Dworshak NFH Salmon Studies

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In 1988, the National Marine Fisheries Service (NMFS) - (Coastal Zone and Estuarine Studies Division) initiated a pilot study at Dworshak National Fish Hatchery (DNFH) to determine the feasibility of manipulating physiological development and associated migratory behavior of juvenile spring chinook salmon. If fingerling were better prepared physiologically to migrate when released from hatcheries; the fish might exhibit behaviors which would enable them to more fully benefit from water management activities such as the Water Budget.

The strategy was to accelerate hatchery smolt development by subjecting a treatment group to a photoperiod cycle advanced by three months and then compare the group's physiological development and inriver migratory behavior to a corresponding untreated control group. Metal halide lights were used to simulate conditions of advanced day length. The photoperiod was advanced by three months for 13 weeks. This study was conducted for three years (1988-1990) and was partially funded by the Bonneville Power Administration. The control group was reared under ambient outdoor light conditions. Test groups were as follows:

Group 1: 18-week exposure to a 3-month advanced photoperiod cycle, and during the final 14 days, the water temperature was increased from ambient (4.5°C) to 11°C.

Group 2: 18-week exposure to a 3-month advanced photoperiod cycle on ambient water temperature.

Physiological development was evaluated using gill Na+-K+ ATPase and thyroid hormones as indices. Members from each group were tagged with passive integrated transponder (PIT) tags.

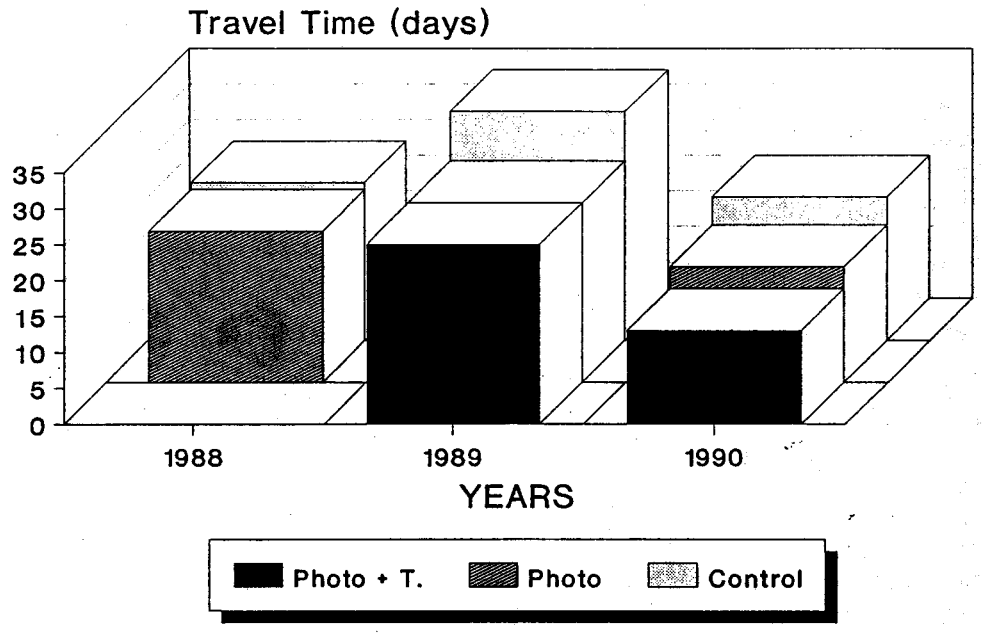
In 1989 and 1990, treatment 1 displayed the most pronounced response with 58 percent and 56% of the tagged fish recaptured, respectively (Fig 1). Smolts from this treatment also exhibited fastest migration (Fig 2). This is significantly higher ($P<0.001$) than the 47.6% and 49.7% observed for the control fish, and equals a pronounced increase in fish collected in the bypass system.

The increased recovery indicates improved survival and/or increased fish guiding efficiency at the recovery sites.

Density

Biologists at DNFH are conducting rearing density experiments with spring chinook salmon. Biologists at spring chinook salmon hatcheries generally try to achieve loading densities of approximately 24 Kg/M^3 or 1.5 lbs/ft^3. Denton (1988) demonstrated that reducing loading densities to 22% of maximum yielded a 7-fold increase in smolt-to-adult survival.

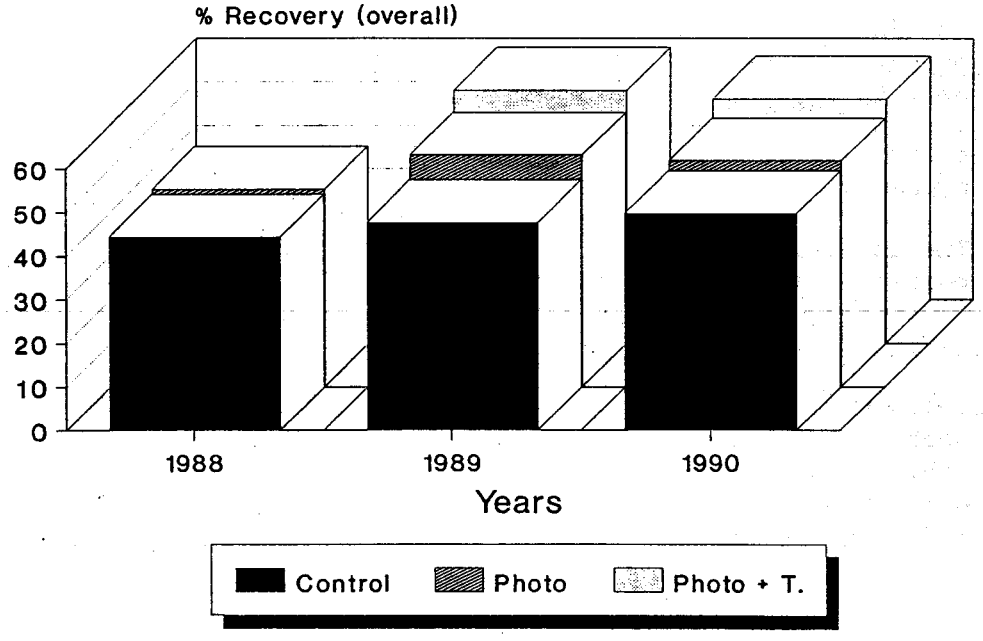
DNFH Spring Chinook Photoperiod Research
Travel Time to Lower Granite Dam



NMFS DATA

Figure 1. Median travel time of experimental groups of spring chinook salmon released from Dworshak NFH to recovery at Lower Granite Dam. Data are based on recovery of PIT-tagged fish. This research was conducted by the National Marine Fisheries Service and partially funded by the Bonneville Power Administration.

DNFH SPRING CHINOOK PHOTOPERIOD RESEARCH
Total Recovery at Collector Dams



NMFS DATA

Figure 2. Total recovery of experimental groups of spring chinook salmon released from Dworshak NFH to recovery at Lower Granite, Little Goose, and McNary Dams. Data are based on recovery of PIT-tagged fish. This research was conducted by the National Marine Fisheries Service and partially funded by the Bonneville Power Administration.

The objectives are as follows:

1. Determine if spring chinook salmon smolts reared at DNFH at different densities have different survival rates to Lower Granite Dam.

2. Determine if rearing densities has any correlation to smolt-to-adult survival.

The treatments are listed in Table 1.

Table 1. Loading densities of Brood Year 1990 spring chinook salmon rearing density evaluation underway at Dworshak National Fish Hatchery.

	lbs/Ft^3	Kg/M^3
Normal	1.89	30.3
2/3 normal density	1.25	20.2
1/3 normal density	0.63	10.1

The study is scheduled for 4 years, 1990-1993, and will use three brood years (BY 1989-1991). The BY 1989 fish was the first year class. Years will be programmed as follows:

BY 1989 - Test started at ponding in 1990
By 1990 - Test started in rearing tanks in 1990
BY 1991 - Tests start in rearing tanks in 1991

Brood chemistry, physiological, and morphometric measurements are collected monthly on low density and high density groups.

0-age SCS Program

We began a 0-age pilot program at the Dworshak-Kooskia NFH Complex in 1989. In order to achieve maximum growth, we accelerated maturation of hatchery-held adult spring chinook salmon by decreasing photoperiod (MacQuarrie et al. 1978, 1979; Whitehead et al. 1978a, 1986b; Eriksson and Lundquist 1980; Zaugg et al. 1986). Zaugg et al. (1986) noted that progeny from early spawning adults resulted in the parr-smolt transformation of 0-age fish, nearly one year prior to scheduled release.

Releasing SCS from DNFH at 0-age may provide a means of lessening the severity of BKD by minimizing exposure time and reducing susceptibility. The production of more fish in 8 to 10 months at reduced production cost provides additional benefits to this program.

During 1989, we successfully spawned the first of the experimental group of SCS on June 29 over two months earlier than control adults on ambient light. For two years we have demonstrated the ability to spawn adults earlier to gain the added growth on the progeny .

We achieved encouraging growth on 0-age progeny, especially the group exposed to an advanced photoperiod schedule (Figure 3 and 4). We PIT-tagged two subgroups (n=500) of these 0-age smolts. One group was reared under ambient photoperiod and the other group was reared on advanced photoperiod. Unfortunately, the advanced photoperiod progeny died (largest fish) prior to release because a technician forgot to turn water back on after cleaning.

We released the remaining control (n=1000) test group (n=500) fish on April 23 at approximately 100 mm. Total recovery of the PIT-tagged 0-age was 31.8%, compared with 44.3% for controls (1+-age) (Fig 5). After release, we discovered that the test group had EIBS.

This is the best results we have seen on juvenile outmigration with 0-age SCS at DNFH. We believe it is possible to produce functional SCS smolts in 9 months at approximately 140 mm (20/lb). We realize that the literature is mostly discouraging on adult returns for 0-age releases. However, I am not aware of any studies that released 0-age smolts at 20/lb.

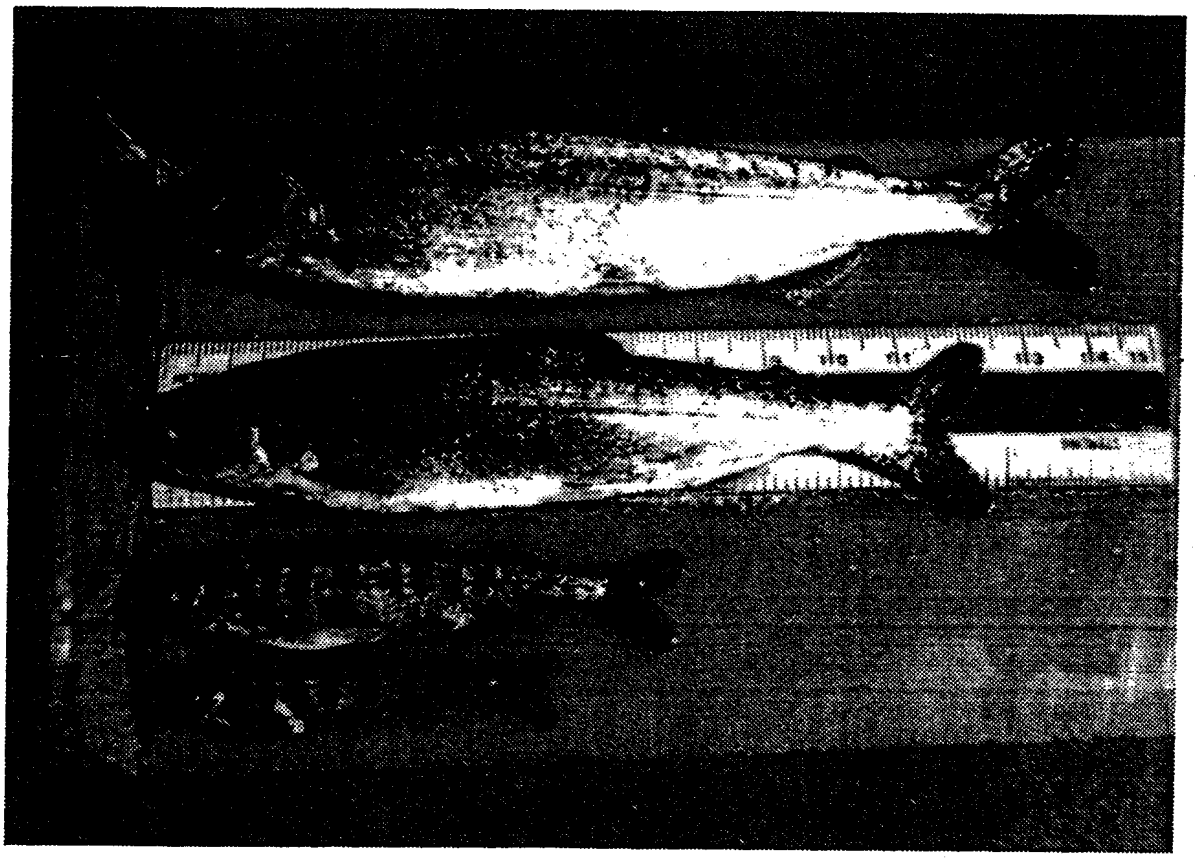


Fig. 3. Comparison of 1+ and 0 age spring chinook salmon reared at Dworshak NFH, 1990. Photograph explanation: Number 1 = 1+ age (BY 1987); number 2 = 0-age progeny of accelerated maturation adults (BY 1988); numbers 3 & 4 = 0-age normal hatchery production (BY 1988) cohorts of fish number 2.

0 - Age Chinook
Growth

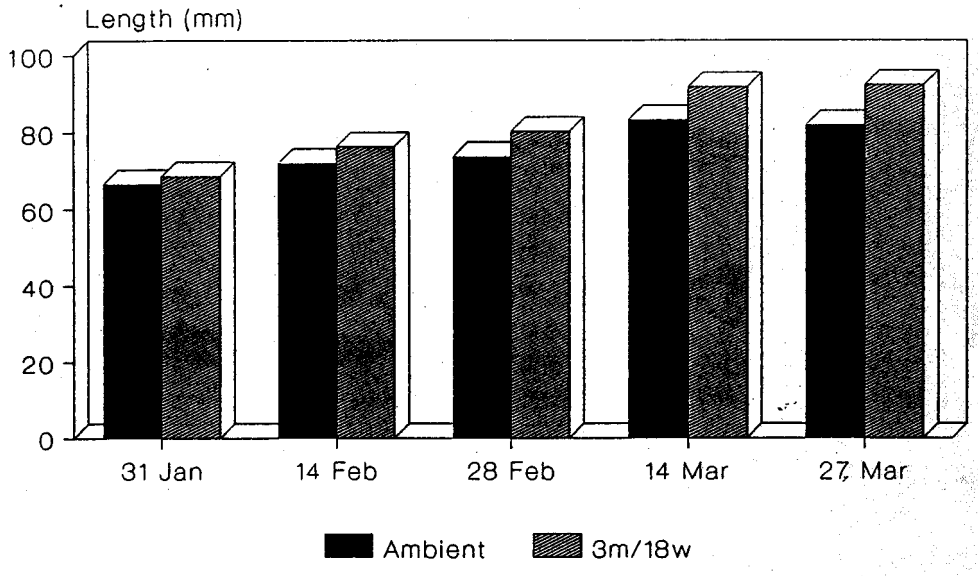


Figure 4. Growth of 0-age spring chinook salmon reared in heated water under two different photoperiod regimes at Dworshak NFH, 1990. Offspring were from adults whose maturation was advanced with photoperiod.

PIT-Tagged SCS From DNF
at Various Recovery Sites

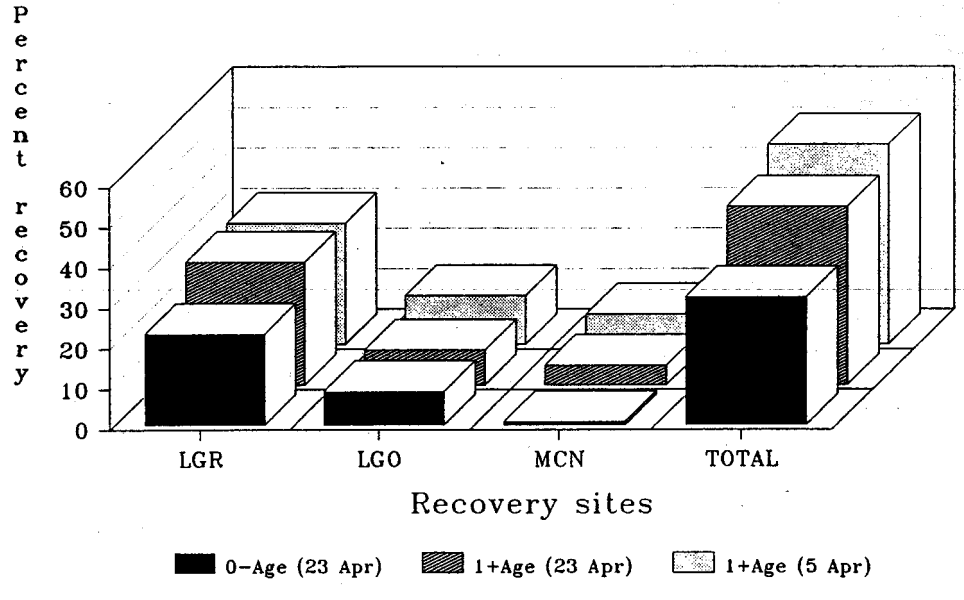


Figure 5. Total recovery of experimental groups of spring chinook salmon released from Dworshak NFH to recovery at Lower Granite (LGR), Little Goose (LGO), and McNary (MCN) Dams. Data are based on recovery of PIT-tagged fish.

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