Fish Health Documents for Leavenworth Hatchery Complex

Leavenworth, Entiat, and Winthrop NFHs

Provided May 1, 2006 to FWS Hatchery Review Team
(via Don Campton, Chair)

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To: Don Campton/AFTC/R1/FWS/DOI@FWS
Cc: Ray Brunson/OFHC/R1/FWS/DOI
bcc

Subject RE: Fish Health Issues at Leavenworth Complex hatcheries?

Hi Don,

Ray forwarded a message that you would consider any information we might want to provide on fish health issues at the Leavenworth Complex Hatcheries for the Review Team. Attached are some documents the Team might find useful during this process. The files contain information about pathogens that have been identified at each location and some Guidelines and General Parameters that we have found useful at these and other facilities.

The following section contains the list of Fish Health Issues of concern for these hatcheries. The major issue in each bullet is underlined, followed by information to explain the problem or concern, and concludes in bold text with my suggestion for improvements, solutions, or actions I hope will be considered by the Review Team when discussing these facilities and programs:

Production numbers - These should be evaluated in light of the scientific information generated for each hatchery by return data, fish cultural studies and observations, and our current capacity to produce "high quality" smolts given many changes in the environment around our hatcheries and current USFWS priorities. The definition of "mitigation responsibilities" may need to be discussed and adjusted. >>Production numbers should be based on the watershed environment, facility capacity, and USFWS priorities.

Fish passage above our hatcheries - This should be matched with available rearing and spawning habitat, especially for anadromous fish. Overloading the system, inside or outside of the hatchery, will not benefit the system as a whole. >>Changes in upstream passage above hatchery intakes, even at an optimized level, may impact hatchery fish receiving that water and necessitate program or production number modifications unless new water sources can be found or surface water is depurated (treated).

Nutrient enhancement with carcasses from our hatcheries - This needs to be done using strict criteria to prevent negative environmental impacts. Carcasses should be selected based on lack of chemical residue and low pathogen load. From a practical standpoint for spring Chinook, this means only the healthy adult males euthanized by a blow to the head or carbon

dioxide anesthesia would be candidates for this use and only after removal of head and viscera and a period of freezing to minimize pathogen loads. >>There should be an evaluation of the target stream to document that the carcasses, screened and prepared for this purpose, will provide a benefit instead of a pathogen risk or nutrient overload or imbalance to the system.

Stock changes - The Winthrop experience has taught us that an undefined genetic composition target is very difficult to achieve while trying to maintain a mitigation production goal and that it can have a tremendous adverse effect on fish health if modifications based on disease risk are not included in the stock change plan (Broodyear 2001). >>Stock designations need to come with clear explanations as to what level of genetic makeup will be considered "acceptable" by the USFWS, how the stock fits into the Mission of the USFWS, and acknowledge that both genetic makeup and health risks need to be addressed in the details of how the change of stock will be accomplished.

Predator exclusion structures - Birds, especially herons and ducks, at all three of these hatcheries remove an unknown number of fish and have frequently been associated with an increase in stress mediated diseases such and BKD. >>Additional raceway covers and enclosures would be beneficial at all three facilities.

Water treatment for egg incubation - Heaters and/or chillers allow us to manipulate development during the egg stage which is much healthier for the fish than starving or overfeeding during the rest of the rearing cycle. >>Leavenworth and Winthrop would benefit from an incubation water temperature control system similar to the one installed at Entiat.

Adult holding facilities - Crowded and/or stressful holding conditions for adult fish are detrimental just as they are for juvenile fish and hence the adult ponds must not be overloaded in space or water flow in an attempt to "ensure" an egg take goal. This is of particular concern at Winthrop and Entiat with the Coho program and the constant increases in numbers and trucking of fish which potentially increases handling in the ponds and potentially reduces fish and egg quality. >>Holding and handling stress can be minimized by pond configuration, fish numbers, and coordination of fish hauling and placement to reduce handling and prevent overloading the system.

Coho program -

Fish Quality - Coldwater disease has been a perpetual problem in the juveniles and has resulted in substantial fish losses exacerbated by the movements from hatchery to hatchery prior to release. Although there is some level of Flavobacter psychrophilum in many places in the Columbia Basin, there is still a concern that these smolts may amplify the levels or introduce new strains of the bacteria with increased virulence or drug resistance into the watersheds where they are released. This is especially of concern when they are transferred into our hatcheries or

into acclimation sites above our hatchery intakes. >>For the benefit of the reintroduction project, since it is now known that this is a limiting problem in this stock, participating facilities should re-evaluate their egg incubation, rearing and holding capacities based on control measures for Coldwater Disease as well as IHNV and only hold, incubate, and rear the numbers that they can provide as healthy high quality eggs/fish to contribute to the project.

Planning and Communication - Due to the involvement of multiple facilities and agencies, this project requires advanced planning and clear communication to keep it running smoothly and maximize its benefit. There have been improvements in communication of fish and egg movements but plans still seem to change frequently and sometimes without adequate notification to those effected by the change. >>Encourage the MC Coho group to provide annually a detailed plan to all participants and follow it unless changes are discussed and agreed to by all entities they effect. This will do much to foster cooperation among all the groups and should lead to an increase in the quality of the fish and success of the project to re-establish coho in the mid-Columbia.

I appreciate the opportunity to present a few of my opinions regarding these hatcheries to you for consideration. I hope there will also be an opportunity for each hatchery and myself to review your draft recommendations to ensure the accuracy of the information used by the Review Team and provide any additional information or clarification that might be beneficial to the Review effort.

Thanks!
Joy

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Pathogens noted at Leavenworth NFH

Parasites:

Ichthyobodo – seen occasionally on Chinook juveniles. Formalin treatments needed occasionally following approved FDA and EPA guidelines.

Trichodina – seen occasionally on Chinook juveniles. Formalin treatments needed occasionally following approved FDA and EPA guidelines.

Epistylis – seen commonly, but usually not a problem. Occasionally formalin treatments are used according to EPA and FDA guidelines.

Ceratomyxa shasta – incidental finding in the lower intestine of Chinook adults. Detected in wild Chinook and Coho throughout the Columbia Basin. No treatment is needed.

Ichthyophtherius multifiliis -– seen intermittently at a high level during the summer and fall and has been associated with large numbers of adult Chinook above the intake. Monitoring numbers of this parasite determines extent of treatment. Formalin treatments follow approved FDA and EPA guidelines.

Fungi:

Saprolegnia spp. – seen occasionally on eggs and returning adults. Controlled by FDA and EPA approved use of formalin. If control measures are used, no problems are encountered. Fungus has been noted on juveniles most often following late fall splits and handling to lower adult ponds. Treatment with FDA and EPA approved formalin usually resolves the problem.

Bacteria:

Renibacterium salmoninarum – present in all populations within the hatchery and documented in wild salmonids throughout the Columbia River system. Disease signs in spring Chinook occur depending on levels of the BKD bacteria in adult females, juvenile rearing densities, and other fish cultural activities. Control measures include injection of adult females with erythromycin about a month before spawn, segregation or elimination of eggs from moderate and high risk BKD female carriers, and as much stress reduction as possible. Treatments are administered only if warranted by severity of the disease and include oral administration of erythromycin by an INAD permit or veterinary extra-label prescription.

Flavobacter psychrophilum – seen occasionally in small fry of Chinook, but usually not a problem and it has not been necessary to administer an antibiotic treatment for Coldwater disease in the Chinook. The juvenile coho have had mild to severe problems with disease caused by this bacteria and some years have been treated several times before they are transferred to Leavenworth from other hatcheries for acclimation.

Aeromonas salmonicida – seen occasionally in returning adults and under certain conditions may be associated with an increase in prespawn mortality.

Viruses:

Infectious Hematopoietic Necrosis Virus (IHNV) – isolated intermittently in adult Chinook during spawning. Has been isolated once in the mid-1980's after the State of Washington planted infected and diseased rainbow trout above hatchery intake. Not a current problem.

Erythrocytic Inclusion Body Syndrome (EIBS) – noted historically but rarely into the present. It does not cause problems. May be associated with "flag-tail". Detected in wild Chinook throughout the Columbia Basin.

Pathogens noted at Entiat NFH

Parasites:

Ichthyobodo – seen occasionally on Chinook juveniles. Formalin treatments needed occasionally following approved FDA and EPA guidelines.

Trichodina – seen occasionally on Chinook juveniles. Formalin treatments needed occasionally following approved FDA and EPA guidelines.

Epistylis – seen commonly, but usually not a problem. Occasionally formalin treatments are used according to EPA and FDA guidelines.

Myxobolus spp – If river water is used for rearing, fish become infected with a neurotropic myxobolid parasite that has not been definitively identified, but is probably *M. neurobius*. No treatment is available, so avoiding surface water is imperative.

Ceratomyxa shasta – incidental finding in the lower intestine of Chinook and Coho adults. Detected in wild Chinook and Coho throughout the Columbia Basin. No treatments needed.

Fungi:

Saprolegnia spp. – seen occasionally on eggs, juveniles, and returning adults. Controlled by FDA and EPA approved use of formalin. If control measures are used, no problems are encountered. If River water is used during rearing, there is more risk that fungus ("flag tail") will occur probably due to some other debilitating cause such as *Myxobolus spp*.

Bacteria:

Renibacterium salmoninarum – present in all populations within the hatchery and documented in wild salmonids throughout the Columbia River system. Disease signs in spring Chinook occur depending on levels of the BKD bacteria in adult females, juvenile rearing densities, and other fish cultural activities. Control measures in Chinook include two injections of adult females with erythromycin about 30 and 60 days before spawn, segregation or elimination of eggs from moderate and high risk BKD female carriers, and as much stress reduction as possible. Treatments are administered only if warranted by severity of the disease and include oral administration of erythromycin by an INAD permit or veterinary extra-label prescription.

Flavobacter psychrophilum – seen occasionally in small fry of Chinook, but usually not a problem. Treatments are not needed at this time.

Aeromonas salmonicida – seen occasionally in returning adults and under certain conditions may be associated with an increase in prespawn mortality.

Viruses:

Infectious Hematopoietic Necrosis Virus (IHNV) – isolated intermittently in adult Chinook and Coho during spawning. Has never been isolated or caused disease in progeny from these adults.

Erythrocytic Inclusion Body Syndrome (EIBS) – noted historically but rarely into the present. It does not cause problems. May be associated with "flag-tail". Detected in wild Chinook throughout the Columbia Basin.

Pathogens noted at Winthrop NFH

Parasites:

Gyrodactylus – seen occasionally on steelhead juveniles. Treatments (formalin) rarely needed.

Ichthyobodo – seen seasonally (spring, summer) on coho, Chinook, and steelhead. Formalin treatments needed occasionally following approved FDA and EPA guidelines.

Ichthyophtherius multifiliis – seen seasonally during spring and summer at varying levels. Monitoring numbers of this parasite determines extent of treatment. Formalin treatments follow approved FDA and EPA guidelines.

Trichodina – seen occasionally on steelhead, Chinook, and coho. Formalin treatments needed occasionally following approved FDA and EPA guidelines.

Epistylis – seen commonly on coho, Chinook, and steelhead, but usually not a problem. Occasionally formalin treatments are used according to EPA and FDA guidelines.

Ceratomyxa shasta – incidental finding in the lower intestine of Chinook and Coho adults. Detected in wild Chinook and Coho throughout the Columbia Basin.

Fungi:

Saprolegnia spp. – seen occasionally on eggs and returning adults. Controlled by FDA and EPA approved use of formalin. If control measures are used, no problems are encountered.

Bacteria:

Renibacterium salmoninarum – present in all populations within the hatchery and documented in wild salmonids throughout the Columbia River system. The disease is almost exclusive to spring Chinook and not currently noted (although detected) in coho (except in smolts received from other hatcheries) or steelhead reared on site. Disease signs in spring Chinook occur depending on levels of the BKD bacteria in adult females, juvenile rearing densities, and other fish cultural activities. Control measures in Chinook include two injections of adult females with erythromycin about 30 and 60 days before spawn, segregation or elimination of eggs from moderate and high risk BKD female carriers, and as much stress reduction as possible. Treatments are administered only if warranted by severity of the disease and include oral administration of erythromycin by an INAD permit or veterinary extra-label prescription.

Flavobacter psychrophilum – seen occasionally in small fry of Chinook, and consistently in steelhead and coho, especially when fish are transferred into Winthrop from other hatcheries. Some years it has been a chronic problem requiring administration of oral antibiotics to control morbidity and mortality.

Aeromonas salmonicida – seen occasionally in returning adults and under certain conditions may be associated with an increase in prespawn mortality.

Viruses:

Infectious Hematopoietic Necrosis Virus (IHNV) – isolated intermittently in adult Chinook and Coho during spawning. Has never been isolated or caused disease in progeny from these adults.

Erythrocytic Inclusion Body Syndrome (EIBS) – noted historically and rarely into the present. It does not cause problems. Detected in wild Chinook throughout Columbia Basin.

Guidelines for Transporting Juvenile Salmonids

1. Fast fish for 48-72 hours to reduce metabolic stress, nitrogen excretion, and oxygen demand during the transport period.
2. Transport truck and tanks must be completely disinfected between loads unless fish are from the same pond.
3. Start aeration at least 10 minutes prior to loading any fish.
4. Handle fish gently when loading and unloading.
5. Minimize mixing of fish by loading trucks so that all of the fish in one rearing unit from the station of origin are loaded into the same compartment. Example: 2 tanks = 1 compartment.
6. Minimize handling of fish by loading so that each compartment can be completely emptied into one rearing unit at the receiving facility. Examples: 1 compartment = 1 raceway at receiving facility or 2 compartments = 1 pond, etc.
7. Loading density is dependent on species, water quality, and age of fish. Guidelines are 0.02-0.11 kg/L or 0.2-1.0 lbs/gal for salmonid fry, 0.06-0.18 kg/L or 0.5-1.5 lb/gal for salmonid fingerling, and 0.05 kg/L or 0.4 lb/gal for smolts. (Wedemeyer 1996)
8. Maintain a range of 80-100% saturation of O_2 in the transport container. Actively swimming and stressed fish may consume 400-800 mg O_2 /kg fish/hour.
9. Re-circulate newly aerated water at least once every 2 minutes to minimize respiratory stress. (Wedemeyer 1996)
10. Ventilate hauling truck to maintain CO_2 less than 20 mg/L to prevent respiratory acidosis.
11. Add 0.25% (1 gm/gal) of Sodium bicarbonate to transport water to maintain a stable blood pH.
12. Add 0.5-1.0% salt in transport water. Adding salt to initial receiving water also helps to alleviate metabolic stress during the early acclimation period to the new water chemistry conditions. The 0.5-1.0% salt approaches physiological levels and reduces metabolic stress and electrolyte depletion that can cause post transport mortality.
13. Transport water may be chilled up to 10°C from source water with chlorine-free ice or chilling units to reduce activity and metabolism. However, electrolyte depletion may still occur at reduced temperatures.
14. Temperature should be matched as closely as possible between transport and receiving water. This can be done after the truck arrives at the destination facility by slow addition of receiving water into the transport water. Water temperature should not be changed faster than 2°F/hour. If receiving water is colder than transport water, the final difference may be as much as 5°F from truck to raceway.
15. Light intensity should be reduced as much as possible during transport.

Optimal Fish Rearing Parameters and Fish Culture Methods for Production of High Quality Salmonid Smolts at National Fish Hatcheries Using Laminar Flow Tanks and Raceways

1. Water Quality parameters
    a. Water temperature range 37-55°F (3-13°C)
    b. Dissolved Oxygen level of 80-100% saturation (10-12ppm at sea level)
    c. Dissolved Nitrogen level less than 100%
    d. pH 7-8
    e. unionized ammonia (NH_3) < 0.05 ppm
    f. Carbon Dioxide (CO_2) 10-15 mg/L
    g. Hardness as $CaCO_3$ 100-200 mg/L
    h. Other site specific parameters such as iron, turbidity, etc. if used for egg incubation.

2. Environmental Quality parameters
    a. High quality water parameters as listed above.
    b. Single pass water (water used on one rearing unit of fish between entering and exiting the hatchery).
    c. Density measured as pounds of fish/cubic feet of rearing space/average total length of fish in inches (or kg of fish/cubic meter/average length in cm). Current recommendation for Pacific salmon species:
        - Spring Chinook at low risk for developing Bacterial Kidney Disease DI < 0.10 (0.63), at moderate risk DI < 0.06 (0.38)
        - Fall Chinook DI < 0.15 (0.95)
        - Coho DI < 0.20 (1.26)
        - Steelhead < 0.25 (1.58)
    d. Flow measured as pounds of fish/gallon per minute inflow/ average total length of fish in inches (or kg of fish/liter per minute inflow/average length in cm). Current recommendation for Pacific salmon species in first pass water:
        - Spring Chinook at low risk for developing Bacterial Kidney Disease FI < 1.0 (0.046), at moderate risk for developing Bacterial Kidney Disease FI < 0.60 (.028)
        - Fall Chinook, Coho, and Steelhead FI < 1.0 (0.046)
    e. Turnover time of 15 minutes regardless of pond or tank configuration, flow measured at least weekly and any time major water adjustments are made in the system.
    f. Water velocity of 0.09 ft/second (3 cm/second) to maintain solids in suspension and help keep raceways clean. Calculate inflow in gpm=0.09ft/second x Width (ft) x Depth (ft) x 7.48 gal/cu ft x 60 seconds/minute. Ex: For an 8'x80'x2' raceway the inflow is 0.09x8x2x7.48x60=646 gpm.
    g. 10:1 ratio of Length to Width with a bottom sloping down from the inflow to the tail screen to promote cleaning.

3. Fish Culture Procedures for preventing disease outbreaks

a. Pond fish directly from incubator trays to the raceway from which they will be released. This reduces the major handling events except initial ponding and tagging. Each handling event potentially increases the risk of developing disease in the population. Start tanks may be beneficial in some species and locations but the same density and flow criteria must be used as in the raceways.
b. Do not mix or combine fish from different rearing units. Many fish pathogens are contagious and keeping them in discrete groups and applying good disinfection procedures reduces the risk of transmission of infectious diseases.
c. Remove dead and sick fish from each rearing unit at least once every day
d. Organic debris in the form of uneaten feed and feces should be removed from the bottom of the pond daily or as needed if fish are not being fed every day.
e. Brush sides and bottom of each rearing unit as often as needed to control algae and prevent parasitic, fungal, and bacterial growth.
f. Feed only high quality fish food that is less than 90 days past production date. Feeds with added Vitamin C or other nutrients may be beneficial if used in conjunction with a major handling event.
g. Administer feed so that it is evenly distributed over the entire population of fish in the raceway and only as much as the fish will readily consume at each feeding. This prevents fouling of the pond with uneaten feed.
h. If manipulation of growth is a necessary part of a program, heating or chilling of the egg incubation water to advance or delay hatching is much less stressful on the fish than over or underfeeding. Overfeeding may foul the raceways with feces and uneaten feed which will promote gill disease, parasite infestations and potentially fungal and bacterial diseases. Underfeeding may cause nutritional deficiencies or imbalances and promote size variation among the fish.
i. If feed restriction is necessary, feed fish to satiation on consecutive days and then do not feed for the rest of the week to reduce the aggressive behavior associated with feeding. Example: The total ration for the week to produce the desired growth on a raceway of fish is 4 lbs, fish are satiated at about 1.5 lbs per day given at three feedings. Administer 0.5 lbs/feeding three times/day for two days, administer two feedings of 0.5 lbs each on the third day, do not feed for 4 days.
j. Withhold feed for 48-72 hours prior to a major handling event such as tagging or transport to reduce metabolic oxygen demand and stress related problems.
k. Observe at least once daily for abnormal behavior such as flashing or feed rejection and inform the attending fish health biologist of any abnormal behavior or signs.
l. Disinfect all implements and gear between ponds. If using PVP iodine or Hyamine, a 10 minute contact time is adequate for most pathogens.
m. Inventory fish quarterly. Accurate numbers and sizes of fish are necessary to monitor and evaluate how each group performs as juveniles and adults and is essential to ensure the appropriate dose is administered if medicated feed treatments are necessary. When performed by traditional methods this is an acute stress, however, the impacts of the stress can be minimized by the use of proper equipment and procedures or completely eliminated by electronic monitors.
n. Use care when working directly in the raceways to prevent unnecessary damage to the fish when performing activities such as brushing, crowding, or counting.

Source Material:

Banks, Joe, 1994, Raceway density and water flow as factors affecting spring Chinook salmon during rearing and after release. Aquaculture 119:201-217.

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May 1, 2002

TO: Co-Managers, Management Biologists and interested parties
FROM: Bob Rogers, Ray Brunson and Joy Evered
SUBJ: Recommendations for Chinook fish health management in the mid and upper Columbia River

This memorandum is the synopsis of a meeting and discussion held by Bob Rogers and Ray Brunson on April 25, 2002 at Cle Elum, Washington, and subsequent recommendations.

Introduction: The following recommendations were arrived at by Bob Rogers, WDFW Region 2 fish pathologist, Ray Brunson, USFWS fish pathologist, and Dr. Joy Evered, Veterinary Medical Officer, USFWS. The objectives were to provide standard guidance for State and Federal programs in the Methow, Wells, and Wenatchee areas to reduce chinook adult stressors and promote adult resistance to infectious agents. Careful adherence to these recommendations will reduce the impact of BKD and other agents on adults, subsequent progeny and wild free-ranging fish within the river basin. These guidelines are sound biological and epidemiological recommendations based on a combination of experience and evidence. These guidelines are deemed necessary to mitigate and prevent the impact of Bacterial Kidney Disease (BKD) or other deleterious effects on these populations of fish and provide the best quality product for survival.

ADULT HANDLING

Haul all adults in 0.5 to 0.6% salt, regardless of duration of haul
Haul all adults at loadings no greater than 4.5ft3 per fish or 34 gallons per fish
Haul all adults in 10 ppm MS-222
Haul from trap site at least daily but 2x-3x per day or more, if needed (see below)
Crowding, netting and handling must be as careful as possible to avoid physical damage to fish

Remove adults from elevated water temperatures as soon as possible to a pathogen free source if available

Initiate formalin treatments for control of external parasites and/or fungus as listed on label, INAD permit or through veterinary prescription. Treatments should be no less than 3 times per week, but may be daily based on recommendation of attending fish pathologist.

Inject all fish or at least all females intraperitoneally within 2 weeks of collection or at time of first sorting of adults.

If needed, repeat injections shall be administered no less than 20 days and no more than 30 days apart to all females.

Inject with not less than 15mg/Kg of ERYTHRO-200 or equivalent

Do not inject less than 14 days prior to spawn

Do not exceed holding parameters greater than 1gpm/adult and 8ft3/adult (chinook). Using estimates of 15lb chinook, this approximates a maximum of 16 lbs/gpm and 1.75 lbs/ft3.

If stocks can be separated before spawning, each stock must be held in separate containers.

ADULT SAMPLING

At a minimum, ELISA-BKD sample all females providing progeny for yearling programs. Best to sample all females, regardless of program

Segregate eggs/fish based upon OD profiles. For State programs, do not use progeny from females with OD's greater than 0.120 for yearling programs (based upon KPL antisera used on the BY 2001) or for Federal programs, do not use progeny from females with OD's greater than Rank 5 based on Olympia Fish Health Center analysis.

Rearing parameters for all yearling programs not to exceed DI= 0.10 and FI= 0.9 at any time during rearing.

All progeny from females with OD's greater than the yearling program limits listed above should be put into a zero-age program or rejected for use.

Only for situations of extremely low population numbers of ESA listed progeny from females with OD's between 0.12 to 0.19 that must be retained, adjust rearing parameters not to exceed FI=0.6 and DI=0.06 and release as zero age fish. Do not rear to yearling size.

For progeny from females with OD's greater than 0.19 (State) or above Rank 6 (Federal), reject completely. Do not use in any culture program. Risk of vertical transmission and amplification of disease is so great that no current fish cultural practices can avoid problems.

TREATMENT AND SPECIAL CONSIDERATIONS:

If recommended by the attending pathologist, an antimicrobial compound will be administered to the progeny.

Marking activities should occur only at appropriate size/times: Never greater than 40 fpp, or within 4 weeks of release.