Statistical Analysis of Adult Fall Chinook Salmon Spawned at Rowdy Creek Fish Hatchery, 1981-83

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INTRODUCTION

The Rowdy Creek Fish Hatchery (Smith River, California) is the only private, non-profit anadromous fish hatchery in California. The hatchery is located on Rowdy Creek, a tributary of the Smith River system, and is operated for the purpose of enhancing the salmon and steelhead resources of the Smith River. Operating funds for the hatchery are obtained through public and private donations, fund raising events and enhancement monies from the State of California's "Bosco funds" (geothermal assessments).

The first statistical analysis of Rowdy Creek spawned salmon was conducted in 1980 (Waldvogel, 1981). Since that time consistent returns of adult fall chinook salmon have entered the hatchery facility each year. The number of adult chinooks spawned at Rowdy Creek Hatchery in 1981-83 was statistically analyzed for the purpose of providing information to better operate the hatchery program.

SAMPLING METHOD & STATISTICAL ANALYSIS

Scale samples were taken from each adult fall chinook salmon spawned and used to age the individual fish. The fork length, weight and sex was recorded for each chinook and any fin clips or hook scar marks were noted. Heads were removed from all salmon that had adipose fin clips and these heads were analyzed by the California Department of Fish & Game in Eureka for coded wire tags (CWT).

The chinook data was statistically analyzed for mean length and weight, number of fish returning, age distribution and percent of return for each age class and sex. Analysis was attempted only in age classes where significant numbers of fish were sampled (three or more fish).

Scale analysis for age determination also showed identifiable differences in the circuli spacing of the scales when hatchery chinook were compared to wild chinook. It was therefore possible to separate unmarked hatchery fish and wild fish as noted in prior Smith River chinook studies (Waldvogel, 1983 and 1984).

RESULTS

Percent of Return

The percent of return of hatchery origin fall chinook salmon to Rowdy Creek Hatchery in each age class for 1980-83 is presented in Table 1. The "percent of return" mentioned in this analysis represents the actual percent of returning fish for each year class, not the standard percent return of salmon smolts released.

Each year the percentage of hatchery and wild chinook coming into the hatchery has varied depending on the number of fish in each age class. The following statistics for 1980-83 represent a total percentage of all chinook entering the hatchery ladder:

1980 - 178 chinooks entered ladder;
92.7% were hatchery origin

1981 - 88 chinooks entered ladder;
71.6% were hatchery origin

1982 - 66 chinooks entered ladder;
84.8% were hatchery origin

1983 - 165 chinooks entered ladder;
87.3% were hatchery origin

The high percentages of hatchery origin fish entering Rowdy Creek's ladder indicates that the hatchery facility is having little effect distracting wild Rowdy Creek chinooks trying to proceed upstream to spawn.

Smolt Releases

The following number of chinook smolts were released directly from Rowdy Creek Hatchery from 1977 through 1983. The hatchery also raised significant numbers of chinook smolts that were released in other tributaries of the Smith River system (128,385 smolts over 7 years).

Age Class	1980 total n = 165 fish	1981 total n = 63 fish	1982 total n = 56 fish	1983 total n = 144 fish
2 year old	64.2% n = 106	6.4% n = 4	76.8% n = 43	17.4% n = 25
3 year old	10.9% n = 18	44.4% n = 28	1.7% n = 1	81.9% n = 118
4 year old	24.8% n = 41	33.3% n = 21	17.8% n = 10	0 n = 0
5 year old	0 n = 0	15.9% n = 10	3.7% n = 2	0.7% n = 1

Table 1: Age class percentages of return for hatchery origin fall chinook salmon returning to Rowdy Creek Hatchery in 1980-83.

Rowdy Creek Releases -

1977 - 74,546 (55/lb.); 9,117 (7/lb.)

1978 - 146,404 (55/lb.); 9,912 (24/lb.); 105,103 (13/lb.)

1979 - 62,338 (51/lb.); 78,550 (14/lb.)

The fish in 1979 were exposed to a severe Furunculosis infection.

1980 - None

1981 - 52,987 (14/lb.)

Approximately 100,000 chinook smolts were destroyed by the California Department of Fish & Game from an IHN infection.

1982 - 115,000 (12/lb.)

1983 - 35,000 (12/lb.)

Chinook smolt releases directly into Rowdy Creek from the hatchery have totaled 688,957 fish since 1977. As noted, these smolts have been released at various sizes (fish/lbs.) over the years. Release times are generally dependent on the flow rates in Rowdy Creek. Early releases (about June) must be completed before the creek gets too low for the smolts to migrate to the main Smith River. Late releases (about October or November) are dependent upon adequate rainfall for smolt migration.

Length and Weight

Table 2 lists the mean fork length (inches) and weight (pounds) of hatchery origin fall chinook that returned to Rowdy Creek Hatchery in 1981-83. Each age class is separated into male and female categories. There is some variation between male and female lengths and weights for each age class between years. The 4 and 5 year old male chinooks are longer and weigh more than the females. Just the opposite is true for 3 year old males and females. A significant reduction in mean length and weight occurred in 1983 for both males and females of all age classes. This reduction is a direct reflection of the El Nino conditions in 1982-83.

	1981				1982				1983			
	Males		Females		Males		Females		Males		Females	
	Length	Wt.	Length	Wt.	Length	Wt.	Length	Wt.	Length	Wt.	Length	Wt.
2 year old	18.9	2.8			18.9	3.0			16.7	2.1		
	n = 4		n = 0		n = 43		n = 0		n = 25		n = 0	
3 year old	28.8	11.3	29.8	13.0	N.S.	N.S.			24.6	6.2	26.4	8.2
	n = 18		n = 10		n = 1		n = 0		n = 98		n = 20	
4 year old	35.4	23.3	34.9	22.3	40.3	32.0	35.7	24.2				
	n = 4		n = 17		n = 3		n = 7		n = 0		n = 0	
5 year old	39.8	29.5	37.8	28.1	N.S.	N.S.	N.S.	N.S.			N.S.	N.S.
	n = 2		n = 8		n = 1		n = 1		n = 0		n = 1	

Table 2: The mean fork length (inches) and weight (pounds) of hatchery fall chinook salmon returning to Rowdy Creek Hatchery in 1981-83. (N.S. = no statistics, n = sample size)

Fecundity

Individual fecundities of female chinook spawned at Rowdy Creek Hatchery was not determined, only an average fecundity for all females spawned each year. The hatchery biologist/culturist uses a dry spawning technique that combines several batches of female fish. An overall fecundity is determined from weights and egg subsamples of these spawnings.

The average fecundity for female chinooks spawned at Rowdy Creek Hatchery ranged from 3,800-4,400 eggs per female in 1980, 1981 and 1982. In 1983, the average fecundity decreased drastically to 2,500 eggs per female. This decrease is attributed to the small size of returning females and poor ocean feeding conditions caused by the El Nino conditions.

Hook Scars

Chinook salmon that have been hooked in the commercial salmon fishery and escaped, or were released as "shakers" (under legal size fish), usually show some signs of this hooking experience. When each chinook was sampled for weight, length and scales, the appearance of any type of hook scar around the jaw area was noted.

The following percentages of hook scars were noted on hatchery fish returning to Rowdy Creek Hatchery in 1981-83:

1981 - Seven hook scarred fish from 63 chinook (13.2%)

1982 - Nine hook scarred fish from 56 chinook (16.1%)

1983 - Fifteen hook scarred fish from 144 chinook (10.4%)

DISCUSSION

Development of a continuous return of adult fall chinook salmon to Rowdy Creek Hatchery since 1978 has allowed the hatchery culturist, Tom Smith, to experiment with different smolt release techniques. During the early years of salmon rearing at the facility, 1977-80, smolts were raised using high pond density concentrations (50,000-80,000 fish per raceway). Some of these rearing periods were attempted without the benefit of the culturist (leave of absence, 1978-79).

Adult salmon returns to the hatchery as a result of these rearing techniques has not exceeded 0.1% for all year classes combined (ages 2-5) for any given brood year. This poor adult return is being attributed to the high pond densities and the frequently occurring disease problems related to this type of rearing (Furunculosis, gill bacteria, "Ich", etc.)

Starting in 1981, the rearing densities were reduced to 25,000-35,000 smolts per raceway and disease problems have been reduced drastically. Although a complete adult year class return has not yet occurred for smolts released in 1981-83, the first returns of two "year classes" indicates a major increase in percent return. The return of 2 and 3 year old adults resulting from the 1981 smolt release has already exceeded 0.3%, with 4 and 5 year old adults yet to come. The return of 2 year old jacks from the 1982 smolt release also looks very encouraging.

The return of large numbers of adult fall chinook salmon has been hindered at Rowdy Creek Hatchery by the low number of smolts released from the hatchery each year. Only once has the number of smolts released exceeded 200,000 fish (1978) and in most years is less than 100,000 smolts (five of eight years). These low smolt releases and resulting returns of few adult chinook make the statistical analysis of hatchery evaluation techniques difficult. Some of the information necessary to improve hatchery operation necessitates larger returns

of adult fish to properly evaluate the facility (age class distribution parameters, percent return, coded wire tagging analysis, male vs. female parameters, etc.).

In years when the chinook egg take is less than 200,000 eggs, the hatchery should make an effort to release as many smolts as possible directly from the facility. Upriver and tributary planting of chinook smolts during low egg abundance years will only perpetuate the long-term problem of obtaining adequate brood stock for the hatchery and future Smith River enhancement programs. Biological rearing conditions created by the hatchery culturist are excellent for the future yearly rearing of 1,000,000+ salmon. Further development of needed rearing ponds, filter systems and improved water sources is a necessary management goal for increased operational levels.

The return of tagged (coded wire tag) chinook salmon has been minimal since the hatchery started using CWTs in 1979. The California Department of Fish and Game has tagged 25,000 to 50,000 chinook smolts with CWTs each year during 1979, 1981 and 1982. These CWT smolts represented from 13-27% of the fish released each year.

Although only one full-cycle year class (1978 brood year) of CWT salmon has returned to the hatchery, partial returns of CWT salmon from subsequent brood years indicates that CWT salmon are returning at much lower rates than untagged salmon. Considering the small numbers of total smolts being released from Rowdy Creek each year and the high percentages of CWT smolts being released, it would probably be a good hatchery practice to discontinue the CWT marking program. Future analysis of biological hatchery practices could be determined using scale analysis of adult chinook returns.

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