred outside to the release pond, where release was delayed for several weeks, they were subjected to the normal fall decrease in day length. The fact that we saw a number of marked fish in the creek subsequent to their release tends to support this theory.

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Table 1. Information on accelerated juvenile coho reared at Rosewall Creek and released June 10, 1974.

Stock	Treatment	Period	Date sampled	No. sampled	$\bar{x}$ Length (mm)	$\bar{x}$ Weight (g)	% increase wt. per day	Mortality No.	Mortality %	Est. total no.	No. days	$\bar{x}$ Water temp. °C	Accum. deg. days	No. fish per lb	Wt. food fed (lb)	Wt. fish (lb)	Gain wt. fish (lb)	Conversion rate: Wt. food / Gain wt. of fish	Av. dissolved oxygen (ppm)
B. Qual.	Fertilized	Nov 21, Dec 1/73								7,096									
Rob.	Fertilized	Nov 14, 30/73								13,422									
B. Qual.	Fry placed in 1 tank	Feb 7/74	Feb 7	50	31.3	0.29		2,597	36.6	4,499		9.0	818.4						
Rob.	Fry placed in 2 tanks	Feb 7	Feb 7	100	33.1	0.34		4,595	34.2	8,827		9.0	818.4						
B. Qual.	Sampled	Feb 8-11	Feb 11	50	36.0	0.47	8.1	514	11.4	5,481[a]	4	16.0	875.9	1,337		4.1			11.1
Rob.	Sampled	Feb 8-11	Feb 11	100	33.0	0.34	0.0	2,504	28.4	10,384[b]	4	16.0	875.9	1,346		7.7			11.1
B. Qual.	Sampled	Feb 12-21	Feb 21	50	36.1	0.54	1.4	531	9.7	4,950	10	16.0	1035.4	778	3.9	6.4	2.3	1.7	9.5
Rob.	Sampled	Feb 12-21	Feb 21	100	33.6	0.35	0.3	1,096	10.6	9,252	10	16.0	1035.4	890	8.2	10.4	2.7	3.0	9.9
B. Qual.	Sampled	Feb 22-Mar 7	Mar 7	50	37.0	0.57	0.4	433	8.7	4,517	14	16.0	1255.6	458	8.3	9.9	3.5	2.4	9.5
Rob.	Sampled	Feb 22-Mar 7	Mar 7	100	36.9	0.55	3.2	1,100	11.8	8,152	14	16.0	1255.6	589	12.7	13.9	3.5	3.6	9.5
B. Qual.	Sampled	Mar 8-21	Mar 21	50	42.4	0.94	3.6	256	5.7	4,261	14	16.6	1485.5	292	15.9	14.6	4.7	3.4	9.5
Rob.	Sampled	Mar 8-21	Mar 21	100	40.9	0.80	2.7	124	1.5	8,028	14	16.6	1485.5	346	31.8	23.2	9.3	3.4	9.2
B. Qual.	Sampled	Mar 22-Apr 4	Apr 4	50	58.7	2.68	6.6	34	0.8	4,227	14	15.7	1705.5	162	14.3	26.2	11.6	1.2	8.7
Rob.	Sampled	Mar 22-Apr 4	Apr 4	100	56.4	2.25	4.2	157	1.9	7,871	14	15.7	1705.5	187	28.6	42.2	19.0	1.5	8.3
B. Qual.	Sampled	Apr 5-18	Apr 18	50	67.2	4.08	2.9	33	0.8	4,194	14	14.9	1917.0	111	21.5	37.8	11.6	1.9	8.5
Rob.	Sampled	Apr 5-18	Apr 18	100	65.0	3.59	3.3	65	0.8	7,806	14	14.9	1917.0	124	37.2	62.9	20.7	1.8	8.4
B. Qual.	Sampled	Apr 19-May 2	May 2	50	68.0	4.19	0.3	26	0.6	4,168	14	15.0	2127.5	91	26.0	45.8	8.0	3.2	7.9
Rob.	Sampled	Apr 19-May 2	May 2	100	67.6	4.00	0.8	37	0.5	7,769	14	15.0	2127.5	106	52.0	73.3	10.4	5.0	8.2
B. Qual.	Sampled	May 3-16	May 16	50	83.9	7.83	4.5	34	0.8	4,134	14	14.8	2336.1	63	39.0	65.6	19.8	2.0	7.3
Rob.	Sampled	May 3-16	May 16	100	77.6	6.44	3.4	47	0.6	7,722	14	14.8	2336.1	74	78.0	104.5	31.2	2.5	7.6
B. Qual.	Sampled	May 17-30	May 30	50	90.8	10.02	1.7	28	0.7	4,106	14	14.9	2545.0	45	32.4	91.2	25.6	1.3	6.7
Rob.	Sampled	May 17-30	May 30	100	85.8	8.27	1.8	53	0.7	7,669	14	14.9	2545.0	54	71.7	142.0	37.5	1.9	7.2
B. Qual.	Killed and sampled	Jun 4	Jun 4	158				158		3,948		7.0							
Rob.	Killed and sampled	Jun 4	Jun 4	169				169		7,500									
B. Qual.	Tagged	Jun 5-7								3,613									
Rob.	Tagged	Jun 5-7								7,019									
B. Qual.		Jun 8-9						10		3,603									
Rob.		Jun 8-9						19		7,000									
B. Qual.	Released	Jun 10								3,603									
Rob.	Released	Jun 10								7,000									
B. Qual.	Est. no. released having tag (93.0%)									3,350									
Rob.	Est. no. released having tag (93.0%)									6,511									

[a]Loss of 514 fry, leaving 3,985. On February 11, added 1,496 fry that were reared in heated water.

[b]Loss of 2,504 fry leaving 6,323. On February 11, added 4,025 fry that were reared in heated water.

Table 2. Information on normally reared juvenile coho raised at Rosewall Creek and released June 10, 1974.

Stock	Treatment	Period	Date sampled	No. sampled	$\bar{x}$ Length (mm)	$\bar{x}$ Weight (g)	% increase wt. per day	Mortality No.	Mortality %	Est. total no.	No. days	$\bar{x}$ Water temp. °C	Accum. deg. days	No. fish per lb	Wt. food fed (lb)	Wt. fish (lb)	Gain wt. fish (lb)	Conversion rate: Wt. food / Gain wt. of fish
B. Qual.	Fertilized	Nov 23/72								5,300[a]								
Rob.	Fertilized	Dec 22/72						667		10,432								
B. Qual.	Fry to 1 tank	Apr 3								5,137			792.6					
	at ambient temp.	Apr 6	Apr 6	50	35.5	0.42		26	0.5	5,111		7.0	813.7	1,087		4.7		
Rob.	Fry to 2 tanks at ambient temp.	Apr 5, 6	Apr 6	100	34.1	0.37		0	0	10,432		7.0	813.7	1,213		8.6		
Rob.	Sampled	Apr 7-May 7	May 7	100	38.4	0.61		542	5.2	9,890	31	7.0	1031.0	749	13.4	13.2	4.6	2.9
B. Qual.	Sampled	Apr 7-May 7	May 7	50	39.8	0.67		892	17.4	4,219	31	7.0	1031.0	681	7.5	6.2	1.5	5.0
B. Qual.	Removed adipose fin from 1,924 fish	May 15						275	6.5	3,944								
B. Qual. and Rob.	Fry mixed together, reared at ambient temp. in 3 tanks	May 15																
B. Qual. and Rob.	Sampled	May 16-30	May 30	150	44.8	1.04		319	2.3	13,476	15	7.5	1214.0	438	17.7	30.8	9.3	1.9
B. Qual. and Rob.	Sampled	May 31-Jun 14	Jun 14	150	47.5	1.35	1.74	55	0.4	13,421	15	9.0	1346.8	335	39.0	40.1	9.3	4.2
B. Qual. and Rob.	Sampled	Jun 15-28	Jun 28	150	52.8	1.92	2.35	33	0.2	13,388	14	9.9	1485.7	236	46.3	56.8	16.7	2.8
B. Qual. and Rob.	Sampled	Jun 29-Jul 12	Jul 12	150	61.9	2.55	2.03	38	0.3	13,350	14	10.4	1637.3	178	70.0	75.2	18.4	3.8
B. Qual. and Rob.	Placed fry in 3 Burrow's ponds Reared at ambient temp.	Jul 12																
B. Qual. and Rob.	Sampled	Jul 13-26	Jul 26	150	69.0	3.91	3.05	56	0.4	13,294	14	14.4	1832.1	116	96.0	114.6	39.4	2.4
B. Qual. and Rob.	Sampled	Jul 27-Aug 9	Aug 9	150	74.6	5.45	2.37	20	0.1	13,272	14	16.1	2056.5	83	143.5	159.2	44.6	3.2
B. Qual. and Rob.	Sampled	Aug 10-23	Aug 23	150	82.7	7.82	2.58	12	0.1	13,260	14	7.9	2234.0	58	115.6	229.6	70.4	1.6
B. Qual. and Rob.	Sampled	Aug 24-Sep 6	Sep 6	150	90.5	9.14	1.11	16	0.1	13,244	14	9.6	2362.3	50	86.6	266.7	37.1	2.3
B. Qual. and Rob.	Sampled	Sep 7-20	Sep 20	150	94.4	10.56	1.06	14	0.1	13,230	14	8.7	2484.8	43	71.2	308.0	41.3	1.7
B. Qual. and Rob.	Placed all fry in 1 Burrow's pond Reared at ambient temp.	Sep 20																
B. Qual. and Rob.	Sampled	Sep 21-Oct 4	Oct 4	50	102.3	12.60	1.23	11	0.1	13,219	14	8.8	2607.0	36	103.3	367.2	59.2	1.7
B. Qual. and Rob.	Sampled	Oct 5-18	Oct 18	50	102.6	12.60	0.00	4	0.03	13,215	14	7.9	2721.3	36	83.1	367.2	00.0	83.1
B. Qual. and Rob.	Sampled	Oct 19-Nov 1	Nov 1	50	105.9	13.34	0.38	16	0.1	13,199	14	7.5	2822.4	34	50.8	388.2	21.0	2.4
B. Qual. and Rob.	Sampled	Nov 2-15	Nov 15	50	108.5	12.60	-0.38	12	0.1	13,187	14	3.6	2873.8	36	40.3	365.8	-22.4	
B. Qual. and Rob.	Sampled	Nov 16-29	Nov 29	50	106.5	13.34	0.38	20	0.1	13,167	14	2.4	2913.7	34	26.3	386.7	20.9	1.2
B. Qual. and Rob.	Sampled	Nov 30-Dec 13	Dec 13	50	106.9	13.75	0.21	12	0.1	13,155	14	3.9	2969.5	33	26.3	398.0	11.3	2.3
B. Qual. and Rob.	Sampled	Dec 14-27	Dec 27	50	109.5	14.18	0.26	21	0.2	13,134	14	4.1	3023.7	32	28.0	409.8	11.8	2.4
B. Qual. and Rob.	Sampled	Dec 28-Jan 10/74	Jan 10	50	106.2	14.18	0.00	21	0.2	13,113	14	2.7	3062.1	32	28.0	409.2	-0.6	
B. Qual. and Rob.	Sampled	Jan 11-24	Jan 24	50	107.8	14.63	0.19	4	0.03	13,109	14	4.3	3115.7	31	28.0	422.2	13.0	2.2
B. Qual. and Rob.	Sampled	Jan 25-Feb 7	Feb 7	50	109.6	15.64	0.47	20	0.2	13,089	14	2.9	3160.8	29	29.8	450.7	28.5	1.1
B. Qual. and Rob.	Sampled	Feb 8-21	Feb 21	50	109.7	16.03	0.18	9	0.1	13,080	14	3.8	3213.1	28	31.5	461.5	10.8	2.9
B. Qual. and Rob.	Sampled	Feb 22-Mar 7	Mar 7	50	113.3	16.80	0.35	5	0.04	13,075	14	3.2	3256.9	27	29.8	483.5	22.0	1.4
B. Qual. and Rob.	Sampled	Mar 8-21	Mar 21	50	113.2	16.80	0.00	17	0.1	13,058	14	3.7	3302.9	27	23.4	482.9	-0.6	
B. Qual. and Rob.	Moved into release pond	Mar 21																
	marked and tagged	Apr 17-22	Apr 17	300	117.1	-		125	0.9	12,933	27							
	Quality control	May 30																
	Sample removed	Jun 4						268		12,665								
	Released	Jun 10								12,665								
	Est. no. released having tag (93.0%)									11,778								

[a]Approximate number "eyed" eggs.

Table 3. Estimated number of tagged accelerated juvenile coho released from Rosewall Creek June 10, 1974.

Stock	Brood year	Procedure	Date	Length category (mm) < 82 Number	< 82 Tag code	82-92 Number	82-92 Tag code	> 92 Number	> 92 Tag code	Total
Rob.	1973	Sampled, killed	Jun 4/74	58	-	54	-	57	-	169
		Tagged	Jun 5-7/74	3,070	183 186	2,340	187	1,609	185	7,019
		Mortality	Jun 7-10/74	8		6		5		19
		No. released	Jun 10/74	3,062		2,334		1,604		7,000
		Estimated no. released having tag	Jun 10/74	2,848		2,171		1,492		6,511
B. Qual.	1973	Sampled, killed	Jun 4/74	49	-	51	-	58	-	158
		Tagged	Jun 5-7/74	871	184	1,082	182	1,660	181	3,613
		Mortality		2		3		5		10
		No. released	Jun 10/74	869		1,079		1,655		3,603
		Estimated no. released having tag (93.0%)	Jun 10/74	808		1,003		1,539		3,350
		Grand total fish released	Jun 10/74	3,931		3,413		3,259		10,603
Rob. plus B. Qual.		Grand total tagged fish released	Jun 10/74	3,656		3,174		3,031		9,861

Table 4. Estimated number of tagged normally reared juvenile coho released from Rosewall Creek June 10, 1974.

Stock	Brood year	Procedure	Date	Length category (mm) < 102 Number	< 102 Tag code	102-121 Number	102-121 Tag code	> 121 Number	> 121 Tag code	Total
Rob.	1972	Tagged	Apr 17-22/74	267	1813	7,863	1811 1812	3,303	189 1810	11,433
		Sampled, killed	May 30 and Jun 4/74	10	-	182	-	42	-	234
		No. released	Jun 10/74	257		7,681		3,261		11,199
		Estimated no. released having tag	Jun 10/74	239		7,143		3,033		10,415
B. Qual.	1972	Tagged	Apr 19-22/74	106	281	1,146	1815	248	1814	1,500
		Sampled, killed	May 30 and Jun 4/74	3	-	24	-	7	-	34
		No. released	Jun 10/74	103		1,122		241		1,466
		Estimated no. released having tag (93.0%)	Jun 10/74	96		1,043		224		1,363
		Grand total fish released	Jun 10/74	360		8,803		3,502		12,665
Rob. plus B. Qual.		Grand total tagged fish released	Jun 10/74	335		8,186		3,257		11,778

Table 5. Estimated numbers of accelerated and normally reared tagged male and female coho smolts of different size groups released from Rosewall Creek June 10, 1974, including estimated mean lengths, weights and freshwater scale characters by sex.

			♂								♀						
Treatment	Stock	Length category (mm)	Est. no. with tags		Length (mm)	Weight (g)	No. circuli	Scale radius (mm) × 254	No. with annulus	No. with 1 check	Est. no. with tags	Length (mm)	Weight (g)	No. circuli	Scale radius (mm) × 254	No. with annulus	No. with 1 check
Accelerated	Rob.	< 82	1,167	$\bar{x}$	71.82	5.53	15.14	88.81	0	327	1,681	71.64	5.44	15.29	87.25	0	487
				SE	1.05	1.20	0.38	2.66				1.28	0.23	0.47	2.43		
		82-92	999	$\bar{x}$	83.91	8.73	18.04	110.00	0	558	1,172	84.18	8.77	18.11	105.00	0	738
				SE	0.57	0.98	0.32	1.57				0.57	0.16	0.35	2.18		
		> 92	850	$\bar{x}$	100.84	14.36	21.03	132.03	0	654	642	98.22	13.34	21.00	130.87	0	417
				SE	1.77	0.69	0.40	3.63				1.88	0.80	0.35	3.69		
		Total	3,016						0	1,539	3,495					0	1,642
				$\bar{\bar{x}}$	84.00	9.08	17.76	108.01				80.73	8.01	17.28	101.21		
	B. Qual.	< 82	275	$\bar{x}$	75.31	6.36	15.94	93.37	0	121	533	72.64	5.81	15.03	87.34	0	165
				SE	1.03	0.23	0.32	2.58				1.05	0.23	0.39	2.66		
		82-92	371	$\bar{x}$	84.66	8.59	17.89	108.05	0	248	632	83.40	8.35	16.86	102.03	0	392
				SE	0.53	0.14	0.36	2.36				0.46	0.16	0.36	2.29		
		> 92	1,016	$\bar{x}$	100.74	13.39	20.59	129.32	0	1,016	523	100.77	13.84	19.72	126.61	0	523
				SE	1.60	0.62	0.44	2.97				1.83	0.65	0.35	3.49		
		Total	1,662						0	1,385	1,688					0	1,080
				$\bar{\bar{x}}$	92.94	11.49	19.22	118.63				85.42	9.25	17.16	105.00		
Normal	Rob. plus	< 102	0	$\bar{x}$	-	-	-	-	-	-	335	100.50	11.60	23.00	125.50	335	335
	B. Qual.			SE	-	-	-	-	-	-	-	-	-	-	-	-	-
		102-121	3,602	$\bar{x}$	115.81	17.90	24.35	137.99	3,494	2,871	4,584	114.36	17.23	24.09	136.73	4,309	3,562
				SE	0.47	0.24	0.25	1.61				0.48	0.24	0.24	1.56		
		> 121	1,433	$\bar{x}$	125.78	22.51	25.25	143.39	1,433	1,376	1,824	126.08	22.85	24.88	147.79	1,714	1,514
				SE	0.74	0.42	0.40	2.87				0.95	0.67	0.42	2.82		
		Total	5,035						4,927	4,247	6,743					6,358	5,411
				$\bar{\bar{x}}$	118.65	19.21	24.61	139.52				116.84	18.47	24.25	139.16		

Table 5 (cont'd)

Treatment	Stock	Length category (mm)	♂♂ plus ♀♀ Est. no. with tags		Length (mm)	Weight (g)	No. circuli	Scale radius (mm) × 254	No. with annulus	No. with 1 check	No. in sample ♂	No. in sample ♀
Accelerated	Rob.	< 82	2,848	$\bar{x}$	71.71	5.48	15.23	87.89	0	814	22	31
				SE								
		82-92	2,171	$\bar{x}$	84.05	8.75	18.08	107.30	0	1,296	23	27
				SE								
		> 92	1,492	$\bar{x}$	99.71	13.92	21.02	131.53	0	1,071	31	23
				SE								
		Total	6,511						0	3,181	76	81
				$\bar{\bar{x}}$	82.24	8.50	17.50	104.36				
	B. Qual.	< 82	808	$\bar{x}$	73.13	5.99	15.34	89.39	0	286	16	31
				SE								
		82-92	1,003	$\bar{x}$	83.86	8.44	17.24	104.26	0	640	18	30
				SE								
		> 92	1,539	$\bar{x}$	100.75	13.90	20.29	128.39	0	1,539	35	18
				SE								
		Total	3,350						0	2,465	69	79
				$\bar{\bar{x}}$	89.15	10.36	18.18	111.76				
Normal	Rob. plus	< 102	335	$\bar{x}$	100.5	11.60	23.00	125.50	335	335	0	2
	B. Qual.			SE	-	-	-	-	-	-	-	-
		102-121	8,186	$\bar{x}$	114.99	17.52	24.20	137.28	7,803	6,433	79	99
				SE								
		> 121	3,257	$\bar{x}$	125.95	22.70	25.04	145.85	3,147	2,890	28	36
				SE								
		Total	11,778						11,285	9,658	107	137
				$\bar{\bar{x}}$	117.61	18.79	24.40	139.32				

Table 6. Costs of spawning, rearing, marking and tagging of accelerated and normally reared juvenile coho released from Rosewall Creek June 10, 1974.

Treatment	Accelerated	Cost $	Normally reared for 14 months	Cost $
Spawning	Robertson R. - 3 people 24 hr B. Qualicum R. - 2 people 4 hr	120.00 20.00		120.00 20.00
Dead egg removal	2 hr	10.00		10.00
Counting fry	2 hr	10.00		10.00
Cleaning	70 hr	350.00	224 hr	1,120.00
Food preparation	19 hr	95.00	70 hr includes removal of mortalities	350.00
Oxygen sampling	19 hr	95.00		
Sampling stock	10 samplings, 4 hr each time = 40 hr	200.00	28 samplings, 4 hr each time = 112 hr	560.00
Water used	Incubation - 4,320 g/day × 90 days @ 4¢/1,000 gal Rearing tanks - 33,120 g/day × 114 days @ 4¢/1,000 gal	15.52 151.00	Incubation - 4,320 g/day × 134 days @ 4¢/1,000 gal Pond - 14 months @ 4,320,000 gal/month @ 4¢/1,000 gal	23.16 2,419.20
Heating water	Incubators - 3 KWH @ 1.3¢/KWH = 3.9¢/hr, 93.6¢/day × 90 days Rearing tanks - 32 g/day × 104 days × 33.4¢/gal = $1,112.00 256 g @ 41.6¢/gal = 106.50	84.24 1,218.50		
Circulating pump	3.86¢/day × 114 days	4.40		
Air pumps	15.6¢/day × 31 days	4.84		
Air compressor	59¢/day × 61 days	36.00		
Marking and quality control	104 hr	520.00	96 hr	480.00
Food	500 lb O.M.P. @ 25¢/lb	125.00	1,460 lb O.M.P. @ 25¢/lb	365.00
Pounds fish released	233.2 lb		469.6 lb	
Conversion rate	2.15		3.1	
Total cost		3,059.50		5,517.36
Number fish released	10,603		12,665	
Cost per fish		0.29		0.44
Cost per fish excluding sampling, marking and tagging	$3,059.50 minus 720.00 = $2,339.50	0.22	5,517.36 minus 1,040.00 = 4,477.36	0.35
Cost per fish if they had not been accelerated	$3,911.52/10,603	0.37		
Cost per fish excluding tagging	$3,191.52/10,603	0.30		

Table 7. Information on accelerated juvenile coho reared at Rosewall Creek and released November 6, 1974.

Stock	Treatment	Period	Date sampled	No. sampled	$\bar{x}$ Length (mm)	$\bar{x}$ Weight (g)	% increase wt. per day	Mortality No.	Mortality %	Est. total no.	No. days	$\bar{x}$ Water temp. °C	Accum. deg. days	No. fish per lb	Wt. food fed (lb)	Wt. fish (lb)	Gain wt. fish (lb)	Conversion rate: Wt. food / Gain wt. of fish
B. Qual.	Fertilized	Dec 1/73																
	Fry placed in three tanks	Jun 21/74								12,369								
		Jun 21-27/74	Jun 27	150	56.7	2.00	3.2	17	0.1	12,352	6	15.0	1526.2	234	18.0	52.8		
		Jun 28-Jul 11	Jul 11	150	63.0	3.16	3.3	40	0.3	12,312	14	15.7	1744.2	138	63.0	88.8	36.0	1.7
		Jul 12-25	Jul 25	150	72.5	4.75	2.9	17	0.1	12,295	14	15.6	1963.1	93	84.0	132.2	48.2	1.7
		Jul 26-Aug 8	Aug 8	127	78.4	6.21	1.9	40	0.3	12,255	14	15.1	2177.1	71	105.0	163.4	31.2	3.4
		Aug 9-22	Aug 22	150	83.8	7.11	1.0	25	0.2	12,230	14	11.7	2356.2	62	107.2	196.4	33.0	3.2
		Aug 23-Sep 5	Sep 5	150	90.9	9.51	2.1	9	0.1	12,221	14	12.7	2529.2	47	87.7	262.3	65.9	1.3
		Sep 6-19	Sep 19	150	93.7	10.22	0.5	2	0.02	12,219	14	9.9	2670.2	44	87.7	288.3	26.0	3.4
		Sep 20-Oct 3	Oct 3	150	95.8	10.88	0.4	3	0.02	12,216	14	9.9	2807.5	44	97.5	279.8	-8.5	
	Tagged	Oct 7-11/74								12,440								
	Killed and sampled during tagging	Oct 7-11/74								146								
	Placed in release pond	Oct 7-11/74																
	Release pond mortalities	Oct 7-Nov 6								45								
	Killed and sampled	Nov 6								140								
	Number released into creek	Nov 6								12,064								
	Estimated number released having tag (90.2%)	Nov 6								10,881								

Table 8. Estimated number of tagged accelerated juvenile coho released from Rosewall Creek November 6, 1974.

Stock	Brood	Procedure	Date	Length category (mm) < 89 No.	< 89 Tag code	89-103 No.	89-103 Tag code	> 103 No.	> 103 Tag code	Total
B. Qual.	1973	Tagged	Oct 7-11/74	2,398	282 284	8,125	283 285 286 287 288 289	1,917	2810	13,333
		Killed and sampled during tagging	Oct 7-11	27		18		-		45
		Release pond mortalities	Oct 7-Nov 6	9		29		7		45
		Killed and sampled	Nov 6	45		212		29		286
		Number fish released into creek	Nov 6	2,317		7,866		1,881		12,064
		Estimated number fish released having tag (90.2%)	Nov 6	2,090		7,095		1,696		10,881

Table 9. Estimated numbers of accelerated tagged male and female juvenile coho of different size groups released from Rosewall Creek November 6, 1974, including mean lengths, weights, and freshwater scale characters by sex.

			♂♂						♀♀					♂♂ plus ♀♀					No. in sample	
Treatment	Stock	Length category (mm)	Est. no. With tags		Length (mm)	Weight (g)	No. circuli	Scale radius (mm) × 254	Est. no. with tags	Length (mm)	Weight (g)	No. circuli	Scale radius (mm) × 254	Est. no. with tags	Length (mm)	Weight (g)	No. circuli	Scale radius (mm) × 254	♂	♀
Accelerated	B. Qual.	< 89	899	$\bar{x}$	83.50	7.08	17.50	107.87	1,191	82.61	6.48	18.67	112.08	2,090	83.05	6.78	18.08	109.97	10	13
				SE	1.08	0.49	1.05	5.85		1.25	0.18	0.53	4.48							
		89–103	3,973	$\bar{x}$	97.36	10.79	19.60	123.29	3,122	95.05	9.46	19.28	119.17	7,095	96.20	10.12	19.44	121.23	53	42
				SE	0.82	0.32	0.28	2.20		0.66	0.32	0.35	2.24							
		> 103	1,085	$\bar{x}$	108.43	13.81	21.58	134.25	611	106.50	12.06	20.12	128.12	1,696	107.46	12.93	20.85	131.18	14	8
				SE	1.43	0.62	0.82	6.86		1.56	0.52	1.14	4.09							
		Total	5,957						4,924					10,881						
				$\bar{\bar{x}}$	96.43	10.56	19.56	121.80		94.72	9.33	19.36	119.79		95.57	9.94	19.46	120.79	77	63