Rehabilitation of Chinook Salmon (Oncorhynchus tshawytscha) Pinheaded Fry for Incorporation into Hatchery Program

by
Raymond P. Dorman
Fish Culturist

Idaho Department of Fish and Game
McCall Summer Chinook Fish Hatchery
McCall, Idaho 83638

July 1993

TABLE OF CONTENTS

LIST OF TABLES

Rehabilitation of Chinook Salmon (Oncorhynchus tshawytscha)
Pinheaded Fry for Incorporation into Hatchery Program

ABSTRACT

The primary focus of this experiment was to devise a method of restoring “pinheaded" summer-run chinook salmon 0. tshawytscha to a condition factor (C) obtained by healthy fry of the same brood year. The target condition factor was C=3,000 x 10-7. This was a minimal condition factor achieved by healthy cohorts at the McCall Fish Hatchery during the 100 days of the experiment. Once the condition factor was met, the fry were put into normal hatchery production with fry of similar weights and lengths. The average success rate of obtaining the target condition factor was 89.15%. Overall survival of the 2,886 fry used in the experiment was 95.43%.

Pinheaded fry, or dropouts, are usually removed as mortalities and have been lost to hatchery production. Reisenbichler and McIntyre (1977) stated that hatchery rearing selects fish which survive well only in the hatchery. "When young fry begin to feed and grow, some fish (up to 2%) may cease feeding, become 'pinheaded', and die." "These fish are thought of as 'dropout'," (Warren 1991). This experiment was undertaken to achieve two possible benefits: 1) reduce production losses; and 2) reduce size variability.

A reduction in production loss has importance due to the low returns of all Idaho chinook stocks, both hatchery and wild. The latter is listed as threatened under the Endangered Species Act. By recouping these losses, they could be used as additional numbers in hatchery releases that would normally not be utilized. On a broader perspective, a reduction in production losses by rehabilitating pinheads may reduce potential artificial selection (domestication selection) created within hatchery programs.

Woods (1979) stated that "Overcrowding and considerable size variation were suspected as being precipitating factors in pinheading." Fry size variation can occur regularly from mixing spawntakes (egg lots) into one production vat to obtain a desired density. This has been a common practice because early and late egg takes tend to be small.

Smith (1984) found that dropout in spring chinook salmon usually occurs when fry are about 1.10 to 1.32 fish per gram and that the disease has usually been characterized by the occurrence of pinheaded fish that are weakened and gather near tail screens. They generally suffered from clubbed gills and have empty gastrointestinal tracts.

If size variation (due to mixed egg lots, temperature units, feeding practices, etc.) could actually be a factor in pinheading, along with a lack of feed in their gastrointestinal tract, it may be possible that pinheaded fry are under-competing with early larger cohorts. Instead of inferior fish, perhaps the pinheaded fry cannot or will not compete successfully for food and space because of initial size disadvantage.

Therefore, the focus of this experiment was to collect pinheaded fry in the early stages and attempt to get them onto feed. Then with the fry back on feed and successfully competing with each other, attempt to grow them to a condition factor (C) of their larger cohorts. Then upon achieving this, return them to hatchery production to continue socialization with the entire production group.

Author:

Raymond P. Dorman, Fish Culturist
Idaho Department of Fish and Game
McCall Summer Chinook Fish Hatchery
McCall, Idaho 83638

MATERIALS AND METHODS

A concrete nursery vat was set up to isolate pinheaded fry from "healthy" larger fry. The vat was divided by an aluminum screen into 3.3 x 1.3 x 0.67 m rearing sections; Section A and Section B. Section A was used for isolating the newly acquired pinheaded fry and for getting the isolated fry onto feed. Section B was utilized for getting the fry to target condition factor C=3,000 x 10-7 as they were already on feed.

Water flow and depth were reduced from the normal hatchery practice of 80 gallons per minute (gpm) and 81.28 cm of depth to approximately 40 gpm and a water depth of approximately 40.64 cm. This was done to allow fry better availability to the food provided. "Very small fish will swim only short distances for food . . . and a conscientious effort must be made by the culturist to distribute the feed as near as possible," (Fowler 1989).

Pinheaded fry were collected individually by hatchery personnel using small-mesh dip nets. Most of the fry were collected near the tail screens of the nursery vats. Another collection site was in the slack water areas behind the nursery vat baffles. This method, although time consuming, allowed for close examination of fry to determine their condition and prevented larger healthy fry from competing with pinheaded fry in isolation.

Bioproduct's Biodiet semi-moist feeds were used throughout the 100-day experimental period. Fry were fed to satiation by hand once every hour in both sections, and after normal working hours a Ziegler Brothers automatic belt feeder was utilized. This was installed over Section A to provide feed in the evening and twilight hours.

Beginning April 6, 1992, and through April 26, 1992, an Erythromycin feed treatment (INAD #4333) was scheduled for the entire brood year as a prophylactic measure against Bacterial Kidney Disease. Both sections in the experiment received the same treatment levels, with the same type of feed as the entire brood year. They received Biodiet 1.0 mm grower with 4.5% Gallimycin 50 for 21 days, at 2% body weight per day. Because of their smaller size and the smallest available medicated feed being the 1.0 mm sized pellets, hatchery personnel had to grind feed every morning to accommodate their size.

Weight and length measurements were performed every 30 days to determine the condition factor the fry had obtained. These were conducted using normal hatchery procedures and techniques. All data collected was in English units. Once weights and total lengths were obtained, the formula $C=W/L^3$ (Piper et al. 1982) was used to determine the condition factor the fry had achieved. A standardized length-weight conversion table (Piper et al. 1982) was also used to verify the condition factor. Percent success was measured by total number of fry divided into the number of fry that did reach target (C).

RESULTS

A total of 2,886 pinheaded fry were collected over 30 days of the 100-day experimental period by hatchery personnel. The collection of fry started March 1, 1992 and ended June 8, 1992.

Throughout the entire experimental period, a total of 35.70 kilograms of feed were fed to the fry (Table 1). This consisted of feed sizes ranging from 0.7mm to 1.3mm. Starter feeds were used for the newly isolated fry in Section A, and grower feeds were utilized by fry already on feed for reaching the target condition factor in Section B. Total cost for feed used over the 100 days was approximately $69.56 (Table 1).

Table 1. Feed allocations for pinheaded fry rearing per month. Costs are per kg. Asterisk denotes a large increase of feed for the month of April. April was the month for the Erythromycin feed treatment for 21 days at 2% body weight per day.

Month	Kilograms of Feed Used	Average Cost of Feed	Cost per Month
March	5.51	$1.90	$10.47
April	*(14.14)	$2.25	31.82
May	9.43	$1.70	16.02
Mid-May	6.62	$1.70	11.25
Total	35.70		$69.56

The first group of pinheaded fry, collected in March (Table 2), averaged 977.84 fish per pound (fpp). These fry came from production vats of cohorts averaging 518.53 fpp. By the end of March, a total of 240 fry averaged 679.83 fpp and had acquired a total length of 1.66 inches, for a condition factor of C=3,215 x 10-7. This constitutes 78.94% success of reaching the target condition factor of 3,000 x 10-7. These fry were then transferred into a production vat containing similarly sized fry; 695.06 fpp and 1.67 inches of total length for a factor of C=3,606 x 10-7. Thirty-seven fry (12.17%) of the first group did not successfully reach the target C and were left in Section B to continue growing. They were included in the following collection period.

The second collection of pinheaded fry occurred in April (Table 2) and averaged 821.63 fpp. These fry came from production vats averaging 397.43 fpp. By the end of April, a total of 627 fry (94.28%) had reached 510.06 fpp and a total length of 1.81 inches for a condition factor of C=3,306 x 10-7. These fry were then transferred into a production vat containing similarly sized cohorts; 405.02 fpp and a total length of 1.75 inches for a C=3,606 x 10-7. Thirty-seven fry (5.56%) of the second experimental group did not reach the target C and were left in Section B.

The third group of pinheads collected in May (Table 2) averaged 753.53 fish per pound (fpp). These fry came from production vats of cohorts averaging 287.02 fpp.

By the end of May, a total of 728 fry (90.88%) had reached 393.13 fpp and a total length of 1.97 inches for a condition factor of C=3,327 *x* 10-7. These fry were then transferred, on the 13th of June, into outdoor ponds containing similar cohorts; C=3,172 x 10-7. Forty-four fry (5.49%) of this third experimental group failed to reach the target C and were left in Section B to continue growing.

The last experimental group was collected in mid-May, prior to all nursery production vats being released outside (Table 2). This group averaged 539.87 fpp and came from vats averaging 2,231.04 fpp.

By June 8, a total of 978 fry (87.63%) had reached 380.48 fpp and a total length of 9.91 inches, for a condition factor of C=3,772 x 10-7. At this point, the experimentation was concluded because all the production vats had been released to the outdoor ponds. Sixty-three fry (5.64%) had not reached the target C, but were released into the outdoor ponds.

Table 2. Numbers of pinheaded fry involved in the 100-day experimental period. Those fry determined to reach target C had a condition factor of C=3,000 x 10-7. Percentage of success of reaching target C was determined by total number of fry divided into those fry that did not reach target C.

month	Monthly total ponded	Fry to reach target C Number	Fry to reach target C Percent	Fry failed to reach target C Number	Fry failed to reach target C Percent	Monthly Mortality
March	304	240	78.94	37	12.17	27
April	665	627	94.28	37	5.56	38
May	801	728	90.88	44	5.49	29
Mid-May	1,116	978	87.63	63	5.64	38
Total	2,886	2,573	89.15	181	6.27	132

Of the 2,886 pinheaded fry used in the 100-day experimental period, a total of 2,573 fry (89.15%) reached the target condition factor. The number of pinheaded fry used in the experiment represents only a sub-sample of the pinheaded fry that could have been obtained. Only 181 fry (6.27%) did not reach the desired goal. Mortality for the entire experiment was 132 fry (4.57%).

DISCUSSION

This experiment was undertaken to achieve two possible benefits: 1) reduce production losses; and 2) reduce size variability.

The 2,886 pinheaded fry collected for this experiment represented approximately 0.45% of the total 636,291 swim-up fry at the McCall Hatchery for the 1991 brood year. Additionally, records were kept on monthly pinhead mortality associated with outdoor rearing. Total mortality from pinheads during may and June was 475. When added to the 2,886 pinheads used in the experiment, the percentage increases to 0.53% of the total production available. During years when the hatchery has a low egg-take year and space, it appears that pinhead losses could be conservatively reduced.

Size disparity between pinheads and normally developing chinook salmon fry was reduced by allowing the pinheaded fry in isolation to obtain feed; and once on feed, to compete among cohorts of similar size. Condition factors gained by the pinheads show it is possible to prevent a large size variability once the fry are back on feed and competing with cohorts.

Mortality rates during the experimental period show that they are not "inferior fish," but under-competing conspecifics. If the pinheaded fry had not been isolated, allowed to take feed, and grown to a healthy condition factor, these fish would have been removed from production.

ACKNOWLEDGEMENTS

I would like to thank Keith Johnson, Fishery Pathologist at the Eagle Hatchery Research Facility, for challenging me with this idea. I would also like to thank those people who reviewed the test and put forth their thoughts and ideas. I am grateful to my supervisor Gene McPherson, McCall Summer Chinook Fish Hatchery Superintendent, for allowing me to do this project. Additionally, I would like to thank Inez Hopkins, Idaho Department of Fish and Game Librarian, whom I have troubled many times in the past for hard to find literature, and again for this paper, for which I am grateful!

LITERATURE CITED

Fowler, L.6. 1989. Feeds and feeding practices for improved fish health. U. S. Fish and Wildlife Service, Abernathy Salmon Culture Technology Center-Technological Transfer Series No. 88-1 Aff/Atc-89-04 p. 20.

Piper, et al. 1982. Fish Hatchery Management. U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC 517p.

Smith, C.E. 1984. Pathological changes associated with dropout disease in rainbow trout, spring chinook salmon, and westslope cutthroat trout. p. 41. In proceedings of the 35th Annual Northwest Fish Culture Conference, Kennewick, WA December 4, 1984. 132p.

Warren, J.W. 1991. Diseases of hatchery fish. Sixth Edition. U.S. Fish and Wildlife Service - Pacific Region 92p.

Woods, J.W. 1979. Diseases of Pacific Salmon: The prevention and treatment. Third edition. Hatchery Division, Washington Department of Fisheries, Olympia, WA 82p.