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TEST REARING OF ANADROMOUS FISH

Completion Report

Period Covered: 1 October 1978 to 30 September 1981

by

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TEST REARING OF ANADROMOUS FISH

ABSTRACT

We concluded that spring chinook salmon and summer steelhead juveniles can be successfully reared to the smolt stage simultaneously in the same dirt bottom pond. The chinook were slightly smaller (10 mm) in the sympatric (mixed) pond than in the allopatric (control) pond, but both were larger at time of release than naturally reared smolts from adjacent wild streams such as the Lemhi River.

The steelhead raised sympatrically with the chinook were the largest one-year reared smolt ever released from the station.

The first two cycles of rearing chinook salmon for spring release were highly successful. Growth was controlled by using mixed spring and Hayden Creek water. Smolts released were near the same size as naturally reared wild smolts in adjacent streams and displayed active downstream migration.

Chemical imprinting tests were initiated in 1980 and 1981 to test the effectiveness of reducing bypass of the`tation by returning adults. Returns will be complete in 1984.

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BACKGROUND

This completion report is a summary of research efforts, findings and conclusions for the period 1 October 1978 to 30 September 1981, conducted at the Hayden Creek research station under project 1-143-R.

Annual reports covering operations have been published for all three years and contain detailed information on incubation, rearing, sampling, feed levels, releases, etc. This report is a summary of the general findings and conclusions of the project and does not address operational details as found in the annual project reports.

OPERATIONS

Beginning with the 1-43-R project in 1978, the rearing regime emphasis at the Hayden Creek station shifted from predominantly steelhead to chinook salmon. Prior rearing programs were keyed to steelhead trout and chinook salmon were raised as a secondary species for fall release. The chinook reared at the station grew well and indications were the station could successfully rear full duration chinook smolts that would return significant numbers of adults to this upriver area.

A:

1978-1979

Sympatric Rearing - Steelhead/Chinook

During this rearing year, an experiment was conducted at the station to determine if steelhead and chinook salmon could be successfully reared simultaneously in the same pond to produce smolts. By obtaining eggs from late spawning chinook salmon from Rapid River hatchery and early spawning steelhead from the Skamania hatchery (Washington) and manipulating water temperature at Hayden Creek, incubation, hatch and development were controlled. At time of ponding (Sept. 1978) both salmon and steelhead fingerlings averaged approximately the same size; (75-80 mm). The south pond received a mix of 50% steelhead and 50% salmon (129,800 total fish) and the north pond received 129,000 chinook salmon only.

Observations were made on behavior, species interaction, cannibalism, and growth during the pond rearing phase (September-April) (Beers 1979). Spatial segregation between species occurred. Steelhead displayed dominance during feed distribution but both species obtained food and grew well in the pond environment. The chinook in the single species pond showed slightly larger final size (155 mm) than the chinook in the mixed species pond which averaged only 10 mm smaller (145 mm). Both groups however, were "smolt" sized at release and exceeded the average size of naturally migrating wild chinook smolts occurring in the Lemhi River drainage. The steelhead smolts produced in the sympatric pond showed better growth rates and larger final size (184 mm) than steelhead reared allopatrically in prior years' operations. No cannibalism was found.

Ponding to release percent (survival) estimates were about the same for the sympatrically reared fish and the allopatrically reared fish.

The sympatric-allopatric rearing experiment demonstrated that steelhead and chinook salmon can be successfully reared to smolt stage simultaneously in a dirt bottomed pond. Where reintroduction or enhancement of both species in a drainage is

centered around a rearing pond situation, this should be considered as a viable alternative to constructing two separate facilities. The economic benefits to both construction and maintenance could be considerable.

Table 1. Numbers and sizes of chinook salmon and steelhead smolts released from the Hayden Creek rearing ponds, April 1979.

	Mixed (sympatric)		Control (allopatric)	
	Chinook South pond	Steelhead South pond	Chinook North pond	
Fish/kg (fish/lb)	39.9 (18.1)	17.9 (8.1)	34.4 (14.7)	
Ave. length mm (in)	145 mm (5.7)	184 mm (7.2)	155 mm	
Total kg (lb)	8,224 (3,276)	16,141	17,585 (7,975)	
Total fish	59,295	59,292	117,233	
Ponding-release %	90	93	91	

In the summer of 1980, 17 one-ocean salmon (jacks) were collected in the Hayden Creek trap from these releases: In the summer of 1981, 73 two-ocean adult spawners returned to the station. Additional three-ocean returns are expected in 1982. Only one steelhead adult was collected at the station in 1980 and none in 1981.

1979-1980

Chinook Rearing

This rearing period marked the first effort of rearing chinook salmon full term from egg to spring release smolt at the station.

A concern that rearing too large a chinook smolt would lead to sexual precociality and residualism, particularly for male fish, was avoided by manipulating water temperatures. An effort to release smolts approximating the size of naturally produced chinook in the Lemhi River system was successful.

In September 1979, 462,200 chinook fingerlings were placed in the two rearing ponds at an average size of 268/kg (122/lb). In April 1980, 424,400 smolts averaging 58.1/kg (26/lb) were released as smolts. The fish were slim and silvery with deciduous scales and displayed strong downstream emigration when released.

Five one-ocean salmon (jacks) were collected at the station trap in the summer of 1981. Additional one- and two-ocean returns of adult spawners are expected in 1982 and 1983.

Morpholine (Chemical) Imprinting

Since the initial construction of the Hayden Creek adult collection facilities in the late 1960's, adult bypass has been a problem. Poor ladder attraction flows and spring seeps above the hatchery result in substantial portions of returning adults bypassing the facility and spawning in Hayden Creek proper in the vicinity of the station. Experiments with temporary weirs have not been successful. In 1979 a morpholine-homing experiment was initiated at Hayden Creek to determine if the use of this imprinting chemical will reduce bypass of returning adults.

Between 3 - 16 March, 1980, a drip application of morpholine at a rate of 1 mg per 54 hrs was metered into the north pond for a period of 303 hours. (12½ days), to imprint the spring chinook being reared in the pond. Prior to release of the chinook on 31 March, 41,600 were given an adipose clip and a coded-wire tag. A similar number were also tagged in the adjoining untreated (south) pond as experimental controls.

Commencing in 1981, and continuing through 1983, morpholine concentrate will be dripped into the fish ladder leading to the station trap during the June-September adult chinook migration period. Returns of tagged fish to the station and recovery of kelts in Hayden Creek will allow determination of the effectiveness of the chemical in attracting imprinted versus unimprinted adults into the trap.

Return of wire tags from marked adults will help determine if morpholine imprinted upper Salmon River-bound fish are attracted into lower Columbia River facilities using the chemical, or if excessive straying ensues compared to non-imprinted fish. It is theorized that a strong attraction to the morpholine will not occur until the fish are on the final approach to their home tributary stream. Adult returns to the station will be complete in 1983.

1980-1981

Chinook Rearing

The 1980-81 chinook test rearing program at Hayden Creek was basically a replicate of the 1979-80 program, except numbers reared were increased 43% from 424,000 smolts to 606,000; primarily dictated by egg availability. Water temperatures were again controlled to reduce excessive growth and to produce a smolt similar in size to naturally occurring stocks (100-130 mm).

Approximately 673,800 chinook fingerlings were placed in the rearing ponds in July 1980 at 297/kg (135/lb). In April 1981, 606,000 smolts averaging 42.8/kg (19.4/lb) and 131 mm average length were released (90% survival rate). At the time of release the smolts displayed the secondary physical characteristics of smoltification and displayed strong downstream emigration.

Morpholine (Chemical) Imprinting

A replicate of the 1980 morpholine experiment was conducted in 1981 with the difference of a shortened imprinting time. In April a group of 52,300 chinook were given an adipose clip and a coded-wire tag and released into a holding raceway where they were exposed to a morpholine solution added to the raceway water at a concentration of 5×10^{-5} mg/l. In the raceway the fish recuperated from the anesthetic used in tagging. The bottom raceway screen was removed so the smolts could migrate voluntarily at the end of each marking day. Most of the smolts were exposed to the morpholine for at least several hours. A tagged group of 50,750 smolts were released with no exposure to morpholine as an experimental control. Adult returns are expected in 1982, 1983 and 1984.

DISCUSSION

Between 1979 and 1981, chinook salmon were reared successfully at the Hayden Creek research station and what appeared to be high-quality actively migrating smolts were released. It will have to wait for future years to define the contribution and returns from these releases.

The past history of the station relative to steelhead production showed good to excellent smolts released from the station but poor adult returns (Tables 2 and 3). We feel this is a reflection of conditions occurring downstream from the station, plus the use of lower Columbia River stocks for many of the rearing cycles, and does not truly reflect the capabilities of the station itself. Some of the factors contributing to low adult return numbers are: station bypass, irrigation diversion in the Lemhi River (42 ditches between Hayden Creek and the mouth of the Lemhi), migration delay, and poor passage and survival of both migrants and adults at Snake and Columbia River dams.

We believe the station would function better as a chinook salmon rearing facility rather than a steelhead facility due primarily to its relatively cool water supply. The 1979-81 rearing tests show encouraging salmon smolt production capability. Adult returns through 1984 should provide final indices of success for this species.

Table 2. Summary of spring chinook smolt releases and adult returns to Hayden Creek research station since 1971.

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
1971	1972 (Oct)	312,000	73,000	RV, L Max	Rapid River	38 (1974)	120 (1975)	10 (1975)
1972	1973 (Oct)	151,000	0	---	Rapid River	27 (1975)	89 (1976)	4 (1977)
1973	1974 (Sept)	350,000	0	---	Rapid River	9 (1976)	45 (1977)	13 (1978)
1974	1975 (Oct)	276,000	0	---	Rapid River	5 (1977)	74 (1978)	7 (1979)
1974	1976 (April)	6,000	6,000	R Max	Rapid River	0 (1977)	0 (1978)	0 (1979)
1975	1976 (Sept)	255,000	0	---	Hayden Creek- Rapid River Mix	19 (1978)	24 { (1979)	1 { (1980)
1976	1977 (April)	99,000	9,600	AD-CWT	Rapid River	0 (1978)	{ (1979)	{ (1980)
1976	1977 (Sept)	86,000	86,000	AD-CWT	Hayden Creek- Rapid River Mix	0 (1979)	4 (1980)	0 (1981)
1976	1977 (Oct)	75,500	0	---	Hayden Creek- Rapid River Mix	3 (1979)	12 (1980)	0 (1981)
1976	1978 (April)	15,300	15,300	AD-CWT	Rapid River	3 (1979)	15 (1980)	0 (1981)
1977	1979 (April)	176,500	58,200	AD-CWT	Rapid River	17 (1980)	73 (1981)	(1982)
1978	1980 (April)	424,400	83,100	AD-CWT	Rapid River	5 (1981)	(1982)	(1983)
1979	1981 (April)	606,000	103,000	AD-CWT	Hayden Creek- Rapid River Mix	(1982)	(1983)	(1984)

Table 3. Summary of steelhead smolt releases and adult returns to Hayden Creek research station since 1970.

Brood Year	Year released	Number juveniles released	Number marked	Mark used	River Race	Number Adults Returned As: one-ocean fish	two-ocean fish
1970	1971 (May)	72,000	38,000	LV	Lemhi, Weir, 1970 return	5 (1973)	17 (1974)
1970	1972 (March)	87,500	50,000	LV	Lemhi Weir, 1970 return	3 (1974)	2 (1975)
1971	1973 (April)	31,700	13,800	LV	Lemhi Weir, 1971 return-	2 (1975)	23 (1976)
1972	1973 (Nov)	47,000	0	--	Lemhi weir, 1972 return	21 (1976)	18 (1977)
1973	1974 (April)	80,000	0	--	Clearwater-		
1973	1975 (April)	229,000	0	--	Clearwater- Hayden Creek	6 (1977)	20 (1978)
1975	1976 (April)	125,000	0	--	Washougal	0 (1978)	8 (1979)
1976	1977 (April)	100,000	100,000	CWT&AD	Washougal	0 (1979)	0 (1980)
1976	1977 (April)	99,000	0	--	Washougal	0 (1979)	0 (1980)
1977	1978 (April)	117,500	0	--	Washougal	0 (1980)	33 { (1981)
1977	1978 (April)	119,300	0	--	Clearwater	0 (1980)	{ (1981)
1978	1979 (April)	59,300	0	--	Washougal	1 (1981)	(1982)

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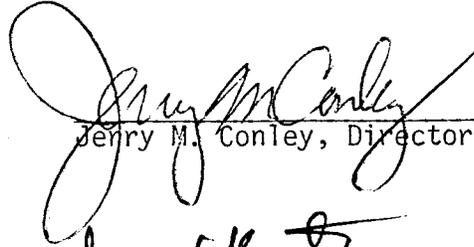
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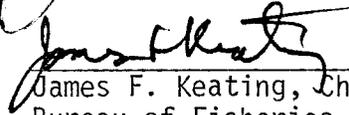
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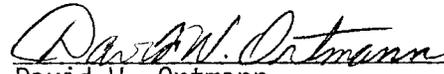
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