Fish Health for Warm Springs NFH
For the Hatchery Review Team

Excerpt from the draft of the Warm Springs NFH Comprehensive Hatchery Management Plan
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3.7 Fish Health Management Program

The primary objective of fish health management programs at USFWS hatcheries is to produce healthy smolts that will contribute to the program goals of that particular stock. Equally important is to prevent the introduction, amplification or spread of certain fish pathogens which might negatively affect the health of both hatchery and naturally reproducing stocks.

3.7.1 Fish Health Policy

The Lower Columbia River Fish Health Center (FHC) in Underwood, WA provides fish health care for Warm Springs NFH under the auspices of the published policy 713 FW in the Fish and Wildlife Service Manual. In addition to this policy, the 1994 annual report "Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries", chapter 5, by the Integrated Hatchery Operations Team (IHOT 1995) provides further fish health guidelines as approved by northwestern state, federal, and tribal entities. The directives of these two documents more than meet the requirements of the Oregon Health Management Policy of 2003. All of these documents provide guidance for preventing or minimizing diseases within and outside of the hatchery. In general, movements of live fish into or out of the hatchery must be approved in the U.S. *v* Oregon Production Advisory Committee forum. Permits from the Oregon Department of Fish & Wildlife, the USFWS, and any other states through which the fish travel must be obtained and approved by co-managers. Fish health exam and certification must be done prior to any releases or transfers from the hatchery to minimize risks from possible disease transmittance.

3.7.2 Fish Health Examinations at Warm Springs NFH

Monthly examination: A pathologist from the FHC visits at least monthly after fry are placed in ponds. Based on pathological signs, age of fish, concerns of hatchery personnel, and the history of the facility, the examining pathologist determines the appropriate tests. This usually includes a necropsy with an external and internal exam of skin, gills, and internal organs and can include other tests for bacteria, virus and parasites. Kidneys, gills and other tissues are checked for common bacterial pathogens by culture. Blood is checked for signs of anemia or other infections, including viral anemia. Additional tests for virus or parasites are done if warranted. The pathologist examines the healthy and moribund/freshly dead fish to ascertain potential disease problems in the stock.

Diagnostic Examination: This is done on an as-needed basis as determined by the pathologist or requested by hatchery personnel. Moribund, freshly dead fish or fish with unusual signs or behavior are examined for disease using necropsy and appropriate diagnostic tests. A pathologist

will normally check symptomatic fish during a monthly examination.

Ponding Examination: The first health exam of newly hatched fish occurs when approximately 50% of the animals are beyond the yolk sac stage and begin feeding. Sixty fish will be sampled and tested for virus.

Pre-release Examination: At two to four weeks prior to a release or transfer from the hatchery, 60 fish from the stock are necropsied and tissues are taken for testing of listed pathogens. The listed pathogens, defined in USFWS policy 713 FW (Aquatic Animal Health Policy, Fish and Wildlife Service Manual) include infectious hematopoietic necrosis virus (IHNV), infectious pancreatic necrosis virus (IPNV), viral hemorrhagic septicemia virus (VHSV), *Renibacterium salmoninarum*, *Aeromonas salmonicida,* and *Yersinia ruckeri*. The FHC tests for *Myxobolus cerebralis,* another listed pathogen upon request.

Adult Certification Examination: At spawning, tissues from adult fish are collected to assay viral, bacterial and parasite infections and to provide a health profile. The FHC tests for all of the listed pathogens, except *Myxobolus cerebralis* (unless requested), and *Ceratomyxa shasta*. The minimum number of samples collected is defined by 713 FW. At Warm Springs NFH, 100% of the adult fish are tested for infectious hematopoietic necrosis virus and for *Renibacterium salmoninarum* (causative agent of bacterial kidney disease, BKD). Eggs are identified by a fish health number corresponding to each female/male mating. This allows tracking of the eggs so that selective culling and/or segregation is possible. If not needed to make production goals, progeny from females with high levels of BKD are culled. Otherwise, these are segregated from progeny at lower risk of disease.

Other Stocks: In years of low returns, spring Chinook salmon eggs from the neighboring Round Butte Hatchery on the Deschutes River can be reared and released from Warm Springs NFH. Prior to import to the station, fish health policy must be met as described in Section 3.7.1. While on station, each stock undergoes fish health sampling as detailed above. Furthermore, any eggs received at the hatchery must be disinfected as described in 713 FW Policy before they are allowed to come in contact with the station's water, rearing units or equipment. This stock is differentially marked and kept separate through rearing and return as adults to prevent incorporation into the breeding stock of Warm Springs.

3.7.3 Chemotherapeutant Use.

The spring Chinook salmon adults are taken into the hatchery, after the opening of the automated fish passage unit in mid-April, and due to the lengthy holding time before spawning in late August, can require formalin treatment three to five times weekly at a rate of 167 ppm to control external fungus and parasites. All adults held for broodstock and for live out-planting are injected with erythromycin to prevent pre-spawning mortality by BKD and to reduce vertical transmission of its causative agent to their progeny. Fish are injected twice in the dorsal sinus, at about 60 days and 30 days before spawning, with a dosage of 10-20 mg/kg body weight. Wild fish handled in the hatchery will also receive an injection prior to release above the hatchery weir. No wild fish will be injected when water temperatures exceed 60^{o}F or within 30 days of spawning. Injections have been done under the INAD 6430 (Investigational New Animal Drug regulation); however, the preferred Erythro-100 solution (100 mg/ml of active erythromycin base in PEG, ethyl acetate and ethyl alcohol) has recently been discontinued by the INAD sponsor, necessitating veterinarian prescription. In 2004, the manufacturer suspended production of all erythromycin so modifications of drug, acquisition, and application may apply in future dates. When pre-spawning mortality caused by *Aeromonas salmonicida* exceeds expected numbers, intra-peritoneal injections of oxytetracycline at 25 mg/kg body weight are given concurrently with the second injection of erythromycin. This has proven effective in reducing/eliminating mortality caused by furunculosis.

The spring Chinook salmon eggs are water-hardened in a solution of polyvinylpyrrolidone iodine compound at 75 ppm iodine in water buffered by sodium bicarbonate (at 0.01%) for 20 minutes during the water-hardening process. Formalin (27% formaldehyde) is dispensed into water if necessary for the control of fungus on eggs or to reduce parasite loads on juvenile fish. To prevent/reduce BKD, the spring Chinook juveniles are fed erythromycin, in spring and late summer, at a daily dosage of 100 mg/kg of fish for a minimum of 21 days. Years of data prove that the Warm Springs salmon fed erythromycin return at two to ten times the number as those fish not fed the drug. Since 2002, a study on the feasibility of reducing erythromycin feedings from two to one has been conducted and should be completed when the last adults return by 2010. As of 2001, there is a temporary INAD 4333 that allows feeding of Aquamycin 100 (erythromycin thiocyanate in a wheat flour base) and prescription by a veterinarian is not required.

3.7.4 Other Fish Health Precautions.

Eggs from female broodstock with high levels of BKD are not used unless egg production is low. The Enzyme-linked Immunosorbent Assay or ELISA is used to measure BKD levels in 100% of the spring Chinook adults. Returning adult numbers permitting, eggs from females measuring greater than 0.199 optical density (O.D.) in this test will be culled to reduce/control BKD. If the number of brood females is low, progeny from highly infected females are segregated into rearing units apart from the rest of the

production and absolute fastidiousness maintained as to using equipment that is disinfected and/or dedicated to these rearing units.

The water supply for the hatchery is the Warm Springs River through which anadromous salmon and steelhead travel on their way to and from spawning grounds above the hatchery. Generally, the fish passage unit at the hatchery weir is designed to permit hands-off separation of adult hatchery and wild fish. Wild steelhead and spring Chinook salmon pass through the barrier while most of the hatchery Chinook and straying hatchery steelhead are dealt with in the hatchery. Of concern are the non-endemic hatchery steelhead which are infected with the parasite *Myxobolus cerebralis*, the agent of whirling disease. To this date, the parasite has not been found in the Warm Springs fish stocks. Despite precautions taken to de-contaminate incoming river water using ultra-violet light treatment of the water, the young fry are still at risk to any pathogens that are brought in by infected anadromous adults. It is therefore critical to remove all non-native fish from other basins to reduce the risks from non-endemic pathogens. In the days prior to the automated fish passage system, all wild and hatchery adult fish were handled and separated in the hatchery. To reduce pre-spawning mortality caused by BKD and the extra handling, all wild spring Chinook salmon were injected with erythromycin. Since, this practice has been discontinued with the caveat noted in the Operational Plan of 2002 to 2006 that injections of erythromycin may be re-intitiated if the wild fish show high pre-spawning mortality in two or more consecutive years (>3.1 fish /redd), low egg to smolt survival and high levels of BKD in wild smolts trapped at the mouth of the Warm Springs River.

Water temperature plays a big role in the health of the spring Chinook salmon at Warm Springs NFH. Summertime water temperatures reaching over 60^{o}F facilitate the onset of many parasites that aggravate the fish and reduce their condition factor. At this time, the hatchery's only recourse has been to increase water flow by removing dam boards in the raceways. Covers over the raceways now provide shade which induces the fish to use the whole area rather than crowding into the thin shadows from uncovered raceway walls. After marking, juvenile fish are ponded at or below 32,000 fish/1800 ft^3 raceway which not only helps reduce transmission of parasites but has also been a major factor in the reduction of BKD.

Decontamination of all holding and rearing units is necessary after release, transfer or spawning of the occupying fish. Units should be dewatered, pressure washed (where feasible), and dried to reduce problems caused by fungus, bacteria and parasites. If necessary, a formalin treatment may be applied to the surface.

Tank trucks or tagging trailers are disinfected before being brought onto the station.

Abernathy Fish Technology Center provides quarterly feed quality analyses to meet nutritional requirements and prevent nutritional diseases.

An ongoing ecological interactions study entails examining health of wild native fish (salmonids and other species) and released hatchery juvenile salmon that inhabit the Warm Springs River. As part of this study, the hatchery and wild adult spring Chinook salmon are compared for levels of BKD, virus and other pathogens. Adult salmon collected from the Warm Springs NFH are being out-planted for restoration of the fish runs to Shitike Creek, a nearby tributary in the basin. To prevent the potential spread of pathogens and ensure survival to spawning, these fish have been injected with erythromycin and oxytetracycline to limit BKD and furunculosis. If possible, ovarian fluid samples are collected from the females at stream-side, just before release to test for virus. The incidence of virus (IHNV) is low in this stock of salmon and it has been felt that benefits of restoring these fish to the Basin outweighs the risk.. The new, non-lethal DNA technology (polymerase chain reaction assay) is being used and compared to traditional cell culture methodologies for detecting the virus in these fish.

For nutrient enhancement of Warm Springs River, the spawned adult spring Chinook salmon carcasses are uniquely numbered, sampled for virus, and then eviscerated/beheaded to remove the organs which might contain pathogens. The carcasses are frozen until health results are available, with any virus-positive carcasses being safely disposed. This prevents inadvertent dissemination of disease to Warm Springs aquatic residents.

An egg isolation building constructed in 2003 allows for the quarantine and segregation of fish for special studies or supplementation projects in the Deschutes River Basin. In 2005, a study on re-conditioning wild native steelhead kelts in this unit began. A condition mandated for this study initiated by the Columbia River Inter-tribal Fisheries Confederation was that no hatchery steelhead kelts were to be used. This was to prevent the spread of the whirling disease parasite which is carried in the hatchery steelhead that stray into the Deshutes Basin.