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Study AFS 41-4
Amendment 1

STATE OF ALASKA

Jay S. Hammond, Governor

Annual Performance Report for

DEVELOPMENT OF A CHINOOK SALMON ENHANCEMENT PROGRAM

by

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RESEARCH PROJECT SEGMENT

State:	Alaska	Name:	Sport Fish Investigations of Alaska
Study No.:	AFS 41	Study Title:	A STUDY OF CHINOOK SALMON IN SOUTHEAST ALASKA
Job No.:	AFS 41-4 Amendment No. 1	Job Title:	Development of a Chinook Salmon Enhancement Program

Period Covered: June 30, 1976 to September 30, 1976.

ABSTRACT

To enhance depleted chinook salmon, Oncorhynchus tshawytscha (Walbaum), populations in Southeast Alaska, the King Salmon Egg Take Committee began a large-scale egg collecting program in 1975 to establish a chinook salmon brood stock. This program was continued the following year and the results for the summer of 1976 are presented in this report. An estimated total of 250,500 eggs were collected from the King Salmon River, Andrews Creek, Chickamin River, Unuk River and Cripple Creek. Low escapements, high water, and a prohibition against collecting eggs in Canadian territory prevented the egg take operation from reaching its 1,000,000 goal. Information was collected on escapements and different methods of egg taking and transfer. Eggs were incubated at the Crystal Lake and Little Port Walter hatcheries.

BACKGROUND

Declining chinook salmon, Oncorhynchus tshawytscha (Walbaum), runs in Southeast Alaska prompted efforts in 1975 to establish a chinook salmon brood stock for the area. Matching funds were made available for this project from Anadromous Fish Funds (PL89-304) and from the Fisheries Rehabilitation, Enhancement, and Development (F.R.E.D.) Division. Few eggs collected in 1975 survived because of disease problems. The King Salmon Egg Take committee, consisting of members of F.R.E.D., Sport Fisheries, Commercial Fisheries, and Hatcheries Divisions of the Alaska Department of Fish and Game, planned a large-scale chinook salmon egg take for Southeast Alaska in 1976 with a goal of 1,000,000 eggs. The Committee planned to remove no more fish from any one region than its escapement could support and a number of river systems were chosen as target areas based on limited data of past escapements. The actual egg takes were conducted by different teams in each region under the direction of local area biologists and the chinook salmon project leader, Paul Kissner.

This report was compiled from notes, memoranda, and preliminary reports written by a number of people involved with different aspects of the egg take project. Inquiries concerning specific aspects of the project may be sent to the King Salmon Egg Take Committee for referral to the appropriate regional project leaders.

RECOMMENDATIONS

1. Continue efforts to establish a chinook salmon brood stock by conducting yearly chinook egg takes until a stock is established. Egg takes should not be allowed to jeopardize native populations.

2. Continue investigations of methods of egg take, transfer, and incubation to determine methods which maximize egg survival.

3. Continue surveys to establish the best chinook egg take locations.

4. Conduct negotiations with the Canadian Government concerning ADF&G egg takes on spawning grounds in Canada.

5. Control chinook harvests to ensure adequate escapements to encourage natural rehabilitation of Southeast Alaska chinook populations.

6. Continue to check all fish captured for disease to prevent contamination of stocks.

OBJECTIVES

1. Develop techniques of enhancing chinook salmon stocks in inside waters of Southeast Alaska.

TECHNIQUES USED

Egg take operations were planned for a number of areas in Southeast Alaska where chinook runs have been historically high: the Taku River, the King Salmon River, the Bradfield Canal area, the Andrews Creek area on the Stikine, the Chickamin River, the Unuk River, and Cripple Creek. Egg take operations followed the general pattern of (1) surveying the river systems to see if the chinook escapement levels were sufficiently high to support an egg take and locating areas of high fish concentration; (2) transporting personnel and equipment to the egg take site; (3) capturing chinook; (4) removing eggs, fertilizing them and transporting them to a hatchery facility; and (5) incubation of the eggs at the hatchery. Biological data such as condition of the fish, mid-eye fork length, and age were also generally collected.

Survey Techniques

Because of the remoteness of most of the areas where egg takes were planned and because of the large areas to be covered, surveys were

usually conducted by air using either fixed wing or helicopter. Dense overgrowth, high water, and the glacial nature of many of the streams often hampered surveying operations. Bad weather sometimes made flight impossible. A few foot and boat surveys were also conducted. Based on stream overgrowth and water conditions, an estimate was sometimes made of the chinook population of a particular stream which was higher than the actual number of fish observed.

Transportation of Equipment and Personnel to the Egg Take Site

In most cases, a helicopter was necessary to transport equipment and personnel to egg take sites since the areas were so remote and because it was essential to reach these sites at the proper time. At Andrews Creek, a barge was used to transport materials to the mouth of the creek and they were relayed from there to the wier site by skiff. To decrease personnel transportation costs, a cabin was rented near the wier for use as a center of operations. A radio was used to communicate with the hatchery. At the Chickamin River a cabin was also rented for use as a headquarters and tent cabins were set up at the wier site. Materials were transported to the outlet of the river by boat (the M/V Sundance) and then taken by helicopter and riverboat to the campsites. No camp was constructed at Unuk River.

Chinook Capture Techniques

The Standard Operating Procedures Manual (S.O.P.) states that adult salmon may be caught by snagging, netting, or trapping. These methods were used at all of the egg take sites except Unuk River and Cripple Creek. Chinook at King Salmon River were caught by snagging. Since they weren't quite mature they were transferred to a glacier pond for several days and then seined for the egg take. Wiers were constructed to catch fish at Andrews Creek and Chickamin River. Unfortunately, the hardware wire wier at Chickamin River washed out after only 11 days because of high water produced by a 6 inch rainfall in 24 hours. Thereafter fish were caught by snagging with sport fishing gear. At the Unuk River and Cripple Creek, two rifles (338) and two snagging rods were used to catch salmon. The rifles were necessary because rods were ineffective in the small creeks where fish had been harassed by bears and were not biting. Fish were shot in the head (Seidelman, 1976b).

Egg Take and Transfer Techniques

Eggs were removed as specified in the SOP manual. At Andrews Creek, Romey (1967a) reports that two basic egg taking methods were used. (a) After females were killed, bled, and cut open, eggs were received in a five gallon bucket containing sperm, at a sex ratio of one male to two females and a total of six female's eggs per 5-gallon bucket. The eggs were then rinsed, water hardened, and transported to the Crystal Lake Hatchery in the same bucket used for for spawning; or (b) eggs and sperm were collected and shipped separately to the hatchery. Eggs were collected in 5-gallon buckets and sperm were kept in sealed 1-quart freezer cartons in the same bucket. The bucket was kept cool with wet burlap. Eggs were Wescodyned and placed in trays within three hours.

At Chickamin River, eggs were collected in an area shaded from direct sunlight by a canvas tarp, and fertilized with milt from two or more males. They were then water hardened, poured into plastic bags filled with water (without air spaces) placed in a chest cooler, filled with water and loose ice to provide further cushioning. Eggs reached the Little Port Walter facility via air transport within 4 1/2 hours (Siedelman, 1976a; Heard Wertheimer, 1976).

Heard and Wertheimer (1976) provide the following description of the care of the eggs at the Little Port Walter Hatchery:

> Water temperature in the plastic bags of eggs was 6° to 7°C on arrival at LPW. Chickamin River water temperature was 10°C during the spawning period. Lapsed time from initial waterhardening to arrival at LPW was about 3.5 hours.
>
> At LPW the water-filled plastic bags were placed in a large fiberglass tub containing a 1:150 dilution of 'jug strength' commercial Wescodyne (100 ppp iodine solution) for tempering. The temperature of water to be used for incubation at LPW was 10.5° to 11.0°C. The plastic bags with eggs and water were tempered for about 15 minutes, until water temperature in the bags was 8.5° to 9.0°C. During this period, some water in the bags was carefully removed and replaced with LPW water. Care was taken to (1) avoid dilution of the Wescodyne solution and (2) prevent 'contamination' from Chickamin River water or hauling containers. All Wescodyne disinfecting solutions used at LPW were buffered with 0.05% sodium bicarbonate.
>
> After the eggs were tempered to about 9°C they were carefully placed in Heath incubation baskets (inside the tub of Wescodyne solution), given a standard 10-minute disinfectant exposure to Wescodyne, and then placed in a Heath incubator cabinet. The hauling containers, bags, ice and water were all disinfected in Wescodyne.

One ripe female caught at Barrier Creek near Chickamin River was used to test three methods of egg transportation to the hatchery. Heard and Wertheimer (1976) report these methods as follows:

> (1) 'dry gamete transport' keeping eggs and milt separate for fertilization and waterhardening at LPW, (2) transport of fertilized waterhardened eggs in moist muslin cloth, and (3) transport of fertilized waterhardened eggs in water.
>
> Eggs from the Barrier Creek test fish were designated as Lot 4A, 4B, and 4C, respectively.
>
> For the comparative tests all eggs were removed from the female into a clean, dry plastic tub. This fish, unfortunately, was not fully ripe and many of her eggs had to be gently teased by hand from the ovaries. The eggs were gently

stirred (without milt or water) to insure uniform mixing and an estimated 20% poured 'dry' into a double plastic bag. (Lot 4A). The bag was sealed with about a 1:1 air-to-egg volume ratio, then placed in an insulated container with ice.

Milt from two males (8 to 10 ml each) was expressed into a separate container. About 5 ml of the pooled milt was poured into a whirlpack, sealed with about a 10:1 air-to-milt volume ratio, and placed in the insulated container.

The remaining milt was poured into the plastic tub of eggs and water added. This group was waterhardened for 1 hour (with several changes of water), then divided (by eye) into equal lots (4B and 4C). Lot 4B was shipped in moist muslin cloth contained in a perforated stryofoam tray inside of a cardboard Heath egg box. Crushed ice was placed on a similar styrofoam tray above the eggs. Lot 4C was shipped in a plastic bag filled with water without air inside of an insulated container with ice.

At Unuk River and Cripple Creek, eggs collected were fertilized immediately because fish had been collected by shooting them, which meant that water had usually entered the colon and the eggs had begun to harden. Also the presence of blood in the eggs reduced the chances of successful late fertilization. Eggs were waterhardened for at least one hour, packaged in ziplock plastic bags, and placed in a cooler which contained water to absorb shock. The cooler was iced lightly to maintain constant temperature. Eggs were then shipped via helicopter to the Little Port Walter facility. Because of poor flight conditions, the first batch of eggs was held temporarily at Deer Mountain Hatchery (DMH). There they were placed in baskets and disinfected in a 150:1 buffered Wescodyne solution.

Incubation of these eggs at DMH proceeded until October 1, where water temperatures ranged from 8.0°C to 11.5°C. The eggs were shocked on September 15, and dead eggs removed. Of the 18,850 original number collected, 9,500 live eggs were transported to LPW.

On October 1, after developing to advanced eyed stage [these] eggs were flown to Little Port Walter in moist muslin cloth in Heath egg shipping containers. The eggs were incubated through about 440 centrigrade temperature units (TU) at DMH (each °C above 0 for a 24-hour period = 1 TU).

On arrival at Little Port Walter, they were tempered, disinfected in about a 1-minute Wescodyne bath and placed in two Heath incubator trays (Heard and Wertheimer, 1976).

At Chickamin River, Unuk River and Cripple Creek, ovarian fluids were collected from all killed femals for infectious hematepoietic necrosis virus (IHNU) analysis.

Incubation and Hatching

Heard and Wertheimer (1976) report methods used to care for the eggs taken to the Little Port Walter hatchery:

> The eggs were maintained at Little Port Walter from when they were received until advanced eyed stage in 13 trays located in one Heath incubator cabinet. The top tray in the cabinet was left empty to serve as a settling basin for silt and debris. Eggs were retained by original lots (six Chickamin River and two Cripple Creek lots) and placed in the cabinet from top to bottom in arrival sequence (i.e. August 5, Chickamin River, Lots 1-3 in the upper three trays, August 18, Cripple Creek, Lot 7 in the lower two trays).
>
> Beginning August 14 and continuing at 5-day intervals, until September 28, the eggs were treated with malochite green for fungus control. A 1-gallon solution of 2 ppm malochite green was dripped into the top tray of the Heath cabinet over a 1-hour interval. Waterflow through the incubator throughout the egg eyeing period was 5 gpm.
>
> The temperature of incubation water at LPW varied from 11.0°C on August 5 to 6.0°C on October 31.

FINDINGS

Results

Taku River Egg Take:

Results of the Taku River egg take operation were provided by E.J. Huizer (1976). Surveys of the Nahlin and Nakina systems of the Taku River to determine chinook salmon escapement counts were begun in July, 1976 and conducted by Paul Kissner. Counts made on July 30 indicated generally higher escapements than were recorded the previous year. On the Nakina below Village Falls, 2,400 chinook were counted compared to 1,600 in 1975. Above Village Falls only 10 were counted this year compared to 200 in 1975. On the Hanlin 600 chinook were counted this year compared to 284 in 1975.

Based on these counts it was determined that the escapement was sufficient to support a limited egg take. However the Canadian Regional Division denied the request for eggs from Canadian territory reportedly because of concern over the effects of the southeastern enhancement program on wild stocks in the Taku River and because of poor survival of eggs collected in 1975 (Kissner, 1976b). Further negotiations with the Canadian Government are underway.

Village Falls appears to be a major block to migrating chinook as well as to sockeye, Oncorhynchus nerka (Walbaum), and pink salmon, O. gorbuscha (Walbaum). Few salmon were observed above the falls. Access to the

upper Taku River, Kuthai Lake, and Silver Salmon Lake is thus hampered. Cooperative work with the Canadians is recommended to more carefully assess the extent of this problem.

King Salmon River Egg Take:

Results of the King Salmon River egg take operation were reported by Paul Kissner (1976). Five helicopter surveys of the King Salmon River on Admiralty Island were conducted between July 6 and July 29, 1976. A foot survey was conducted on July 30. Kissner reports results of those surveys as follows:

Survey Type	Date	Chinook Observed
Helicopter	July 6	4 chinook (all in intertidal area)
	July 17	no fish observed
	July 20	33 chinook
	July 22	65 chinook
	July 28	no fish observed
	July 29	62 chinook
Foot	July 30	59 chinook

The water in the King Salmon River was sometimes too high to see any fish and it was estimated by Kissner that the river contained 75 to 100 chinook.

Four male and four female chinook were transferred to a glacial pond for the egg take. An estimated 12,000 eggs were obtained with 60% mortality within two days, probably due to deep snagging and injury of one of the females.

Bradfield Canal Area Egg Take:

Results of the Bradfield Canal egg Take operation were reported by Paul Novak (1977). Surveys were begun on the Bradfield Canal Area on July 20, 1976 using fixed wing and helicopter survey techniques. Novak reports results as follows:

Survey Type	Date	Spawners Observed by Watershed		
		Harding R.	Eagle R.	Bradfield R.
Fixed wing	July 20	--	0	0
Helicopter	August 4	0	0	0
Fixed Wing	August 8	0	0	0
Fixed Wing	August 23	15	15	0

The surveys indicated that escapement was essentially non-existent in the above watersheds so no egg take operations were undertaken. Overfishing was probably responsible for the recent decline in chinook salmon escapement in Harding and Eagle Rivers and habitat destruction has severely affected rearing and spawning areas on both forks of the Bradfield River.

Andrews Creek Egg Take:

Results of the Andrews Creek egg take operation were provided by Dan Romey (1976a&b). A wier was constructed on Andrews Creek, tributary of the lower Stikine river, in order to capture chinook salmon for egg take operations (Figure 1). the first chinook reached the wier on July 29, 1976, and the first egg takes occurred on August 4. Approximately 50,000 eggs were obtained from ten females on August 4.

Egg takes conducted on August 9, 11, and 23, from 25 additional females produced 125,000 eggs for a estimated total of 175,000 eggs from the Andrews Creek site. Eggs were taken at varying times during the run to be sure that a random sample of age classes was obtained. The following schedule was prepared by the Commercial Fishery Division in Petersburg:

10% of the first 50 females (ideally 1 out of every 10)
20% of the next 50 females (ideally 1 out of every 5)
20% of the next 50 females (ideally 1 out of every 5)
20% of the next 50 females (ideally 1 out of every 5)
50% of the next 50 females (ideally every other one)

This schedule was adhered to as closely as possible.

Survival of the first lot of eggs shipped was 75% and higher survival was anticipated for the later shipments. Preliminary results indicate that survival is higher when male and female gametes are shipped separately.

The entire chinook salmon run occured between July 28 and August 24. A total of 235 chinook females passed through the weir of which 35 were killed for egg takes and the remainder were released to spawn naturally upstream.

Chickamin River Egg Take:

Results of the Chickamin River egg take operation were provided by Don Siedelman (1976a). A wier was built on Chickamin River about twenty miles from the mouth (Figure 2). The wier began fishing on July 30, but it only lasted until August 10 when it washed out due to high water. A total of 6 male and 3 female chinook passed through the wier during its operation. Three other chinook were observed outside the wier, giving an estimated total of 12 chinook in the creek in 1976 compared to 100 chinook in 1975.

A survey of Indian Creek on July 21 revealed only 2 or 3 chinook. No chinook were seen in the Harding or Eagle Rivers or Eulachon Creek on a July 29 survey. In the south fork of the Chickamin River and nearby Barrier Creek 23 chinook were observed on August 4 actively spawning or near their redds and 6 were seen near the mouth of Barrier Creek. This is considerably less than half the number observed in the same areas last season during the same time periods. Several of these fish were captured for egg takes but logistical difficulties in transporting the eggs to Little Port Walter necessitated the release of the first fish captured. Individual chinook salmon biological data collected from August 4 and 5 as reported by Siedelman are as follows:

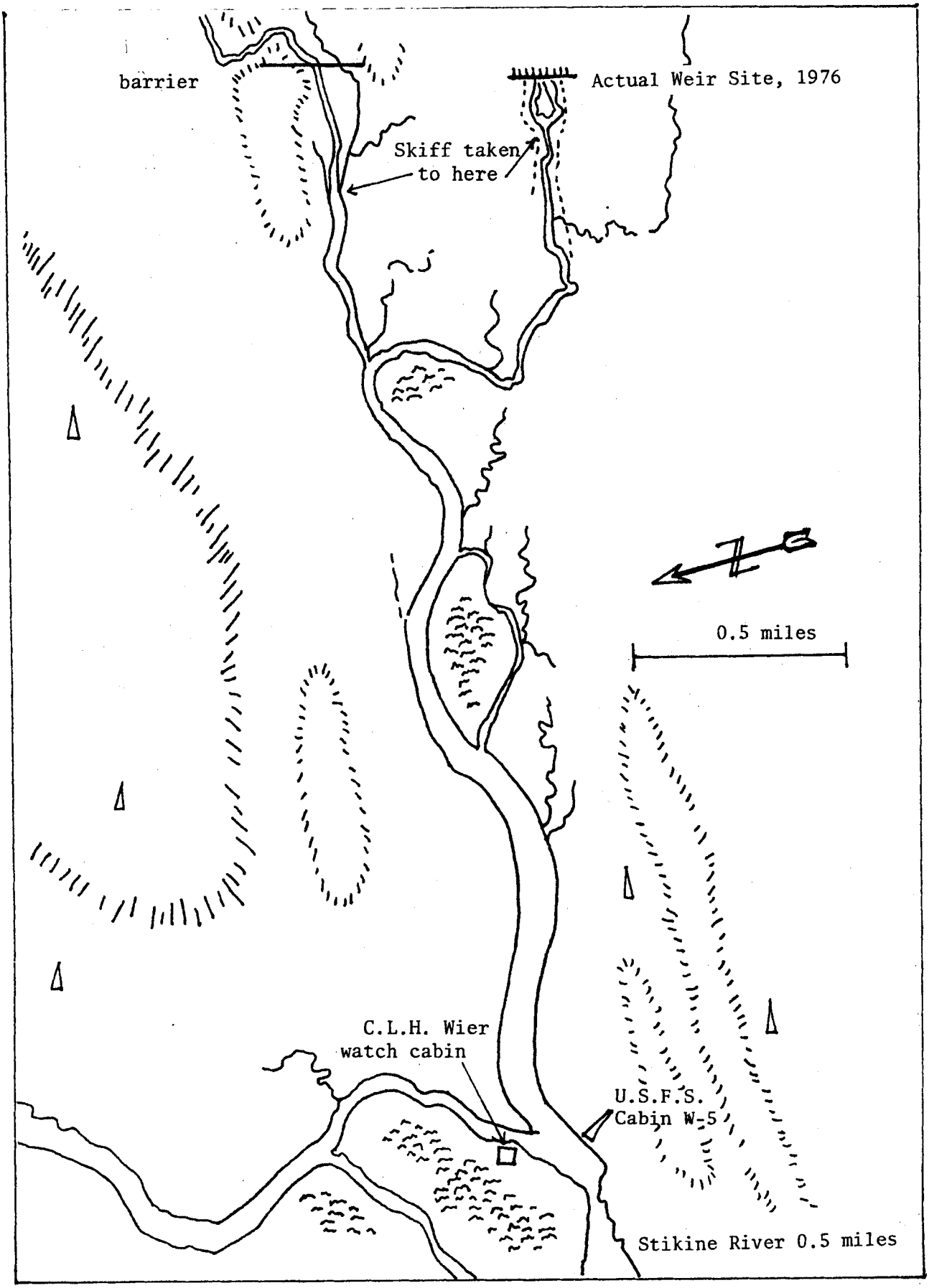

Figure 1. Actual weir location at Andrews Creek in reference to the Stikine River and Cabins. (Romey, 1976)

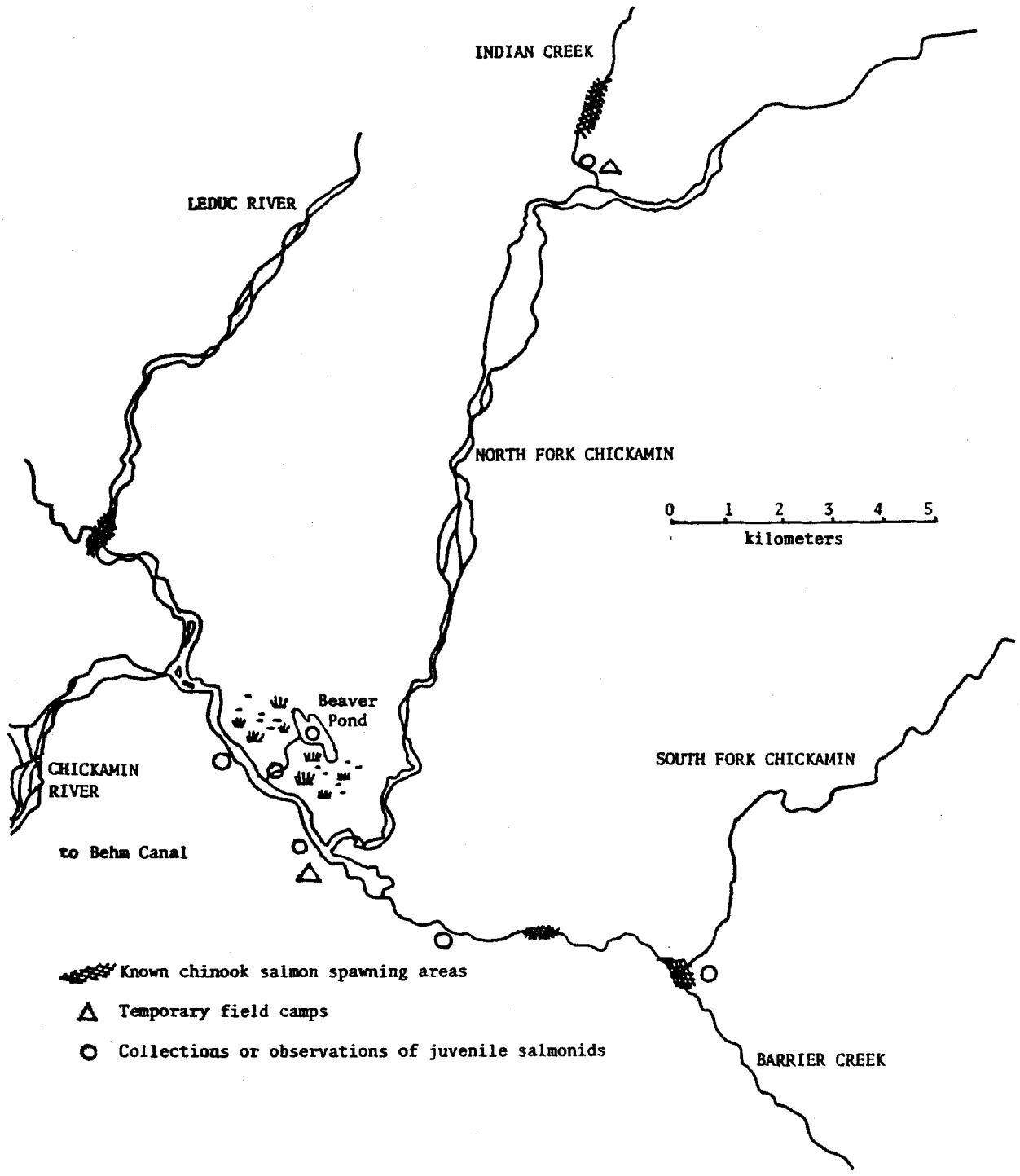

Figure 2. Chickamin River System showing the location of areas connected with 1976 chinook salmon spawn-take activities including known spawning grounds, temporary field camps, and sites where collections of juvenile salmonids were made. (Heard and Wertheimer, 1976)

Length (mm)	Sex	Area Collected	Condition
884	F	South Fork	Spent
974	F	South Fork	Spent
1005	F	Barrier Creek	Spent
877	F	Barrier Creek	Partial Spent (3800)
864	F	Island Channel	Ripe (6000)
1092	F	Barrier Creek	Partial Spent
904	F	South Fork	Spent (200)
788	M	South Fork	Mature
947	M	Barrier Creek	Mature
844	M	South Fork	Mature
1057	M	Chickamin River	Spent

Approximately 4,000 eggs were obtained on August 5 from spent and partially spent females at the South Fork and Barrier Creek and approximately 6,000 eggs were obtained from a ripe female from Island Channel as indicated in parentheses in the above table. Four males were used to fertilize the eggs which were then water hardened and transfered to the Little Port Walter rearing facility. On August 6 air surveys of the Chickamin River and lower South Fork were conducted. Too few fish were observed in the Chickamin River to consider an egg take but 44 chinook were observed in the lower South Fork. Eggs were collected from fish caught in the South Fork area on August 7 along with one additional fish from Barrier Creek. Siedelman reports the following biological data of fish captured August 6 and 7:

Length (mm)	Sex	Area Collected	Condition
1095	F	Barrier Creek	Ripe (8000)
945	F	South Fork	3/4 Spent (800)
881	F	South Fork	Ripe (4000)
960	F	South Fork	Spent
1061	M	South Fork	Ripe
995	M	South Fork	Ripe
935	M	South Fork	Spent
656	M	South Fork	Jack

Air surveys of the Chickamin River area were conducted on August 14 with fixed wing and August 15 by helicopter. Few fish were observed so no further egg takes were planned. Results of these surveys as presented by Siedelman are presented below.

Area	9/14	9/15	Peak Est.
South Fork Chickamin (Glacial Stream)	15	46	46
Indian Creek	2	5	5
LeDuc Creek	12	--	12
Butler Creek	14	15	15
El Paso Creek (Fly Creek)	25	30	30
LeDuc Branch	6	--	6
	74	94	114

Estimated total eggs taken at the Chickamin River egg take was 22,800.

Unuk River and Cripple Creek Egg Takes:

Results of the Unuk River and Cripple Creek egg take operations were provided by Don Siedelman (1976b). Air surveys were conducted on the Unuk River on August 16 and 17, 1976. Siedelman reports the numbers of chinook observed as follows:

Stream	8/16	8/17
Eulachon River		2
Grant River		1
Klahani River		0
Clear Creek	4-6	
Lake Creek (at Falls)	0	
Sawmill Slough	11	
Cripple Creek	40-45	

For the second season in a row there were no spawning chinook at the falls at Lake Creek. Cripple Creek was surveyed by helicopter on August 18 and 112 chinook were observed including an unusually large proportion of small 1-ocean and 2-ocean males. Surveyors estimated the total number of chinook in the creek to be between 150 and 200. Twenty-five chinook were captured there and sampled of which 18 were females. Most of them were already spent however and eggs were only obtained from five salmon. Capture was usually accomplished by shooting the fish in the head with a rifle. Rods were ineffective in this small stream where fish had been much harassed by bears. Approximately 14,000 eggs were collected in total. Biological data including numbers of eggs collected are presented in Table 1. Bad weather prevented transportation of the eggs by air to Little Port Walter so they were taken to the Deer Mountain Hatchery instead. After eyeing they were transfered to Little Port Walter.

A second egg take at Cripple Creek on August 21 yielded approximately 26,700 eggs. These were successfully transported to Little Port Walter. Biological data on the fish captured on August 21 are presented in Table 2.

Estimated total eggs taken at the Unuk River and Cripple Creek egg takes was 40,700.

Incubation and Hatchery Survival:

Heard and Wertheimer (1976) report the following incubation and hatchery survival results for the Little Port Walter Hatchery.

> The accumulative TU (temperature unit = each °C above 0° for a 24-hour period) required for the Chickamin River eggs to reach early eyed stage was not determined. The first pick-off of dead eggs from Lots 1, 2, and 3 (August 5 spawning) was on September 16 when, after 391 TU, the eggs were already

Table 1.* Chinook Collected at Cripple Creek, August 18, 1976

Length ME-FT (mm)	Sex	Condition
875	F	Spent
875	F	Spent
875	F	Spent
845	F	Spent
805	F	Spent
830	F	Spent
965	F	Spent
870	F	Spent
695	F	Spent
820	F	Spent
810	F	200 Eggs
960	F	3000
830	F	800
585	M	-
810	M	-
650	M	-
600	M	-
810	M	-
610	M	-
825	F	-
670	M	-
825	F	5000
820	F	5000
800	F	Spent
900	F	Spent
Estimated Total Eggs		14,000

* Data provided by Siedelman, 1976b.

Table 2*. Chinook Collected at Cripple Creek, August 21, 1976.

Length ME-FT (mm)	Sex	Condition
790	M	-
675	M	-
660	M	-
675	M	-
760	M	-
805	M	-
520	M	-
595	M	-
695	M	-
545	M	-
850	M	-
600	M	-
740	M	-
655	M	-
620	M	-
835	M	-
765	M	-
972	M	-
875	F	Spent
760	F	Spent
860	F	Spent
780	F	Spent
860	F	Spent
835	F	Spent
810	F	Spent
780	F	Spent
790	F	Spent
835	F	Spent
880	F	Spent
900	F	Spent
890	F	6000
880	F	6000
935	F	3000
860	F	6000
740	F	5000
795	F	700
815	F	Spent
	Total Eggs	26,700

* Data provided by Siedelman, 1976b.

well-eyed. Egg Lots 4-6 (August 7 spawning) were also well-eyed after 370 TU on September 17. Cripple Creek eggs spawned on August 21 (Lot 8) were very faintly eyed on September 17 with about 225 TU. Dead eggs were first removed from Lot 8 eggs on September 20 after 251 TU.

The first hatching was in Lots 1-3, beginning about October 1 (520 TU) and ending by October 7 (580 TU). Lots 4-6 followed closely with hatching beginning October 4 (523 TU) and ending October 10 (570 TU). In Lot 8, hatching began October 21 (570 TU). Lot 7, incubated to about 440 TU at DMH before transport to LPW on October 1, began hatching about October 12 (535 TU) and was essentially completed by October 21 (596 TU).

In summary of temperature regimes during incubation to hatching, both Chickamin and Unuk River stocks apparently require an accumulation of about 250 centrigrade temperature units to early eyed stage and between 525 and 600 temperature units to complete hatching.

Cripple Creek eggs collected on August 18 (Lot 7) were noticeably larger than those collected on August 21 (Lot 8). Two counts of volumetric measures of eggs from both lots at LWP on October 4 indicated that Lot 7 eggs (2,489/l) were about 12% larger than Lot 8 eggs (2,794/l).

Survival of Egg Lots to Eyed Stage

The total number of live and dead eggs in each of the Chickamin River System groups (Lots 1-6) were individually counted after the eggs were well-eyed. In the Unuk River System eggs (Cripple Creek, Lots 7-8) individual dead eggs were counted as they were removed from the lots and remaining live eyed eggs were estimated volumetrically.

The survival of Chickamin River eggs, from numbers of green eggs collected to live advanced eyed stage, ranged from a high of 97.2% in Lot 5 to a low of 48.9% in Lot 4C (Table 3). In the Unuk River, eggs survival was 50.4% for Lot 7 and 85.2% for Lot 8. Survival of Unuk River and Chickamin River eggs pooled by spawning dates, including a separate pooling of eggs from the August 7 female used for testing egg transport techniques, is compared in Table 4.

Egg Transport Survival:

Heard and Wertheimer (1976) report the following results for different egg transport techniques:

The Barrier Creek female selected on August 7 for testing different methods of transporting eggs was 1,095 mm (mid-eye fork length) and she had a total complement of 9,513 eggs. The test was designed to minimize gamete bias by only using

Table 3*. Date of Spawning, Source of Eggs and Survival to Advanced Eyed Stage for Specific Lots of Chickamin River System Chinook Salmon Eggs Incubated at Little Port Walter.

Egg lot	Date of Spawning	Source of eggs	Dead eggs removed	Live eyed eggs	Total eggs in lot	Survival to advanced eyed stage (percentage)
1	8/5/76	Barrier Creek, 2 nearly spent females	164	616	780	78.9
2	8/5/76	Barrier Creek 1 ripe female	619	5,849	6,468**	90.4
3	8/5/76	Barrier Creek, 2 partly spawned females	1,067	3,819	4,886	78.2
4A	8/7/76	Barrier Creek, female: dry gamete transfer	316	1,126	1,442	78.1
4B	8/7/76	Barrier Creek, test female waterhardened transfer moist	1,477	2,657	4,134	64.2
4C	8/7/76	Barrier Creek, test female waterhardened, transfer wet	2,009	1,928	3,937	48.9
5	8/7/76	S. Fork Chickamin, 1 ripe female	133	4,593	4,726	97.2
6	8/7/76	S. Fork Chickamin 1 partly spawned female	147	1,234	1,381	89.3
Total:			5,932	21,882	27,754	78.6

* From Heard and Wertheimer, 1976.

** This female apparently had a full complement of eggs; she was 864 mm (mid-eye fork length) long.

Table 4*. Summary of Green Eggs to Advanced Eyed Egg Survival for Chickamin and Unuk River Chinook Salmon Collected in 1976.

Source of Eggs and Date of Spawning	Number of Eggs collected	Number Advanced Eyed Live Eggs	Survival to Advance Eyed Egg (Percent)
Chickamin River System			
Barrier Creek; August 5 (4 females, Lots 1, 2, & 3)	12,134	10,284**	84.7
Barrier Creek; August 7 (Test females, Lots 4A, 4B, 4C)	9,513	5,711**	60.0
South Fork; August 7 (2 females, Lots 5 & 6)	6,107	5,827	95.4
Chickamin Totals	27,754	21,822	78.6
Unuk River System			
Cripple Creek; August 18 (? females, Lot 7)	18,850***	9,500****	50.4
Cripple Creek; August 21 (? females, Lot 8)	19,362	16,500****	85.2
Unuk Totals	38,212	26,000	67.9

* From Heard and Wertheimer, 1976.
** Actual counts.
*** Information on total Cripple Creek eggs collected on August 18 from Mike Ward, F.R.E.D. in Ketchikan. These eggs were incubated to advanced eyed stage at Deer Mountain Hatchery and shipped to LPW on October 1.
**** Volumetric estimates made at LPW.

eggs from one female and combining milt from two males before any mixing of eggs and milt occurred. The survival of eggs to eyed stage for the three transport methods was 78.1% for Lot 4A (dry gamete transfer), 64.2% for Lot 4B (waterhardened, transfer moist) and 48.9% for Lot 4C (waterhardened, transfer in water). The number of eggs in each of these lots is reviewed in Table 3.

IHNV Analysis

Ovarian Fluids were collected from all chinook salmon caught on the Chickamin and Unuk Rivers and Cripple Creek to check for infectious hematopoietic necrosis virus (IHNV). Results were negative for all fish sampled.

DISCUSSION

The King Salmon Egg Take committee established a goal of 1,000,000 eggs for the 1976 egg take. This number was deemed necessary to insure the establishment of a healthy brood stock with a good age distribution. The total number of eggs actually collected in 1976, based on field estimation, was only 250,000.

The Egg Take Committee had hoped that the Nakina River on the Taku Inlet would be a major egg-take site. The Alaska Department of Fish and Game collected eggs from this river in 1975. However the spawning grounds on the Nakina River are in Canada and the Canadian government refused permission to collect eggs there in 1976. Low escapements and unusually high water prevented the planned Bradfield Canal area egg take altogether and resulted in low egg takes in the King Salmon River and the Chickamin River. Because of these low egg takes, the Unuk River egg take was added but the total of eggs collected was still far below the goal. The 1,000,000 goal was established in the first place only to serve as a tentative estimate of the number of eggs which could be taken. Results of the 1976 egg take will be useful in setting up realistic future egg take goals. Plans for a 1977 egg take are now in operation.

The difficulties involved in obtaining chinook eggs in 1976 emphasize the need to maximize the survival of all eggs which are obtained. The survival of various lots of Chickamin River system and Unuk River system eggs varied considerably, as summarized in Tables 3 and 4. As noted previously, a controlled experiment was attempted with the eggs of one Barrier Creek female. Different egg transfer methods and resultant survivals were as follows:

Dry gamete transfer	78.1%
Water hardened, moist transfer	64.2%
Water hardened, transfer in water	48.9%

Heard and Wertheimer (1976) discuss these results:

Differences in survival of eggs transported by the three methods appear to favor the dry gamete procedure, however, because of several complicating factors this difference is difficult to evaluate. First, the best survival in the comparative test (Lot 4A, 78.1%) is not at an acceptable level. Second, the egg transport procedure producing the poorest survival in the test (Lot 4C, 48.9%) was the same procedure used to transport egg Lots 5 and 6 on the same day, and survival of these eggs to eyed stage was 97.2% and 89.3% respectively (Table 3).

The generally poor survival to eyed stage of eggs from the test female (average 60.0% for all three methods, Table 4) is probably related to the physiological conditions of the eggs when they were removed from the female. Since many of the eggs, when this fish was spawned, were still intact in the anterior portion of the ovaries and had to be teased or shaken free of ovarian connective tissue, the female was obviously not fully ripe and presumably many of the eggs not ready for fertilization. This point is further emphasized by the fact that in late October, after hatching of eggs from the test female was completed, a high percentage of the alevins were malformed. Why the three egg-transport methods tested would produce the different rates of survival to eyed stage under the given conditions of the test and the physiological condition of ovaries and eggs is unknown.

The wide variations in survival of eggs in Lot 4C, Lot 5, and Lot 6 (three separate females) collected, fertilized, waterhardened, and transported in the same manner, on the same day, must be related to maternal variability and not to the milt used or to handling of gametes. All of the eggs were fertilized with milt from the same four males and two or more males were used with each female. The relative condition of the females, in this instance, became more important than the egg transporting technique used, emphasizing the need of having access to adequate numbers of potential brood fish, so careful selection of spawners in the proper stage of maturity can occur.

Further investigation of egg transfer techniques will help to more clearly establish the best methods of transfer.

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