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Project 1-57-D Completion Report

Experimental Rearing of Anadromous Fish, Lemhi River Drainage, Idaho (Hayden Creek Research Station)

1 July 1970 - 30 June 1974

By

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Experimental Rearing of Anadromous Fish, Lemhi River Drainage, Idaho (Hayden Creek Research Station)

ABSTRACT:

Dirt pond rearing of summer-run steelhead trout at the Hayden Creek Research Station showed that the percent of smolts produced was similar for both 1-year and 2-year reared fish. Fewer sub-smolts were produced in the 2-year rearing cycle but this advantage was offset by the high incidence of nonmigrating sexually precocial males. Grading prior to placing steelhead in the ponds is necessary to prevent excessive size range and reduce pond mortality. Preliminary test rearing of early acquired steelhead indicates rearing these for 1 year may give maximum cost/benefit returns for smolt production.

Summer rearing-fall release of spring chinook salmon was made an integral part of the station regime in 1971. Salmon are very responsive to pond rearing and thrive in a pond situation. There appears to be no need to grade chinook prior to ponding. Numbers of smolts released for the last 5 years (1970-74) should be adequate to provide large enough returns to evaluate the program by 1976.

Future plans for the station include feed and grading experiments and investigation of techniques and procedures to increase the quantity and quality of the smolts produced at the station. Experimenting with other races of steel-head might be a beneficial undertaking at the Hayden Creek Research Station.

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INTRODUCTION:

The Hayden Creek Research Station was constructed in 1966 as an effort to initiate and investigate techniques in pond rearing of summer-run steelhead trout. The initial program began on the basis of rearing steelhead on a 1-year pond-rearing-release cycle. In 1970, we also began annual fall releases of 5-month pond-reared spring chinook salmon smolts.

Annual project progress reports have been submitted since the initiation of the program and contain detailed information on each year's operations, including rearing costs, feed distributed, growth rates, experiments conducted and results, smolts released, construction and improvements, etc.

This report is a summary of project operations, results and conclusions over the period 1 July 1970 to 30 June 1974.

DESCRIPTION OF FACILITIES:

The Hayden Creek Research Station is located about 4.8 km (3 mi.) up Hayden Creek from its confluence with the Lemhi River, about 48.3 km (30 mi.) from the town of Salmon, Idaho.

Basically, the station rearing facilities consist of two 0.2 ha (0.6 acre) dirt ponds, approximately 2.1 m (7 ft.) deep, and associated water control structures (Figure 1). Neilsen automatic feeders distribute feed to the fish in the ponds and motor-driven rotary drum screens at the outlet prevent escape (Figure 2). The ponds are supported by two 61.0 x 1.2 m (200 x 4 ft.) concrete raceways and an incubator building housing 10 Heath incubator stacks.

A 61.0 x 4.0 m (200 x 13 ft.) roofed concrete slab with various water transport and control pipes and valves provides an experimental section where various troughs, vats, channels, etc., are installed, arranged and manipulated for various experiments.

At the lower end of the station, a short fish ladder leads to a 3.7 m (12 ft.) square adult fish trap with a raiseable floor (Figure 3). Associated with this trap is a holding pen complex where adult salmon and steelhead can be sorted and held (Figure 4). An adult holding pond surrounds the trap and pens, and can accommodate a large number of adults if needed.

A 14.6 x 4.9 m (48 x 16 ft.) prefabricated metal building provides feed storage, shop, laboratory area, shower and toilet facilities, and a small office. Mobile homes provide housing for the hatchery superintendent and one fish culturist permanently assigned to the station. A fisheries technician assigned to D-J projects in the area and on the station provides part-time assistance.

Water for fish cultural purposes can be drawn from either a 11 C (52 F) spring (approximately 5 cfs volume) or directly from Hayden Creek. Two separate water transport systems to all facilities allow both sources to be mixed at will. Maximum dissolved oxygen in the spring water is 5 ppm and at times can become a limiting factor at the station necessitating addition of

Figure 1. The Hayden Creek Research Station lies some 1,207 river km (750 river mi.) upstream from the Pacific Ocean on the Columbia River drainage. Two 0.2 hectare (0.6 acre) dirt ponds are used to rear spring chinook and summer-run steelhead trout

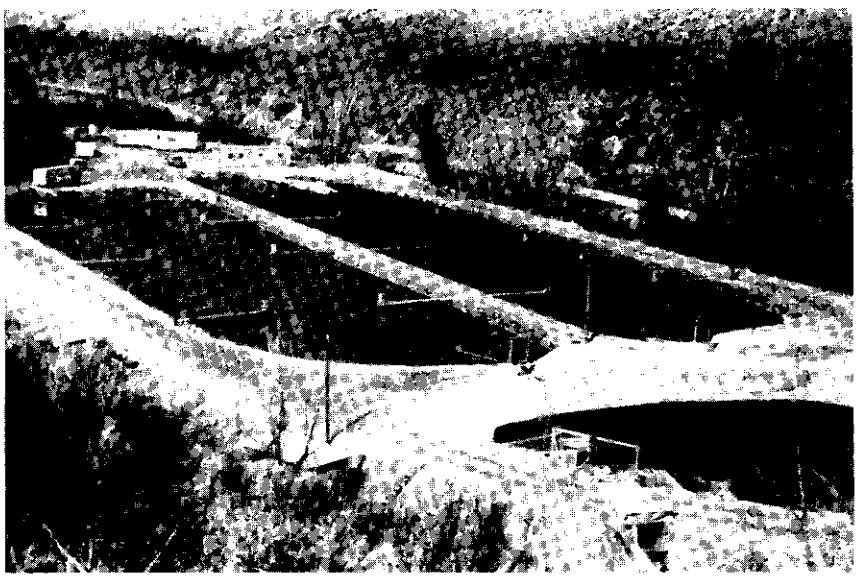

Figure 2. Neilsen automatic feeders surround the ponds. Adult ladder, trap, pens and holding pond are in right lower foreground.

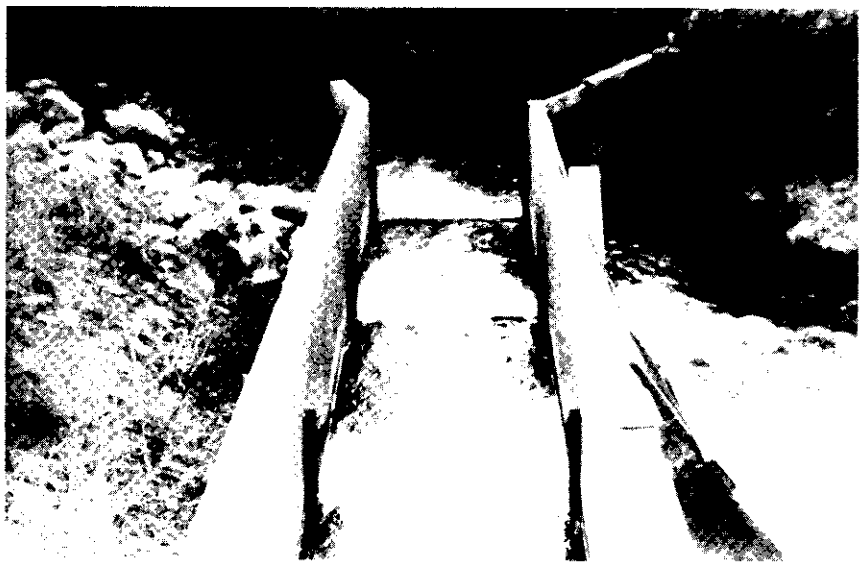

Figure 3. Adult salmon and steelhead returning to the station ascend this ladder into the trap.

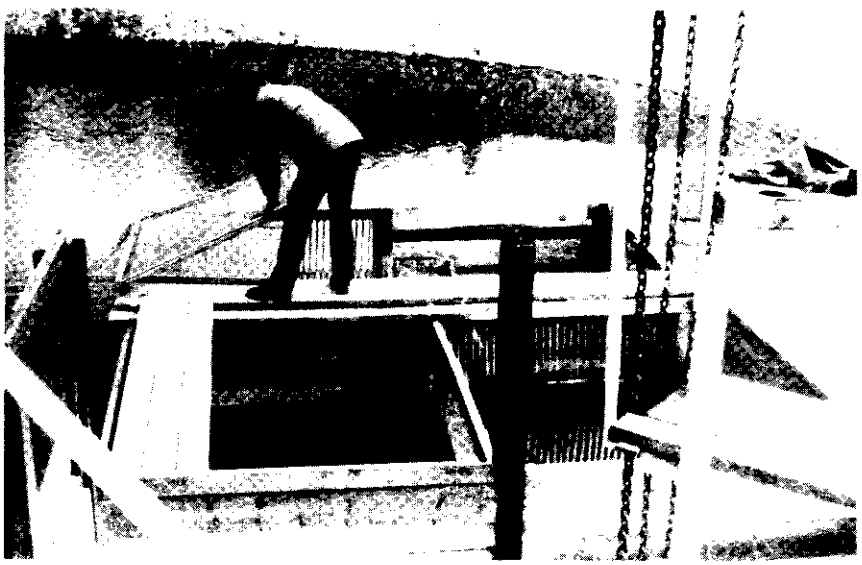

Figure 4. Adults removed from the trap are sorted into these pens or released into the pond in the background.

creek water to prevent anoxia. The spring water contains rather high ionic levels of zinc and copper and, if used at 100% levels to incubate green eggs, can produce deformities in sac fry and cause high mortalities. This is not a factor after the eggs have reached the eyed stage.

The station is at an elevation of approximately 1,524 m (5,000 ft.) above sea level and seasonal temperatures range from a high of around 35 C (95 F) in mid-summer to -34 C (-30 F) in mid-winter. It lies approximately 1,207 river km (750 river mi) upstream from the Pacific Ocean.

SUMMARY OF OPERATIONS:

1 July 1970 to 30 June 1971

Steelhead - Juveniles

In October 1970, we placed approximately 152,000 graded steelhead fingerlings averaging 109/kg (240/lb.) in the north rearing pond. We reared these fish over the winter and released them in April 1971, at an average size of 165 mm (6.5 in.) and 4.8/kg (10.5/lb.). Nearly 60% of the release exceeded 160 mm (6.3 in.) total length, a size that appears to be the necessary minimum for good downstream emigration.

At the same time in October 1970, we placed 152,000 steelhead fingerlings in the south rearing pond. These were the lower half of the graded steelhead placed in the north pond and averaged 119/kg (262/lb.). We planned to rear this group for release the following spring. However, because of their small size at release time in April 1971, we decided to rear them for an additional year. At that time, we shifted the south pond over from constant temperature spring water to Hayden Creek water.

We decided to experiment with 2-year pond rearing regimes for the next few steelhead brood-years.

Steelhead - Adults

In the spring of 1971, 15 adult steelhead entered the ladder and fish trap at the Hayden Creek Research Station. We expected few, if any, returns in 1972 because the 1967 release of Clearwater River, 2-ocean stock and the 1968 release of Snake River, 1-ocean stock both returned in 1970, and the 1969 release of Clearwater stock was due to return in 1972.

Chinook Salmon - Juveniles

In June 1970, we placed approximately 209,000 spring chinook salmon fingerlings in the south pond for summer rearing and fall release (Figure 5). This initial chinook rearing project was financed by Dingell-Johnson funds and was an experimental rearing operation designed to utilize the ponds during the summer period when the steelhead fry were in the raceways. The chinook thrived in the ponds and we released 83,200 into Hayden Creek in October 1970, at 5.9/kg (13/lb.) and 148 mm (5.8 in.) average fork length. The other 125,800 were released in the upper Salmon River. They showed strong fall downstream emigration

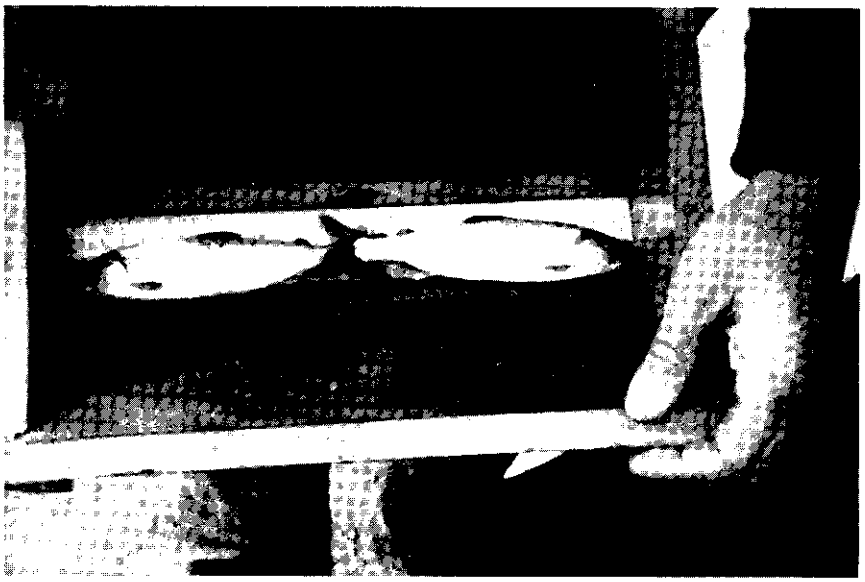

Figure 5. Chinook smolts spend 5 months in one rearing pond (May-September). They display strong downstream emigration when released in October.

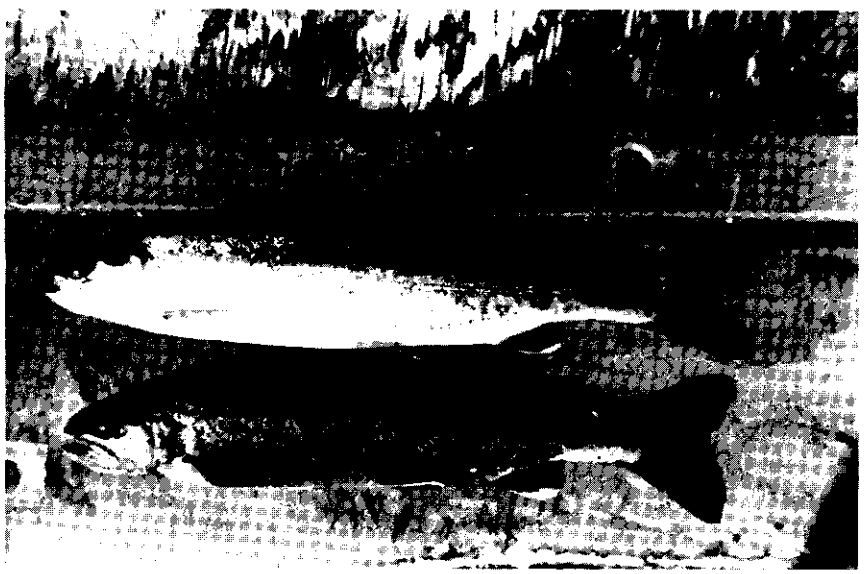

Figure 6. Two year rearing cycles produced upwards of 20% precocial males (bottom fish) compared to less than 1% for 1-year cycles. The upper fish is a smolt; slim, silvery, with deciduous scales.

and marked fish were captured as far downstream as Ice Harbor Dam by mid-December 1970.

This initial rearing experiment was very encouraging and summer-rearing fall-release of spring chinook salmon was made an integral part of the station regime in 1971, under the P.L. 88-309 project.

1 July 1971 to 30 June 1972

Steelhead - Juveniles

During the 1971-72 fiscal year, we continued the experimental 2-year rearing program at Hayden Creek. The 1970 brood-year steelhead were released from the south pond in late March. At release these fish averaged 196 mm (7.7 in.) and 2.5/kg (5.6/lb.). Over 80% of the fish exceeded 160 mm (6.3 in.) total length.

Total count of the 1-year reared fish, at release in April 1971, was 72,000 (47%) of the original ponding of 152,000. Total count of the 2-year reared group (March 1971) was 87,500 (58%). However, an unknown number of steelhead escaped from both ponds early in the program which confounds direct comparison of pond survival. We installed jump barriers and improved screen seals between releases preventing further escape of the 2-year reared group. Of the 72,000 1-year reared fish released, 41% were classed as sub-smolts (less than 160 mm (6.3 in.) T.L.), 1% as precocial males and 58% as smolts (Figure 6). Of the 87,500 2-year reared fish, 19% were classed as sub-smolts, 19% as precocial males and 62% as smolts (Table 1).

Table 1. Comparison of two groups of 1970 brood-year steelhead reared in the Hayden Creek rearing ponds.

Rearing time	No. fish released	Percent sub-smolts	Percent precocial males	Percent smolts
1-year	72,000	41	1	58
2-year	87,500	19	19	62

The 2-year reared group averaged significantly larger than the 1-year reared group, 196 mm (7.7 in.) vs 165 mm (6.5 in.), and percent of sub-smolts in the 2-year reared group was less than half that of the 1-year reared group (19% vs 41%). However, the incidence of sexually precocial nonmigrating male fish in the 2-year reared group (19%) offset the number advantage, and percent of smolts released was nearly the same (62% vs 58%).

It may be that the larger average size of the 2-year reared smolt is a survival advantage; however, all adult returns from these groups will not be complete until the spring of 1975. Even then, comparisons drawn between fish years are confounded by massive downriver passage problems on both downstream migrating smolts and upstream migrating adults.

We used 10,631 kg (23,438 lb.) of dry feed at a cost of $2,109 to rear the steelhead in the north pond and 26,303 kg (57,988 lb.) of dry feed at a cost of $5,219 to rear the steelhead in the south pond. Cost of feed per smolt produced was $.050 for the 1-year reared group and $.096 for the 2-year reared group. Because of unknown escapement of both groups from the ponds during the early rearing phase, these figures are probably not directly comparable. However, this first attempt at 1-year vs 2-year rearing indicated that the cost-benefit ratio for a 2-year rearing program was not encouraging.

In November 1971, we placed an estimated 73,000 steelhead fingerlings at 53.5/kg (118/lb.) in the north rearing pond. Due to generally depressed steelhead runs into Idaho in 1971, we were limited to eggs from the Lemhi Weir and returns to the station, hence the low numbers.

Project plans were to rear these fish on a 100% natural water temperature regime until the spring of 1973. We raised the pond outlet drum screen in May 1972, and counted out 4,300 voluntary first-year emigrants. Visible mortality, less these first-year emigrants, left us with an estimated 66,300 fish in the pond entering fiscal year 1972-73.

Steelhead - Adults

Between 21 April and 15 May 1972, a total of 17 adult steelhead entered the trap at the station. Of this number, two fish carried a left ventral (LV) fin clip from a portion of the May 1969 release (Figure 7). Three other adults showed dorsal fin deformities which indicates hatchery origin. Six other LV clipped adult fish were noted at a steelhead angler check station in the fall and spring of 1971-72.

Figure 7. Both these adult steelhead returnees show a deformed dorsal fin indicating hatchery origin. The upper fish has a left ventral fin clip.

Chinook Salmon - Juveniles

We reared 200,000 juvenile chinook in the north pond between June and October 1971. We released them on 2 October at 6.7/kg (14.7/lb.) and 131 mm (5.2 in.) average fork length. We fin-clipped 52,000 prior to release. These fish were collected in good numbers at downstream trapping sites indicating good fall downstream movement.

1 July 1972 to 30 June 1973

Steelhead - Juveniles

In April 1973, we drained the north pond and released the remaining 1971 brood-year steelhead that were ponded in November 1971. We counted and/or weighed out 31,700 fish for a survival of 48% over the 2-year rearing cycle. Of these fish, we classed 61% as top quality smolts, all over 160 mm (6.3 in.), 13% precocial males, and 26% sub-smolts.

The results of this first effort at a 2-year 100% natural water temperature rearing regime were not encouraging. We achieved approximately this same level of survival and smolt percentage with past 1-year cycles (Table 2).

For this and previous rearing cycles, we were limited by not having enough steelhead eggs to grade fingerlings prior to ponding. This led to a large size disparity in the ponds and a high percentage of sub-smolts. We have noted that if steelhead fingerlings are not graded prior to ponding, the larger individuals quickly dominate the feeder stations, relegating smaller individuals to the pond perimeters where they do not compete and receive little or no feed. Growth ceases and most of them perish. Most of this mortality appears to occur within the first few months of ponding and, because the fish are small and die off over an extended period, most of the loss is not visible. It appears that if we attempt to rear ungraded steelhead in the ponds we can expect about 50% survival.

In December 1972, we placed 108,000 1972 brood-year steelhead fingerlings, at 56.7/kg (125/lb.), into the south pond. Again, a limited supply of eggs plus pick-off and some disease problems in the fry stage prevented us from having sufficient numbers to grade and load to capacity in 1972. We noted considerable size disparity among the fish when we ponded them.

In late May 1973, a Petersen population estimate indicated a 50,000 fish population remaining in the pond, an estimated loss of 54% of the original pond stock in the first 6 months. This approximates previous survival rates we found for ungraded pond-reared steelhead in prior rearing cycles.

Steelhead - Adults

Between 25 March and 31 May 1973, 20 adult steelhead entered the trap at the research station. Of this number, 3 fish carried a left ventral fin clip, 12 showed fin deformities indicating hatchery origin, and 5 were unmarked. Of these 20 fish, we classified five as 1-ocean returns from the 1971 smolt release and 15 as 2-ocean fish released in 1970 (Table 3).

Table 2. Summary of steelhead pond rearing program at the Hayden Creek Research Station since inception of the project in 1966.

Brood year	Rearing length	Release date	No. fish released	No. fish stocked	Pond survival	Percent sub-smolts	Percent prec. males	Percent smolts	Feed cost per smolt	Average fish size
1966*	8 mos.	May '67	187,000	189,000	99%	19%	0%	81%	$.013	190 mm
1967*	4 mos.	May '68	372,000	375,000	99%	50%	0%	50%	N/A	164 mm
1968	1 year	May '69	87,400	170,000	51%	52%	0%	48%	.065	151 mm
1969*	1 year	May '70	189,000	218,500	86%	46%	0%	54%	.025	159 mm
1970*	1 year	Apr "71	72,000	152,000	47%	41%	1%	58%	.050	164 mm
1970*	2 year	Apr '72	87,500	152,000	58%	19%	19%	62%	.096	196 mm
1971	2 year	Apr '73	32,000	73,000	48%	26%	13%	61%	.101	169 mm
1972	1½ year	Nov '73	42,000	108,000	39%	44%	0%	56%	.049	157 mm
1973*	5 mos.	Apr '74	79,700	101,000	79%	27%	0%	73%	N/A	167 mm

* Graded prior to ponding

Table 3. Summary of steelhead smolt releases and adult returns to Hayden Creek Research Station since initiation of the program in 1966.

Brood year	Year released	Number juveniles released	Number marked	Mark used	River race	Number adults returned as: One-ocean fish	Number adults returned as: Two-ocean fish
1966	1967 (May)	180,000	22,800	LV	Clearwater	48 (1969)	46 (1970)
1967	1968 (May)	340,000	12,000 11,700	LV LV AD	Snake	8 (1970)	10 (1971)
1968	1969 (May)	87,500	26,700 20,000	LV L Brand	Clearwater	5 (1971)	6 (1972)
1969	1970 (May)	187,400	55,000	LV	Clearwater, Lemhi 1969 return	11 (1972)	15 (1973)
1970	1971 (May)	72,000	38,000	LV	Lemhi Weir, 1970 return	5 (1973)	17 (1974)
1970	1972 (Mar.)	87,500	50,000	LV	Lemhi Weir, 1970 return	3 (1974)	__ (1975)
1971	1973 (Apr.)	31,700	13,800	LV	Lemhi Weir, 1971 return	__ (1975)	__ (1976)
1972	1973 (Nov.)	47,000	0	--	Lemhi Weir, 1972 return	__ (1976)	__ (1977)
1973	1974 (Apr.)	80,000	80,000	Tetra-cycline	Clearwater	__ (1977)	__ (1978)

Chinook Salmon - Juveniles

On 13 May 1972, we placed 312,000 spring chinook salmon, at 61.7/kg (136/lb.), in the south pond. This was a 50% increase over previous stocking density.

During the first week of September, the chinook showed signs of anoxia distress and nocturnal losses of 400-600 fish occurred three or four nights in sequence despite an increase in the pond inlet flow to nearly 7 cfs. We released 13,000 fish into Hayden Creek which alleviated the problem. It appears that pond carrying capacity for chinook (and steelhead) is around 8,164 kg (18,000 lb.) maximum. The remaining fish were released in October 1972, at an average size of 135 mm (5.3 in.) fork length.

In April 1973, we placed some 266,000 Rapid River stock 1972 brood-year spring chinook averaging 193 per pound in the north pond. In late June, 100,000 of these fish were transferred to a Dingell-Johnson rearing pond project on the upper Salmon River. On 30 June 1973, the remaining 160,000 fish averaged 24.9/kg (55/lb.) and 85-95 mm (3.3-3.7 in.) fork length.

Chinook Salmon - Adults

Between 5 June and 5 September 1973, 30 adult spring chinook salmon entered the trap at Hayden Creek. Of this number, two fish carried an adipose fin clip applied to the 1969 brood-year fish released in the fall of 1970, and two carried fin clips applied to the 1970 brood-year fish released in the fall of 1971. An additional 12 chinook salmon adults from Hayden Creek were counted at the Lemhi Weir and on spawning beds in Hayden Creek above the station.

1 July 1973 to 30 June 1974

Steelhead - Juveniles

Original plans were to rear the 1972 brood-year steelhead in the south pond until April 1974, a 2-year rearing cycle. In past years, we determined that it is difficult, if not impossible, to successfully rear much more than 50-60% of a pond population of summer steelhead to smolt sized fish in 1 year at Hayden Creek. However, a 2-year cycle did not produce much better results due to the high incidence of nonmigrating males. At Hayden Creek (and the Lemhi Weir), adult steelhead for our egg source are not available until May, and the 9-month period from egg hatch to spring release is not enough time to bring a majority of the fish to the smolt stage. We felt that if we had access to an earlier egg source and an additional 6-8 weeks of rearing time, we could rear a 1-year smolt at the station.

In order to test this procedure promptly, we obtained 101,000 top grade Hagerman-reared steelhead fingerlings originally from Dworshak National Fish Hatchery in Orofino, Idaho, from their earliest returning adults. These fish were approximately 2 months ahead of the steelhead fingerlings hatched from the adults that returned to the Lemhi Weir and Hayden Creek in 1973. This necessitated releasing the 50,000 steelhead in the south pond in mid-November 1973, and replacing them with the early Dworshak fish.

Upon release in November 1973, these 1972 brood-year fish averaged 5.4/ kg

(11.9/lb.) and 157 mm (6.2 in.) total length. The number released (42,000) was within 5% of the Petersen population estimate (plus observed mortality) conducted on the pond population in May 1973. At the time of release, we classed 44% of the fish as sub-smolts below 160 mm (6.3 in.) in length and 56% as smolts. We noted less than 1% precocial males, presumably because of the time of release (fall) and the relatively small average size of the fish, 157 mm (6.2 in.).

The 101,000 early stock fish were delivered to the north pond in early December 1973, at an average length of 105-110 mm (4.1-4.3 in.) 13.2/kg (29/lb.). We reared these fish for 4.5 months and released them in mid-April 1974, at an average size of 167 mm (6.6 in.) 4.7/kg (10.3/lb.). We classed 73% of the fish as smolts, 160 mm (6.3 in.) or more total length and 27% as sub-smolts. There were few precocial males.

In late January, an outbreak of the viral disease Hagerman Redmouth occurred in the north pond. We treated the fish successfully with Terramycin medicated feed. Mortality was approximately 20,000 steelhead. In addition, we treated the north pond fish just prior to release with formalin to eliminate a gill infestation of parasites believed to be in the genus Tricodina.

This experimental effort of rearing early maturing steelhead encouraged us to plan future rearing efforts around the acquisition of early eggs from sources other than returns to Hayden Creek and the Lemhi Weir, with the long range objective of establishing an early run back to the station.

As of 30 June 1974, we had on hand approximately 235,000 1973 brood-year steelhead juveniles in the south pond. Plans are to rear this group on close to natural water temperatures for two seasons and release them simultaneously in April 1975, with a group of 1974 brood-year early-stock fish in the north pond. This will give us our first direct comparison between 1- and 2-year reared groups and adult returns.

The 235,000 1973 brood-year fish were intensely graded prior to ponding in December 1973, and so far have maintained the closest size range of any rearing group. We noted almost complete absence of stunted fish around the pond primeters which was common in past years when we did not grade prior to ponding steelhead.

Steelhead - Adults

Between 11 April and 28 June 1974, 20 adult steelhead returned to the adult trap at the station. Half of the fish displayed fin clips applied as smolts. Most also showed dorsal fin deformities indicating hatchery origin.

Chinook Salmon - Juveniles

Early in October 1973, we released 150,000 age I spring chinook salmon smolts from the north pond. The fish averaged 7.3/kg (16/lb.) and 131 mm (5.2 in.) fork length. This was the fourth straight year of fall released chinook smolts from the station. They displayed good downstream emigration.

Chinook Salmon - Adults

All adult salmon from the 1969, 1970 and 1971 brood-year releases returned to Hayden Creek after 30 June 1974. However, I include them in this report to maintain continuity.

Forty-eight adult spring chinook returned to the station between 10 July and 18 August 1974 (Figure 8). Two of the adults displayed fin clips received as juveniles at Hayden Creek. We classed 38 of the returning adults as 1-ocean fish, 7 as 2-ocean fish and 3 and 3-ocean fish (Table 4). As spawning time approached in late August, we noted considerable numbers of adult salmon digging redds in Hayden Creek adjacent to the station. One count of 23 live fish was made. As the natural run of chinook into Hayden Creek is very small, we assumed hatchery origin for these fish. Redd counts conducted on Hayden Creek from Basin Creek to the mouth on 9 September disclosed 28 redds. This compares to a 5-year (1969-73) average of approximately five redds.

Figure 8. An adult chinook salmon being spawned at Hayden Creek. Forty-eight salmon entered the trap in 1974, and others were noted spawning in Hayden Creek near the station.

DISCUSSION OF STEELHEAD POND REARING:

Table 2 is a summary of the results of the various steelhead rearing experiments since initiation of the project in 1966. Other than the 1967 release, which was reared and graded at Hagerman Fish Hatchery prior to delivery to Hayden Creek, and the 1974 release from early maturing adults, the percent of smolts produced is similar for both 1-year and 2-year reared fish (Table 2). Two-year reared smolts averaged larger, but only future adult returns will indicate whether

Table 4. Summary of spring chinook smolt releases and adult returns to Hayden Creek Research Station since initiation of the program in 1969.

Brood year	Year released	Number juveniles released	Number marked	Mark used	River race	Number adults returned as: One-ocean fish	Two-ocean fish	Three-ocean fish
1969	1970 (Oct.)	83,200	25,200	AD	Lemhi Weir	0 (1972)	20 (1973)	3 (1974)
1970	1971 (Oct.)	201,000	52,000	½D, AD, LV	Rapid River	10 (1973)	7 (1974)	__ (1975)
1971	1972 (Oct.)	312,000	73,000	RV, L Max	Rapid River	38 (1974)	__ (1975)	__ (1976)
1972	1973 (Oct.)	151,000	0	--	Rapid River	__ (1975)	__ (1976)	__ (1977)

this is a large enough difference to affect survival. Cost per smolt is considerably higher for the 2-year reared fish. A direct comparison will be drawn between 1- and 2-year reared groups in 1975.

Preliminary test rearing of early acquired steelhead from Dworshak Hatchery indicates this procedure may give maximum cost/benefit returns for smolt production.

Grading is necessary prior to ponding to prevent excessive size range and reduce pond mortality. Once the fish are in the pond no grading is possible. A 1-year rearing cycle also produces a closer size range than a 2-year cycle. Although there are fewer sub-smolts produced in the 2-year rearing cycle, this is offset by the high incidence of nonmigrating sexually precocial males. The percent of smolts produced is comparable for both 1- and 2-year fish. A 1-year rearing program also has the benefit of allowing twice the production of a 2-year program over a 2-year period.

At this stage, it appears that to maximize smolt output at the Hayden Creek Research Station the basic procedure is to:

1. Obtain eggs from the earliest returning stock of steelhead available. (At this time, this appears to be from Dworshak National Hatchery).

2. If green, bring them to the eyed stage on 50% Hayden Creek-50% spring water.

3. After the eyed stage, hatch on 100% spring water.

4. Feed the swim-up fry in the raceways until they are approximately 100 per pound (± October).

5. Grade periodically during the raceway rearing phase.

6. Grade just prior to ponding.

7. Rear the steelhead on spring water during the pond rearing phase, adding only enough creek water to maintain dissolved oxygen levels at or above 5 ppm.

8. Release the smolts approximately 10 April.

With the basic rearing procedures established, it now remains for us to investigate those methods, techniques and procedures within those parameters to increase the quantity and quality of the smolts produced at the station.

Feed experiments were initiated in 1974, which indicate that starting steelhead fry on a moist diet produces better growth and higher survival during this critical period (Mate 1974). Further tests and experimentation are slated for future rearing cycles.

Improved methods and devices for grading fish are being explored. It appears that a portion of the fish graded off can be brought up to size if

separated, but if not needed to satisfy hatchery goals should be removed from the hatchery. Grade-outs should not be retained if not needed, and never if it means crowding the top grade fish.

It appears that prophylactic treatment for diseases common to the station before they manifest themselves is beneficial for even growth and diminishing size disparity in the raceways.

The possibility of experimenting with other races of steelhead might be a beneficial undertaking at the Hayden Creek Research Station.

DISCUSSION OF CHINOOK POND REARING:

Chinook salmon are markedly more responsive to pond rearing than steelhead and thrive in a pond situation. There appears to be no need to grade chinook prior to ponding.

In 1972, we loaded one pond with over 300,000 chinook, intentionally crowding carrying capacity. Although we later had to release some to prevent an oxygen deficiency in the pond, by the end of September, their average size was 135 mm (5.3 in.) fork length (Reingold 1973).

When we ponded these ungraded fish in May 1972, it appeared, as with steelhead, that the larger fish immediately dominated the feeder stations. Unlike steelhead, however, the smaller chinook appeared to maintain their aggressiveness and competed for food. As they gained size and strength, they eventually moved into the main feeding areas and resumed their normal rate of growth. This was reflected in a bimodal length frequency at release time in October. When the ponds are loaded at just under carrying capacity ($\pm$ 250,000) or less, this bimodal size grouping diminishes.

Chinook salmon normally rear to smolt size, 80-85 mm (3.1-3.3 in.)and over, in one year in the natural environment and our one-season pond rearing operation closely parallels this natural rearing time. (Steelhead normally rear 2 or 3 years in the freshwater streams in the area and we find it more difficult to rear these fish to smolts in 1 year.)

We have successfully reared and released large numbers of high quality chinook smolts at the Hayden Creek Research Station for the last 5 years (1970-74). Numbers released, 83,000 to 312,000, should be adequate to provide large enough adult returns to evaluate the program by 1976. It may be desirable to experiment with raceway densities, release times, smolt age release times, and feed types on chinook in future years.

Since 1973, approximately 400,000 chinook fingerlings have been reared at the station annually for an experimental chinook rearing pond near Stanley, Idaho, on the upper Salmon River. All operations and costs for this program are funded by Dingell-Johnson.

DISCUSSION OF GENERAL OPERATIONS:

Besides the basic responsibilities of exploring pond rearing techniques for salmon and steelhead, the Hayden Creek Research Station provides a fertile environment for other fisheries research work. The Idaho Cooperative Fisheries Unit maintains an ongoing program of fisheries research in conjunction with student projects for MS and PhD degrees in fisheries. Station personnel are regularly involved in these activities and other aspects of fish research and culture. Dingell-Johnson monies fund these programs and time spent on them by station personnel are paid for by D-J funds.

Adult returns are the ultimate measure of success or failure of any smolt rearing program. At Hayden Creek Research Station adult steelhead and chinook salmon returns to date have not reached percentages experienced at other anadromous fish hatcheries in the state. We feel that low return percentages may be partly explained because the station has not yet reached optimum rearing procedures and it took the first few years of operation to solve problems inherent in the facility. Also, downstream problems at main stem dams have wreaked havoc on upriver anadromous fish runs the last few years. Small returns have persisted, however, indicating other probelms may be present.

In 1974, we noted a number of adult chinook spawning in Hayden Creek adjacent to the station. Steelhead adults spawn during spring runoff periods when it is very difficult or impossible to observe adults bypassing the station. This may be a larger factor than we previously thought. While we may be able to install a temporary weir to divert chinook salmon into the station in July and August, it is impractical to attempt to weir Hayden Creek in April or May. However, we may need some type of temporary or permanent weir structure that diverts returning adults into the station to help us evaluate smolt to adult figures with more confidence.

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