Snake River Spring/Summer Chinook Captive Broodstock Rearing and Research

Annual Report
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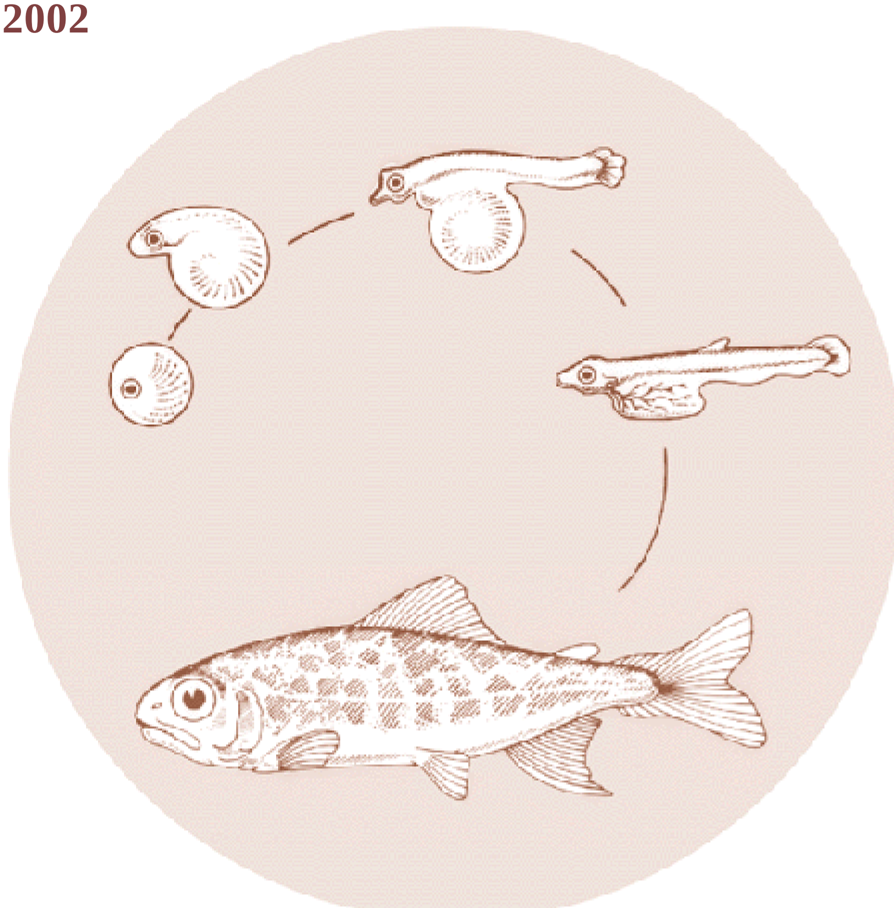

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SNAKE RIVER SPRING/SUMMER CHINOOK CAPTIVE BROODSTOCK REARING AND RESEARCH, 2002

Annual Report

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Executive Summary

In 1995, the National Marine Fisheries Service (NMFS), in cooperation with the Idaho Department of Fish and Game (IDFG), the Oregon Department of Fish and Wildlife (ODFW), and the Bonneville Power Administration (BPA) established captive broodstock programs to aid in the recovery of Snake River spring/summer chinook salmon (*Oncorhynchus tshawytscha*) listed as endangered under the U.S. Endangered Species Act (ESA). These programs were intended to provide safety nets for Salmon and Grande Ronde River Basins spring/summer chinook salmon stocks. They also provide a basis of examining the efficacy of captive rearing and captive breeding programs as tools for recovering listed salmonid populations. In years when no or few naturally produced fish return from the sea, captive fish and their progeny can be used to maintain populations in these two Snake River Basin tributaries.

The NMFS facility at Manchester, WA, provides the crucial seawater environment needed to culture anadromous salmonids during the marine phase of their life cycle. At the Manchester Research Station, the fish are cultured in 6.1m diameter circular tanks housed in a fully enclosed and secure building. The tanks are supplied with seawater that has been processed to eliminate most marine pathogens. The fish are fed a commercially prepared diet and held at densities and loading rates designed to maximize fish quality. When fish begin to mature, they are transferred to ODFW or IDFG freshwater facilities in Oregon and Idaho for final maturation. The states then release the mature fish (Idaho) or their progeny (Oregon) back into their native Snake River tributary waters in restoration efforts. In FY 2002, NMFS cultured 1996, 1997, 1998, 1999, and 2000 broodyear fish at its Manchester Facility. This report addresses program activities from September 1, 2001 to August 31, 2002.

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INTRODUCTION

In spring 1995, the National Marine Fisheries Service (NMFS), US Fish and Wildlife Service (USFWS), Idaho Department of Fish and Game (IDFG), Oregon Department of Fish and Wildlife (ODFW), Confederated Tribes of the Umatilla Indian Reservation, and Nez Perce Tribe, initiated captive broodstocks as part of conservation efforts for ESA-listed stocks of Snake River spring/summer chinook salmon (*Oncorhynchus tshawytscha*). The Oregon captive broodstock program focuses on three stocks (upper Grande Ronde River, Catherine Creek, and Lostine River) captured as juveniles from the Grande Ronde River Basin. Idaho's Snake River captive broodstock program includes three stocks (Lemhi River, East Fork Salmon River, and West Fork Yankee Fork) captured as eyed eggs or juveniles from the Salmon River Basin. Beginning with broodyear 2000, IDFG narrowed its focus to collecting eyed eggs from only two streams, the West Fork Yankee Fork and East Fork of the Salmon River. IDFG and ODFW requested that a portion of each broodstock be reared by NMFS in protective culture in seawater.

The captive broodstock concept differs from the conventional hatchery approach in that fish are maintained in captivity until they mature, rather than being released as conventional smolts that migrate to sea. Captive breeding fish are artificially spawned when they mature and their offspring are released back into their native waters as juveniles to supplement or restore the natural population. The relatively high egg-to-adult survival provided by the protective hatchery environment enables these programs to produce large numbers of juveniles in a single generation that can be used to jump start a depleted population (Flagg et al. 1995a,b). In addition, the relatively stable egg supply captive breeding programs provide helps ensure the success of supplementation efforts for depleted stocks. Oregon has chosen this traditional captive breeding approach where maturing fish are returned to Oregon, spawned, and the offspring incubated, reared to the smolt stage, and then released into their native watersheds to restore their chinook salmon populations.

Captive rearing, the approach adopted by Idaho for their captive broodstocks differs from captive breeding, in that the mature adults are released back into their natal streams to spawn naturally. As with captive breeding, the high egg-to-smolt survival offered by the protective culture environment is used to rapidly increase the number of spawning adults above that which would occur if they had gone to sea. However, this approach is unproven and it is unclear whether hatchery-reared adults will retain the characteristics necessary for successful spawning in the wild. Because the success of achieving wild-fish attributes is uncertain, it is possible that in some years gametes may also be returned to Idaho to help maintain these gene pools using a captive breeding approach.

The NMFS Manchester Research Station (Manchester, WA) is one of the few West Coast facilities able to provide the crucial marine rearing needed to maintain the anadromous life history traits of Pacific salmon. Chinook salmon are an anadromous species that spawn in freshwater, spend one to two years rearing in streams and rivers, and then migrate to sea as smolts where they spend the majority (3-4 years) of their life (Healey 1991). When they begin to mature, adults migrate back to their natal rivers or streams to spawn. Salmon are thought to migrate to the sea, even though it imposes greater predation risk, because it provides better feeding and growing conditions. Thus, potential survival reductions are offset by females producing more eggs and males developing enhanced sexual capabilities compared to population members that remain in freshwater. In addition, anadromous populations, with a portion of their members at sea each year, have an increased chance of survival when natural catastrophes (volcanic ash falls, drought years, etc.) eliminate all freshwater residents. Anadromy is the key life history characteristic of Pacific salmon that enabled them to recolonize the vast vacant areas west of the Continental Divide after glacial recession. This evolutionary and ecological importance of anadromy behooves that conservation programs maintain captive Pacific salmon populations in seawater during the marine portion of their life cycle to eliminate possible selection against anadromous traits that might occur with full term freshwater rearing. The importance of seawater rearing during the marine phase of the salmon life cycle is recognized and called for by the NMFS Interim Standards for the Use of Captive Broodstocks (NMFS 1999).

The Snake River chinook salmon captive broodstocks are created by sourcing fish or eggs from natal river systems in Idaho and Oregon each year. Some of these fish are collected as parr in their first summer of life (ODFW 2002), while others are obtained by pumping eyed eggs out of the gravel (Venditti et al. 2002). After collection, the fish or eyed eggs are transported to the IDFG Eagle Fish Hatchery or the ODFW Lookinglass Hatchery for freshwater rearing until they reach the smolt stage. Most of the smolts from the IDFG program and a third to half of the smolts from the ODFW program are transferred to the marine rearing facilities at Manchester. The fish are reared in seawater at Manchester until they begin to show signs of maturity. They are then transferred back to freshwater facilities in Idaho and Oregon for final maturation. The mature fish in the IDFG captive rearing program are released into enclosures in Salmon River streams to spawn naturally. ODFW artificially spawns the mature fish in its captive broodstock program at their Bonneville Hatchery to produce juveniles for smolt releases in their Grande Ronde Basin supplementation program. Investigators are comparing the relative success of the two reintroduction strategies and the effect of freshwater versus seawater rearing.

The use of captive broodstock fish to restore anadromous runs of Snake River chinook salmon is an action required to reach many of the objectives of the Northwest Power Planning Council's (NPPC) Salmon Subbasin, and Grande Ronde Subbasin Summaries, and the 2000 NPPC Columbia Basin Fish and Wildlife Program. In addition, safety net captive broodstocks are among the Reasonable and Prudent Alternative (RPA 175, 176, 177) actions called for in the 2000 NMFS Biological Opinion, and are an ESA mandated item in the NMFS Recovery Plan for Snake River Salmon (Schmitten et al. 1995, 4.1a and 4.1b).

In August 1996, NMFS began a Bonneville Power Administration (BPA) funded project (Project 96-067-00) to rear Snake River spring/summer chinook salmon captive broodstocks in seawater at the NMFS Manchester Research Station. During 1997-2000, modifications were undertaken at Manchester to provide secure facilities for rearing of these ESA-listed fish. This included construction of a building housing a total of twenty 6.1-m diameter fiberglass rearing tanks, upgrade of the Manchester seawater pumping and filtration/sterilization systems to a total capacity of 4,542 L/min (1,200 gpm), and installation of an ozone depuration system.

Between 1996 and 2002, NMFS has captively-reared groups of Snake River spring/summer chinook salmon from Idaho and Oregon (Flagg et al. 1997, 1998; McAuley et al. 2000a,b). Maturity of these fish in captivity between fall 1996 and 2002 has resulted in more than 2,440 prespawning adults provided to IDFG and ODFW. In upcoming years, the cooperative broodstock program should continue to provide large numbers of animals for use in recovery efforts. Continuation of the cooperative captive broodstock programs is considered critical to recovery of Snake River spring/summer chinook salmon.

FACILITIES

The marine rearing of the chinook captive broodstocks is conducted by NMFS at its Manchester Research Station near Manchester, Washington. The facility is located on nine hectares of land adjoining Clam Bay in central Puget Sound. A major advantage of the site is the excellent seawater quality. Clam Bay is a major tidal mixing zone between Sinclair and Dyes Inlets to the west and waters of central Puget Sound to the east. Annual seawater temperature at the site normally ranges 7-13°C and salinity ranges 26-29 ppt. The high quality seawater environment, combined with a 250-m pier made available to the station by the EPA Region X Laboratory, make the Manchester Research Station an excellent site for salmon culture.

A 700-m-long pipeline from the end of the pier supplies about 4,542 L/min (1,200 gpm) of pumped seawater to the Station's land-based facilities. Water is pumped via two 50-hp vertical drive centrifugal pumps. The system is outfitted with back-up 50-hp pumps in case of primary pump failure. An alarm system monitors the pumps and electrical supply and is tied into an automatic dialer system linked to pagers and home and office telephones. Redundant emergency generators are automatically activated in the event of a power failure.

The marine rearing activities are conducted in Building 12 and 13. The 400-m^2 Building 12 contains six tan colored 4.1-m circular tanks inside the building and four gray colored 3.7-m fiberglass tanks in the adjoining fenced area outside the building. The 1,280-m^2 Building 13 houses 20 gray colored 6.1-m diameter circular fiberglass tanks. Tanks in both facilities are used for the project. In addition to these circular tanks, a number of portable circular tanks ranging in size from 0.8 to 2.3 m can be quickly set up for temporary fish holding.

The seawater supplied to these tanks is processed to eliminate pathogens. Filtering consists of primary sand filters containing number 20-grade sand that filters out all organic and inorganic material more than 20 microns in diameter. Water exiting the sand filters immediately enters a secondary cartridge filter system capable of filtering out all material more than 5 microns in diameter. The water then passes through UV-sterilizers for disinfection. Flow and pressure sensors monitor flow through the seawater filtration/disinfection system.

The processed seawater is passed through packed column degassers to strip out any potential excess nitrogen and to boost dissolved oxygen levels. In addition, oxygen is continuously supplied to all rearing containers to both boost ambient dissolved oxygen levels to saturation and provide an emergency oxygen supply in the event of an unanticipated water flow interruption.

Prior to delivery to Building 13, water can be shunted through a chiller capable of reducing the temperature of a 1,135 L/min water supply by 5 degrees centigrade. Each rearing tank in Building 13 can be supplied with both ambient and chilled water through separate lines so that water temperature can be adjusted as needed. In most circumstances, water temperature will never be dropped more than 2 degrees centigrade below ambient. This will prevent an excessive temperature rise impacting fish health in the rare event of chiller failure.

The Manchester Research Station complies with Washington State quarantine certification standards by injecting ozone into all seawater exiting captive broodstock rearing areas. This enables fish from whirling disease-positive areas in the states of Idaho and Oregon to be moved in to the facility.

CAPTIVE BROODSTOCK FISH CULTURE PRACTICES

During the reporting period, the fish were reared using standard fish culture practices and approved therapeutics (for an overview of standard methods see Leitritz and Lewis 1976, Piper et al. 1982, FRED 1983, Rinne et al. 1986, Shreck et al. 1995, and Pennell and Barton 1996). However, because captive broodstock husbandry for wild stocks is a new concept, the program generally used those practices that maximize fish quality and survival, rather than the number or kg of fish produced as in traditional enhancement or commercial farming programs. All fish culture practices at the Manchester Research Station conformed to the husbandry requirements detailed in ESA Section 10 Propagation Permits for rearing of Idaho (Permit 972) and Oregon (Permit 973) stocks of ESA-listed Snake River spring/summer chinook salmon.

Both rearing and loading density were maintained on the low end of the scale to provide the best rearing environment possible. Generally, juvenile-to-adult rearing density in the tanks was maintained at under 8 kg/m^3 (0.5 lbs/ft^3) during most of the culture period, however, fish density ranged up to 15 kg/m^3 (1.0 lbs/ft^3) at maturity. Loading densities ranged from 0.29 kg/Lpm (2.5 lbs/gpm) to 0.84 kg/Lpm (7 lbs/gpm).

All tanks used for chinook captive broodstock rearing were completely covered with a taut 2.5 x 2.5 cm or smaller mesh nylon netting to prevent fish from jumping out. The energy absorbing properties of the nylon mesh minimizes injuries that can occur to fish when they leap against it. In addition to the mesh, half of each tank is covered with solid black fabric to provide a covered refuge area fish can move under when disturbed.

Fish were fed commercially prepared dry brood diets (Moore-Clark New Age Pacific and Pedigree Salmon Brood Special)[1]. The daily ration ranged from 0.4 to 2.7% per day depending on estimated fish size and water temperature (Iwama 1996). Pellet size was determined from a

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[1] Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

chart provided by the manufacturer that is based on current guidelines for commercial aquaculture (Moore-Clark 1997). If necessary, pellet size was adjusted from the chart recommendation to ensure the smallest fish in the population could feed. Fish were fed by point source automatic feeders (Allan feeders or belt feeders). Each day, prior to loading the feeders, a small portion of the day's ration was broadcast over the surface to observe the fish's feeding response. The Allen feeders are programmed to disperse feed about 8 to 12 times a day during daylight hours. The feeding frequency was varied with both day length and fish size with smaller fish being fed 12 times per day and gradually reducing the frequency to 8 times per day as they grew. The belt feeders were only used for a short period with newly arriving smolts to disperse feed continuously over a 10-hour period.

A mild current (< 35 cm/sec) was generated in the rearing tanks by their circular shape, center drain, and a subsurface water jet inlet. This current primarily provided a self cleaning action and only a very slight exercise potential. At least once a week, bottom material that was not swept out of the tank by the current was removed by a combination of brushing and tank draining.

In May 2002, IDFG and ODFW transferred groups of 2000-brood Snake River spring/summer chinook salmon smolts to Manchester for rearing to adult (Table 1). IDFG and ODFW both transferred the fish to Manchester as smolts in the spring of their second year of life. The first transfers from ODFW and IDFG were sentinels (10 fish from each stock) to determine the readiness of the population for seawater transition. When it was demonstrated these sentinels were surviving well and had begun to feed, the remainder of the fish were transferred. The main smolt groups were transitioned to seawater in 4-m diameter circular tanks in Building 12. The first step in this transitioning process was to add pathogen-free freshwater to each tank. The next step was to introduce the smolts to the tanks and then gradually add full strength Puget Sound seawater until all the freshwater had been displaced (an 8-12 h process). The postsmolts were generally held in these tanks through the summer before being transferred to the 6.1-m diameter circular tanks in Building 13. Transfers of fish to Building 13 began when tanks became available as earlier year classes matured and were moved off-station. Similar transfer and rearing activities are planned for subsequent year-classes of fish.

Every effort was made to maintain the fish on low levels of natural lighting following the natural photoperiod. Both Building 12 and 13 had relatively small windows or translucent panels allowing a small percentage of ambient light to enter the building. In Building 13, additional lighting is provided by halogen lights that are automatically controlled to follow the natural photoperiod. These lights had a 30-minute ramp up (sunrise) and ramp down (sunset) feature. This ramping process reduces additional stress on the fish by avoiding the startle response associated with lights being instantaneously turned on at full intensity. In Building 12, additional lighting was provided by incandescent lights that are switched on and off as needed.

In general, the fish were handled with extreme care and kept in water to the maximum extent possible during transport and processing procedures. The transfer of ESA-listed fish was done with a dip net or fish transfer tube that held water during transfer to prevent the added stress of an out-of-water transfer. Additionally, the tank's center standpipe holds at least 15 cm of water depth in the tank when the external standpipe is pulled to minimize the chance of fish being accidentally dewatered during tank cleaning operations.

The Idaho stocks were not routinely sampled to minimize the impact of handling stress. Occasionally, the Idaho stocks were subsampled to assess fish size for determining proper feed size and ration. Sampling consisted of crowding the fish in a pool using two screens to form a wedge that confined the fish into a smaller area that facilitated netting. Netted fish were transferred to a tank containing an anesthetic solution (MS222) and their PIT tag, weight, and length were recorded using the PITTag2 program (Pacific States Marine Fisheries Commission, Gladstone, Oregon). The fish were then returned to the pool. After each pool was sampled, all equipment was disinfected with iodophor before sampling the next pool. The length (nearest 1 mm) and weight (nearest 0.1 g) of Oregon stocks was sampled four times a year by a team of NMFS, ODFW, and Nez Perce and Umatilla tribal personnel. ODFW is responsible for analyzing and reporting this sampling data.

The majority of inter-site transportation of juvenile or adult fish was be done by ODFW and IDFG, with assistance from NMFS. All transportation conducted by NMFS was done in a manner that emphasized fish health and safety. All transportation occurred in insulated containers and temperature was not allowed to rise more than two degrees centigrade. The transport containers were supplied with a continuous oxygen supply that maintained dissolved oxygen at full saturation. The oxygen reservoir contained at least twice the oxygen needed to make the entire trip. The containers were loaded at no more than 0.06 kg/L (0.5 lbs/gallon). Additionally, drivers were equipped with cell phones, and had backup personnel ready to respond in event of equipment failure.

In previous years the captive broodstock fish were reared in seawater until they began to show the first visible signs of maturation. In May of each year fish culturists would conduct maturation checks on fish in all groups suspected of having ripening adults. Maturating fish were visually distinguished by changes in their skin sheen, skin coloration, and body morphology. However, these visual characteristics are not well enough developed in March and April to enable fish culturist to identify maturing fish at the time when they would naturally reenter freshwater (Howell et al. 1985, Berman and Quinn 1999). The visual characteristics present in May have also not developed enough to enable culturists to identify the sex of maturing fish. Theoretically, the delay and other maturation problems associated with Pacific salmon maintained in marine captive broodstock programs may be associated with the six to eight week delayed timing of their return to freshwater rearing conditions. With other species ultrasound scanning technology has been found useful for identifying maturing fish and their sex (Martin et al 1983, Reimers et al. 1987, Bonar et al. 1989, Shields et al. 1993, Blythe et al. 1994, Martin-Robichaud and Rommens 2001). In the spring of 2002, the efficacy of using modern ultrasound imaging technology as a tool for identifying maturing captive broodstock chinook salmon earlier in the year was investigated. The projects goal was to return marine reared captive broodstock fish to freshwater in concert with the natural timing of their reentry into the freshwaters of the Columbia River. The success of this project depended on ensuring nonmaturing salmon were not reintroduced to freshwater in years they would not mature.

The maturation sort of all Oregon stocks in early April 2002 was immediately followed by a maturation sort of Idaho stocks in mid-April 2002. Both maturation sorts were conducted in a manner similar to the sample weighting process described earlier in this report. The fish were crowded into one section of the pool, anesthetized, and then their PIT tag, length, and weight recorded. Each fish was then ultrasonically scanned using a portable ALOKA SSD-500V model ultrasound machine. This process involved laying an anesthetized fish, ventral side up, on a V-board and then, starting just below the gills, passing a wand posteriorly down the length of the fish's body cavity to observe a real time cross sectional image of gonad development on a monochrome video monitor. An image showing enlarged reproductive organs was considered an indication of impending maturation. Maturing fish were usually transferred to freshwater within a week of their maturation status being identified by ultrasound imaging. All maturing adults in the Idaho program were returned to freshwater at EFH. Approximately 75% of the maturing Oregon adults were also returned to freshwater at BFH. The remaining 25% were held in seawater at Manchester and transferred in May 2002, as in previous years. This 25% holdback was used to examine the effects of freshwater transfer time on adult survival, egg viability, and maturation timing. Overall, the Manchester fish culture staff found the ultrasound scanning approach to be very effective in identifying maturing fish earlier in the year and providing reliable sexual identification that yielded greater flexibility for creating a spawning matrix (Chinook Captive Broodstock Program Technical Oversight Team (CCBTOT) and Chinook Salmon Captive Propagation Technical Oversight Committee (CSCPTOC) communications). The earlier transfer of maturing fish also freed up seawater for supporting immature fish during this period of historic peak water use. The additional seawater was used to provide better rearing conditions for immature fish in this marine captive broodstock program for Snake River chinook salmon.

In 2002, maturing adult fish from 1997- through 2000-year classes were returned to Idaho and Oregon for use in recovery efforts for these stocks (Table 1). The transition from seawater back to freshwater is accomplished during transfer by transporting the maturing adults in a mixture of 1/4 seawater and 3/4 freshwater. This provides sufficient acclimation to allow the adults to be placed directly into freshwater tanks when reaching their respective freshwater captive broodstock rearing facilities.

Observable indices of fish health were checked daily by examining feeding response, external condition, and behavior of fish in each tank as initial indicators of developing problems. In particular, fish culturists observed for signs of lethargy, spiral swimming, side swimming, jumping, flashing, unusual respiratory activity, body surface abnormalities, and unusual coloration. A fish pathologist routinely monitored captive broodstock mortalities to determine cause of death. When a treatable pathogen was either detected or suspected in an Idaho stock, a veterinarian, in consultation with IDFG fish health staff, prescribed appropriate prophylactic and therapeutic drugs to control the problem. For the Oregon stocks, ODFW fish health staff prescribed appropriate treatments. Select mortalities were appropriately preserved for pathology, genetic, and other analyses. Specimens that were not vital to analysis were disposed of in a manner consistent with ESA permits.

NMFS provided daily staffing at the facility for protective culture of these fish, with constant electronic security and facilities monitoring. Staffing during some weekends and holidays was covered by drop-in site inspections. These inspections involved inspecting the facilities, loading feeders, removing and processing mortalities, and the mandatory daily backflushing of the filtration system. Electronic security and facilities monitoring were provided at all times. NMFS coordinated the details of rearing parameters for these fish with ODFW and IDFG through the CSCPTOC, and CCBPTOT process.

REINTRODUCTION STRATEGIES

The NMFS captive broodstock program has successfully generated prespawning adult chinook salmon to help restoration efforts for these ESA-listed endangered stocks. Spring/summer chinook are being reared for the following two different reintroduction strategies as integral parts of the recovery process:

- Captive breeding (Oregon)—Adults are artificially spawned to provide offspring for smolt releases back into natal streams.

- Captive rearing (Idaho)—Adults are released into their natal streams for volitional spawning and natural production of offspring.

REARING ACTIVITIES

Brood-year 1996

No age 6 adults remained by the time of maturity sorting in April 2002.

Brood-year 1997

In April 2002, remaining age-5 adults were checked for maturation status. A total of 34 prespawning Oregon adults were transferred to BFH for spawning in early fall 2002. A total of 44 prespawning Idaho adults were transferred to EFH for captive spawning, or release for volitional spawning in August 2002. Depending on stock, the percent survival in marine culture ranged from 50.3 to 91.1 for fish that matured by age 5 (Table 1).

Brood-year 1998

In April 2002, remaining age-4 adults were checked for maturation status. A total of 141 prespawning Oregon adults were transferred to BFH for spawning in early fall 2002. A total of 167 prespawning Idaho adults were transferred to EFH for captive spawning, or release for volitional spawning in August 2002. Percent survival in marine culture for the various stocks of this year class ranged from 27.8 to 89.5 for fish that matured by age 4 (Table 1).

Brood-year 1999

In April 2002, remaining age-3 adults were checked for maturation status. A total of 138 prespawning Oregon adults were transferred to BFH for spawning in early fall 2002. A total of 146 prespawning Idaho adults were transferred to EFH for captive spawning, or release for volitional spawning in August 2002. Percent survival in marine culture for the various stocks of this year class ranged from 71.9 to 98.2 for fish that matured by age 3 (Table 1).

Brood-year 2000

In May 2002, ODFW transferred 722 smolts from Catherine Creek and Lostine River stocks to Manchester from Lookingglass Hatchery and IDFG transferred 581 smolts from West Fork Yankee Fork and East Fork of the Salmon River stocks to Manchester from EFH. Sentinel fish from each stock were transferred approximately seven days prior to the main group's transfer as a check to ensure the fish were ready for seawater entry. In 2002, there were significant changes in how both state programs operated their smolt transfer activities compared to previous years.

The Oregon program transferred one half of their brood-year 2000 smolts to seawater instead of the traditional one third, to provide greater rearing condition equality between their freshwater and seawater rearing treatments. This was a one time only transfer unless additional funding can be secured to increase the Manchester facilities seawater pumping capacity.

The smolts from the Idaho program were roughly three times larger in weight (40g vs. 145g) than previous brood years, with a high potential for the development of precocial males that usually do not migrate to sea prior to their second birthday. Therefore, NMFS used ultrasound scanning as a tool to check the maturation status of Idaho's age-2 presmolts prior to seawater transfer. The identification and sorting of precocious male parr at EFH was used to alleviate the stress associated with the transfer of these maturing fish to seawater and then back to freshwater two months later.

The NMFS staff used the earlier described ultrasound technique as a tool to identify precocial male parr at EFH. Unfortunately, it was more difficult to accurately determine the presence of developing testes in fish this small (145 g). Therefore, of the 726 fish scanned, 54% were called immature, 19% maturing, and the maturation status of the remaining 27% could not be determined. It was concluded it would be better to transfer undetected precocious males to saltwater than to risk holding immature smolts in freshwater. Therefore, both the unknown and immature groups were transferred to seawater in the spring of 2002. Three months after their transfer to seawater (the end of this reporting period) precocious males were observed to be swimming in the Manchester rearing tanks, indicating the earlier ultrasound had failed to diagnose all developing fish. A final tally cannot be made until fall of 2002 when all precocial males can be identified and removed from the population. The retention of known precocious fish at EFH may aid in resolving fish health problems for the immature fish that were transferred to seawater, as fewer physiologically stressed fish were present in the marine rearing population.

SUMMARY

The program has successfully maintained these ESA-listed populations in captivity and provided fish for use in restoration. The captive broodstock and captive rearing programs provide seawater rearing facilities that help ensure the retention of anadromous traits. This program, united with the IDFG and ODFW captive broodstocks should continue to provide for the restoration of self-sustaining natural runs of spring/summer chinook to the Salmon and Grande Ronde River Basins.

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Table 1. Inventory records for Oregon and Idaho stocks of ESA-listed 1994-, 1995-, 1996-, 1997-, 1998-, 1999-, and 2000-brood spring/summer chinook salmon being reared from smolt to adult in seawater at the NMFS Manchester Research Station, September 2002.

Stock	Number transferred	Cumulative mortality	Precocial (%)[b]	Jacks (%)[c]	4, 5, and 6 year old adults (%)[c]	Number remaining	Survival[a] (%)[d]
			1994-BROOD				
IDAHO							
Lemhi River	75	27	4 (5.4)	2 (2.9)	42 (95.5)	0	64.0
West Fork Yankee Fork	87	41	1 (1.2)	17 (23.9)	28 (75.7)	0	52.9
East Fork	75	26	4 (5.4)	17 (23.2)	28 (82.4)	0	65.3
OREGON							
Catherine Creek	167	32	15 (9.2)	38 (27.3)	82 (94.3)	0	80.8
Lostine River	160	70	5 (3.3)	20 (16.5)	65 (76.4)	0	56.3
			1995-BROOD				
IDAHO							
Lemhi River	69	15	2 (3.4)	14 (24.6)	38 (62.3)	0	78.3
OREGON							
Catherine Creek	156	79	6 (5.0)	24 (23.3)	47 (65.3)	0	49.4
Lostine River	149	47	6 (4.2)	46 (35.3)	63 (79.4)	0	68.5
			1996-BROOD				
IDAHO							
Lemhi River	110	64	0 (0.0)	12 (17.4)	34 (55.7)	0	41.8
West Fork Yankee Fork	60	50	8 (18.2)	0 (0.0)	2 (100.0)	0	16.7
East Fork	5	5	0 (0.0)	0 (0.0)	0 (0.0)	0	0.0
OREGON							
Catherine Creek	165	69	2 (1.3)	35 (23.0)	59 (52.2)	0	58.2
Lostine River	164	79	8 (5.2)	39 (26.0)	38 (55.1)	0	51.8
Grande Ronde	165	34	0 (0.0)	45 (30.2)	86 (93.5)	0	79.4

Table 1. Continued

Stock	Number Transferred	Cumulative mortality	Precocial (%)[b]	Jacks (%)[c]	4, 5, and 6 year old Adults (%)[c]	Number remaining	Survival[a] (%)[d]
			1997-BROOD				
IDAHO							
Lemhi River	102	22	10 (10.2)	18 (20.9)	52 (94.5)	0	78.4
West Fork Yankee Fork	165	59	18 (12.0)	16 (14.5)	72 (46.3)	0	64.2
OREGON							
Catherine Creek	158	14	7 (4.5)	36 (24.0)	101 (91.1)	0	91.1
Lostine River	161	80	16 (10.0)	25 (18.5)	40 (81.6)	0	50.3
Grande Ronde	167	30	13 (7.8)	49 (32.7)	75 (84.3)	0	82.0
			1998-BROOD				
IDAHO							
Lemhi River	158	38	12 (8.3)	25 (19.4)	56 (64.4)	27	76.0
West Fork Yankee Fork	193	40	25 (14.8)	35 (25.4)	62 (65.3)	31	79.3
East Fork	145	61	11 (12.8)	18 (24.0)	30 (54.5)	25	57.9
East Fork SN[e]	229	166	31 (15.3)	9 (22.0)	19 (70.4)	4	27.8
OREGON							
Catherine Creek	162	17	6 (3.7)	51 (32.7)	64 (66.0)	24	89.5
Lostine River	159	20	34 (21.7)	32 (26.2)	60 (81.1)	13	87.4
Grande Ronde	164	84	2 (1.2)	55 (34.8)	17 (65.4)	6	48.8

Table 1. Continued

			1999-BROOD				
<u>IDAHO</u>							
Lemhi River	210	59	47 (22.9)	41 (34.2)	--	63	71.9
West Fork Yankee Fork SN[f]	242	48	15 (6.5)	69 (38.5)	--	110	80.2
East Fork	113	15	44 (38.9)	26 (45.6)	--	28	86.7
East Fork SN[e]	65	14	6 (9.7)	10 (21.3)	--	35	78.5
<u>OREGON</u>							
Catherine Creek	166	4	8 (4.9)	74 (47.7)	--	80	97.6
Lostine River	166	3	19 (11.5)	64 (44.1)	--	80	98.2
			2000-BROOD				
<u>IDAHO</u>							
West Fork Yankee Fork	203	1	64 (31.5)	--	--	138	99.5
East Fork	378	7	116 (30.7)	--	--	255	98.1
<u>OREGON</u>							
Catherine Creek	246	8	12 (4.9)	--	--	226	96.7
Lostine River	232	17	20 (8.6)	--	--	195	92.7
Grande Ronde	244	6	11 (4.5)	--	--	227	97.5

[a] Survival from seawater transfer.

[b] Precocious fish from Oregon stocks were transferred to the ODFW Bonneville Fish Hatchery and milt cryopreserved. Precocious fish from Idaho stocks were removed from population and assayed for pathology, for all brood years except 1997. Precocial males from brood year 1997 were returned to the IDFG Eagle Hatchery and used in recovery evaluation.

[c] Jacks, age 4, age 5, and age 6 adults from Oregon stocks were transferred to the ODFW Bonneville Fish Hatchery. Jacks, age 4, age 5, and age 6 adults from Idaho stocks were transferred to the IDFG Eagle Hatchery and used in recovery evaluations.

[d] 100% - ((Number of mortalities/starting number) * 100%). Fish that survived to maturity are included as survivors.

[e] East Fork Safety Net. These fish are second generation progeny of adults reared in captivity and spawned by IDFG at the Eagle Hatchery.

[f] West Fork Yankee Fork Safety Net. These fish are second generation progeny of adults reared in captivity and spawned by IDFG at the Eagle Hatchery.