ANNUAL REPORT
FY 15

FISH HEALTH SERVICES
AND
TECHNICAL COORDINATION
FOR
FWS LSRCP HATCHERY PROGRAMS

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INTRODUCTION

The following is an annual report for all the activities scheduled for completion under each goal of the Idaho FHC Fish Health Program during Fiscal Year 2015. Specific objectives and tasks completed are listed and discussed below.

OBJECTIVES AND TASKS

GOAL 1 **Provide fish health services for the SCS program at Dworshak NFH to help ensure that its mitigation goal for the Lower Snake River Compensation Plan program is met.**

Approach: The mitigation goal for the Dworshak NFH spring Chinook salmon program is to return 9,135 adults above Lower Granite dam. A thorough evaluation of the success of this program requires careful documentation of the events and circumstances that occur throughout the fish's entire life history; including any and all aspects of fish health and its affect on the life history of spring Chinook salmon at Dworshak NFH. This life history is about five years from the time of egg fertilization and incubation to the time the last adults return from the ocean. At the end of the life cycle, a complete report and evaluation is written for that brood year. Because of the configuration of the federal fiscal year and the resultant lag time, data compilation and summary is being done on seven brood years simultaneously. Each year, a new brood year is started and one brood year life cycle is completed with the adult return that year. The objectives below are designed to provide the data and information necessary for completing these brood year evaluation reports.

Objective 1.1 Disease sampling at spawning of Dworshak NFH spring Chinook salmon adults that returned to the project area above Lower Granite Dam in 2015.

Approach: Specific samples were collected from adult salmon at spawning.

Task 1.1.1 Due to the unavailability of erythromycin injectable, a pilot study using tulthromycin was conducted. About half of the female SCS adults were injected with tulathromycin at 5 mg/kg of body weight under veterinary extra label prescription beginning 21 days prior to spawning and continuing as adults returned until spawning started.

Task 1.1.2 Kidney samples were collected for Bacterial Kidney Disease (*Renibacterium salmoninarum*) testing by Enzyme-linked Immunosorbent Assay (ELISA) from each female spawned.

Task 1.1.3 ELISA assays were performed for quantitative BKD results of each female adult to provide recommendations for culling/segregation of eggs to Dworshak NFH production staff. For FY 2015, fourteen females had values over the Clearwater Annual Operation Plan (AOP) recommended ELISA optical density (O.D.) cut off level of 0.250 and were recommended to be culled. This was slightly increased compared to the

most recent 10 year average of 11 females.

Task 1.1.4 Kidney and spleen samples (60 fish put into twelve 5 fish pool samples) were collected throughout spawning for bacteriology testing:

A. *Yersinia Ruckeri:* All were found negative for this pathogen.
B. *Aeromonas salmonicida:* All adults tested were found negative for this pathogen.

Task 1.1.5 Five fish pooled kidney/spleen samples (60) from males and 3 fish pooled ovarian fluid (150) samples were collected throughout the spawning season for virology testing:

A. Infectious Hematopoetic Necrosis Virus: 41.7% positive in kidney/spleens sampled (males) and 87.3% positive in ovarian fluid tested (females).
B. Infectious Pancreatic Necrosis Virus: not detected
C. Viral Hemorrhagic Septicemia Virus: not detected

Task 1.1.6 Cranial tissue (60) was collected throughout spawning for *Myxobolus cerebralis* testing by pepsin/trypsin assay. All tested were negative for this parasite.

Task 1.1.7 Intestinal scrapings (30) were collected throughout spawning for *Ceratomyxa shasta* detection. These adults were found positive for this parasite, as in most years.

Task 1.1.8 In FY 2015, there were sufficient numbers of ripe females to meet production goals. No females were injected with the GNRHa hormone.

Task 1.1.9 The IFHC served as INAD monitor for Dworshak NFH SCS program as necessary in FY 2015.

Task 1.1.10 For FY 2015, no drugs or chemicals were administered under INAD to the SCS adults.

Task 1.1.11 All SCS adults were treated with formalin bath for fungus during holding at Dworshak NFH with treatments administered up to every other day under veterinary extra label prescription.

Objective 1.2 Disease sampling and monitoring of SCS juveniles and smolts at Dworshak NFH

Approach: Specific samples were collected from juvenile salmon during rearing.

Task 1.2.1 Fish health exams for disease detection were performed as needed with a total of 6 diagnostic cases, 16 monitoring and 4 inspections for the SCS program at Dworshak in FY15. Monitoring results were combined with

the SCS density study and can be found under Objective 3.2. From June through Sept, the spring Chinook juveniles were seen to have water quality issues resulting in swollen gills and much debris observed on the gills. In June, low levels of the bacteria *Aeromonas hydrophila* were detected from kidneys of one raceway. Beginning in August through Sept, low levels of Gas Bubble Disease were detected on gills of the SCS in several raceways. In July, SCS juveniles in raceway A9 were detected positive for IHN (Infectious Hematopoietic Necrosis) virus. Mortalities remained at a low chronic level through August in this raceway.

Task 1.2.2 Kidney samples (10 each month) were collected on a monthly basis for 6 months prior to release for *Renibacterium salmoninarum* (BKD) monitoring by the ELISA test. By the ELISA analysis, *Renibacterium salmoninarum* was not detected in any monitoring samples (see density study results under Objective 3.2).

Task 1.2.3 Tissue samples (60) were collected prior to release to assess smolt readiness and disease status. Assays included virology, bacteriology, parasitology, hematocrits, and visual notations of smolt stage. No viruses or bacteria were detected at pre-release, however many pinheads were noted.

Task 1.2.4 SCS juveniles were not treated under an INAD (Investigational New Animal Drug) in FY 15.

Task 1.2.5 Summary reports were provided as requested for FY 2015 and to Idaho FRO for Brood year reports.

Objective 1.3 Participate in the preparation of spring Chinook salmon brood year reports for Dworshak NFH.

Approach: Brood Year Reports were recommended in the Region One, U.S. Fish and Wildlife Service, Fisheries Vision Action Plan and are intended to provide a broad overview of stock performance and is a compilation of data from various other reports. Data on adults that are spawned to create the brood year, egg production, nursery rearing, juvenile rearing, smolt releases, fish health, smolt emigration, adult contribution to fisheries, and adult returns to the hatchery are summarized. Evaluation projects and other research studies involving the pertinent brood years are only briefly described in these reports. Because brood year reports are a relatively new activity, there is a large backlog of reports that need to be completed. Emphasis for this activity will be for the brood years most recently completed with backlog reports being completed as time permits.

Task 1.3.1 All fish health related information was compiled for BYs of spring Chinook salmon as requested and submitted to Idaho FRO for compilation into complete Brood Year Reports.

GOAL 2 **Disease sampling and monitoring of STT juveniles and smolts at Hagerman NFH to provide assistance in meeting its summer steelhead smolt production goal for the Lower Snake River Compensation Plan program.**

Approach: The mitigation goal for Hagerman NFH in the LSRCP program is to return 13,600 adult summer steelhead above Lower Granite Dam. The program at Hagerman NFH is unique in that it is a cooperative effort between the U.S. Fish and Wildlife Service (Service) and the Idaho Department of Fish and Game (State). The State is responsible for selecting the stocks to be used in the program, for brood stock collection and spawning, and delivering the fertilized eggs to Hagerman NFH. Hagerman NFH is responsible for incubation, hatching, rearing, and transportation of summer steelhead smolts to locations in the upper Salmon River selected by the State.

Objective 2.1 Monitor summer steelhead rearing activities at Hagerman NFH.

Approach: The production goal established for Hagerman NFH is about 1.3 million smolts. In cooperation with hatchery and FRO personnel, steelhead culture at Hagerman NFH will be monitored to identify factors that may be affecting fish quality and survival. Production space and water use is limited. Reaching established mitigation goals for adult steelhead by increasing production much beyond present levels is not a viable strategy. Therefore, it is imperative that every opportunity is taken to improve fish quality and survival.

Task 2.1.1 Diagnostic work for disease detection was performed as needed. In FY 2015 there were 4 diagnostic, 22 monitoring, and 5 inspection cases conducted for steelhead at Hagerman NFH. Bacterial results included Bacterial Coldwater Disease (*Flavobacterium psychrophilum*) and Furunculosis (*Aeromonas salmonicida)*. For the Bacterial Coldwater Disease, florfenicol medicated feed treatment was recommended and Veterinary Feed Directives (VFDs) were provided for BY15 in June and July for three tanks in the nursery. For BY14, several raceways were found positive and treated for Furunculosis with florfenicol by VFD in February and March. Plans were made to change the administration of the Furunculosis vaccine to address the infections for future years. For BY 14, several formalin bath treatments were recommended for the parasite *Ichthyophthirius* in Oct. 2014.

Parasites detected included *Nucleospora salmonis*, *Ichthyophthirius multifiliis* (Ich), and *Gyrodactylus*. Gas Bubble Disease was also noted.

See Hagerman Recirculating Aquaculure System (RAS) study for further fish health results (Goal 5).

Task 2.1.2 Tissue samples were collected prior to release (60 from each stock, East Fork and Sawtooth) to assess smolt readiness and disease status. Assays included virology, bacteriology, parasitology, PCR, and visual notations of smolt stage. At pre-release exam, the parasite *Gyrodactylus* was detected in low levels in the Sawtooth stock. *Aeromonas hydrophila* was also

detected in 2 samples from the Sawtooth stock. By the ELISA analysis, *Renibacterium salmoninarum* (BKD) was detected in one prerelease sample at a very low level. No viruses were detected in prerelease samples. *Nucleospora salmonis* was detected in both the Sawtooth and East Fork stocks. Gas Bubble Disease was also detected in both stocks. All above pathogens were found in low levels; not warranting any action or treatment before release.

Task 2.1.3 Monthly visits for monitoring/diagnostic work were performed, except when no fish were on station.

Task 2.1.4 Summary reports were provided as requested for FY 2015 and to IFRO for Brood year reports.

GOAL 3 Participate in the development of recommendations for Dworshak and Hagerman NFHs that will produce sufficient smolts to meet each hatchery's LSRCP mitigation goals.

Approach: In the light of completed brood year evaluation reports and other information, constraints or problems in the production programs at Dworshak and Hagerman NFHs may be identified which are preventing the hatcheries from successfully meeting their respective mitigation goals. The objectives under Goal 1 and 2 are designed to generate the information necessary to develop recommendations for changes in the production programs that will overcome any problems or constraints that are identified. Specific projects will be designed and conducted to examine alternatives to existing hatchery practices. Recommendations for improving hatchery production will be based on the results of these projects.

Objective 3.1 Participate as a member of the Dworshak and Hagerman Hatchery Evaluation Teams.

Approach: In order to increase the effectiveness and efficiency of the LSRCP Hatchery Evaluation Programs at the Dworshak and Hagerman NFHs, Hatchery Evaluation Teams (HETs) were formed for both facilities. The Teams are represented by personnel from the Idaho FRO, the respective hatchery production staffs, and the Dworshak FHC. Although formation of HETs at federal hatcheries in Region 1 is primarily a Service program, the IDFG is an equal participant on the Hagerman HET because of their role in that program. The Teams are involved with most aspects of evaluations. Activities concentrate on problem identification, development of projects to examine alternative production strategies, development of recommendations for improving hatchery production, and facilitation of information transfer.

Task 3.1.1 All HET meetings were attended by IFHC personnel during FY15.

Task 3.1.2 Assistance was given in development of study plans for specific evaluation projects as requested and as problems were identified, such as with Gas Bubble Disease. All meetings to address problems were attended.

Objective 3.2 Provide fish health disease sampling and monitoring for Dworshak Fisheries Complex HET Density Study.

Approach: With the goal of improving adult returns of spring Chinook salmon adults to Dworshak National Fish Hatchery, the Dworshak HET proposes to increase densities in the SCS raceways at Dworshak NFH for broodyears of 2012, 2013, and 2014. In order to evaluate the fish health component of increased densities, fish health will increase sampling and testing for pathogens accordingly. All pathogen screening will be conducted in accordance with the USFWS/AFS-FHS Blue Book (2014). If significant fish health issues or an epidemic occurs anytime during the experiment in the Treatment group, established treatment and contingency actions will be taken accordingly. In the event an epidemic occurs that does not respond to treatment, the experiment may be terminated. An epidemic is defined as 1% mortality in a single raceway for three successive days (Integrated Hatchery Operations Team 1995).

Task 3.2.1 Ten spring Chinook salmon were randomly collected from the Treatment and Control groups monthly and were subjected to the standard monthly fish health monitoring program at Dworshak National Fish Hatchery.

Task 3.2.2 Standard observations were made of gills, skin, fins, internal organs, parasite presence, gas embolisms, fat levels in viscera and feeding behavior. Of the one hundred spring Chinook salmon screened for external parasites during monthly monitoring from the Control and Treatment groups, only one low level observation was made of external protozoan parasites. This was of the parasite Ambiphyra in the low density group in February in very low levels. No treatment was recommended.

Task 3.2.3 Screening for *Renibacterium salmoninarum* was conducted on two-five fish pools of kidney tissue from each treatment monthly starting six months prior to release. In December, *Renibacterium salmoninarum* (Bacterial Kidney Disease) was detected in one two fish pool from the High Density group at moderate levels.

Task 3.2.4 Hematocrits levels were measured for all 10 fish as described above. Hematocrit levels for Control and Treatment groups were normal during monthly monitoring.

Task 3.2.5 Thirty spring Chinook salmon smolts were randomly collected each from the Treatment and Control group within 6 weeks prior to release for viral, bacterial and parasite pathogens of concern. Many pinheads were noted at the time of pre-release collection.

Task 3.2.6 Kidney, spleen and gill tissue were five-fish pooled for viral detection using conventional cell culture technique. No viral pathogens were detected from the High or Low Density group.

Task 3.2.7 Viral pellets were used for screening of the bacterial pathogens *Aeromonas salmonicida* and *Yersinia ruckeri* on trypticase soy agar with negative detection.

Task 3.2.8 Kidney tissues were two-pooled and screened for *Renibacterium salmoninarum* using the Enzyme Linked Immunosorbent Assay.

Task 3.2.9 Six five-fish pools of cranial elements from the Control and Treatment group each were screened for the mxyospridian parasite *Myxobolus cerebralis* by the pepsin-trypsin digest technique. *Myxobolus cerebralis* was not detected in the Control or Treatment group.

Task 3.2.10 Viral pellets were screened for the microsporidian parasite *Nucleospora salmonis* using conventional nested Polymerase Chain Reaction with negative detection.

Task 3.2.11 Hematocrit levels were determined for twenty spring Chinook salmon for the Control and Treatment group. Blood samples were taken from the caudal vein in a heparinized 70 µL micro-hematocrit tube and was centrifuged at 10,000 RPM for five minutes. The percent packed cell volume (PCV) was determined by measuring the volume of packed red blood cells divided by the total volume of the blood sample. Hematocrit levels were normal for the Control and Treatment group.

Task 3.2.12 The fish health data was used to build qualitative comparison table for each month during rearing and for pre-release conditions (Table 1).

Table 1: Spring Chinook salmon density pilot study Brood Year 13 fish health monitoring results for low and high density raceways (low density: B22-30, high density: B16-22).

Case Number	Date	Case Type	Number	R.sal.	Virology	Bacteria	External Parasite	Hematocrit Mean
15-014- LD	10/16/2014	Monitoring	10	0/1-10fp +	NA	NA	0/5 +	41.8
15-015- HD	10/16/2014	Monitoring	10	0/1-10fp +	NA	NA	0/5 +	42.8
15-034- LD	11/13/2014	Monitoring	10	0/1-10fp +	NA	NA	0/5 +	43.7
15-035- HD	11/13/2014	Monitoring	10	0/1-10fp +	NA	NA	0/5 +	40.7
15-050- LD	12/12/2014	Monitoring	10	0/5-2fp +	NA	NA	0/5 +	39.4
15-051- HD	12/12/2014	Monitoring	10	1/5-2fp +	NA	NA	0/5 +	41.9
15-072-LD	01/23/2015	Monitoring	10	0/5-2fp +	NA	NA	0/5 +	50.5
15-073- HD	01/23/2015	Monitoring	10	0/5-2fp +	NA	NA	0/5 +	43.8
15-091-LD	02/12/2015	Monitoring	10	0/5-2fp +	NA	NA	2/5 +	41.4
15-092-HD	02/12/2015	Monitoring	10	0/5-2fp +	NA	NA	0/5 +	41.9
15-098-LD	03/02/2015	Inspection	30	0/15-2fp +	0/6-5fp +	0/6-5fp +	0/5 +	46.8
15-100-HD	03/03/2015	Inspection	30	0/15-2fp +	0/6-5fp +	0/6-5fp +	0/5 +	
TOTAL (LD)			**80**	***0/40 +**	**0/6-5fp**	**0/24-5fp**	**2/25 +**	
TOTAL (HD)			**80**	***1/40 +**	**0/6-5fp**	**0/24-5fp**	**0/25 +**	

* pooled samples for R. sal. screened by ELISA

Additional diagnostic case:

15-016- HD 10/16/14 from raceway B17, 3/5 fish found positive for R.sal by FAT.

GOAL 4 Facilitate inter- and intra-agency coordination and cooperation with FWS LSRCP hatchery production and evaluation programs in Idaho.

Approach: IDFG and the NPT have management authority for fishery resources in Idaho. Therefore, coordination of FWS hatchery operations with the IDFG and the NPT is an operational necessity. In addition, various other agencies, such as the National Marine Fisheries Service, the Fish Passage Center, and the University of Idaho routinely conduct research projects and other studies involving the LSRCP programs at Dworshak and Hagerman NFHs. Close involvement by the Idaho FRO is necessary with all research and evaluation projects at these facilities to insure smooth and efficient production and evaluation of the programs. Most of this activity will be handled through the HETs.

Objective 4.1 Virus testing of Dworshak NFH steelhead adults at spawning for transfer of eggs to Magic Valley State Hatchery.

Task 4.1.1 Individual ovarian samples were collected during two takes of the 2015 Dworshak NFH steelhead spawning season for virology testing for eggs transferred to Magic Valley State Hatchery:

A. Infectious Hematopoietic Necrosis Virus:

Dworshak Take 8: 0 of 44 samples or 0% were positive in ovarian fluid.

Dworshak Take 10: 37 of 91 samples or 40.7% were positive in ovarian fluid.

B. Infectious Pancreatic Necrosis Virus: not detected.

C. Viral Hemorrhagic Septicemia Virus: not detected.

Objective 4.2 Coordinate LSRCP activities between the Idaho FHC and the LSRCP Coordinator's Office.

Task 4.2.1 Upon request, the LSRCP Coordinator's Office was provided with technical assistance in reviewing and/or writing project proposals, progress reports, completion reports, position papers, or other pertinent materials.

Task 4.2.2 LSRCP coordination meetings, project reviews, and other meetings were attended as required and presentations given at those meetings as requested.

Task 4.2.3 Assistance was provided on an as requested basis regarding LSRCP federal programs to the Coordinators Office and Fish and Wildlife Service, Regional Office on the Columbia River Fishery Management Plan and fish harvest negotiations.

Objective 4.3 Develop an Annual report for FY 2016 and a Statement of Work for FY17.

Approach: A yearly statement of work was developed to clearly outline the objectives and tasks for the upcoming fiscal year.

Task 4.4.1 The Statement of Work for FY16 was written with modifications and adjustments that reflected any anticipated changes in the FHC Fish Health Program for FY16.

Task 4.4.2 The LSRCP office was provided with out-year budgets, work plans, and project proposals as requested.

Objective 4.5 Participate in meeting HRT recommendations for Hagerman NFH.

Approach: The USFWS initiated a series of hatchery reviews to assure that its hatchery programs in the Northwest are part of a scientifically-sound and integrated strategy, consistent with State, Tribal and other Federal strategies, for conserving wild stocks and managing fisheries in watersheds within the Region. The Hatchery Review Team (HRT) developed a list of recommendations specific to the Hagerman NFH.

Task 4.5.1 Fish health input for HRT recommendation implementations were submitted from the IFHC as requested. In addition, the IFHC has a FONs project submitted for HRT recommended research studies regarding the pathogen *Nucleospora salmonaris*.

GOAL 5 Fish Health Evaluation of Steelhead Reared in a Reuse Aquaculture System at Hagerman NFH

Idaho Fish Health Center RAS Study Evaluation – Year 1

The Idaho Fish Health Center conducted the fish health evaluations for the RAS study at Hagerman National Fish Hatchery. There were three evaluation groups in the study. The first group consisted of the RAS Group, which included fish to be reared in the reuse system. The second group, the RAS Control, included fish to be reared in the raceways at the same density as the RAS Group. The third group included fish that are held in the raceways at Hagerman's historic rearing densities and are referred to as the Raceway Group. The Raceway Group and RAS Control originated from the same lot of fish and were sampled together in the pre-ponding examination. For clarification the combined group will be called RAS Control/Raceway.

The Idaho Fish Health Center conducted many fish health exams and assessments throughout this study. Steelhead health assessments were conducted prior to being ponded into the RAS system and the raceways (pre-ponding examination), during the entire grow out period (monthly monitoring) and then again just prior to release (prerelease examination). Pre-ponding and prerelease examinations conducted by the Idaho Fish Health Center included histology testing, visual analysis of body conformation, fat levels, and fin condition. Other testing included Bacteriology by Tryptic Soy Agar (TSA) and Tryptone Yeast Extract Salt (TYES) culture media and Analytical Profile Index (API) strips for confirmation, virology by cell culture, external parasite observations by microscopy, and Polymerase Chain Reaction (PCR) testing for the parasite *Nucleospora salmonis* (NS) and pepsin-trypsin digest testing for the parasite *Myxobolus cerebralis* (Whirling disease). Enzyme-linked immunosorbent assay (ELISA) was used to detect the causative agent of Bacterial Kidney Disease (BKD), *Renibacterium salmoninarum* (R. sal).

The Ausum program, or the autopsy-based fish health/condition assessment system, was used to assess and quantify fish health and condition at ponding and again at the prerelease inspection examinations. This is a modified version of the original AuSum program by Ron Goede and was modified by Roger Mellenthin, Utah division of Wildlife Resources in 2002 (Mellenthin 2002). The prerelease exam was conducted 4-6 weeks before fish were released as smolts. Fish health monitoring was conducted at least once a month and included observations of external parasites, testing for NS, visual analysis of fat levels, fin measurements and histology. Diagnostic testing was conducted as needed.
The Idaho Fish Health Center followed American Fishery Society (AFS) Bluebook testing protocols, specifically the section entitled "Procedures for Aquatic Animal Health Inspections." The AFS Bluebook serves as a set of standard testing and lab protocols to be followed when carrying out health inspections on aquatic animals for the United States. This handbook reflects the combined efforts and expertise of the United States Fish and Wildlife Service Fish Health Centers and the American Fisheries Society Fish Health Section, and is a compilation of methodologies determined to be most appropriate for detecting the presence of specific pathogens during an aquatic animal health inspection.

Sample rates for pre-ponding and prerelease sampling conducted by the Idaho Fish Health Center was at the 95% confidence level, as recommended by the AFS Bluebook. Unless otherwise dictated by the receiving jurisdiction, the number of fish to be collected from each lot must be in accordance with a plan that provides 95% confidence that at least one infected fish will be collected if the minimum assumed pathogen prevalence level (APPL) of infection equals or exceeds 5%.

Pre-ponding Examinations

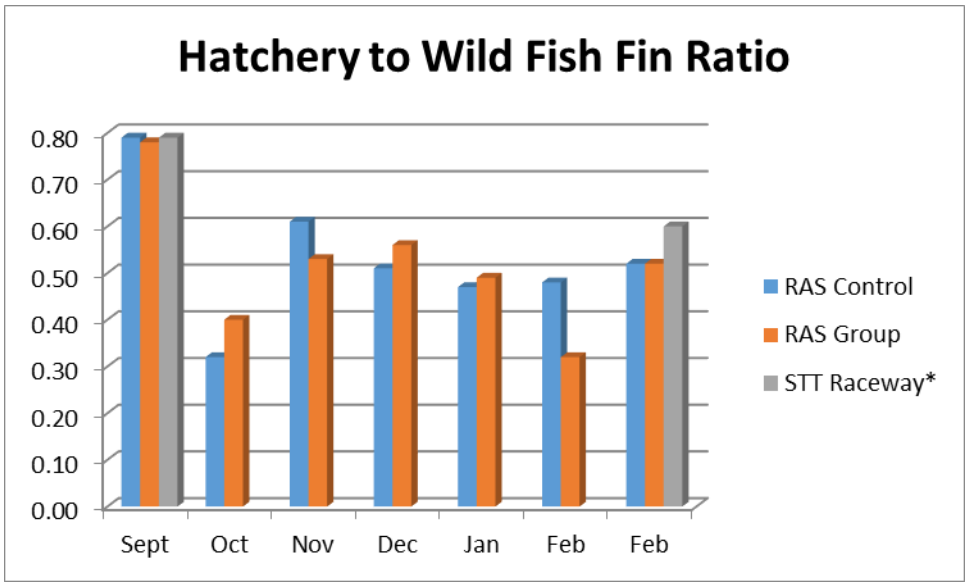
For year one of this study, pre-ponding examinations were conducted on September 9, 2014. Two groups were examined; the RAS Group and the RAS Control/Raceway. Both groups were being held in tanks in the Hatchery 1 building on Main Spring water. The RAS Group and RAS Control fish had to be marked and returned to Hatchery 1 for continued rearing until modifications to the carbon dioxide (CO_2) and low head oxygenator (LHO) could be completed for the RAS system. In following years the RAS Group will be raised in rectangular tanks within the RAS building on Spring 17 water. Fish destined for the raceways were moved out into the raceways after marking. Shortly after marking, steelhead moved to the raceways started exhibiting flashing. After examination it was confirmed that the fish had the parasite *Ichthyophthirius multifiliis* (Ich) and started receiving formalin treatments. Both RAS Control and the RAS Group were treated with formalin while in hatch 1 due to exposure to a transport tank that was not disinfected after having Ich positive fish in it. RAS Control fish were then moved out to the raceways and the RAS Group was moved to the RAS building. Formalin treatments continued to both the RAS Control (in the raceways) and the Raceway Group until the first week of December. The raceway formalin treatments consisted of a 50 part per million (ppm) – 6 hour flow through three times per week. The formalin treatments were reduced to once per week as the levels of Ich decreased. These fish were being held on "Mixing Chamber" water that is a mixture of Main Spring water and Bickle creek and Riley creek water. Ich has been observed in this water system in the past typically in low levels. February 2014 Ich was detected in high levels in the bottom bank of the raceways. After Ich was detected again in the fall of 2014 sentinel fish were placed in Bickle creek and Riley creek. While Ich in Bickle creek were not detectable, high levels of Ich were detected on the senitinel fish and also on the resident

sculpin in Riley creek. Measures were taken during the summer of 2015 to remove all sculpin and dry Riley creek out to eradicate it of Ich.

Fin Condition

Fin condition was calculated using "The Ashton Method" of finding qualitative fin measurements of hatchery fish. Fin measurements included the length in millimeter of both pectoral fins and the dorsal fin as well as the fork length of the fish. Fin measurements were taken from 20 fish during the pre-ponding and prerelease examinations from each study group. Monthly monitoring examinations included fin measurements from 10 fish of each study group. The first year monitoring fin measurements were taken from just the left pectoral fin, the dorsal and the fork length. Consequent monitoring will include the right pectoral fin as well. These measurements were then calculated to get an average of percent fin length remaining compared to wild fish fins (Chapman 1991).

Pre-ponding fin measurements did not show a significant difference between the study groups with a range from RAS Group at 78% of wild fish fins to RAS Control/Raceway at 79% of wild fish fins. October measurements were much lower with the RAS Group measuring 40% and the RAS Control measuring 32%. Delayed ponding and increased densities could have contributed to the nearly 40% drop in October. By November the fin quality had improved 30% in the RAS Control fish to an average of 61% and 13% in the RAS Group to an average of 53%. Fin measurements were not taken from the Raceway Group until the prerelease examination. Overall, at the prerelease inspection both the RAS Control and the RAS Group measured 52%, while the Raceway Group measured closest to the wild fish fins at 60%. See Graph 1.



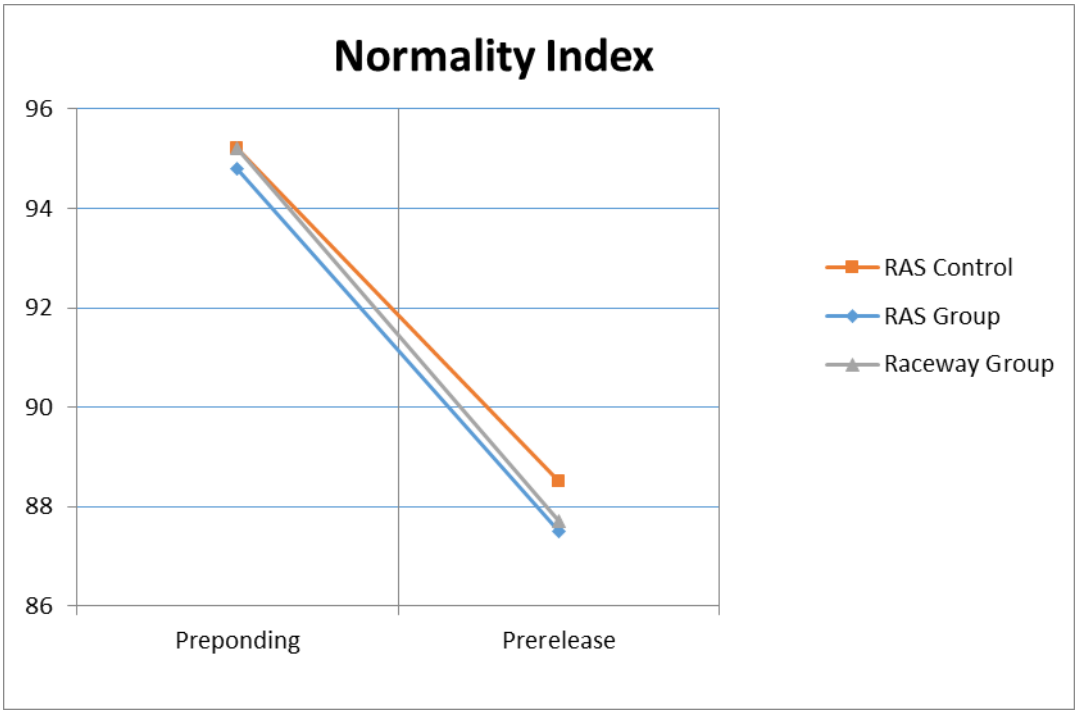
Graph 1

* Pre-ponding fin measurements from the combined RAS Control/Raceway

Normality Index

The Idaho Fish Health Center used the modified Goedes/Adams index to assess and quantify fish condition at the time of ponding and again during the prerelease inspection. A normality index was calculated based on the percentages of anomalies observed in the tissues and organs of individuals sampled from a population. These tissues and organs included the eyes, gills,

pseudobranchs, spleen, hind gut, kidney, liver, and opercles. The autopsy system scores the degree of normality or abnormality of the mentioned tissues and organs. It then assigns values in accordance to the findings to provide a quantitative index, also known as the normality index, so that statistical comparisons can be made between data sets and can include variables in the health index that reflect the degree of damage incurred as a result of environmental stressors or pathogens. Abnormal conditions are indicated when there is a greater than 10% deviation from normal. The major purpose of this approach is that it provides a means of establishing trends in the health of a fish population over time. Sixty fish were included in a pre-ponding examination from each of the RAS Control/Raceway and the RAS Group just prior to being ponded. Four to six weeks prior to release a prerelease examination was conducted on sixty fish from each of the RAS Control, RAS Group and Raceway Group. Pre-ponding normality ranged from 95.2 in the RAS Control/Raceway and 94.8 in the RAS Group. The RAS Group and the Raceway Group rated nearly the same at a normality index of 87.5 and 87.7 respectively. The RAS Control group was one point higher at 88.5, not an appreciable difference. See Graph 2.



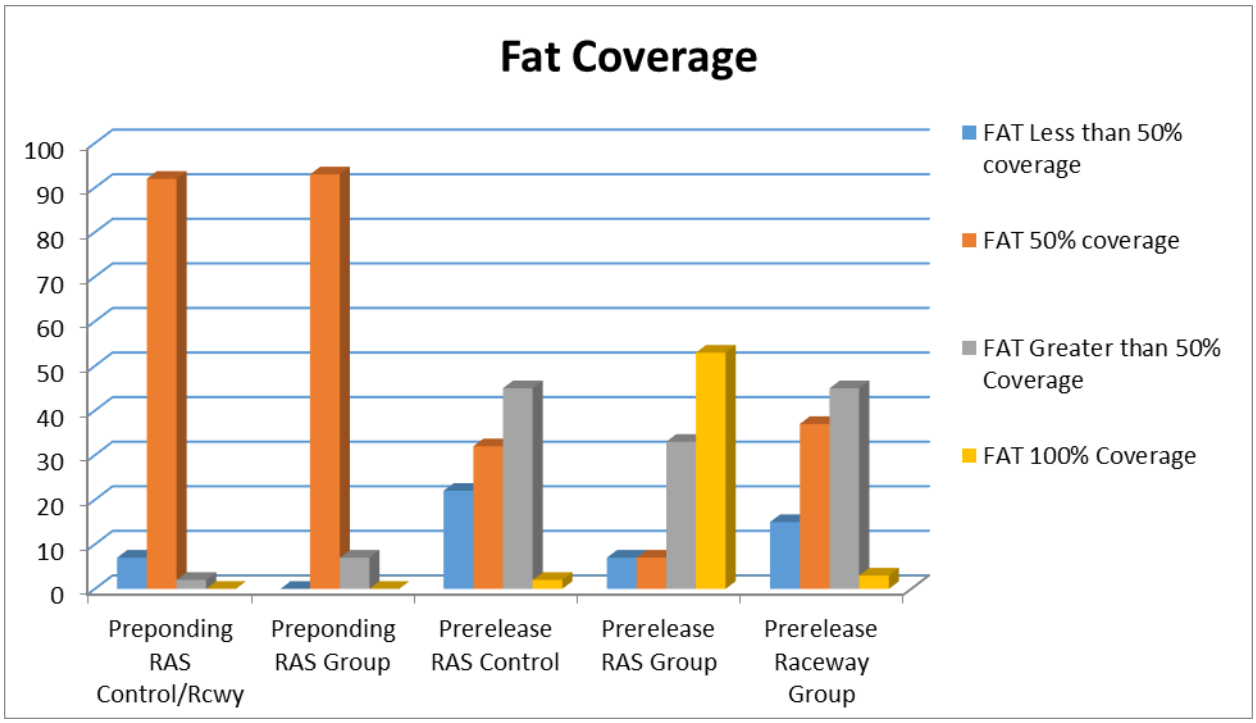
Graph 2

Fat Coverage

The Goedes/Adams normality index does not take into account the mesentery fat observations. During the pre-ponding examinations and again during the prerelease examinations individual fish from each of the study groups was evaluated for the quantity of fat covering the pyloric caeca. It was divided into four options: less than 50% coverage, 50% coverage, greater that 50% coverage and 100% coverage. The majority of the fish in both the RAS Control/Raceway and the RAS Group were in the 50% coverage group at pre-ponding. However, at the prerelease exam 40% of both the RAS Control and the Raceway Group had more than 50% fat coverage while more than 50% the RAS Group had 100% fat coverage.

The feeding schedule on the raceways was conducted according to the Hatchery Evalutation Team (HET) recommendations which consisted of feeding on a 4 day schedule to alleviate

dissolved oxygen (D.O.) issues caused by the three-deck serial reuse setup. Raceways are fed a four day ration once every four days. The RAS circular tanks do not have this constraint and are operated with a more regular feeding schedule. To target final rearing size goals, feed was adjusted each month after pound counts. This difference in the feeding regime could possible account for the difference in fat levels during the prerelease examination. See Graph 3.



Graph 3

Pathogen Testing Results

Virology, bacteriology, and parasitology testing was conducted during the pre-ponding examination and again during the prerelease examination. Bacteriology and virology was conducted during the pre-ponding and prerelease examinations only unless examinations during the monthly monitoring indicated a health problem. No viral agents were detected in any of the examinations. 1/6 samples were positive *Aeromonas hydrophila* and 2/6 samples were positive for *Flavobacterium psychrophilum* (Cold Water Disease) bacteria in the RAS Group pre-ponding examination. *Aeromonas hydrophila* was also detected in 2/12 prerelease samples of the Raceway Group.

Parasitology included looking for the parasites *Myxobulus cerebralis* (Whirling Disease), *Nucleospora salmonis* as well as observation of external parasites such as *Ichthyophthirius*, *Trichodina*, *Ichthyoboda* (Costia) and *Gyrodactylus*. *Myxobulus cerebralis* was only tested for in the pre-ponding and prerelease exams. All other parasites were tested for during all examinations. *Myxobulus cerebralis* was not detected. *Nucleospora salmonis* was detected in 15/20 RAS Control samples and the 19/20 RAS Group samples in the pre-ponding examinations. It was also detected in 4/20 Raceway Group samples during the prerelease examinations. Light levels of Ich were detected in the RAS Control fish monthly monitoring during the time the raceways were being treated with formalin for Ich. Light levels of *Gyrodactylus* were also detected in the RAS Control during the prerelease examination. It is important to note again that the RAS building is on a different water supply (Spring 17) than the raceways (Mixing Chamber)

in which the RAS Control and Raceway Group are reared.
Enzyme-linked immunosorbent assay (ELISA) was used to detect *Renibacterium salmoninarum* (R. sal) during the pre-ponding and prerelease examinations only. R. sal was detected at a low level in 1/60 of the RAS Control fish during the prerelease examination. R. sal was detected at a low level in 1/60 fish in the RAS Group during the pre-ponding examination. R. sal was not detected in the prerelease examination of the Raceway Group. Five fish from each study group were preserved in Davidson's fixative and sent to the Bozeman Fish Health Center for histological analysis at each exam including monthly monitoring. Tissues to be evaluated by histology include gill, kidney, pseudobranch, spinal cord, liver, heart, swim bladder, stomach, pyloric caeca, intestines, skeletal muscle, skin, spleen. Histology results are still pending. See Table 1 for more information.

Conclusion

The first year health assessments did not show large variations between the study groups except for internal fat levels. At the pre-ponding examinations all groups had similar fat coverage. The prerelease examination showed a large difference between the RAS Control and the Raceway Group compared to the RAS Group. The fish held in the raceways had greater than 50% coverage of fat on their pyloric caeca but very few that had 100% fat coverage. The majority of the RAS Group had 100% fat coverage of the pyloric caeca. Again, this could possibly be explained by the differences in the feeding regime. Though no bacteria were detected in the RAS Control group, *Aeromonas hydrophila* was detected in the raceway system in the Raceway Group and at similar levels in the RAS Group. *Flavobacterium psychrophilum* was only detected in the RAS Group fish and only at preponding where it was being held in the same water and similar densities as the RAS Control/Raceway. Hatchery to Wild Fish Fin Ratio of the RAS Group and RAS Control was identical at prerelease. The Raceway Group showed the best fin quality at prerelease. This could be attributed to the lower densities of the Raceway Group compared to the higher densities in the RAS Group and RAS Control. Parasites were detected only in the RAS Control group monthly monitoring and prerelease examinations. This could be attributed to the Mixing Chamber water supply versus Spring 17 water of the RAS Group. The Raceway Group was not monitored monthly but there were raceways throughout the year that Ich was detected in. The only difference between the RAS Control and Raceway Group during the prerelease examinations was the increased densities in the RAS Control. Overall, the normality index was very similar in all of the study groups. Monthly monitoring is being conducted for the Raceway Group and will be included in further evaluations.

TABLE 1

Case Number	Date	Study Group	Case Type	Number	R.sal.	Virology	Bacteria		Nucleospora salmonis	External Parasite
							Aeromonas Hydrophila	Flavobacterium Psychrophilum		
14-219	9/4/2014	RAS Control/Raceway	Pre-ponding	60	0/6 10fp	0/6 10fp	0/6 10 fp	0/6 10 fp	15/20	None
14-220	9/4/2014	RAS Group	Pre-ponding	60	1/6 10fp	0/6 10fp	1/6 10fp	2/6 10fp	19/20	None
15-017	10/17/2014	RAS Control	Monitoring	10	--	--	--	--	0/10	Ich (light)
15-018	10/17/2014	RAS Group	Monitoring	10	--	--	--	--	0/10	None
15-044	11/25/2014	RAS Control	Monitoring	10	--	--	--	--	0/10	Ich (light)
15-045	11/25/2014	RAS Group	Monitoring	10	--	--	--	--	0/10	None
15-055	12/16/2014	RAS Control	Monitoring	10	--	--	--	--	0/10	None
15-056	12/16/2014	RAS Group	Monitoring	10	--	--	--	--	0/10	None
15-068	1/22/2015	RAS Group	Monitoring	10	--	--	--	--	0/10	None
15-069	1/22/2015	RAS Control	Monitoring	10	--	--	--	--	0/10	None
15-081	2/4/2015	RAS Group	Monitoring	10	--	--	--	--	0/10	None
15-082	2/4/2015	RAS Control	Monitoring	10	--	--	--	--	0/10	None
15-093	2/25/2015	RAS Control	Prerelease	60	1/60 1fp	0/12 5fp	0/12 5fp	0/12 5fp	0/20	Gyrodactylus (light)
15-094	2/25/2015	RAS Group	Prerelease	60	0/60 1fp	0/12 5fp	0/12 5fp	0/12 5fp	0/20	None
15-095	2/25/2015	Raceway Group	Prerelease	60	0/60 1fp	0/12 5fp	2/12 5fp	0/12 5fp	4/20	None
TOTAL (RAS Control)				**170**	**1/120 +**	**0/120**		**0/18 samples**	**15/100**	**3/7 cases**
TOTAL (RAS Group)				**170**	**1/120 +**	**0/120**	**1/6 samples**	**2/18 samples**	**19/100**	**0/7 cases**
TOTAL (RCWY Group)				**60**	**0/60 +**	**0/60**	**2/12 samples**	**0/12 samples**	**4/20**	**0/7 cases**

References:

Chapman, Jerry. 1991. Ashton Hatchery, Resident Hatchery Annual Report.

Mellenthin, Roger. (2002) A Computer Program for the Autopsy-Based Fish Health/condition Assessment System. Based on the original AuSum program by Ron Goede. Utah Division of Wildlife Resources. Fisheries Experiment Station.