FISHERY RESEARCH

CAPTIVE REARING PROGRAM FOR SALMON RIVER CHINOOK SALMON

PROJECT PROGRESS REPORT
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CAPTIVE REARING PROGRAM FOR SALMON RIVER CHINOOK SALMON

Project Progress Report

2007 Annual Report

By

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ABSTRACT

During 2007, the Idaho Department of Fish and Game (IDFG) continued to develop techniques to rear Chinook salmon *Oncorhynchus tshawytscha* to sexual maturity in captivity and to monitor their reproductive performance under natural conditions. Eyed eggs were collected from the East Fork Salmon River (EFSR) and the West Fork Yankee Fork Salmon River (WFYF) to establish study groups for an emergence survival study initiated in 2006. Captive rearing groups were not collected in 2007; brood year 2005 (BY05) represents the final brood cohorts collected for full-term captive rearing studies in the EFSR and WFYF. Brood year 2005 presmolts were elastomer tagged and vaccinated against *Vibrio* spp. and bacterial kidney disease (causative agent *Renibacterium salmoninarum*) prior to being transferred to the National Oceanic & Atmospheric Administration Fisheries, Manchester Research Station, Manchester, Washington (Manchester) for seawater rearing through maturity. BY05 smolt transfers included 303 individuals from the WFYF and 301 from the EFSR. Maturing fish transfers from Manchester to Idaho for release to natal waters included 260 individuals from the WFYF and 313 from the EFSR (BY02-BY05). All maturing captive-reared Chinook salmon were released in 2007. No maturing adults were spawned at Eagle FH for gamete evaluations, precluding the availability of eggs for in-stream incubators. Mature adults were released to evaluate reproductive performance of captive-reared adults as well as behavioral interactions of captive x captive and captive x natural adults. Seven redds were constructed by volitionally spawning captive-reared Chinook salmon females in the WFYF and 63 constructed in the EFSR. Fin samples from Chinook salmon parr were collected in the WFYF (n = 54) and the EFSR (n = 100) to assess production levels from volitional spawning events resulting from program releases conducted in 2006. Genetic material from these juveniles will be analyzed with samples taken from all program adults and natural carcasses collected within the study area. This information will be used in future parental exclusion analyses.

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INTRODUCTION

Idaho Department of Fish and Game's (IDFG) long-term management objective for Chinook salmon *Oncorhynchus tshawytscha* is to maintain Snake River salmon populations at levels that will provide sustainable harvest (IDFG 2001). Restoring currently depressed populations to historic levels is a prerequisite to this condition. Artificial propagation of spring and summer Chinook salmon in the Salmon River basin, through Lower Snake River Compensation Plan (LSRCP) and Idaho Power Company hatcheries, was initiated to compensate for lost recruitment and productivity caused by the construction and operation of private and federal hydroelectric facilities in the basin. The mitigation approach was to trap, spawn, and rear a portion of the historically productive local broodstock to produce a large number of smolts (Bowles 1993). When Chinook salmon trapping began in 1981 as part of the LSRCP, it was assumed that enough Chinook salmon adults would return to provide for harvest and continued hatchery production needs. It was also assumed hatchery programs would not negatively affect the productivity or genetic viability of target or other populations, and natural populations would remain self-sustaining even with hydropower projects in place. In reality, smolt-to-adult survival in natural Snake River Chinook salmon declined abruptly with completion of the federal hydroelectric system by the mid-1970s (Petrosky and Schaller 1994; Petrosky et al. 1999), and numbers of naturally produced salmon declined at various rates throughout the Snake River basin. Survival rate estimates used in the hatchery program models appear to have been substantially overestimated, which has led to hatchery programs that have not consistently mitigated for reductions in Chinook salmon production and productivity. Spring/summer Chinook salmon returns have been insufficient to meet artificial and natural smolt and adult production goals; much less provide a consistent harvestable number of adults (Hassemer 1998).

Development of the Snake River hydrosystem has substantially influenced the decline of local spring/summer Chinook salmon stocks by reducing productivity and survival (Raymond 1979; Schaller et al. 1999) and has contributed to the listing of Snake River Chinook salmon under the Endangered Species Act (ESA; National Marine Fisheries Service [NMFS] 1992). A recovery strategy incorporating natural river function is most likely to increase the smolt-to-adult return rate and provide for recovery of these populations (Marmorek et al. 1998). However, until smolt-to-adult survival increases, our challenge is to preserve the existing metapopulation structure (by preventing local or demographic extinctions) of these stocks to ensure they remain extant to benefit from future recovery actions. This project is developing technology that may be used in the recovery of the listed Snake River spring/summer Chinook salmon evolutionarily significant unit (ESU), which consists of 31 subpopulations (i.e. breeding units or stocks; McClure et al. 2003). Preserving the metapopulation structure of this ESU is consistent with the various Snake River Salmon Recovery Plans (NMFS 1995; Schmitten et al. 1997; McClure et al. 2003), and supports the Northwest Power and Conservation Council's (NPCC) goal of maintaining biological diversity while doubling salmon and steelhead runs (NPCC 1994).

Idaho and Oregon state, tribal, and federal fish managers met during 1993 and 1994 to discuss captive culture research and implementation in the Snake River basin. The outcome of those meetings was an agreement that two programs would be initiated: 1) the Oregon Department of Fish and Wildlife (ODFW) would initiate a captive broodstock program using selected Grande Ronde River Chinook salmon populations, and 2) the IDFG would initiate captive rearing research using selected Salmon River Chinook salmon populations. Both captive culture techniques begin by bringing naturally produced juveniles (eggs, parr, or smolts) into captivity and rearing them to sexual maturity in a hatchery. At this point, the two programs use different techniques: IDFG returns the F_1 generation from its captive rearing program to their natal streams so they can spawn naturally, while the F_1 generation from ODFW's captive broodstock program is spawned in the hatchery where the resulting F_2 progeny are held until smoltification. This F_2 generation is then released as smolts to their natal streams to emigrate volitionally. The primary focus of these programs is to evaluate the effectiveness of the two forms of captive culture to meet population conservation objectives. Implicit within each research project is the objective to develop and test appropriate facilities and fish culture protocols specific to the captive culture of Chinook salmon for conservation management of depressed populations.

Little scientific information regarding captive culture techniques for Pacific salmonids was available at the inception of these programs, but a substantial amount of new literature was published in the ensuing years. The Chinook Salmon Captive Propagation Technical Oversight Committee (CSCPTOC) was formed to convey this new information between the various state, federal, and tribal entities involved in the captive culture of Chinook salmon. The CSCPTOC meets approximately every two months, which allows an adaptive management approach to all phases of the program and provides a forum of peer review and discussion for all activities and culture protocols associated with this program. Flagg and Mahnken (1995) provided an initial literature review of captive rearing and captive broodstock technology, which provided the knowledge base upon which the program was designed. Using this work, the IDFG captive rearing program for Salmon River Chinook salmon was initiated to further the development of this technology by monitoring and evaluating captive-reared fish during rearing and post-release spawning phases. Since the program's inception, studies documenting the spawning behavior of captive-reared Chinook salmon (Berejikian et al. 2001b), coho salmon *O. kisutch* (Berejikian et al. 1997), and Atlantic salmon *Salmo salar* (Fleming et al. 1996) have been published. Other studies have also compared the competitive behavior of male captive-reared and natural coho salmon during spawning (Berejikian et al. 2001a) and the competitive differences between newly emerged fry produced by captive-reared and natural coho salmon (Berejikian et al. 1999). Finally, Hendry et al. (2000) reported on the reproductive development of sockeye salmon *O. nerka* reared in captivity.

The IDFG captive rearing program was developed as a way to increase the number of naturally spawning adults and maintain metapopulation structure in selected populations at high risk of extinction while avoiding the impacts of multigenerational hatchery culture described in Reisenbichler and Rubin (1999). The strategy of captive rearing is to prevent cohort collapse in the target populations by returning captive-reared adults to natural spawning areas to augment depressed natural escapement (or replace it in years when no natural escapement occurs). This maintains the continuum of generation-to-generation smolt production and provides the opportunity for population maintenance or increase should environmental conditions prove favorable for that cohort. However, the success of the captive rearing approach to produce adults with the desired morphological, physiological, and behavioral attributes to spawn successfully in the wild remains somewhat speculative (Fleming and Gross 1992, 1993; Joyce et al. 1993; Flagg and Mahnken 1995).

The IDFG captive rearing program was initiated in 1995 with the collection of brood year (BY) 1994 Chinook salmon parr from three study streams. Since then, naturally spawned Chinook salmon progeny from BY95-BY05 have been represented in captivity to continue the project. Hassemer et al. (1999, 2001), Venditti et al. (2002, 2003a, 2003b, 2005), and Baker et al. (2006, 2008) summarize project activities from inception through 2006. The streams selected for inclusion in the captive rearing program include the Lemhi River (LEM), the East Fork Salmon River (EFSR), and the West Fork Yankee Fork Salmon River (WFYF). Project activities were completed on the LEM in 2003 with the release of mature BY99 adult fish, enabling increased monitoring intensity on the EFSR and WFYF to the present day (Figure 1).

All three study streams were selected because of their water temperature and water quality. Water temperatures are ideal for juvenile Chinook salmon rearing in all three streams, while water quality ranges from sufficient to ideal. Habitat quality ranges from relatively pristine to areas of riparian degradation caused by sedimentation, grazing, mining, logging, road building, and irrigation diversion. The LEM drains productive basaltic parent material resulting in rapid fish growth. The lower section of this river flows through private land developed extensively for agriculture and grazing and typically reflects C channel conditions (Rosgen 1985). A C-type channel is slightly entrenched with a moderate to high width-to-depth ratio, moderate sinuosity, and a slope between 0.001 and 0.039% (Rosgen 1985).The EFSR drains a relatively sterile watershed of granitic parent material associated with the Idaho batholith. The lower 30 km of the EFSR runs through ranch and grazing property developed during the last century, but the upper reaches reflect near pristine conditions with little historical disturbance from logging, mining, or agriculture. Stream habitat in the EFSR typically reflects C and B conditions (Rosgen 1985). A B-type channel is defined as being moderately entrenched with a moderate width-to-depth ratio, moderate sinuosity, and a slope of 0.02 to 0.099%. The WFYF, which drains a sterile watershed similar to the EFSR, remains primarily roadless and nonimpacted by land use practices for nearly half a century. Stream habitat typically reflects B and C conditions (Rosgen 1985).

The goal of the captive rearing program is to evaluate the potential usefulness of the captive rearing concept as applied to the conservation of Snake River spring/summer Chinook salmon. We have identified two primary project objectives needed to accomplish this goal. These are to: 1) develop and implement culture practices and facility modifications necessary to rear Chinook salmon to maturity in captivity having morphological, physiological, and behavioral characteristics similar to natural fish; and 2) evaluate the spawning behavior and success of captive-reared individuals under hatchery and natural conditions. These objectives divide the program into two functional units including fish culture and field evaluations, but the success of the program is dependent on the synchronous development of both. This report documents activities performed in both aspects of the evaluation from January 1, 2007 through December 31, 2007. This project was coordinated with the Northwest Power and Conservation Council's Fish and Wildlife Program (NPCC 2000), identified as project 200740300. Funding was provided through the Bonneville Power Administration under contracts 00029463 and 00035399.

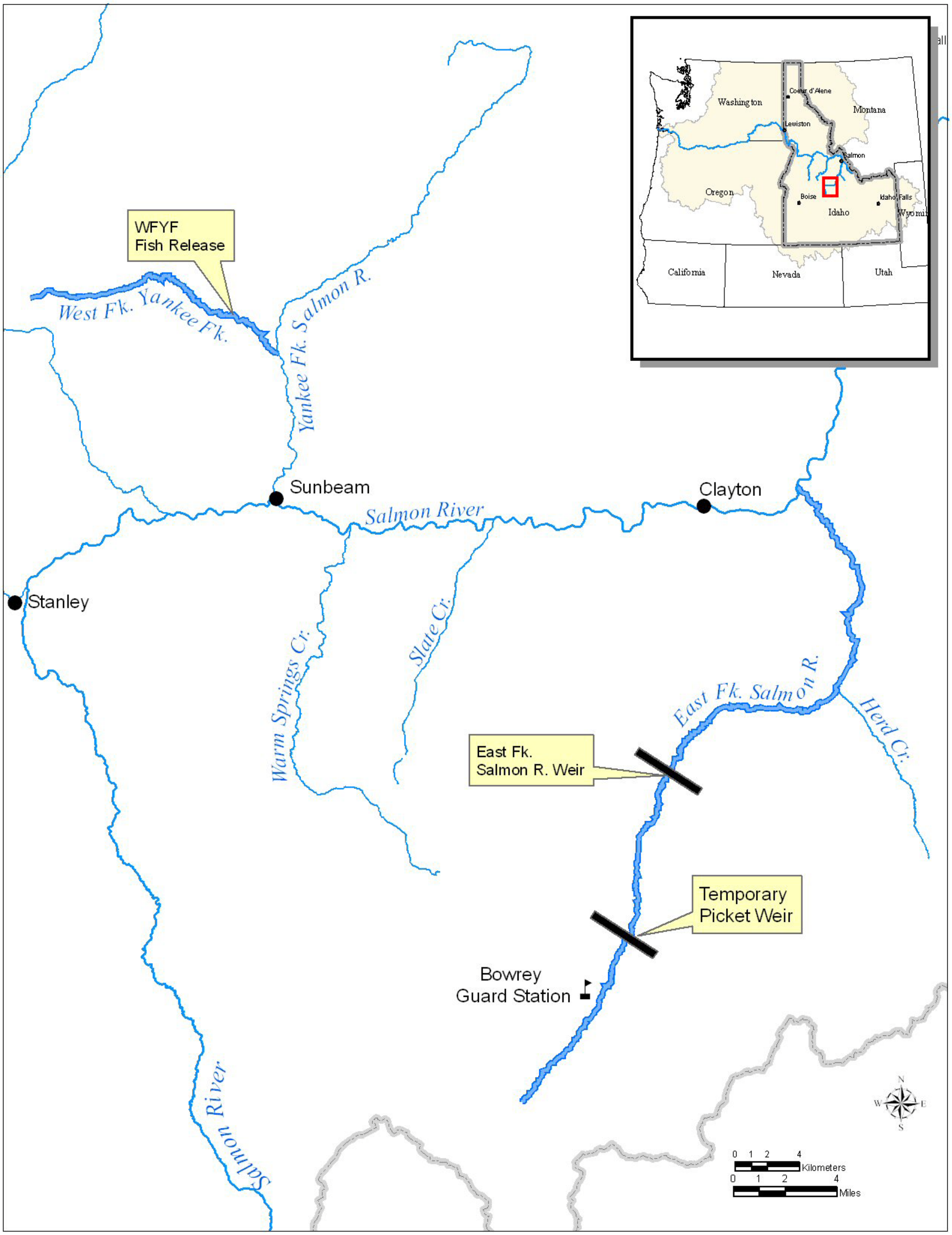

Figure 1. Location of study streams included in the Idaho Department of Fish and Game Captive Rearing Program for Salmon River Chinook salmon.

FACILITIES

Eagle Fish Hatchery

The IDFG Eagle Fish Hatchery (Eagle FH), Eagle, Idaho is the primary Idaho site for the captive culture of program fish. The hatchery is supplied with pathogen-free artesian water from three wells, and artesian flow is augmented with three separate pump and motor systems. Ambient water temperature and total dissolved gas average 13.5°C and 100%, respectively, after degassing. Water chilling capability was added in 1994 and expanded in 2001 for use during various stages of the captive rearing process. Water temperature is maintained between 7.0°C and 9.0°C during the egg incubation period of the rearing cycle. From ponding through transfer of smolts to seawater, water temperature is maintained between 8.0°C and 10.0°C. Chilled water is also used in holding tanks of maturing, adult Chinook salmon prior to in-hatchery spawning or release for natural spawning. Backup and system redundancy is maintained for degassing, pumping, and power generation. Ten water level alarms are linked through an emergency service operator. Additional security is provided by limiting public access and by the presence of three onsite residences occupied by IDFG hatchery personnel.

Tanks of various sizes and configurations are maintained at Eagle FH to accommodate the various life stages and sizes of Chinook salmon maintained on station. Fish are segregated by brood year and stream origin throughout all rearing phases. Plastic incubators and fiberglass tanks ranging in size from 0.7–3.0 m in diameter are used to culture Chinook salmon from eggs to maturity. Fertilized eggs are held in incubators until swim-up, transferred to 0.7 m semisquare tanks (0.09 m^3), then transferred to 1.0 m diameter semisquare tanks (0.30 m^3) where they remain until they reach approximately 10 g. Fish are then moved to 2.0 m semisquare tanks (1.42 m^3) where they remain until transfer to seawater at smoltification. At maturation, fish are transferred from seawater back to freshwater at Eagle FH or released directly to their natal waters. Maturing fish are held in 3.0 m circular tanks (6.50 m^3) until they are released into their natal waters or spawned in the hatchery to monitor specific reproductive success variables.

Flow to all tanks at Eagle FH is maintained at a minimum of 1.5 exchanges per hour, with shade covering (70%) and jump screens used where appropriate. Tank discharge standpipes are external and assembled in two sections (“half-pipe” principle) to prevent tank dewatering when removed for tank cleaning.

Manchester Research Station

Seawater rearing is provided for all study animals post smoltification at the National Oceanic & Atmospheric Administration (NOAA) Manchester Research Station in Manchester, Washington (Manchester). This facility is located on Puget Sound near Seattle, Washington, and is supplied with approximately 5,000 L/min of seawater that ranges in temperature between 7°C and 14°C annually and averages 29% salinity. Raw seawater is passed through sand and cartridge filters to remove particles >5 μ, sanitized with ultraviolet light, and degassed prior to entering fish rearing tanks. Effluent from the rearing tanks is treated with ozone prior to being returned to Puget Sound (Frost et al. 2002).

METHODS

Fish Culture

Fish husbandry practices employed at Eagle FH ranged from traditional to experimental. Fish health issues were handled using only approved therapeutants, and standard fish culture practices were employed whenever possible (for an overview of standard methods see Leitritz and Lewis 1976; Piper et al. 1982; Erdahl 1994; Bromage and Roberts 1995; McDaniel et al. 1994; Pennell and Barton 1996). However, due to the experimental nature of the work conducted at Eagle FH, some aspects of the incubation, rearing, and feeding protocols differ from those used at production hatcheries. Eyed eggs were hatched in specially designed incubators (Heindel et al. 2005) that can allow siblings from individual spawn crosses or redds to be maintained separately until the juveniles are tagged with passive integrated transponder (PIT) tags (Prentice et al. 1990) to permit future familial identification. Rearing tank size, density, and food ration varied with fish age and were managed to promote optimum growth and the attainment of program objectives. Juveniles were periodically anesthetized, weighed to the nearest 0.1 g, and measured to the nearest 1 mm fork length (FL) to track growth and to ensure that projected weights tracked closely with actual weights.

Fish were fed standard commercial diets produced by Bio-Oregon (Warrenton, Oregon) and Skretting (Vancouver, British Columbia, Canada). Ration and water temperature were manipulated to simulate the ration and temperature profiles that would be experienced in the natural environment to modulate growth and reduce precocial male development. This feeding regimen was developed collaboratively with NOAA Fisheries Project Number 200740300.

Juvenile Rearing, Marking, and Transportation

Swim-up fry were fed for one week while in their incubators prior to ponding to 0.7 m semisquare tanks, and individual family groups were maintained separately until PIT tagging. Fry were fed hourly during daylight hours, approximately eight times/day, until they reached a mean weight of 1.0 g. Growth projections were developed at this time, and feeding rates were reduced to four times/d. Ambient and chilled water was added to the tanks to maintain a temperature of approximately 8.5°C and 1.5 exchanges/hour. Fry were fed a commercial diet (Bio-Oregon Starter #2) at approximately 2% of their body weight/d. As fish grew, ration and pellet sizes were increased accordingly. Sample counts were conducted as needed to ensure actual growth closely tracked the projected growth rate, but fish were handled as infrequently as possible.

Age-1 juvenile Chinook salmon (BY05) were marked during two separate events at Eagle FH: 1) PIT tagging involved injecting a PIT tag into the peritoneal cavity of age-1 juveniles. Age-1 juveniles were anesthetized in MS-222 (tricaine methanesulfonate; buffered to neutrality with sodium bicarbonate), weighed to the nearest 0.1 g, and measured to the nearest 1 mm FL. A modified 12-gauge hypodermic needle was used to inject the PIT tag into the body cavity slightly anterior to the pelvic girdle and just off the ventral midline. The PIT tag gave each individual a unique identity within the program and was used to track each fish through the remainder of its life. 2) Visual implant elastomer (VIE) marking was conducted shortly before fish were transported to Manchester. Fish were anesthetized in buffered MS-222, weighed to the nearest 0.1 g, measured to the nearest 1 mm FL, and a color-coded VIE tag was injected into the clear tissue immediately posterior to the eye (Olsen and Vøllestad 2001; Close and Jones 2002), based on stream of origin.

All age-1 juvenile Chinook salmon (BY05) were transported to Manchester as smolts for seawater rearing on May 1, 2007. Smolts were transported between facilities in truck-mounted, insulated tanks (950 L capacity) with alarm and backup oxygen systems and "fresh flow" mechanical water aeration units on board. Loading volumes did not exceed 89 g/L (0.75 lb/gal). Prior to offloading, if necessary, transport water was tempered to within 2.0°C of the receiving water and fish were moved, by stock, to 6.0 m circular tanks filled with full strength freshwater for seawater acclimation. Once in the circular tanks, full strength seawater was introduced into the tanks until the freshwater was completely replaced (approximately 12 h, C. McAuley, NOAA Fisheries, personal communication).

Adult Rearing, Transportation, and Marking

Maturing Chinook salmon at Manchester were transported to Idaho (Eagle FH and/or stream of origin) to complete the freshwater phase of their maturation and for spawning performance evaluation. Maturation state was determined for all individuals at Manchester by ultrasound examination using an Aloka SSD-500V ultrasound unit with an Aloka Electronic Linear Probe UST-556L-7.5. A second maturation sort was also conducted at Manchester several weeks after the initial sort to identify any maturing fish not detected in the earlier ultrasound examination. Adults were transported using similar equipment and techniques as described above, and loading volumes did not exceed 89 g/L. Maturing fish from multiple brood years were pooled by stock for transport to Idaho, although stocks that may have posed a health risk to other program fish were transported in separate vehicles. Tanks were loaded with approximately ¼ seawater and ¾ freshwater (by volume) to begin freshwater acclimation during transport. Adults destined for return to Eagle FH were transferred from truck tanks to 3.0 m circular tanks filled with full strength freshwater at Eagle FH. Adults destined for return to natal waters were transferred from truck tanks to streamside release sites.

Maturing Chinook salmon destined for release for natural spawning were fitted with spaghetti tags prior to release. Spaghetti tags were color-coded to identify the brood year to which the fish belonged. Fish were anesthetized in buffered MS-222, weighed to the nearest 1.0 g, and measured to the nearest 1 mm FL. Water temperature in the anesthetic baths was determined by the tank temperature to which the fish were being exposed. Spaghetti tags were attached by passing a stainless steel needle through the musculature of the dorsal surface just ventral to the midline of the dorsal fin. The two ends of the spaghetti tag were then tied in a knot to secure. After marking, all fish were allowed to recover in coolers of temperature-appropriate water before being returned to the holding tanks.

Fish Health Monitoring

When required, the captive rearing program has utilized various disinfectants, antibiotics, vaccinations, and antifungal treatments to control pathogens. When used, the dosage, purpose of use, and method of application were as follows:

1) Antibiotic therapies: therapeutic erythromycin treatments are administered orally in Bio-Diet soft-moist feed obtained from Bio-Oregon (Warrenton, Oregon) to produce a dose of 100 mg/kg of body weight for up to 28 d. When oral administration is not feasible, as with maturing adults, an intraperitoneal injection of erythromycin is given to fish at a dose of 20 mg/kg of body weight. In addition, fingerlings may be fed oxytetracycline as needed to control outbreaks of pathogenic *myxobacteria*, *aeromonad*, and *pseudomonad* bacterial infections.

2) Vaccinations: age-1 Chinook salmon generally receive intraperitoneal injections of Renogen® (Aqua Health, Ltd., Charlottetown, Prince Edward Island, Canada) *Arthrobacter* spp. to vaccinate against bacterial kidney disease (BKD) and Vibrogen® (Aqua Health, Ltd.) to vaccinate against *Vibrio* spp. After each marking event, fish are allowed to recover in coolers of fresh water before being returned to the general population.

3) Egg disinfection: newly fertilized eggs are water hardened in 100 mg/L solution of Iodophor for 20 min. to inactivate viral and/or bacterial pathogens on the egg surface and in the perivitelline space. In addition, eyed eggs transferred to Eagle FH from field collections are disinfected in a 100 mg/L Iodophor solution for ten min. prior to incubator transfer.

Fish health was monitored daily by observing feeding response, external condition, and behavior of fish in each tank as initial indicators of developing problems. In particular, fish culturists looked for signs of lethargy, spiral swimming, side swimming, jumping, flashing, unusual respiratory activity, body surface abnormalities, and unusual coloration. Presence of any of these behaviors or conditions was immediately reported to the program fish pathologist. When a treatable pathogen was either detected or suspected, the program fish pathologist prescribed appropriate prophylactic and therapeutic drugs to control the problem.

Tissue samples were collected from dead program fish during necropsies to monitor for the presence of common bacterial and viral pathogens. American Fisheries Society Bluebook procedures were employed to isolate bacterial or viral pathogens and to identify parasite etiology (Thoesen 1994). All examinations were conducted under the direction of the program fish pathologist. Genetic samples were also collected from these fish in the event that they may be needed in future mitochondrial DNA and/or nuclear DNA evaluations for Chinook salmon populations held in the program. After necropsy, carcasses that were not vital to further analysis were disposed of as per language contained in the ESA Section 10 permit for the program.

Spawning adults were analyzed for common bacterial and viral pathogens. Tissue samples were collected from the kidney, spleen, and pyloric caeca of each fish, and ovarian fluid samples were collected from each female and analyzed at the Eagle Fish Health Laboratory. In addition, tissues from maturing Chinook salmon transferred to the State of Idaho from Manchester were screened for *Piscirickettsia salmonis*, and additional ovarian fluid was "blind passed" in a separate test for the North American strain of viral hemorrhagic septicemia. These pathogens do not occur in Idaho, but have been identified in fish reared at a seawater net pen location close to the Manchester site in prior years. Results of fish health analyses on spawned fish were used by IDFG and the CSCPTOC to determine the disposition of eggs and subsequent juveniles.

Growth and Survival of Completed Brood Years

Each program year, individual brood cohorts are terminated with respect to remaining live individuals of a certain age component (typically after year 5 of culture). In order to track the contribution of individual cohorts through time, measures such as growth, mortality by age, and maturation by age were summarized for completed brood groups. Fish weights collected during routine sampling at both Eagle FH and Manchester were plotted over time, and both individual fish weight and group means were calculated. Finally, we determined the total number of brood year program fish from each study stream that reached sexual maturity and computed the percentage that matured at age-2, -3, -4, and -5. In this report, the growth and survival of BY02 Chinook salmon is summarized. However, this brood year was raised entirely at Manchester (no freshwater rearing after smoltification) precluding a comparison between fish raised at Eagle FH and Manchester.

Volitional Spawning

A fish weir was installed in the EFSR to assess captive reared mature Chinook salmon spawning success in a natural stream environment. The components of a blocking weir were transported by truck to a construction site and assembled at the downstream end of the study section to ensure that project fish remained in the study area above the weir. Trap boxes built into the weir allowed natural Chinook salmon and other species to be trapped and passed in either direction; however, study fish attempting to move out of the study area were returned to the stream above the weir. Generally, study sections were divided into multiple reaches of varying length to permit systematic observations of Chinook salmon spawning above the weir. Thermographs were used to document the thermal histories of redds created by captive-reared individuals. Thermal records provided a means to accurately determine when redds should be sampled and ultimately to determine fertilization rates and survival to the eyed egg stage of development. No weir was constructed on the WFYF during this reporting period, thus fish released into the WFYF were allowed to migrate unrestricted throughout the drainage.

Following weir construction, maturing captive-reared Chinook salmon were transported by truck to a streamside site in preparation for release into the study section. Water temperature in the transport tank varied with respect to the stream temperature into which they were released and represented a compromise temperature appropriate for the transport of both study groups. Fish were released at various sites after streamside transfer in insulated coolers and/or specially constructed, water-filled slings that were carried to the release site.

Monitoring of Chinook spawning activity began approximately 24 h after captive-reared fish were released. Each field crew was assigned 3-4 stream reaches within a study section to monitor each day. Depending upon the crew availability, the entire study section was monitored a minimum of three times per week. Field technicians walked slowly upstream surveying for Chinook salmon with the aid of polarized sunglasses. When fish were identified, field technicians remained motionless and viewed each fish for a minimum of 5 minutes looking for spawning behaviors. During this time, the technician determined the number of fish observed, whether it was a natural origin or captive-reared fish based on the presence or absence of a spaghetti tag, and the gender of each fish was identified if possible. For each female Chinook observed, its location was recorded on a handheld global positioning system receiver and the location marked with flagging. On the flagging the observer noted the gender, origin (natural or captive), and spawn activities observed for each fish (Table 1). Not all spawn activities listed in Table 1 were recorded, but were used as guidance for determining the likelihood of spawning and redd completion to occur. For each spaghetti-tagged study fish, the identification color was also recorded. For each female Chinook observed, a unique redd number was recorded along with the date and the observer initials. When multiple female Chinook were observed simultaneously, their activity and location information were recorded separately and each assigned their own redd number and GPS waypoint.

Table 1. Spawn behavior variables recorded during observations of captive-reared and natural Chinook salmon.

General Behavior	Definition
Holding	Remaining in one position
Milling	Movement not resulting in displacement
Moving (A)	Movement in an upstream direction
Moving (B)	Movement in a downstream direction
Aggression	Aggression between Chinook of undetermined sex
Redd Holding	Maintaining position on or near a redd
Courting	Active male and receptive female
Spawn	Observed release of eggs and milt
Male Behavior	**Definition**
Quiver	Dart toward female ending with body vibrations
Crossover	Movement to opposite side, head passing over peduncle
Aggression (A)	Male on male aggression
Aggression (B)	Male on female aggression
Aggression (C)	Male on other species aggression
Following	Female present, no redd
Satellite	Holding away or downstream of a courting pair
Female Behavior	**Definition**
Aggression (A)	Female on female aggression
Aggression (B)	Female on male aggression
Aggression (C)	Female on other species aggression
Test dig	2–6 body flexures, not concentrated
Nest dig	5–8 body flexures in a concentrated area
Cover dig	8–12 body flexures along redd perimeter

Production Estimation

Parr Collections—Fin clips from Chinook salmon parr were collected in previously supplemented study streams to determine if they were the progeny of captive reared parents (program adults) via genetic analysis. Parr were previously collected by snorkelers using aquarium dip nets (Bonneau et al. 1995) and via angling, but more recently only with rotary screw traps within the study area (operated by Shoshone-Bannock fisheries biologists). Once captured, parr were transferred to tubs filled with fresh stream water along the shore, lightly anesthetized with MS-222, and measured to the nearest 1.0 mm FL. A small portion of the anal fin was removed and preserved in 95% ethanol. Scissors used to remove fin tissues were swabbed with isopropyl alcohol between specimens to reduce the possibility of DNA cross-contamination. After recovering in a tub of fresh water, parr were released back into the stream near their point of collection. Genetic material from these juveniles will be analyzed with samples from all program adults and natural carcasses recovered from the study area. These samples will be used in future parental exclusion analyses through the use of microsatellite markers (parental exclusion analysis; Colbourne et al. 1996; Talbot et al. 1996; Estoup et al. 1998; Bernatchez and Duchesne 2000; Eldridge et al. 2002). These analyses will allow us to determine the reproductive success of captive-reared adults (released for volitional spawning in the previous year) as well as in-stream incubator production (eggs produced from hatchery spawning and planted in the previous year) from F_1 progeny (parr collections).

Emergence Survival Study—In this study, we adapted techniques described by Rubin (1995) to estimate eyed egg to emergence survival of progeny from captive-reared and natural Chinook salmon that spawned naturally in the EFSR and the WFYF. Our objective was to test the following hypothesis:

1. There is no difference in survival from the eyed egg stage to fry emergence for eggs produced by captive-origin versus natural origin Chinook salmon.

This hypothesis will be tested by estimating survival to the eyed egg stage, and survival from eyed egg to emergence for both captive-reared and natural fish that have volitionally spawned within our study areas. Field investigations for this study began during the fall of 2006 and are expected to continue thru the fall of 2009.

Eyed-eggs for this study were collected using hydraulic sampling methods described in Venditti et al. (2005) and Baker et al. (2008). This system consists of two main components. The first is a gasoline-powered pump attached to a 3.8 cm diameter aluminum probe via flexible tubing. Holes drilled near the top of the probe infuse air into the water-stream through venturi action. The second component is the collection net frame, which consists of a "D" shaped aluminum frame with expanded plastic mesh along its curved portion and netting around the bottom and sides of its straight portion. When the pump is operating, water and air are forced through the probe, which is worked into the substrate within the net frame. The air/water mixture lifts eggs out of the substrate, where they are swept downstream into the net. The expanded plastic screen confines eggs lifted out near the periphery and directs them into the net. In order to minimize disturbance to the redd, sampling is initiated downstream of estimated nest pocket locations and progresses upstream. This prevents fine materials lifted out of the substrate from settling back into the redd and possibly smothering the remaining eggs. Care is also taken to keep personnel below or to the side of the net frame to minimize redd disturbance.

Hydraulic sampling gear previously used for eyed-egg collections for captive rearing were modified to allow eyed eggs to be inserted back into their natal redd after being enumerated and carefully placed into an egg capsule. The only modification made to equipment already being used in this program was the addition of an aluminum sleeve that fits snuggly around the outside of the existing probe while the sampling gear is in use. Aluminum washers between the probe and the sleeve form a seal that blocks rocks or debris from becoming lodged between the probe and sleeve.

Actual egg numbers collected per redd varied, but attempts were made to collect between 70 and 100 eggs per redd. We enumerated dead eggs, eggshells, and live eggs to estimate survival to the eyed-egg stage of development. Forty live eggs were placed into an egg capsule (treatment group) which was placed back in the redd. Another portion of up to 40 eggs was taken to the Eagle FH and raised to buttoned-up fry stage (genetics group) as per culture techniques described in Venditti et al. (2005) and Baker et al. (2008). If more than 80 live eggs were collected at sampling, surplus eggs were placed in an extra egg capsule and buried in the same redd (different location). This extra capsule could then be retrieved as a means of determining emergence timing for the redd without jeopardizing premature retrieval and subsequent loss of the treatment capsule results. In a few cases, the extra capsule was filled with lower or higher densities of eggs than the treatment capsules to see if loading density affected survival.

Egg transport tubes made of rigid plastic mesh, currently used at Eagle FH (Venditti et al. 2005; Baker et al. 2008), were modified and used as the egg capsules for eggs placed back into the redd (treatment groups). Egg capsules were approximately 30 cm x 8 cm with mesh holes measuring 1 mm x 2 mm. A plastic-coated steel cable (extraction cord) was secured to the bottom of the capsule and extended through the middle of the capsule, with a 0.5 m “tail” protruding out the top of the capsule to facilitate future removal (Figure 2).

When an egg pocket was encountered while sampling a redd, the pump was shut off and the probe kept in place while eggs were collected. Egg capsules were filled with gravel collected from the receiving redd, thus representative of the habitat sought by naturally spawning fish. Eyed eggs were then distributed throughout the capsule and around the gravel to minimize egg-to-egg contact, and the environment inside each egg capsule was made as similar to the natural conditions as possible. Eggs were not exposed to metal inside the capsule and only stainless steel was used for securing the extraction cord to the outside of each capsule. The probe, still in the gravel at the depth of the egg pocket, was then pulled out of the sleeve and the egg capsule dropped into the empty sleeve and pushed to the bottom. The sleeve was then lifted out of the gravel leaving the egg capsule in the same location from which the eggs were extracted. This method eliminates the additional step of using a spike and tube described by Dumas and Marty (2006).

Figure 2. Egg capsules used for emergence survival study.

Embryo development was then monitored through water temperatures. When estimated emergence timing was reached, the capsules were extracted from the gravel and hatched fish were enumerated. This method was thought to provide a reliable estimate of survival to emergence because a known number of eggs were placed into each capsule and a known number of fry are collected when a capsule was extracted.

Surviving fry from both hatchery and egg capsule study groups were sampled after depletion of yolk reserves, determined by tracking accumulated thermal units and using historic emergence timing estimates for similar stocks of Chinook salmon. Fry hatched from BY07 egg collections from egg capsules (treatment) were released into the stream after enumeration. Fry from the hatchery groups were lethally sampled, after yolk-absorption in early 2008, and fin clips taken for parentage genetic analyses.

Captive-reared fish and natural fish were treated as the two different treatment groups and each redd was treated as a sample unit. The number of sample units per study group was not equal, but did not exceed 2:1. Eyed-egg to emergence survival was averaged from all redds created by captive-reared fish and natural fish, respectively.

A statistical test for a difference in survival between study groups was then performed using a T-test (alpha level of 0.05). Survival rates varying by more than 60% could confound the ability to detect a relationship between study groups and data will be transformed to allow a better measure of the relationship between groups. Survival was assumed similar between both study streams; thus, all data were combined for the analysis.

East Fork Salmon River Weir Operations

The EFSR adult weir was operated to collect genetic samples from returning natural Chinook salmon as well as to monitor the movement of resident species. The facility is located near Big Boulder Creek, approximately 29 river kilometers upstream from the confluence with the main Salmon River. The facility was checked regularly between 0700 and 2000 (every 2-3 hours) to assure proper trap settings and operation. Fish were individually netted and the trap was emptied daily. Chinook salmon were placed in a separate holding tank for further data collection. All other fishes were identified by species, measured to FL, genetic samples collected on salmonids, and released upstream of the weir. Additionally, bull trout received a PIT tag placed into the left operculum in order to assess recapture timing and distribution.

Procedures for examining trapped Chinook salmon included placing fish in an anesthetic bath containing MS-222 (50 mg/L) buffered with sodium bicarbonate. After each Chinook salmon was adequately sedated, it was checked for any visible marks, scanned for a coded-wire tag, gender was determined, and FL recorded. If the Chinook salmon was not a recapture, it received a numbered jaw tag (installed around the lower-left mandible), and a genetic sample was taken from the caudal fin with the aid of a hole punch. The genetic sample location on the caudal fin was subsequently treated with iodophor and sealed with n-butyl cyanoacrylate (veterinary tissue adhesive) in an effort to minimize the possibility of infection. The fish was then placed into a freshwater recovery bath until ready for release upstream of the weir. All information was recorded on data sheets, and total Chinook salmon numbers were reported to the Idaho Fish and Game trapping database daily via internet.

To determine if the weir was altering the movements of migrating adult Chinook salmon, the area downstream of the weir was monitored by snorkeling periodically from July through September, and all observed fish were enumerated by species. Snorkeling efforts were concentrated in the river channel from the pool immediately below the weir to approximately 250 m downstream to the confluence with Big Boulder Creek.

RESULTS AND DISCUSSION

Brood Year Report Outline

The following information reflects culture history for the reporting period January 1 through December 31, 2007. During this reporting period, one brood year rearing group was in culture at Eagle FH representing stocks from the WFYF and EFSR. Summaries of losses, transfers, and releases while in culture are presented in Tables 2 and 3. The acronyms NE and BY are used in the following section of the report to describe culture groups: NE refers to "natural egg" or fish generated from the collection of eyed eggs from redds constructed by natural adults; BY refers to brood year or the year of development of specific culture groups (e.g., BY02 refers to brood year 2002).

In addition to the rearing groups noted above, one brood year experimental group was in culture during this reporting period to facilitate emergence survival studies as described below in the Monitoring Programs.

Brood Year 2005 Culture Groups

Eyed-egg collections for BY05 cohorts were conducted in September and October of 2005 in both the WFYF and EFSR study areas. A total of 336 WFYF-NE and 327 EFSR-NE eyed-eggs were collected from redds of natural Chinook salmon in 2005. Starting inventory was 304 WFYF-NE and 302 EFSR-NE juveniles in culture. On May 1, 2007, all smolts (303 WFYF-NE and 301 EFSR-NE) were transferred to Manchester to complete maturation in seawater. Ending inventory for BY05 groups at Eagle FH totaled zero and zero, WFYF-NE and EFSR-NE juveniles, respectively (Tables 2 and 3).

Juvenile Rearing, Marking, and Transportation

Juvenile Chinook salmon from BY05 culture groups destined for transfer to Manchester for seawater rearing received intraperitoneal injections to provide a measure of protection from two common pathogens. Both vaccines were administered on March 15, 2007, and all fish were measured to the nearest mm FL and weighed (g). Juveniles from the WFYF averaged 127.3 mm FL and 25.5 g (N = 303, range 108–152 mm FL and 12.6–49.1 g), and those from the EFSR averaged 129.9 mm FL and 26.3 g (N = 301, range 96–173 mm FL and 9.0–41.8 g). Juveniles from the WFYF cohort received VIE tags (orange, left eye), the EFSR cohort was not VIE tagged in 2007. Improved feed rationing and the availability of chilled water at Eagle FH during incubation and early rearing resulted in smolts of a more appropriate size (compared to their natural counterparts) than those produced in prior years (Venditti et al. 2002, 2003a, 2003b, 2005).

Brood year 2005 juvenile Chinook salmon were transferred from Eagle FH to Manchester as smolts on May 1, 2007. Smolts transferred between facilities included 303 fish from the WFYF-NE group (Table 2) and 301 fish from the EFSR-NE group (Table 3).

Table 2. Summary of losses and magnitude of mortality for one West Fork Yankee Fork (WFYF) captive-reared Chinook salmon culture group reared at Idaho Department of Fish and Game facilities in 2007. Culture group was designated by brood year (BY) and by the method in which the group was sourced (NE = natural egg).

	Culture Group
	BY05 NE
Starting Inventory (January 1, 2007)	304
Eyed-egg to Fry	
Undetermined[a]	n/a
Mechanical Loss	
Handling	0
Jump-out	0
Transportation	0
Noninfectious	
Lymphosarcoma	0
Nephroblastoma	0
Other[b]	1
Infectious	
Bacterial	0
Viral	0
Other	0
Hatchery Spawning	
Male Spawners	0
Female Spawners	0
Cryopreservation	0
Relocation	
Transferred In	0
Transferred Out	303
Planted/Released	0
Ending Inventory (December 31, 2007)	0

[a] Typical egg to fry mortality includes nonhatching eggs, abnormal fry, and swim-up loss.

[b] Includes mortality due to maturation, culling associated with cultural anomalies, and all undetermined, noninfectious mortality.

Table 3. Summary of losses and magnitude of mortality for one East Fork Salmon River (EFSR) captive-reared Chinook salmon culture group reared at Idaho Department of Fish and Game facilities in 2007. Culture group was designated by brood year (BY) and by the method in which the group was sourced (NE = natural egg).

	Culture Group
	BY05 NE
Starting Inventory (January 1, 2007)	302
Eyed-egg to Fry	
Undetermined[a]	n/a
Mechanical Loss	
Handling	0
Jump-out	0
Transportation	0
Noninfectious	
Lymphosarcoma	0
Nephroblastoma	0
Other[b]	1
Infectious	
Bacterial	0
Viral	0
Other	0
Hatchery Spawning	
Male Spawners	0
Female Spawners	0
Cryopreservation	0
Relocation	
Transferred In	0
Transferred Out	301
Planted/Released	0
Ending Inventory (December 31, 2007)	0

[a] Typical egg to fry mortality includes non-hatching eggs, abnormal fry, and swim-up loss.
[b] Includes mortality due to maturation, culling associated with cultural anomalies, and all undetermined, noninfectious mortality.

Adult Rearing, Marking, and Transportation

Captive adult Chinook salmon from the WFYF and EFSR stocks identified as maturing were transferred from Manchester directly to their natal streams on July 12, 2007. Mature adults included fish from three brood years (BY02, BY03, BY04) for both the WFYF and EFSR stocks (Appendix A).

On June 5, spaghetti tags were attached to EFSR and WFYF Chinook salmon destined for release to their natal streams. A total of 261 WFYF and 322 EFSR Chinook salmon were tagged during this event (Table 4). Post-tagging mortality occurred in ten fish (WFYF-1 and EFSR-9). Transport mortalities totaled eight fish (WFYF–7 and EFSR–1).

On July 12, a total of 253 and 312 Chinook salmon were released into the WFYF and EFSR, respectively (Table 4). In addition, radio transmitters were inserted into the abdominal cavity of seven WFYF captive-reared Chinook salmon prior to release. Radio tracking of the movements of these fish provided a relative measure of captive fish distribution throughout the drainage, especially since a picket weir was not installed to keep them in the WFYF. PIT tag numbers for these seven fish were not able to be determined since the PIT tag reader was not operational at the time of radio tagging. Thus, radio transmitter numbers were not listed in Appendix B.

Table 4. Number of captive-reared Chinook salmon tagged, transferred, and released into their natal waters (West Fork Yankee Fork Salmon River= WFYF and East Fork Salmon River=EFSR). Tagging mortalities, transfer mortalities, and mean FL and weight of adults at release are summarized by BY and stock.

		Number of Captive Adult Chinook						
		Tagged		Transferred		Released		
Stock / Release Location	BY	Number Tagged	Tagging Mortalities	Number Transferred	Transfer Mortalities	Number Released	Mean FL (mm)	Mean Weight (g)
EFSR	2002	6	1	5	0	5	498	1691
EFSR	2003	136	4	132	1	131	532	2336
EFSR	2004	96	2	94	0	94	405	1016
EFSR	2005	84	2	82	0	82	188	106
Total EFSR		322	9	313	1	312		
WFYF	2002	10	1	9	0	9	493	1573
WFYF	2003	113	0	113	3	110	513	2089
WFYF	2004	76	0	76	3	73	410	1104
WFYF	2005	62	0	62	1	61	188	114
Total WFYF		261	1	260	7	253		
TOTAL ALL		**583**	**10**	**573**	**8**	**565**		

One transportation mortality occurred in the EFSR stock while seven mortalities occurred during transportation in the WFYF stock. One of the WFYF transport mortalities was due to handling (transportation mortalities were not included in the post release mortalities mentioned below). At the time of release, fish appeared to be in good condition.

In the WFYF, three days post release (July 15), 118 mortalities were recovered from a release of 253 fish. One hundred thirteen of the 118 mortalities in the WFYF were recovered within 0.5 miles downstream of the release location. Recovered mortalities included fish from all brood years (BY02–BY05; Table 5). Necropsies were performed on 107 fish, which provided confirmation of sex, maturity, and PIT tags recovery from these carcasses. Potential causes of mortality were not determined from necropsies. PIT tags were then referenced with the final maturation files to summarize mortality by gender, which included 49 males and 58 females (Table 6). All recovered carcasses with readable PIT tags were traced back to transport vehicles and included 50 from the NOAA truck and 59 from the IDFG ¾ ton trucks.

Table 5. Numbers of mature adult captive Chinook released into the West Fork Yankee Fork (WFYF), and number of necropsied mortalities recovered post release. An additional eleven adult captive Chinook mortalities were recovered from the WFYF, but not necropsied.

		Released	
BY	**Stock / Release Location**	**No. Released**	**Necropsied Mortalities**
2002	WFYF	9	6
2003	WFYF	110	59
2004	WFYF	73	41
2005	WFYF	61	1
	Total	**253**	**107**

Total recovered mortality in the WFYF one week post release equaled 121 captive Chinook salmon. However, mortalities were not limited to captive Chinook salmon. We also recovered four mountain whitefish and during this same time period, we observed three natural Chinook salmon mortalities (one jack and two adult males).

Table 6. Brood year (BY), gender, rearing pond number. (Manchester Fish Hatchery), and transport vehicle associated with Captive Chinook salmon 2007 adult mortalities from recoveries one week post release into the West Fork Yankee Fork (WFYF). Values reported are only from necropsied fish at recovery; an additional eleven mortalities were not necropsied from the WFYF.

	Mortalities			Rearing	Transport
BY	**Male**	**Female**	**Total**	**Pond No.**	**Vehicle**
2002	0	9	9	24	NOAA
2003	10	49	59	25	IDFG 3/4 ton
2004	38	3	41	22	NOAA
2005	1	0	1	6	unknown
Total	**49**	**58**	**107**		

Hauling densities in 2007 were certainly greater than in 2006 (Table 7) and likely contributed greatly to the observed post release mortality. In fact, the vehicles with the highest hauling densities transferred fish that experienced the majority of post released mortality in the WFYF. However, we suspect the environmental conditions of the WFYF on and after July 12 also contributed to the observed post release mortality.

General environmental conditions in the WFYF at the time of release were not noticeably different from past years. The stream depth appeared to be slightly less than recent years due to poor winter snowpack. The major difference compared to past years was a forest fire that had burned over much of the lower four miles of the WFYF during the previous fall. Sediment (presumably from the fire) had distributed and settled throughout the stream in the lower four miles of the drainage. Water clarity was excellent at the time of release; however, during the afternoon of the July 12 and 13, thunderstorms passed through the WFYF drainage resulting in heavy rain that increased the stream flow, increased the suspended sediments, and reduced water visibility. Unfortunately, water quality data were not collected. It should also be noted that post-release mortality of captive-reared Chinook in the EFSR during 2007 was negligible, with only three documented mortalities 13 days post-release.

Table 7. Comparison between 2006 and 2007 Salmon River Captive Chinook project adult transfer hauling densities. Tank or pond number, brood year (BY), and fish weight information summarized below is only for the 2007 adult transfer.

Vehicle	Tank No. (Pond)	Gallons per Tank	Brood Year(s) and Stock	Fish Weight (lbs)	Hauling Density (lbs/gal) 2006	Hauling Density (lbs/gal) 2007
NOAA Transport Truck	1 (P22)	250	BY04/BY05 WFYF	150	0.376	0.600
	2 (P24)	250	BY02/03 WFYF	148	0.376	0.592
	3 (P24)	250	BY02/03 WFYF	148	0.380	0.592
IDFG Adult Truck	1 (P21)	700	BY04/05 EFSR	234	0.219	0.334
	2 (P23)	700	BY03 EFSR	347	0.186	0.496
	3 (P30)	700	BY03 EFSR	379	0.483	0.541
IDFG 3/4 T Truck 1	1 (P25)	250	BY03 WFYF	156		0.624
IDFG 3/4 T Truck 2	1 (P25)	250	BY03 WFYF	152		0.608
				Mean	**0.337**	**0.548**

Radio tags were implanted in seven of the 253 adults released into the WFYF for natural spawning. Radio-tagged fish were tracked one to two times weekly from July 13 through August 7, 2007. All but one radio tagged fish were found dead (85.7%) within one week of release, which was a much higher post-release mortality rate than that of fish not radio tagged (46.6%). This suggests considerable mortality attributable to radio tagging. As mentioned previously, however, there was evidence that the environmental events and subsequent stream conditions may have impacted not only captive reared, but also natural Chinook salmon during July 2007. We did experience greater than expected mortality of mature captive reared adult Chinook salmon released into the WFYF on July 12, 2007.

Fish Health Monitoring

Pathogen Sampling and Detection

Calendar year 2007 captive Chinook salmon stocks rearing in freshwater at Eagle FH included progeny from BY05 (WFYF, EFSR) natural-egg collections. No post-ponding mortality occurred in either stock (WFYF, EFSR) of BY05 Chinook salmon juveniles cultured at Eagle FH during 2007. As a result, no laboratory accessions were generated for BY05 Chinook salmon during the 2007 reporting period.

In 2007, all maturing adults were transported and released directly to their natal streams and resulted in zero Eagle Fish Health Lab accessions for maturing adults. Pathogen sampling and detection in Chinook salmon stocks reared in seawater at Manchester is the responsibility of NOAA Chinook salmon program staff and is reported under a separate cover.

Vaccine and Antibiotic Treatments

Brood year 2005 cohorts from both the WFYF (n = 303) and EFSR (n = 301) received a 21-day medicated erythromycin feed treatment (100 mg ERY/kg biomass) between January 12 and February 1, 2007. Additionally, on March 15, 2007, all BY05 cohorts received intraperitoneal injections of Renogen® and Vibrogen® vaccinations.

Growth and Survival of Brood Year 2002

Brood year 2002 captive-reared Chinook salmon were transferred as smolts to Manchester in May 2004. General sources of mortality in this cohort were similar to those observed previously (Hassemer et al. 2001; Venditti et al. 2002, 2003a, 2003b, 2005), although losses to BKD were lower than for some previous brood years (Venditti et al. 2003b). Primary sources of mortality in this group included mortality of 1) immature fish during hatchery rearing, 2) unproductive mature adults (includes mature hatchery mortality and mature culls), 3) and productive mature adults (spawned at Eagle FH, precocial culls at Manchester, or released for volitional spawning). Of the 328 BY02 EFSR eyed eggs collected, 255 fish (77.7%) survived to maturity (productive mature adult), 69 fish (21.0%) died as immature fish (n = 42), unproductive mature fish (n = 25), or maturity was undetermined (n = 2). Additionally, four fish were either missing or unaccounted. Of the 308 BY02 WFYF eyed eggs collected, 163 fish (52.9%) survived to maturity (productive mature adult), 134 fish (43.5%) died as immature fish (n = 59), unproductive mature fish (n = 31), or maturity was undetermined (n = 44); (Figure 3). Eleven fish were either missing or unaccounted.

Of the 255 fish that matured in the EFSR cohort, 48 fish (18.8%) matured as age-2 (precocial) adults, 124 fish (48.6%) matured as age-3 fish, 78 fish (30.6%) matured as age-4 fish, and five fish (2.0%) matured as age-5 fish. Of the 69 fish that died during culture of the EFSR cohort, eight fish (11.6%) died as age-1, eight fish (11.6%) died as age-2, 16 fish (23.2%) died as age-3, 33 fish (47.8%) died as age-4, and four fish (5.8%) died as age-5 fish (Figure 3).

Of the 163 fish that matured in the WFYF cohort, 34 fish (20.9%) matured as age-2 (precocial) adults, 52 fish (31.9%) matured as age-3 fish, 68 fish (41.7%) matured as age-4, and nine fish (5.5%) matured as age-5 fish. Of the 134 fish that died in culture from the WFYF cohort, 36 fish (26.9%) died as age-1, 11 fish (8.2%) died as age-2, 33 fish (24.6%) died as age-3, 48 fish (35.8%) died as age-4, and six fish (4.5%) died as age-5 fish (Figure 3).

From 636 eyed eggs collected, 474 fish reached maturity (74.5%). Of the 474 fish that reached maturity, 56 fish died before release (mature mortality). The precocity rate (age-2 maturation) for the EFSR and WFSR stocks combined averaged 21.2% for BY02 compared to brood years 97-01 average rate of 17.1% (Hassemer et al. 2001; Venditti et al. 2002, 2003a, 2003b, 2005). Average maturation rate (productive mature adult) combined for both stocks of BY02 (65.7%) was greater than the average of the previous four brood years (60.0%). Length at maturity, but more so weight at maturity, in BY02 was less than that of previous brood years (Figures 4 & 5).

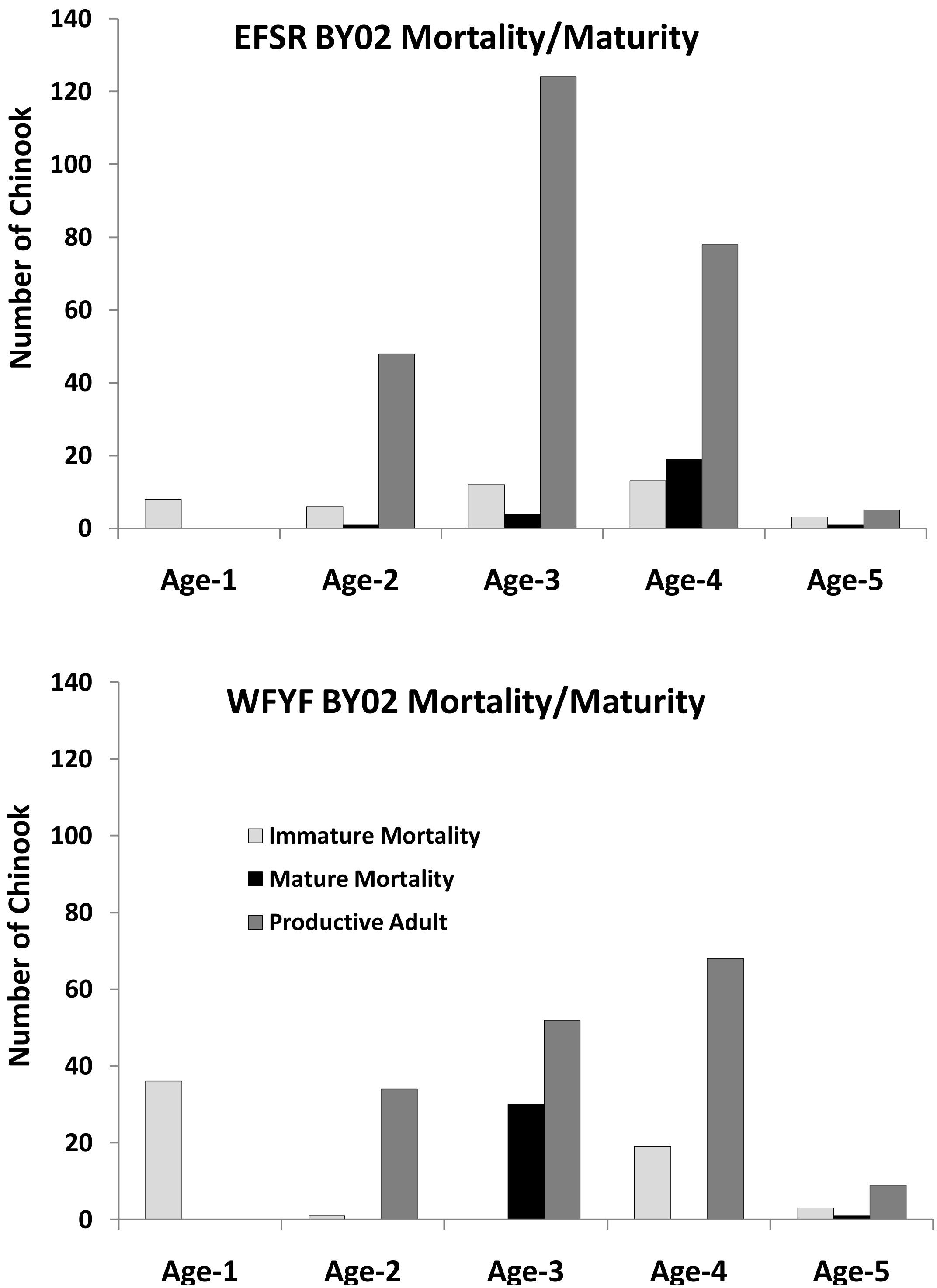

Figure 3. Mortality by age and age at maturation for East Fork Salmon River and West Fork Yankee Fork captive-reared brood year 2002 stocks. Immature Mortality = fish that died prior to reaching sexual maturity; Mature Mortality = fish that reached sexual maturity but did not spawn; Productive Adults = fish that reached sexual maturity and were released to spawn.

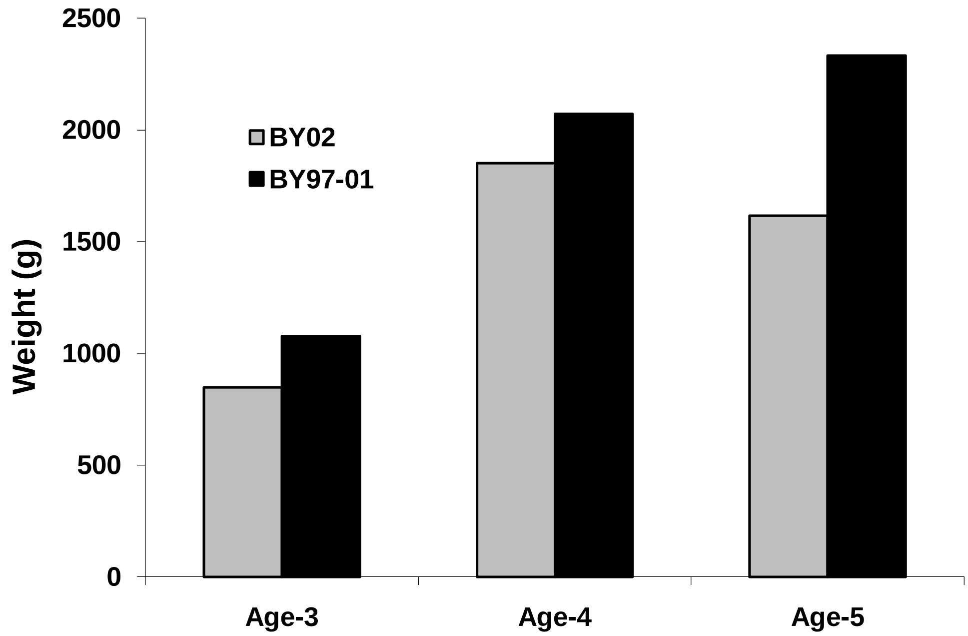

Figure 4. Weight at maturity by age for captive-reared Chinook salmon from BY02 and the average of BY97-BY01. No data is available for BY97 age-3, BY00 age-5, or BY01 age-5 fish.

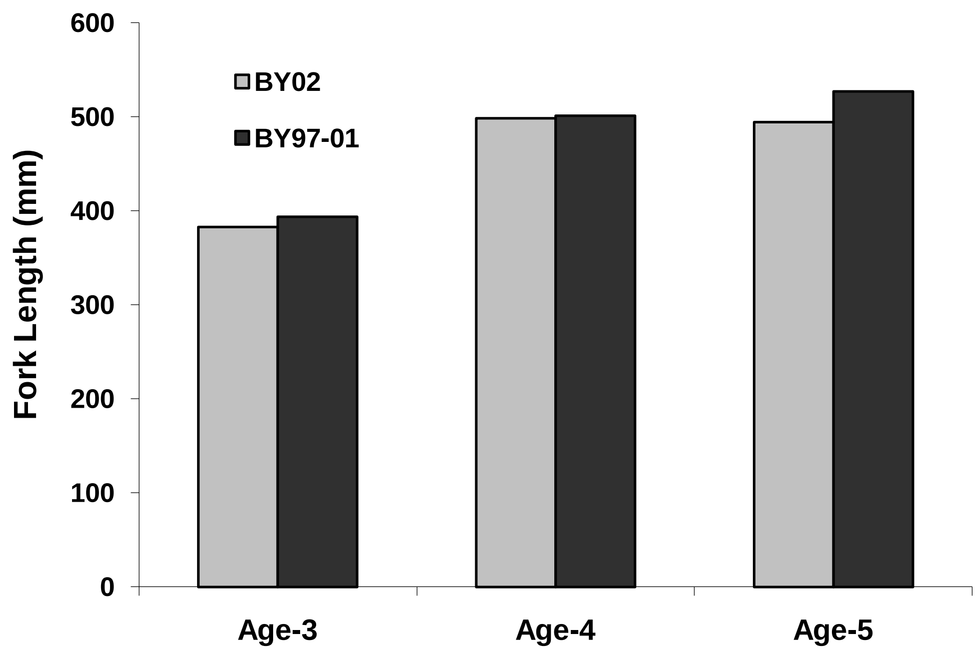

Figure 5. Length at maturity by age for captive-reared Chinook salmon from BY02 and the average of BY97-BY01. No data is available for BY97 age-3, BY00 age-5, or BY01 age-5 fish.

Volitional Spawning

In 2007, maturing adults were released into their natal streams for natural spawning and spawning observation studies on July 12 in both the EFSR and WFYF (Appendix B). Only general spawning activity of captive-reared adults released into their natal streams were documented during 2007; habitat associations were not recorded as was done in previous years.

Between August 16 and September 5, 2007, three redds constructed by natural adult Chinook salmon were identified in the WFYF compared to the previous five-year average of 12. Between September 6 and September 20, 2007, seven redds constructed by captive-reared adults were identified within the WFYF study area. The ratio of redds/captive female was less than previous years (Table 8). Annual Chinook salmon aerial redd counts conducted by IDFG Region 7 staff in EFSR trend sites identified 7 redds in 2007, compared to the previous five-year average of 8 (Table 9).

Between September 4 and September 27, 2007, 63 redds constructed by captive-reared adults were identified within the EFSR study area by ground counts. The ratio of redds/captive female was higher than previous years (Table 8). Between August 16 and September 9, 2007, 24 redds constructed by natural adults were identified within the EFSR study area. Annual Chinook salmon aerial redd counts conducted by IDFG Region 7 staff in EFSR trend sites (NS-1a and NS-1b) identified 46 redds in 2007, compared to the previous five-year average of 89 (Table 9).

During 2007, water temperatures during August and September in both the EFSR and the WFYF were warmer than the average of the previous five years (Figure 6). Water temperatures during August and September averaged 9.6°C in the EFSR (minimum 7.1°C / maximum 15.0°C) and 10.2°C in the WFYF (minimum 4.7°C / maximum 14.1°C).

Table 8. Number of captive-reared female Chinook salmon released and redds produced by these fish, 2001-2007 in the West Fork Yankee Fork Salmon River (WFYF) and East Fork Salmon River (EFSR). Captive redds were enumerated via ground counts.

Study stream	Year	Females release	Captive redds	Redds per captive female
WFYF	2001	46	18	0.39
WFYF	2002	61	33	0.54
WFYF	2003[a]	62	0	0.00
WFYF	2004	59	11	0.19
WFYF	2005	10	2	0.20
WFYF	2006	48	8	0.17
WFYF	2007	113	7	0.06
EFSR	2001	6	1	0.17
EFSR	2002	30	0	0.00
EFSR	2003[a]	18	0	0.00
EFSR	2004	4	1	0.25
EFSR	2005	25	8	0.32
EFSR	2006	73	13	0.18
EFSR	2007	124	63	0.51

[a] No fish survived to spawn post release in 2003 due to unknown causes (Venditti et al. 2004).

Table 9. Number of redds observed from aerial counts, 1997-2007 on the West Fork Yankee Fork Salmon River (WFYF) and East Fork Salmon River (EFSR).

Stream	Section Description	Number of Redds Counted										
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
WFYF	WFYF mouth to Lightning Cr[5]	2	2	0	4	10	10	18	5	1	0	7
	Lightning Cr to Cabin Cr[6]	1	2	0	0	3	1	7	0	0	0	0
	Total	**3**	**4**	**0**	**4**	**13**	**11**	**25**	**5**	**1**	**0**	**7**
EFSR	Mouth of East Fork to Herd Cr (NS-2a)[1]	2	6	3	12	17	56	15	38	12	7	3
	Herd Cr to 3.5 mi downstream of EF Weir (NS-2b)[2]	3	13	4	20	59	79	60	37	18	19	31
	3.5 mi downstream of EF Weir to EF Weir (NS-1a)[3]	3	18	19	18	48	100	93	55	32		21
	EF Weir to Bowrey Guard Station (NS-1b)[4]	0	15	4	9	12	44	59	24	16	2	25
	Total	**8**	**52**	**30**	**59**	**136**	**279**	**227**	**154**	**78**	**28**	**80**

Section Start Waypoint - Section End Waypoint (WGS-84 datum; Zone 11):

[1]713337mE 4905174mN - 715846mE 4892489mN
[2]715846mE 4892489mN - 709618mE 4891548mN
[3]709618mE 4891548mN - 705656mE 4887911mN
[4]705656mE 4887911mN - 700640mE 4872303mN
[5]681207mE 4913151mN - 675543mE 4917302mN
[6]675543mE 4917302mN - 672961mE 4918255mN

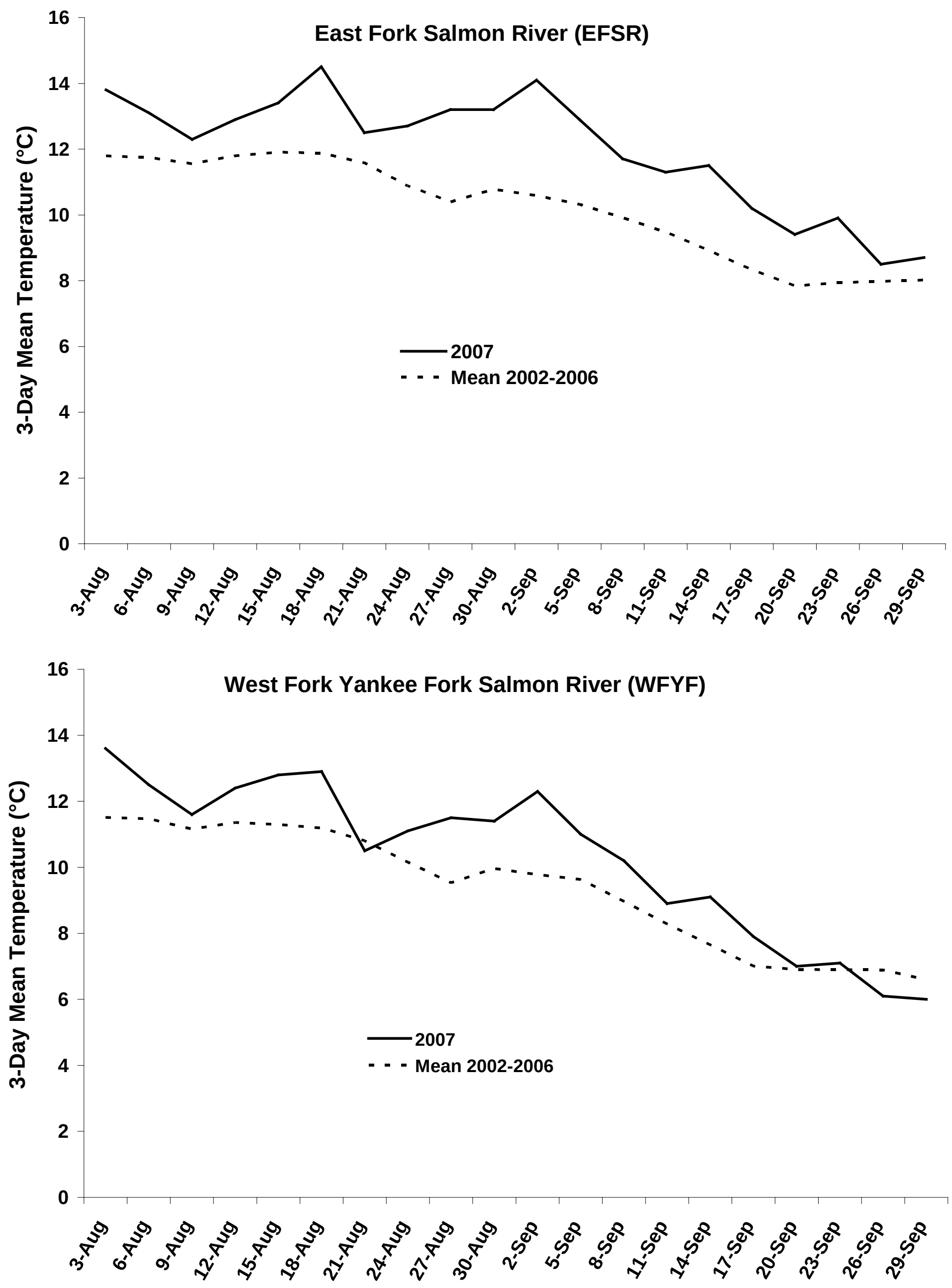

Figure 6. Three-day moving average temperatures for the East Fork Salmon River (EFSR) and the West Fork Yankee Fork (WFYF) during 2007 compared to the mean for 2002-2006.

Production Estimation

Parr Collections

One hundred Chinook salmon parr were collected from the EFSR and 54 from the WFYF from April to October in 2007. Genetic samples were collected from all captured parr, and no mortalities occurred during sampling. Samples collected in 2007 will be used for future parental exclusion analysis to determine relative production of program releases. Genetic analysis is currently ongoing and will be reported as results become available.

Emergence Survival Study

Emergence survival results were anticipated for treatment groups from BY06 collections, but unforeseen limitations of the egg capsules compromised the utility of these estimates for comparisons. During retrieval of treatment egg capsules in the spring of 2007, emergent fry were observed sticking out of the sides of the egg capsule mesh. Upon enumerating the contents of the egg capsules (eggs, dead fry, parts, and live fry), it became evident that some of the eggs initially placed in the capsules were unaccounted for. Evidently, an unknown portion of emergent fry were able to fit through the openings in the capsules and thereby escape. Based on these findings, survival estimates for the 2006-2007 emergence survival study were determined unreliable and therefore not reported. Subsequently, a smaller mesh screen was fit inside egg capsules, which was large enough to allow water to flow through but small enough to stop emigration of fry from the capsule and to exclude most predators from entering the capsule. These new capsules were then used for BY07 eggs collected for the emergence survival study during the fall of 2007, summarized below.

Naturally spawned eyed eggs were collected from October 4 to November 15, 2007 in both the WFYF and EFSR study areas. No eggs were collected for broodstock captive culture during this reporting period. All eyed eggs collected during 2007 were used as research subjects for this study as described in the methods section. These BY07 eyed eggs were used to establish either capsule (treatment) or hatchery (genetics) study groups. Collections totaled 2,406 eyed eggs from the EFSR (26 redds) and 256 eyed eggs from the WFYF (four redds; Table 10). Eggs were collected from 15 redds formed by captive-reared female adult Chinook salmon and 11 redds formed by natural returning fish on the EFSR. In the WFYF, all 256 eggs were collected from four redds formed by a captive-reared female adult Chinook salmon, no eggs were collected from redds formed by natural returning fish. Survival to the eyed stage of development and CTUs at the time of collection are reported in Table 10. At the end of this reporting period, study groups were still developing (sac fry) in hatchery incubators and study redds. Emergence survival results from these fry will be covered in calendar year 2008 reporting.

Table 10. Summary of eyed egg collections in the East Fork Salmon River (EFSR) and West Fork Yankee Fork (WFYF) as part of the emergence survival study. The number of eggs collected are summarized by capsule and hatchery groups, and Celsius Temperature Units (CTUs) are reported for the time of collection.

Stream	Name	Origin	Collection Date	Capsules (treatment)	Hatchery (genetic)	Survival to eye	CTUs at collection
WFYF	redd 1	captive	6-Nov	0	11[a]	0.0[a]	258
WFYF	redd 2	captive	6-Nov	40[a]	28[a]	0.0[a]	202
WFYF	redd 3	captive	7-Nov	40	56	0.92	327
WFYF	redd 4	captive	7-Nov	40	41	0.87	261
EFSR	redd 1	natural	4-Oct	40	104	0.92	374
EFSR	redd 2	natural	4-Oct	40	28	0.99	364
EFSR	redd 4	natural	5-Oct	40	41	0.93	374
EFSR	redd 5	natural	5-Oct	40	13	0.76	389
EFSR	redd 6	natural	10-Oct	40	58	0.83	386
EFSR	redd 7	natural	10-Oct	40	54	0.88	396
EFSR	redd 8	natural	11-Oct	30	21	0.42	350
EFSR	redd 10	natural	12-Oct	0	0	0.00	365
EFSR	redd 11	natural	12-Oct	40	70	0.90	365
EFSR	redd 12	natural	12-Oct	0	0	0.00	365
EFSR	redd 15	natural	17-Oct	40	42	0.95	361
EFSR	redd 16	natural	18-Oct	0	0	0.00	361
EFSR	redd 17	natural	18-Oct	0	0	0.00	319
EFSR	redd 18	natural	18-Oct	40	46	0.73	308
EFSR	redd 19	natural	18-Oct	40	30	0.97	308
EFSR	redd 20	captive	24-Oct	40	105	0.89	365
EFSR	redd 21	captive	24-Oct	40	34	0.55	365
EFSR	redd 22	captive	25-Oct	40	39	0.48	337
EFSR	redd 23	captive	25-Oct	0	0	0.0	337
EFSR	redd 24	captive	25-Oct	40	40	0.90	337
EFSR	redd 25	captive	25-Oct	0	0	0.0	337
EFSR	redd 26	captive	25-Oct	0	0	0.01	337
EFSR	redd 27	captive	31-Oct	40	45	0.70	332
EFSR	redd 28	captive	31-Oct	40	38	0.41	332
EFSR	redd 29	captive	31-Oct	40	61	0.91	314
EFSR	redd 30	captive	31-Oct	40	52	0.49	314
EFSR	redd 31	captive	31-Oct	40	71	0.58	314
EFSR	redd 32	captive	14-Nov	40	38	0.87	358
EFSR	redd 33	captive	14-Nov	40	100	0.46	355
EFSR	redd 34	captive	14-Nov	40	36	0.95	346
EFSR	redd 35	captive	14-Nov	0	0	0.0	271
EFSR	redd 36	captive	15-Nov	40	100	0.46	384
EFSR	redd 37	captive	15-Nov	40	47	0.57	384
EFSR	redd 38	captive	15-Nov	40	63	0.97	366

[a] Eggs not eyed.

East Fork Salmon River Weir Operations

In 2007, the Sawtooth FH satellite weir on the EFSR was operated to collect genetic samples from returning natural Chinook salmon, as well as to monitor the movement of Chinook salmon and other resident species. During operation of the site from June 7 through September 25, eighty-nine adult Chinook salmon (27 females, 29 males, 33 jacks) were trapped at the facility and released upstream (Table 11). Chinook ages were based upon previously established age at length relationships from scale aging data. One additional adipose-clipped jack (hatchery origin) was trapped and subsequently relocated back to the main stem Salmon R. Additional species trapped included bull trout *Salvelinus confluentus*, westslope cutthroat trout *O. clarkii lewisi*, rainbow trout *O. mykiss*, steelhead *O. mykiss*, and mountain whitefish *Prosopium williamsoni* (Table 12).

Table 11. Disposition of natural adult Chinook salmon trapped at the East Fork Salmon River weir facility during 2007.

	Gender				
	Females	**Males**	**Jacks**		**Total**
June	10	5	1		16
July	6	4	11		21
August	10	19	19		48
Sept	1	1	2		4
Total	**27**	**29**	**33**		**89**
		Age			
Age (length)	**3 (≤64 cm)**	**4 (64-82 cm)**	**5 (>82 cm)**		**Total**
Females	0	9	18		27
Males	0	19	10		29
Jacks	33	0	0		33
Total	**33**	**27**	**28**		**89**
		Recaptures			
Age (length)	**3 (≤64 cm)**	**4 (64-82 cm)**	**5 (>82 cm)**	**Unk[a]**	**Total**
Females	0	0	0	0	0
Males	0	9	1	1	11
Jacks	6	0	0	0	6
Total	**6**	**9**	**1**	**1**	**17**

[a] One recaptured adult male Chinook salmon lost its tag prior to recapture and the length was not remeasured.

Table 12. Summary of additional fish trapped at the East Fork Salmon River weir and genetic samples collected from these fish during 2007.

Species	Trapped	Recaptured [a]	Genetics samples collected
Bull trout	229	37	228
Westslope cutthroat trout [b]	6	0	4
Rainbow trout	3	0	1
Steelhead	1	0	0
Mountain whitefish	66	5	61

[a] Including trapping mortality.
[b] One westslope cutthroat trout appeared to be a rainbow trout/cutthroat trout hybrid.

Snorkeling surveys were conducted periodically in the pool immediately downstream of the weir to the confluence of Big Boulder Creek. No Chinook were observed holding within the reach during the 2007 trapping season. Based on these observations, the weir did not appear to inhibit Chinook salmon from migrating upstream. Additional species observed during snorkeling included bull trout, rainbow trout, cutthroat trout, and mountain whitefish.

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APPENDICES

Appendix A. Summary of fish transfers conducted by the Chinook Salmon Captive Rearing Project during 2007. MAN = Manchester Research Station, WFYF = West Fork Yankee Fork River, EFSR = East Fork Salmon River, EAG = Eagle Fish Hatchery, Brood Year = BY. NP, NE, and SN refer to natural parr, natural egg, and safety net groups, respectively.

Source Stream	BY	EAG to MAN	Transfer Date	MAN to EAG	Transfer Date	MAN to WFYF	Transfer Date	MAN to EFSR	Transfer Date
WFYF-NE	02			0	NA	9	7/12		
WFYF-NE	03			0	NA	113	7/12		
WFYF-NE	04			0	NA	76	7/12		
WFYF-NE	05	303	5/1	0	NA	62	7/12		
EFSR-NE	02			0	NA			5	7/12
EFSR-NE	03			0	NA			132	7/12
EFSR-NE	04	301	5/1	0	NA			94	7/12
EFSR-NE	05			0	NA			82	7/12

Appendix B. Tag and identification summary for captive-reared Chinook salmon released for volitional spawning in the West Fork Yankee Fork Salmon River (WFYF) and the East Fork Salmon River (EFSR). Fish were spaghetti-tagged for visual identification (Florescent = FLOR). A portable ultrasound unit was used on maturing fish reared at the Manchester Research Station (MAN) to determine sex, and classified as undetermined = UN, female = FEM, or male = MAL.

PIT Tag Code	Stock	BY	Sex	Spaghetti Tag Color	Rearing
3D9.1BF1BBC7A0	WFYF	2002	FEM	FLOR PINK	MAN
3D9.1BF1BBCC69	WFYF	2002	FEM	FLOR PINK	MAN
3D9.1BF1BBE183	WFYF	2002	FEM	FLOR PINK	MAN
3D9.1BF1BBFF66	WFYF	2002	FEM	FLOR PINK	MAN
3D9.1BF1BCEB6E	WFYF	2002	FEM	FLOR PINK	MAN
3D9.1BF1BCFAD7	WFYF	2002	FEM	FLOR PINK	MAN
3D9.1BF1BD8F36	WFYF	2002	FEM	FLOR PINK	MAN
3D9.1BF1BDD38C	WFYF	2002	FEM	FLOR PINK	MAN
3D9.1BF1BE0288	WFYF	2002	FEM	FLOR PINK	MAN
....	WFYF	2003	FEM	FLOR PINK	MAN
....	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF11B3E46	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF11B3FDB	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF11B4517	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF11B451C	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF11B4C88	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF11B53F2	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF11B60EB	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF11B68F3	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF11B74A8	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF11B7B32	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1A1D84C	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1A1DB59	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1A1DD14	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1A1DEBF	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1A1E286	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1A1E57D	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1A1E66D	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1A214E7	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1A2193D	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1A21996	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1A21B02	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1A22358	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1A22AF9	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1A2314A	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1A2319D	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1A2498C	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1A2539F	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1A7229F	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1A73720	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1A76AA7	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1A7787C	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1A778F6	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1A7A6E6	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F6FD0A	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F71053	WFYF	2003	FEM	FLOR PINK	MAN

Appendix B. Continued.

PIT Tag Code	Stock	BY	Sex	Spaghetti Tag Color	Rearing
3D9.1BF1F71117	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F71B89	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F76462	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F76648	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F77DAB	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F782F1	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7845E	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F78977	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F78F15	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7908B	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F797E2	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F79D36	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7B4CB	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7B866	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7BFA8	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7C3A2	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7C542	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7C5F3	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7C610	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7C635	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7C82C	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7CEA2	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7D057	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7D0B9	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7D7D7	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7DA74	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7E600	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7EBED	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7EC4B	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7EC86	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7ED07	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7ED98	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7EDE7	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7EED2	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7F389	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7F7ED	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7F840	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7FA82	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7FBE6	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F7FDB1	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F80C28	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F80F18	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F814F4	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F82576	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F84D81	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F85351	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F853CC	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F85875	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F85C5A	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F86D88	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F86EE9	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F86F35	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F86F78	WFYF	2003	FEM	FLOR PINK	MAN

Appendix B. Continued.

PIT Tag Code	Stock	BY	Sex	Spaghetti Tag Color	Rearing
3D9.1BF1F87766	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F88020	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F88E56	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F88FDC	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F891BD	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF1F8C3DE	WFYF	2003	FEM	FLOR PINK	MAN
3D9.1BF11B4698	WFYF	2003	MAL	FLOR PINK	MAN
3D9.1BF11B4963	WFYF	2003	MAL	FLOR PINK	MAN
3D9.1BF11B6078	WFYF	2003	MAL	FLOR PINK	MAN
3D9.1BF11BEC9C	WFYF	2003	MAL	FLOR PINK	MAN
3D9.1BF1A1E672	WFYF	2003	MAL	FLOR PINK	MAN
3D9.1BF1A21A7D	WFYF	2003	MAL	FLOR PINK	MAN
3D9.1BF1A7837A	WFYF	2003	MAL	FLOR PINK	MAN
3D9.1BF1F79635	WFYF	2003	MAL	FLOR PINK	MAN
3D9.1BF1F7C302	WFYF	2003	MAL	FLOR PINK	MAN
3D9.1BF1F7DB19	WFYF	2003	MAL	FLOR PINK	MAN
3D9.1BF1F7E909	WFYF	2003	MAL	FLOR PINK	MAN
3D9.1BF1F80330	WFYF	2003	MAL	FLOR PINK	MAN
3D9.1BF1F8104E	WFYF	2003	MAL	FLOR PINK	MAN
3D9.1BF1F836A7	WFYF	2003	MAL	FLOR PINK	MAN
3D9.1BF1F86785	WFYF	2003	MAL	FLOR PINK	MAN
3D9.1BF1F88F5A	WFYF	2003	MAL	FLOR PINK	MAN
3D9.1BF1F88FA6	WFYF	2003	MAL	FLOR PINK	MAN
3D9.1BF242F91E	WFYF	2004	FEM	YELLOW	MAN
3D9.1BF24309DE	WFYF	2004	FEM	YELLOW	MAN
3D9.1BF24311B2	WFYF	2004	FEM	YELLOW	MAN
3D9.1BF243126A	WFYF	2004	FEM	YELLOW	MAN
3D9.1BF243392E	WFYF	2004	FEM	YELLOW	MAN
3D9.1BF243395C	WFYF	2004	FEM	YELLOW	MAN
3D9.1BF2433A2D	WFYF	2004	FEM	YELLOW	MAN
3D9.1BF244B03D	WFYF	2004	FEM	YELLOW	MAN
3D9.1BF242C193	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF242C1BB	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF242C24F	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF242C2B0	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF242C33F	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF242C388	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF242C403	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF242C454	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF242CB53	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF242CB7D	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF242CBBA	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF242F372	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF242F538	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF242F54F	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF242F5C7	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF242F6BD	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF242F727	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF242F78F	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF242F85E	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF242F8E8	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF242FA22	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF242FA3E	WFYF	2004	MAL	YELLOW	MAN

Appendix B. Continued.

PIT Tag Code	Stock	BY	Sex	Spaghetti Tag Color	Rearing
3D9.1BF242FC34	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF242FCD5	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF242FDE9	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF24309EC	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2430A5A	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2430A5E	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2430B22	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2430BB5	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2430D03	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2430D7D	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2430DF4	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2430E3A	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2430ECD	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2430EEF	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2430EFF	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2430F92	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2431066	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF24310DA	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF24310EE	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF24310F5	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF24311F2	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2431263	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF24312DA	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF243130A	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2431352	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF24313C0	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2431464	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF243146B	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF243149E	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2433997	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2433B01	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2433B04	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2433B3E	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2433B9A	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2433BF9	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2433C31	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2433C34	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2433C3C	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2433CB4	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2433CC0	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2433D43	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2433D55	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2433D9B	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2433DD0	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2433E25	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2434B55	WFYF	2004	MAL	YELLOW	MAN
3D9.1BF2583610	WFYF	2005	MAL		MAN
3D9.1BF258427A	WFYF	2005	MAL		MAN
3D9.1BF258439A	WFYF	2005	MAL		MAN
3D9.1BF2584483	WFYF	2005	MAL		MAN
3D9.1BF2584502	WFYF	2005	MAL		MAN
3D9.1BF25847B8	WFYF	2005	MAL		MAN
3D9.1BF25847C6	WFYF	2005	MAL		MAN

Appendix B. Continued.

PIT Tag Code	Stock	BY	Sex	Spaghetti Tag Color	Rearing
3D9.1BF258485D	WFYF	2005	MAL		MAN
3D9.1BF25848BB	WFYF	2005	MAL		MAN
3D9.1BF25849E2	WFYF	2005	MAL		MAN
3D9.1BF2584A35	WFYF	2005	MAL		MAN
3D9.1BF2584A47	WFYF	2005	MAL		MAN
3D9.1BF2584ACB	WFYF	2005	MAL		MAN
3D9.1BF2585E9B	WFYF	2005	MAL		MAN
3D9.1BF25868FD	WFYF	2005	MAL		MAN
3D9.1BF2586C65	WFYF	2005	MAL		MAN
3D9.1BF2586D10	WFYF	2005	MAL		MAN
3D9.1BF2586E0C	WFYF	2005	MAL		MAN
3D9.1BF2587640	WFYF	2005	MAL		MAN
3D9.1BF25877E4	WFYF	2005	MAL		MAN
3D9.1BF2587865	WFYF	2005	MAL		MAN
3D9.1BF258C913	WFYF	2005	MAL		MAN
3D9.1BF258CB13	WFYF	2005	MAL		MAN
3D9.1BF258CB6D	WFYF	2005	MAL		MAN
3D9.1BF258D2FB	WFYF	2005	MAL		MAN
3D9.1BF2590C25	WFYF	2005	MAL		MAN
3D9.1BF2590C52	WFYF	2005	MAL		MAN
3D9.1BF2590C8B	WFYF	2005	MAL		MAN
3D9.1BF2590FD0	WFYF	2005	MAL		MAN
3D9.1BF259107A	WFYF	2005	MAL		MAN
3D9.1BF2591736	WFYF	2005	MAL		MAN
3D9.1BF2591A97	WFYF	2005	MAL		MAN
3D9.1BF2591C1F	WFYF	2005	MAL		MAN
3D9.1BF2591C25	WFYF	2005	MAL		MAN
3D9.1BF2591CBC	WFYF	2005	MAL		MAN
3D9.1BF2591EA4	WFYF	2005	MAL		MAN
3D9.1BF2591F0E	WFYF	2005	MAL		MAN
3D9.1BF2591F62	WFYF	2005	MAL		MAN
3D9.1BF259221B	WFYF	2005	MAL		MAN
3D9.1BF25922E0	WFYF	2005	MAL		MAN
3D9.1BF2592340	WFYF	2005	MAL		MAN
3D9.1BF2592503	WFYF	2005	MAL		MAN
3D9.1BF25926E5	WFYF	2005	MAL		MAN
3D9.1BF2592777	WFYF	2005	MAL		MAN
3D9.1BF259277A	WFYF	2005	MAL		MAN
3D9.1BF2592857	WFYF	2005	MAL		MAN
3D9.1BF2592878	WFYF	2005	MAL		MAN
3D9.1BF25928D6	WFYF	2005	MAL		MAN
3D9.1BF2594673	WFYF	2005	MAL		MAN
3D9.1BF25946D6	WFYF	2005	MAL		MAN
3D9.1BF2594744	WFYF	2005	MAL		MAN
3D9.1BF2594791	WFYF	2005	MAL		MAN
3D9.1BF25947C5	WFYF	2005	MAL		MAN
3D9.1BF25947D7	WFYF	2005	MAL		MAN
3D9.1BF25948AB	WFYF	2005	MAL		MAN
3D9.1BF2594FAF	WFYF	2005	MAL		MAN
3D9.1BF2594FDA	WFYF	2005	MAL		MAN
3D9.1BF25956F8	WFYF	2005	MAL		MAN
3D9.1BF2595AE5	WFYF	2005	MAL		MAN
3D9.1BF2596561	WFYF	2005	MAL		MAN

Appendix B. Continued.

PIT Tag Code	Stock	BY	Sex	Spaghetti Tag Color	Rearing
3D9.1BF25966CB	WFYF	2005	MAL		MAN
3D9.1BF2596997	WFYF	2005	MAL		MAN
3D9.1BF1BC828D	EFSR	2002	FEM	FLOR GREEN	MAN
3D9.1BF1BD6A7D	EFSR	2002	FEM	FLOR GREEN	MAN
3D9.1BF1BD8645	EFSR	2002	FEM	FLOR GREEN	MAN
3D9.1BF1BD9FC2	EFSR	2002	FEM	FLOR GREEN	MAN
3D9.1BF1BDDECB	EFSR	2002	FEM	FLOR GREEN	MAN
3D9.1BF1A1D21B	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A1D274	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A1D6B8	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A1E75E	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A1E7CC	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A1EA5A	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A1EC7A	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A1ED31	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A217FD	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A2186D	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A22161	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A2224E	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A22525	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A228A8	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A22A86	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A22B36	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A22E12	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A22FA9	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A240DF	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A2518D	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A73ABE	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A74536	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A748CC	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A753F1	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A75AFA	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A765B6	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A769A7	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A76B72	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A76DE6	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A77165	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A772A2	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A77413	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A77768	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A77878	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A77898	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A7805F	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A78377	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1A79AE6	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F70D80	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F70DF4	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F711E4	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F71DD8	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F72215	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7235E	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F75740	EFSR	2003	FEM	FLOR ORANGE	MAN

Appendix B. Continued.

PIT Tag Code	Stock	BY	Sex	Spaghetti Tag Color	Rearing
3D9.1BF1F75F07	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F76991	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F76DFB	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F771EA	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F77889	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F78057	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F78D49	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F78FA2	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F79621	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F79982	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7B2E4	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7B495	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7B740	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7BBC0	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7C06D	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7C0A8	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7C8B8	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7CE5E	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7D74C	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7DBCE	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7DC3F	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7E087	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7E296	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7E5AA	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7E5E0	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7E8CD	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7E914	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7EBE1	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7EC30	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7ED8A	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7EEA4	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7F13F	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7F174	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7F2E2	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7F4A2	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7F4D8	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7F53B	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7F7CF	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7FA80	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7FBC9	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7FE22	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F7FEA9	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F800C8	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F813B5	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F81B21	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F81DC6	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F81EF5	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F8209F	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F820E5	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F82271	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F826A0	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F82F40	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F84090	EFSR	2003	FEM	FLOR ORANGE	MAN

Appendix B. Continued.

PIT Tag Code	Stock	BY	Sex	Spaghetti Tag Color	Rearing
3D9.1BF1F84640	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F8477A	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F8501F	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F86396	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F86416	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F868C2	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F86F41	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F871A2	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F87C10	EFSR	2003	FEM	FLOR ORANGE	MAN
3D9.1BF1F87C13	EFSR	2003	MAL	FLOR ORANGE	MAN
3D9.1BF1F88154	EFSR	2003	MAL	FLOR ORANGE	MAN
3D9.1BF1F88313	EFSR	2003	MAL	FLOR ORANGE	MAN
3D9.1BF1F88486	EFSR	2003	MAL	FLOR ORANGE	MAN
3D9.1BF1F88842	EFSR	2003	MAL	FLOR ORANGE	MAN
3D9.1BF1F888F7	EFSR	2003	MAL	FLOR ORANGE	MAN
3D9.1BF1F88944	EFSR	2003	MAL	FLOR ORANGE	MAN
3D9.1BF1F890C0	EFSR	2003	MAL	FLOR ORANGE	MAN
3D9.1BF1F8939C	EFSR	2003	MAL	FLOR ORANGE	MAN
3D9.1BF1F893FE	EFSR	2003	MAL	FLOR ORANGE	MAN
3D9.1BF1F8B2EB	EFSR	2003	MAL	FLOR ORANGE	MAN
3D9.1BF1F8B322	EFSR	2003	MAL	FLOR ORANGE	MAN
....	EFSR	2003	MAL	FLOR ORANGE	MAN
3D9.1BF1A1EE16	EFSR	2003	MAL	FLOR ORANGE	MAN
3D9.1BF1A73A55	EFSR	2003	MAL	FLOR ORANGE	MAN
3D9.1BF1A7480A	EFSR	2003	MAL	FLOR ORANGE	MAN
3D9.1BF1A75722	EFSR	2003	MAL	FLOR ORANGE	MAN
3D9.1BF1A765C5	EFSR	2003	MAL	FLOR ORANGE	MAN
3D9.1BF1F72336	EFSR	2003	MAL	FLOR ORANGE	MAN
3D9.1BF1F79FB4	EFSR	2003	MAL	FLOR ORANGE	MAN
3D9.1BF1F7D929	EFSR	2003	MAL	FLOR ORANGE	MAN
3D9.1BF1F7F5F4	EFSR	2003	MAL	FLOR ORANGE	MAN
3D9.1BF1F80103	EFSR	2003	MAL	FLOR ORANGE	MAN
3D9.1BF1F87C0F	EFSR	2003	MAL	FLOR ORANGE	MAN
3D9.1BF1F892F4	EFSR	2003	MAL	FLOR ORANGE	MAN
3D9.1BF2433CB0	EFSR	2004	FEM	FLOR YELLOW	MAN
....	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242C19E	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242C1A2	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242C1C8	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242C1D1	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242C1D6	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242C232	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242C241	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242C25B	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242C35D	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242C39F	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242C3BA	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242C3E9	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242C45E	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242C4C5	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242C4F8	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242C4FB	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242C5F3	EFSR	2004	MAL	FLOR YELLOW	MAN

Appendix B. Continued.

PIT Tag Code	Stock	BY	Sex	Spaghetti Tag Color	Rearing
3D9.1BF242C77E	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242CBB0	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242F3F6	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242F42A	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242F452	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242F510	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242F55C	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242F569	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242F612	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242F76E	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242F7A1	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242F7EB	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242F88D	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242F947	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242F948	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242FAB1	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242FB47	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242FB4F	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242FC09	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242FC93	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242FDF8	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF242FE0D	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2430570	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2430ABA	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2430ACE	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2430B5E	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2430B63	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2430C12	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2430C9A	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2430CA5	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2430D13	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2430E16	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2430E41	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2430E88	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2430EB4	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2430F57	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2430F7A	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2430FB2	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2430FB3	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2430FE5	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF243102E	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF243106D	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF24310B8	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF24310D5	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2431120	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF243113D	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF243114D	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF243119E	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF24311D3	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF24311D4	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2431243	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF24312C0	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF24312FE	EFSR	2004	MAL	FLOR YELLOW	MAN

Appendix B. Continued.

PIT Tag Code	Stock	BY	Sex	Spaghetti Tag Color	Rearing
3D9.1BF243135A	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2431370	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF24313C5	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2431434	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2431440	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2431453	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF243149B	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF24314ED	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2433901	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF243392A	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF243394B	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2433950	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2433952	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF24339E2	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2433A99	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2433B13	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2433B14	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2433BEE	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2433C0B	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2433CE8	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2433D59	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2433DB8	EFSR	2004	MAL	FLOR YELLOW	MAN
3D9.1BF2583618	EFSR	2005	MAL		MAN
3D9.1BF2583642	EFSR	2005	MAL		MAN
3D9.1BF2584261	EFSR	2005	MAL		MAN
3D9.1BF25845AC	EFSR	2005	MAL		MAN
3D9.1BF258470C	EFSR	2005	MAL		MAN
3D9.1BF258484D	EFSR	2005	MAL		MAN
3D9.1BF2584859	EFSR	2005	MAL		MAN
3D9.1BF2584876	EFSR	2005	MAL		MAN
3D9.1BF25848B9	EFSR	2005	MAL		MAN
3D9.1BF258491D	EFSR	2005	MAL		MAN
3D9.1BF2584AB0	EFSR	2005	MAL		MAN
3D9.1BF2584C96	EFSR	2005	MAL		MAN
3D9.1BF2584C9E	EFSR	2005	MAL		MAN
3D9.1BF25868E4	EFSR	2005	MAL		MAN
3D9.1BF2586BB3	EFSR	2005	MAL		MAN
3D9.1BF2586FF1	EFSR	2005	MAL		MAN
3D9.1BF258755F	EFSR	2005	MAL		MAN
3D9.1BF2587623	EFSR	2005	MAL		MAN
3D9.1BF25876DC	EFSR	2005	MAL		MAN
3D9.1BF258787E	EFSR	2005	MAL		MAN
3D9.1BF258C949	EFSR	2005	MAL		MAN
3D9.1BF258C95C	EFSR	2005	MAL		MAN
3D9.1BF258C98E	EFSR	2005	MAL		MAN
3D9.1BF258CCE1	EFSR	2005	MAL		MAN
3D9.1BF258CE23	EFSR	2005	MAL		MAN
3D9.1BF258D024	EFSR	2005	MAL		MAN
3D9.1BF258D1C8	EFSR	2005	MAL		MAN
3D9.1BF258D37F	EFSR	2005	MAL		MAN
3D9.1BF258F69A	EFSR	2005	MAL		MAN
3D9.1BF2590BF1	EFSR	2005	MAL		MAN
3D9.1BF2590C3D	EFSR	2005	MAL		MAN

Appendix B. Continued.

PIT Tag Code	Stock	BY	Sex	Spaghetti Tag Color	Rearing
3D9.1BF2590C71	EFSR	2005	MAL		MAN
3D9.1BF2590D6B	EFSR	2005	MAL		MAN
3D9.1BF2590DD1	EFSR	2005	MAL		MAN
3D9.1BF2590DE5	EFSR	2005	MAL		MAN
3D9.1BF2590E54	EFSR	2005	MAL		MAN
3D9.1BF2590E88	EFSR	2005	MAL		MAN
3D9.1BF2590F5A	EFSR	2005	MAL		MAN
3D9.1BF2591033	EFSR	2005	MAL		MAN
3D9.1BF2591049	EFSR	2005	MAL		MAN
3D9.1BF2591061	EFSR	2005	MAL		MAN
3D9.1BF2591075	EFSR	2005	MAL		MAN
3D9.1BF25910C8	EFSR	2005	MAL		MAN
3D9.1BF2591692	EFSR	2005	MAL		MAN
3D9.1BF259173A	EFSR	2005	MAL		MAN
3D9.1BF2591C06	EFSR	2005	MAL		MAN
3D9.1BF2591C14	EFSR	2005	MAL		MAN
3D9.1BF2591C71	EFSR	2005	MAL		MAN
3D9.1BF2591D56	EFSR	2005	MAL		MAN
3D9.1BF2591DB1	EFSR	2005	MAL		MAN
3D9.1BF2591F4A	EFSR	2005	MAL		MAN
3D9.1BF2591F9C	EFSR	2005	MAL		MAN
3D9.1BF2591FE2	EFSR	2005	MAL		MAN
3D9.1BF2591FE7	EFSR	2005	MAL		MAN
3D9.1BF2592026	EFSR	2005	MAL		MAN
3D9.1BF25920B5	EFSR	2005	MAL		MAN
3D9.1BF259224D	EFSR	2005	MAL		MAN
3D9.1BF259227D	EFSR	2005	MAL		MAN
3D9.1BF25922D8	EFSR	2005	MAL		MAN
3D9.1BF25923D1	EFSR	2005	MAL		MAN
3D9.1BF25924CB	EFSR	2005	MAL		MAN
3D9.1BF2592CA9	EFSR	2005	MAL		MAN
3D9.1BF2592D06	EFSR	2005	MAL		MAN
3D9.1BF2592E2F	EFSR	2005	MAL		MAN
3D9.1BF259472E	EFSR	2005	MAL		MAN
3D9.1BF25947C4	EFSR	2005	MAL		MAN
3D9.1BF259480C	EFSR	2005	MAL		MAN
3D9.1BF259482E	EFSR	2005	MAL		MAN
3D9.1BF2594D42	EFSR	2005	MAL		MAN
3D9.1BF2594E23	EFSR	2005	MAL		MAN
3D9.1BF2594E64	EFSR	2005	MAL		MAN
3D9.1BF2594EA7	EFSR	2005	MAL		MAN
3D9.1BF2594EAD	EFSR	2005	MAL		MAN
3D9.1BF2594F08	EFSR	2005	MAL		MAN
3D9.1BF2594F25	EFSR	2005	MAL		MAN
3D9.1BF2595A26	EFSR	2005	MAL		MAN
3D9.1BF2595A3C	EFSR	2005	MAL		MAN
3D9.1BF2596295	EFSR	2005	MAL		MAN
3D9.1BF25965F2	EFSR	2005	MAL		MAN
3D9.1BF2596613	EFSR	2005	MAL		MAN
3D9.1BF2596636	EFSR	2005	MAL		MAN
3D9.1BF25966E4	EFSR	2005	MAL		MAN

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