58TH ANNUAL NORTHWEST FISH CULTURE CONFERENCE

NWFCC 2007
Enhancing Fisheries
Creating Opportunities

December 4-6, 2007 **Doubletree Lloyd Center –Portland, Oregon**

Proceedings

Hosted by:

Oregon Department of Fish and Wildlife

NWFCC Planning Committee

Executive Committee

Committee Chair:	**Shaun Clements**
Secretary:	**Linda Lytle**
Treasurer:	**John Leppink**

Subcommittee Chairs

Hotel Arrangements:	**Bill Otto**
Registration:	**Shari Beals**
Raffle/Door Prizes	**Greg Grenbemer, Ryan Couture, Doug Curtis**
Social/Gifts:	**Tami Edmunds**
Hall of Fame:	**John Thorpe**
Logo:	**Scott Patterson**
Trade Show/Vendors:	**Manny Farinas, Tim Wright**
Outdoor Exhibits:	**Mike Grover**
A/V Support:	**Tyler Marriot, Jan Johnson**
Website:	**Kathy Munsel**
Publicity:	**Christie Scott**
Proceedings:	**Guy Chilton**

Session Chairs

Applied Aquaculture:	**Lyle Curtis, Brett Boyd**
Applied Hatchery Research:	**Debra Eddy**
Co-Tribal Management	**Scott Patterson**
Creating Opportunities/ Enhancing Fisheries:	**David Costas**
Fish Health	**Tony Amandi**
Posters	**Marla Chaney**

We would like to thank the following for their generous prize donations/contributions

Vista Balloon Adventures
Chinookwinds
Kathryn Kostow
Burris Sports Optics- Burris Co.
G. Loomis
Reel Adventures
Wildhorse Resort & Casino
Hatchery International
NW Outdoor Center
Edgewater Inn
Swarvoski
Pure Fishing
BioMark
FLOY Tag
Zoller's Outdoor Odysseys
EKA Chemicals
Steve Warner
Jim Skarr
Lookinglass hatchery
Lyle Curtis
Joe Watkins
Henry Repeating Arms
Aquatic Ecosystems
Northwest Fluid Solutions
England Marine
PR Aqua
First Bite Jigs
Oregon Anglers Research Society
Rouge Ales
Bonneville Gift Shop
Coleman
Winchester Bay RV Resort

Oregon Experience
Columbia River Knife & Tool
Delorme Mapping
Big 5
Benchmade Knife Co
Buck Knives
Pure Fishing
Oregon Coast Aquarium
Seven Feathers
All American Cycle
Rouge Rods
Jerry's Rouge Jets
Hunting & Fishing News
Duck Commander
Jim Teeny
Outdoor Life
Bio Oregon
ADEA Wine Co.
Dan Meyer
Susan Gutenberg
Mary Edwards
Full Sail
Skretting
Silver Cup
EWOS
Hatchery International
Jensorter, LLC
Kikko Net USA
Rangen, Inc
Water Management Technologies
Diamond Lake Resort

We would also like to thank the Oregon Chapter of AFS for their donation towards the student scholarship fund

Table of Contents:

2007 NWFCC: Final Schedule

DAY 1: TUESDAY, DECEMBER 4, 2007

09:00 AM	Registration
12:30 PM	Opening Remarks: **John Thorpe,** ODFW Fish Propagation
12:35 PM	Welcome: **Ed Bowles,** ODFW Fish Division Director
12:45 PM	Keynote Address: **Dr David Noakes,** Oregon Hatchery Research Center

Session 1 Applied Aquaculture I
Session Chair: Lyle Curtis, ODFW

1:10 PM	**Charles Pratt,** ADFG, Gizmos, Gadgets And Gumption: The Use Of Hatchery Made Items To Improve Productivity
1:30 PM	**Ed Jouper,** WDFW, Development Of Improved Methods For Processing Adult Chinook And Coho Salmon At George Adams Hatchery
1:44 PM	**Jordan Neilson,** University of Idaho, Feasibility Of Two Step System For Removing New Zealand Mudsnails From Infested Hatchery Inflow Waters
2:04 PM	**Charles Baker,** ODFW, Oxygen Supplementation Using Aeration and Recirculation - When The Water is Low Or High
2:18 PM	**Robert Glidewell,** ODFW, Improved Ergonomic Design And Hazard Reduction In Fish Grading And Other Hatchery Techniques
2:32 PM	**Ron Harrod,** ODFW, Welcome To Clackamas Fish Hatchery (ODFW)
2:46 PM	**Roger Warren,** ODFW, Gnat Creek Hatchery Low Cost Oxygen Supplementation: Select Area Fisheries

3:00 PM	Break
3:25 PM	Door Prize Drawing
3:30 PM	Scholarship Presentation

Session 2 Applied Hatchery Research I
Session Chair: Debra Eddy, ODFW

3:35 PM	**Joseph O'Neil,** ODFW, Education And Outreach At The Oregon Hatchery Research Center
3:55 PM	**Mike Petersen,** IDFG, Working Together To Assist Snake River Sockeye Salmon: Utilizing Partnerships Between Hatcheries And Research To Gain Ground Towards Recovery.
4:15 PM	**Dan Green,** IDFG, Emergence Survival for Progeny of Captive-Reared Chinook Salmon Allowed to Spawn Naturally
4:35 PM	**Maureen Kavanagh,** USFWS, Evaluating The Impacts Of Hatchery Releases On Wild Fish Populations At Eagle Creek National Fish Hatchery
4:55 PM	**Bill Gale,** USFWS, Juvenile Steelhead (*Oncorhynchus mykiss*) Release Strategies: A Comparison of Volitional and Force Release Practices.
5:15 PM	**Benjamen Kennedy,** USFWS, Smolt Development And Migration Timing Relate To Avian Predation Risk Of Juvenile Steelhead Trout In The Columbia River Estuary

5:35 PM	Announcements/Door Prize Drawing

5:40 PM Trade show/ Poster Session/ Social

DAY 2: WEDNESDAY, DECEMBER 5, 2007

7:55 AM Door Prize Drawing
8:00 AM Introduction/Messages: **John Thorpe,** ODFW
8:10 AM Keynote Address**: Dr Brian Winter,** National Park Service

Session 3 Enhancing Fisheries/Creating Opportunities
Session Chair: David Costas, ODFW

8:30 AM **Holly Truemper,** ODFW, Diamond Lake Tui Chub: Cost Of Few Anglers Or Recreationalists At The Lake = Devastating, Cost Of Rotenone Treatment = $1.5 M, Cost Of Clean Water, A Great Fishery, And Happy Anglers = Priceless.
8:50 AM **Ken Scheer,** FW Fisheries Society of BC, Nechako White Sturgeon Fish Culture Recovery Initiative
9:10 AM **Nick Ackerman,** PGE, An Overview Of The Deconstruction Of Marmot Dam
9:30 AM **Dianne Loopstra,** ADFG, Sterile Fish Production For Lake Stocking Programs- Using Hydrostatic Pressure To Induce Triploidy In Five Salmonid Species
9:50 AM **Tod Jones,** Clatsop County Fisheries, Select Area Fisheries Enhancement Program

10:04 AM Break
10:25 AM Door Prize Drawing

Session 4 Applied Hatchery Research II
Session Chair: Debra Eddy, ODFW

10:30 AM **Don Larsen,** NOAA, High Rates Of Age-2 Precocious Male Maturation, "Minijacks", In Spring Chinook Salmon Hatchery Programs: Prevalence, Causes, And Potential Solutions.
10:50 AM **Brian Beckman,** NOAA, Variation In MiniJack Production Among Columbia River Chinook Salmon Hatcheries
11:10 AM **Brent Young,** Great Lakes Institute for Environmental Research, Supportive Breeding Programs: Genetic Diversity vs. Genetic Quality, And The Inclusion Of Jacks.
11:30 AM **Barry Berejikian,** NOAA, The Reproductive Behavior And Breeding Success Of Jack And Adult Chinook Salmon
11:50 AM **Tim Hoffnagle,** ODFW, The Imnaha River Chinook Salmon Supplementation Program After Twenty-five Years: A Model Program In Need Of Reform?

12:10 PM Lunch
1:15 PM Door Prize Drawing

Session 5 Fish Health
Session Chair: Tony Amandi, ODFW

1:20 PM **John Kaufman,** ODFW, Infectious Hematopoietic Necrosis Virus (IHNV) In Oregon
1:40 PM **Erik Withalm,** ODFW, Managing for IHNV In Rainbow Trout At Leaburg Hatchery

1:54 PM	**Doug Munson,** IDFG, Hatchery Management Strategies for *Ichthyophthirius multifilis* At Idaho Department of Fish And Game Hatcheries
2:14 PM	**Skip Thompson,** NC State University, Aquaflor® Efficacy For The Treatment Of Bacterial Coldwater Disease On North Carolina Trout Farms
2:34 PM	**Sherry Mead,** FW Fisheries Society of BC, Flavobacterium psychrophilum: A Holistic Management Approach
2:54 PM	**David Lovetro,** Eka Chemicals, 35% PEROX-AID ® Some Safety And Handling Considerations For The Recently FDA Approved Veterinary Drug

3:10 PM Break
3:35 PM Door Prize Drawing

Session 6 Co-Tribal Management: Snake River Fall Chinook
Session Chair: Scott Patterson, ODFW

3:40 PM	**Scott Patterson,** ODFW, Co-Management of the Snake River Fall Chinook-Introduction
3:45 PM	**Bradley Hostetler,** WDFW, Co-Management of the Snake River Fall Chinook-Lyons Ferry Hatchery: General Practices For Rearing Fall Chinook
4:00 PM	**Scott Everett,** Nez Perce, Co-Management of the Snake River Fall Chinook-Nez Perce Tribal Hatchery Fall Chinook Supplementation
4:10 PM	**Mike Key,** Nez Perce, Co-Management of the Snake River Fall Chinook: Nez Perce Tribe Fisheries Fall Chinook Acclimation Project
4:20 PM	**Deborah Milks,** WDFW, Co-Management of the Snake River Fall Chinook-Lower Granite Dam Run Reconstruction: Anyone Have An Easy Button?
4:40 PM	**Mark Schuck,** WDFW, Co-management Of Snake River Fall Chinook: Lyons Ferry Hatchery Production of Snake River Fall Chinook: A Qualified Success Story.
5:00 PM	**Group,** Round Table Questions and Answers
5:10 PM	Door Prize Drawing

DAY 3: THURSDAY, DECEMBER 6, 2007

7:40 AM Door Prize Drawing
7:45 AM Introduction/Messages **John Thorpe,** ODFW

Session 7 Co-Tribal Management: Grande Ronde Spring Chinook
Session Chair: Scott Patterson, ODFW

7:50 AM	**Scott Patterson,** ODFW, Co-Management Of The Grande Ronde Spring Chinook -Introduction
7:55 AM	**Diane Deal,** ODFW, Co-Management Of The Grande Ronde Spring Chinook -Lookingglass Fish Hatchery Operations
8:05 AM	**Michael McLean,** Confederated Tribes of the Umatilla Indian Reservation, Co-Management of the Grande Ronde Endemic Spring Chinook Supplementation Program: The Captive and Conventional Production Components
8:15 AM	**Peter Cleary,** Nez Perce, Co-Management of the Grande Ronde Endemic Spring Chinook Salmon Supplementation Program: Monitoring And Evaluation Of The Supplementation Strategy

8:35 AM **Brad Smith,** ODFW, Co-Management of the Grande Ronde Spring Chinook -Fishery Management And Evaluation Plan

8:50 AM **Group,** Round Table Questions and Answers

9:00 AM **Hall of Fame Presentation**

9:20 AM Break

9:40 AM Door Prize Drawing

Session 8 Applied Aquaculture II

Session Chair: Brett Boyd, ODFW

9:45 AM **Michael Hogansen,** ODFW, Rearing Wild Bull Trout Fry At Leaburg Hatchery

9:59 AM **Tyler LeBard,** ODFW, Lightweight, Portable Scale Hanger: Sampling Made Simple

10:13 AM **Anitra Firmenich,** ODFW, Use Of Flow-Thru Heated Water Method For Shocking Rainbow Trout Eggs To Induce Triploidy

10:27 AM **Matthew Bleich,** HDR FishPro, Development Of A Model For Predicting Effluent And Treatment Options In Flow-Through Hatchery Systems

10:47 AM **Charles Pratt,** ADFG, Artemia And Cyclopeeze Fill Void Left By BioKyowa In The Intensive Early Rearing Of Arctic Grayling (Thymallus Arcticus).

11:07 AM **Jim Seeland,** Consultant-NSRAA, Alaska Enhancement Program

11:24 AM **Jim Seeland,** Consultant, Innovative Chinook Rearing Strategies at the Medvejie Salmon Hatchery / Sitka, AK

11:45 PM Closing remarks/ **Grand Prize drawings**

Poster Session (5:40-7:30, Tuesday 4th Dec)

Session Chair: Marla Chaney, ODFW

1. **Ron Twibell**, USFWS, Evaluation of Commercial Diets for First-Feeding Spring Chinook Salmon (Oncorhynchus tshawytscha)
2. **Ewann Berntson**, NOAA, Salmon Populations Dance The Metapopulation Limbo: How Low Can They Go?
3. **Mike Grover**, ODFW, Diamond Lake Restoration Project - Post treatment public education for prevention of invasive species and the tui chub monster.
4. **Glenda O'Connor**, ODFW, Use of ELISA for Monitoring Bacterial Kidney Disease in Naturally Spawning Chinook Salmon
5. **Roger Warren**, ODFW, Gnat Creek Hatchery Low Cost Oxygen Supplementation
6. **Melissa Baird**, NOAA, Conclusions about relative reproductive success in captive Chinook salmon are tempered by spatial and temporal variability: Finding the appropriate scale for interpretation
7. **Clint Bentz**, Oregon Aquaculture Association
8. **Todd Hanna**, Mt Hood Community College, Mt. Hood Community College Fisheries Technology Program
9. **Mike McLean,** Confederated Tribes of the Umatilla Indian Reservation, Spring Chinook Salmon Broodstock Marking Techniques Used In Northeast Oregon
10. **John Schmitz**, ODFW, Revisiting the Salt Floatation Method for Eyed Egg Picking Activities
11. **Larry Ward,** Lower Elwha Klallam Tribe, Use Of Native-Origin Brood For Winter Steelhead Restoration In the Elwha River Watershed

12. **Larry Ward,** Lower Elwha Klallam Tribe, The Elwha River Fish Restoration Plan: What are we going to do once the dams are gone?
13. **Don Hair**, ODFW, Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program: Cooperation at Work – A Multi-agency, Hatchery, Research and Management Project (Project Overview)
14. **Tim Hoffnagle**, ODFW, Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program: ODFW Fish Research
15. **Chad Aschenbrenner**, ODFW, Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program: Initiation of Feeding and Pre-Smolt Rearing at Wallowa Hatchery
16. **Carlin McAuley**, NOAA, Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program: Smolt to Adult Rearing
17. **Marla Chaney**, ODFW, Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program: Matrix Spawning at Bonneville Hatchery and Incubation of Eggs at Oxbow Hatchery
18. **Peter J. Cleary**, Nez Perce, Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program: Lostine River Spring Chinook Salmon F_1 Smolt Stocking and Adult Returns
19. **Mike McLean**, Confederated Tribes of the Umatilla Indian Reservation, Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program: Upper Grande Ronde River and Catherine Creek Spring Chinook Salmon Juvenile Acclimation and Adult Collection
20. **Derek Gibbs**, ODFW, Leading Causes of Mortality for Oregon Captive Broodstock 1994-2002 Cohorts with an Emphasis on Bacterial Kidney Disease

Applied Aquaculture I

Charles Pratt, ADFG, Gizmos, Gadgets And Gumption: The Use Of Hatchery Made Items To Improve Productivity

Ed Jouper, WDFW, Development Of Improved Methods For Processing Adult Chinook And Coho Salmon At George Adams Hatchery

Jordan Neilson, University of Idaho, Feasibility Of Two Step System For Removing New Zealand Mudsnails From Infested Hatchery Inflow Waters

Charles Baker, ODFW, Oxygen Supplementation Using Aeration and Recirculation - When The Waters Low Or High

Robert Glidewell, ODFW, Improved Ergonomic Design And Hazard Reduction In Fish Grading And Other Hatchery Techniques

Ron Harrod, ODFW, Welcome To Clackamas Fish Hatchery (ODFW)

Roger Warren, ODFW, Gnat Creek Hatchery Low Cost Oxygen Supplementation: Select Area Fisheries

Gizmos, Gadgets And Gumption: The Use Of Hatchery Made Items To Improve Productivity.

Chuck Pratt*

Alaska Department of Fish and Game, Fort Richardson Hatchery, Broodstock Development Center, Box 5267, Fort Richardson, AK 99508 charles.pratt@alaska.gov

Aquaculture is part science and part art. The biological processes of growing fish are straight forward yet may take years to master all of the variables involved. The art of growing fish is knowing how and when each variable must be altered. Conceptually, all hatcheries perform the same function. Yet, individual sites deal with the challenges of rearing fish uniquely. A fish culturist often makes tools used during daily routine or to assist in performing special projects. Often the same problem is solved two different ways at two different sites. While, the scientific literature is filled with feed studies, chemical resistance trials, fertilization rates, stocking rates, etc., the ways to make fish culture easier often do not get communicated.

This paper conveys items made by Fort Richardson Hatchery personnel which may benefit others.
Of particular interest are the methods used to control solid waste in the three pass brood stock raceway system. Two floating/traveling baffles made of floating collars of two inch HDPE and aluminum plates move solids down and out of the raceways. These floating/traveling baffles allow the fish to pass beneath, work well in outdoor winter conditions, do not require track or other structures to guide down the raceway, are able to be installed and removed by one person and are inexpensive (~$250). In head and tail race areas traditional stationary baffles transfer solids to settling raceways. In raceways where two groups of fish are separated by a screen the screen has a plate placed across the whole face except the bottom eight inches, effectively making a screened baffle to prevent solids collecting just behind the screen. This multi baffle approach controls solids in an effective and efficient manner.

Other items include brackets to prevent baffle screens from dislodging, a method for changing circular tank center screens while the fish are still in the tank, small net bags which fit in 5 gallon buckets for lake stocking, aluminum dam boards which replace wooden ones, a raceway mounted hanging scale/clip board bracket, tool racks, a swiveling spray nozzle to reduce hand fatigue, sorting tub dividers to speed up sorting of anesthetized fish, upwelling egg picking buckets, belt feeder mounting brackets, bucket holders to remove buckets off of the walkways and jump screens on various rearing containers.

Ultimately, the desired outcome of this presentation is for culturists get some gumption, reevaluate their areas of responsibility looking for innovative ways to improve their hatcheries' processes by tinkering with new gadgets and gizmos.

Development of improved methods for processing adult chinook and coho salmon at George Adams Hatchery

Ed Jouper*

Washington Department of Fish and Wildlife, George Adams Hatchery, W. 40 Skokomish Valley Rd. Shelton, Wa. 98584 joupeeci@dfw.wa.gov

George Adams Hatchery is located in Washington State at the southern end of Hood Canal. It is sited on Purdy Creek, a tributary to the Skokomish River. The hatcheries primary function is to produce chinook and coho salmon for harvest in recreational and tribal fisheries. The George Adams stocks are used to evaluate the effectiveness of selective fisheries and their impacts on naturally produced fish. This is accomplished by double index tagging the populations. A portion of each population is coded wire tagged and adipose fin clipped. Another portion is coded wire tagged with the adipose present. In order to recover all the tags every fish must be tested for the presence of coded wire tags and the presence or absence of an adipose fin must be noted.

In recent years returns to the rack of 12 to 14,000 chinook salmon have been common and coho returns have been as high as 25,000. Since double indexing began in 1998 the number of coded wire tags recovered and processed has been over 11,000 annually. In order to increase the efficiency, the safety and the accuracy of tag recovery new adult handling equipment and methods were developed. This report will detail how equipment such has the Wallaby Whacker, CanaVac pump, R-9500 coded wire tag detector, tote tilt and sorting table have improved the George Adams operation.

Feasibility of Two Step System for Removing New Zealand Mudsnails from Infested Hatchery Inflow Waters

Jordan Nielson* and Christine Moffitt[1] and Barnaby Watten[2]

[1] USGS Cooperative Fish and Wildlife Reseach Unit, Department of Fish and Wildlife Resources, University of Idaho, Moscow, ID 83844-1136, (208)885-7139 (tel), jnielson@vandals.uidaho.edu, cmoffitt@uidaho.edu
[2] USGS Leetown Science Center, 11649 Leetown Road, Kearneysville,WV 25430 (304) 724-4425 (tel), bwatten@usgs.gov

New Zealand Mudsnail (*Potamopyrgus antipodarum;* NZMS) infestations at fish hatcheries can restrict the options for stocking hatchery-reared fish because of the risks of spreading snails to new locations. Reliable and environmentally friendly methods that remove NZMS from source waters are required so that hatchery managers can create an environment for snail–free fish production and/or transportation. We are evaluating the feasibility of a two-step control method of removing NZMS in the piped spring water supply of Hagerman National Fish Hatchery (HNFH). The process involves hydrocyclonic separation of NZMS followed by carbonation of the hydrocyclone waste (snail) stream. Hydrocyclone filters use centrifugal force to remove particles with a specific gravity greater than water. We conducted field trials with a test prototype at HNFH during the summer and fall of 2007 and found that the hydrocyclone system successfully separated all sizes of NZMS present in the intake water including adults, juveniles and neonates. We measured and modeled the transit time of water and three sizes of NZMS through the test system at two flow rates, 68 and 97 gpm. We found that the residence time of water particles was the same regardless of flow rate, but residence time of the snails increased with size of NZMS and with decreased flow rates. We have found that NZMS are sensitive to CO_2 under both atmospheric and hyperbaric pressure conditions. Testing of NZMS at 100 kPa CO_2 and 8°, 15°, and 20°C has been completed for the adult and juvenile life stages of snails (>2.5mm, 1mm to 2.5 mm). Probit models indicate that these life stages react very similarly to exposure to CO_2 at elevated dissolved gas pressure. A probit model of survival predicts the 100% lethal time of exposure for adult NZMS at 89.4, 13.9, and 8.9 h for 8°, 15°, and 20°C respectively indicating an inverse relationship between temperature and survival during elevated CO_2 treatments. Hydrocyclonic separation/ CO_2 treatment of NZMS from hatchery inflow shows promise because of the high filtration efficiencies observed, relatively low capital costs and the ability to operate on the line pressures present at the HNFH and other similar fish hatcheries in the Hagerman Valley.

Oxygen Supplementation Using Aeration and Recirculation: When the waters low or high

Charles Baker* and Bob Hudspeth

Oregon Department of Fish and Wildlife, Cedar Creek Fish Hatchery, 33465 Hwy. 22 Hebo, OR 97122.
cedarcreek.hatchery@state.or.us

Cedar Creek Hatchery uses aerators and recirculation to increase oxygen supplies, not only when the creek is low during the late summer and early fall but also when it is raging during winter storms.

Improved Ergonomic Design and Hazard Reduction in Fish Grading and other Hatchery Techniques

Robert T. Glidewell*

Oregon Department of Fish and Game, Cole M. Rivers Hatchery, 200 Cole M. Rivers Drive, Trail, OR 97541.
Rob.T.Glidewell@coho2.dgw.state.or.us

Over the past two years significant alterations have been made to the traditional grading, fin-marking, and pond splitting processes at Cole Rivers hatchery. These changes, in both design and procedure, are such that grading is no longer performed in ponds, marking does not require netting fish, and future pond inventory division will be considerably faster. Although these modifications have increased operational efficiency, the original intention was to reduce workplace injuries and ergonomic hazards. This presentation will briefly highlight these changes with the hope of stimulating the worker involvement and management commitment necessary for a successful health and safety program.

Welcome to Clackamas Fish Hatchery (ODFW)

Ron Harrod * and Trevor R. Clark

Oregon Department of Fish and Wildlife, Clackamas Fish Hatchery, 24500 S Entrance Rd, Estacada, OR 97023.
clackamas.hatchery@state.or.us

An overview of Clackamas Fish Hatchery will be presented. Clackamas Fish Hatchery has been operated by the Oregon Department of Fish and Wildlife since 1979. The hatchery raises Spring Chinook and Steelhead. The Spring Chinook provide a commercial harvest in the Ocean and Columbia River. They also generate a substantial sport fishery in the Columbia, Willamette, and Clackamas Rivers for one of the most sought after salmon in the Northwest. Some of the fish culture tools and techniques used at Clackamas Hatchery will be discussed.

Gnat Creek Hatchery Low Cost Oxygen: Supplementation Select Area Fisheries

Roger Warren*, Tod Jones

Oregon Department of Fish and Wildlife, Gnat Creek Hatchery 92645 Gnat Hatchery Rd. Clatskanie, OR. 97016
Clatsop County Fisheries, 2001 Marine Dr. Rm 253, Astoria, OR. 97103

Gnat Creek Hatchery supplies all the spring Chinook pre-smolts for the Oregon Select Area Fisheries Enhancement (SAFE) program. Historical problems of low water with elevated temperatures constrains production and frequently requires fish be transferred to estuary net pens earlier than is appropriate resulting in poor fish health, elevated costs for medicated feed and low marine survival. Adding oxygen during low flows has been demonstrated to be effective in holding fish at the hatchery until estuary temperatures drop to acceptable levels. Other facilities have abandoned attempts to supplement with O2 as costs were prohibitive and technology was marginally effective. Sourcing low head oxygen (LHO) units coupled with inexpensive oxygen separators has now made O2 supplementation effective and inexpensive.

During the summer and fall of 2005 using liquid oxygen and a custom LHO, Gnat Creek Hatchery ran a trial on one raceway to test the functionality of this method before considering further investment. Results were encouraging and design for applying the concept to the entire 15 raceway complex ensued. An R&E grant for $104,000 will allow all fifteen raceways to be fitted with LHO units and sufficient oxygen separators.

The 2007 season again experienced low flows and elevated temperatures in Gnat Creek. Temporary fitting of five raceways with LHOs and O2 separators allowed all fish to be held on site until November. This is and effective methodology for maintaining healthy fish in spite of decreased water/oxygen supply.

Applied Hatchery Research I

Joesph O'Neil, ODFW, Education and Outreach at the Oregon Hatchery Research Center

Mike Petersen, IDFG, Working Together To Assist Snake River Sockeye Salmon: Utilizing Partnerships Between Hatcheries And Research To Gain Ground Towards Recovery.

Dan Green, IDFG, Emergence Survival for Progeny of Captive-Reared Chinook Salmon Allowed to Spawn Naturally

Maureen Kavanagh, USFWS, Evaluating the Impacts Of Hatchery Releases On Wild Fish Populations At Eagle Creek National Fish Hatchery

Bill Gale, USFWS, Juvenile Steelhead (*Oncorhynchus mykiss*) Release Strategies: A Comparison of Volitional and Force Release Practices.

Benjamen Kennedy, USFWS, Smolt Development And Migration Timing Relate To Avian Predation Risk Of Juvenile Steelhead Trout In The Columbia River Estuary

Education and Outreach at the Oregon Hatchery Research Center

Joseph O'Neil*

Oregon Department of Fish and Wildlife, Oregon Hatchery Research Center, 2418 E. Fall Creek Rd., Alsea, OR 97324.
oregonhatchery.researchcenter@state.or.us

The Oregon Hatchery Research Center has been tasked with a directive to "Educate the public on the relationship between hatchery and wild fish; the connection between fish and watershed, estuarine and ocean systems; and the implications for fish management and stewardship. Provide educational facilities and programs for K-12 students. Design and manage the facility to provide an environment of passive and active learning for visitors. Conduct undergraduate programs and classes at the facility. Provide opportunities for educators and others to use the facility for meetings workshops and programs that advance public understanding of the relationship between fish and watershed health," In attempting to reach out to the K-12 educational community the center started a collaborative effort with the Lincoln County School District to design a program at the Waldport Schools to involve youth in activities at the center. This presentation outlines the steps taken to engage the local school district its teachers, administrators and students. The presenter will give an overview of the process along with the pitfalls and successes of the endeavor.

Working together to assist Snake River sockeye salmon: Utilizing partnerships between hatcheries and research to gain ground towards recovery.

M. Peterson*[1], P. Kline[1], K. Plaster[1], D. Baker[1], J. Heindel[1], and D. Green[1].

[1]Idaho Department of Fish and Game, Eagle Fish Hatchery, 1800 Trout Rd, Eagle, ID 83616. ***** mpeterson@idfg.idaho.gov.

Snake River sockeye salmon *Oncorhynchus nerka* were listed as endangered in 1991. Prior to listing, a captive broodstock program was initiated to prevent species extinction and to begin rebuilding the population. Between 1991 and 2006, the captive broodstock program produced approximately 3,479,000 eyed-eggs to meet broodstock as well as reintroduction needs. Progeny from the captive broodstock program are reintroduced using four strategies: 1) eyed-eggs are planted in Pettit and Alturas Lakes in November and December; 2) age-0 presmolts are released to Alturas, Pettit, and Redfish lakes in October; 3) age-1 smolts are released into Redfish Lake Creek and the upper Salmon River in May; and 4) hatchery-produced adult sockeye salmon are released to Redfish Lake for volitional spawning in September. Joint hatchery and research monitoring and evaluation efforts have focused on maximizing the use of limited hatchery rearing space and identifying and prioritizing the most successful reintroduction strategies. The programs near term goals of preserving genetic diversity and ultimately preventing extinction have been successful. Current and future plans focus on transitioning from a genetic conservation program to a species recovery program. To enable this transition, the current broodstock station at Eagle, Idaho is under construction to double production and the development of a new smolt rearing facility is under investigation. The program is a cooperative effort among IDFG, NOAA Fisheries, Shoshone-Bannock Tribes, ODFW, and University of Idaho with funding primarily provided by the Bonneville Power Administration.

Emergence Survival for Progeny of Captive-Reared Chinook Salmon Allowed to Spawn Naturally

Dan Green*, Dmitri Vidergar, Dan Baker, Josh Gable, Jeff Heindel, Paul Kline

Idaho Department of Fish and Game, Eagle Fish Hatchery, 1800 Trout Rd, Eagle, Idaho 83616. dgreen@idfg.idaho.gov

Captive rearing strategies are often used by conservation hatcheries to strengthen native fish stocks while minimizing the effects of domestication. Captive rearing involves collecting eggs or young fish from their natal waters, raising them at a hatchery until they reach maturity, then releasing the fish to spawn naturally. Facilities that use captive rearing strategies invest considerable time and effort to raise fish to maturity with the goal that released fish will spawn naturally with the same success as their natural counterparts. However, once mature fish are released, monitoring is rarely performed to identify whether fish spawn successfully and if resulting gametes are viable.

We conducted weekly spawning ground surveys post release to identify redds produced by captive-reared and natural Chinook salmon in two tributaries of the upper Salmon River, Idaho. By monitoring water temperature units we identified when eggs had developmentally reached the eyed stage and used hydraulic sampling gear to collect approximately 70 eyed from each redd. Eyed eggs were placed in modified egg transport tubes and inserted back into the redds at the depth the eggs were collected. By continuing to monitor water temperature units we estimated the time of emergence and extracted the egg capsules to enumerate live fry.

In 2006, a total of 13 redds produced by captive-reared Chinook salmon and five redds produced by natural Chinook salmon were sampled. Survival to eye for captive-reared fish averaged 85% and ranged from 44 to 97%. Survival to eye for natural fish averaged 90% and ranged from 84 to 96%. Survival to emergence for captive-reared fish averaged 56% and ranged from 00 to 93%. Survival to emergence for natural fish averaged 39% and ranged from 00 to 85%.

We plan to repeat our survival estimates during the 2007 and 2008 spawning seasons. Although still preliminary, the results indicate that our methods may provide a reliable way to estimate emergence survival for captive-reared naturally spawned Chinook salmon.

Evaluating the impacts of hatchery releases on wild fish populations at Eagle Creek National Fish Hatchery

Maureen Kavanagh*, Bill Brignon, Trevor Conder, Jeff Hogle, Doug Olson

USFWS Columbia River Fisheries Program Office, 1211 SE Cardinal Court, Suite 100 Vancouver, WA 98683.
Maureen_Kavanagh@fws.gov

Eagle Creek National Fish Hatchery is located 40 miles east of Portland, Oregon along Eagle Creek, a tributary of the Clackamas River. The hatchery raises 150,000 juvenile winter steelhead and 500,000 coho salmon for on station volitional release into Eagle Creek. Eagle Creek also supports naturally spawning populations of winter steelhead and coho which are both listed as threatened under the Lower Columbia River ESU. This study evaluates releases from the hatchery and their potential interaction with wild fish populations. From 2003-2007, a radio-telemetry study was conducted on juvenile steelhead released from Eagle Creek National Fish Hatchery to provide information on potential residualism of hatchery fish in Eagle Creek. The study was expanded in 2005 to include distribution monitoring, migration timing, and location of spawning areas for adult hatchery and wild steelhead returning to Eagle Creek. During the study period, 235 juvenile hatchery steelhead were surgically implanted with coded radio-transmitters (Lotek Wireless, model NTC-4-2L) and 140 adult hatchery and 70 wild steelhead were gastrically implanted with coded radio-transmitters (Lotek Wireless; model MCFT-3A). Adult and juvenile fish were monitored through a combination of mobile tracking and fixed telemetry stations. Radio-telemetry data on juvenile steelhead released from the hatchery indicate mean migration times of two to nine days from the hatchery receiver (Rkm 20.9) to the mouth of Eagle Creek (Rkm 1.1). Approximately 50% of radio-tagged juvenile fish potentially residualized in Eagle Creek. For adult steelhead, less than 20% of the total number of radio-tagged hatchery adults were collected during spawning operations. Overlaps in run timing of hatchery and wild steelhead occurred in 2005 and 2006, however run timing was temporally separated in 2007. Additional information is collected on the effect of hatchery rearing density on survival and stream residualism, genetic contribution of wild and hatchery fish in the stream, and habitat preference of wild fish in the stream.

Juvenile Steelhead (*Oncorhynchus mykiss*) Release Strategies: A Comparison of Volitional and Force Release Practices.

William L. Gale[1*], Chris R. Pasley[2], Benjamen M. Kennedy[1], and Kenneth G. Ostrand[1].

[1] U.S. Fish and Wildlife Service, Abernathy Fish Technology Center, 1440 Abernathy Creek Rd, Longview, WA 98632. (360) 425-6072, william_gale@fws.gov
[2] U.S. Fish and Wildlife Service, Winthrop National Fish Hatchery, 453A Twin Lakes Rd, Winthrop, WA 98862.

Gill Na^+, K^+ ATPase activity, body size, condition factor (K), migratory behavior, and apparent downstream survival were compared between volitional release migrants (VM), force release migrants (FRM), and volitional release non migrants (VNM). In 2004 and 2005, juvenile steelhead (*Oncorhynchus mykiss*) reared at Winthrop National Fish Hatchery (Winthrop, WA) were tagged with 12 mm passive integrated transponders (PIT) and subjected to a volitional or force release. Downstream migration was monitored by PIT tag interrogation at the hatchery as well as at downstream sites at McNary, John Day, and Bonneville Dams. Apparent survival (Φ) and recapture probability to McNary and John Day Dams were estimated using a model averaging approach with program MARK. Gill Na^+, K^+ ATPase and body size did not differ between VNM, VM, and FRM groups, though ATPase did change between sample dates. Condition factor varied by sample date and migrant group, with VM having similar K throughout the release period and VNM and FRM fish displaying a higher K at the beginning and middle of the release period. At the end of the volitional release period all three groups had similar K. Volitional non migrants consistently demonstrated a lower Φ to McNary Dam than the other migrant groups which had three to eight times greater probability of survival than VNM. Volitional migrants had a higher rate of survival to McNary than FRM in 2005; however survival was similar between the two groups in 2004. Apparent survival between McNary and John Day Dams was similar between all three migrant groups in 2004 and 2005. By combining the results from VNM and VM fish we were able to compare the apparent survival between the two release strategies. In 2004 force release fish had a significantly higher probability of survival to McNary Dam than volitionally released fish, whereas there was no difference in apparent survival between the two release strategies in 2005. Median travel time to McNary Dam was not consistently different between migrant groups and differed between years. In 2004 FRM were significantly faster than the other groups, whereas travel time was similar between migrant groups in 2005. Overall there was little evidence for a survival, size, or physiology related advantage for volitionally released fish as compared force released fish. The consistently lower apparent survival of VNM does provide support the use of volitional release as a means to screen out those fish which are likely to remain in the natal stream instead of emigrating to the ocean.

Smolt development and migration timing relate to avian predation risk of juvenile steelhead trout in the Columbia River Estuary

Benjamen M. Kennedy[1*], W.L. Gale[2], and K.G. Ostrand[2]

[1]Abernathy Fish Technology Center, U.S. Fish and Wildlife Service, 1440 Abernathy Creek Rd, Longview, WA 98632, benjamen_kennedy@fws.gov
[2]Abernathy Fish Technology Center, U.S. Fish and Wildlife Service, 1440 Abernathy Creek Rd, Longview, WA 98632

Steelhead smolts migrating through the Columbia River Estuary are vulnerable to predation by Caspian terns and double-crested cormorants. Previous studies have found that over 10% of PIT-tagged steelhead passing Bonneville Dam were eaten and deposited by birds on estuary islands. We examined avian predation risk of juvenile steelhead trout (*Oncorhynchus mykiss*) migrating from Abernathy Creek, WA (rkm 87) through the Columbia River Estuary in relation to their osmoregulatory physiology, body length, rearing conditions (hatchery or wild), migration timing, and migration year. From 2003 to 2006, mean gill Na^+, K^+-ATPase activity of migrating wild steelhead was greater than hatchery steelhead. Hatchery steelhead were always longer than wild steelhead. More PIT tags from hatchery fish (19%; 126 of 678 fish) were detected on East Sand Island among bird nesting colonies than PIT tags of wild fish (14%; 70 of 509 fish), presumably consumed by birds. As gill Na^+, K^+-ATPase activity and migration date within a year increased, the probability of an individual fish being eaten by an avian predator decreased. Length, rear type, and year were not related to predation risk. These results show that physiology and migration timing of juvenile steelhead play an important role in a migrant's risk to avian predation within an estuary.

Enhancing Fisheries/Creating Opportunities

Holly Truemper, ODFW, Diamond Lake Tui Chub: Cost Of Few Anglers Or Recreationalists At The Lake = Devastating, Cost Of Rotenone Treatment = $1.5 M, Cost Of Clean Water, A Great Fishery, And Happy Anglers = Priceless.

Ken Scheer, FW Fisheries Society of BC, Nechako White Sturgeon Fish Culture Recovery Initiative

Nick Ackerman, PGE, An Overview Of The Deconstruction Of Marmot Dam

Dianne Loopstra, ADFG, Sterile Fish Production For Lake Stocking Programs- Using Hydrostatic Pressure To Induce Triploidy In Five Salmonid Species

Tod Jones, Clatsop County Fisheries, Select Area Fisheries Enhancement Program

Diamond Lake tui chub:
Cost of few anglers or recreationalists at the lake = Devastating,
Cost of rotenone treatment = $1.5 M,
Cost of clean water, a great fishery, and happy anglers = Priceless.

Holly A. Truemper*[1], Joe Eilers[2], Dave Loomis[3], Mari Brick[3]

[1]Oregon Department of Fish and Wildlife, 28655 Hwy 34, Corvallis, OR 97333,
Holly.Truemper@oregonstate.edu
[2]MaxDepth Aquatics, Inc. 1900 NE 3rd St., Suite 106-10, Bend, OR, 97701
j.eilers@maxdepthaq.com
[3]Oregon Department of Fish and Wildlife, 4192 N.Umpqua Hwy, Roseburg, OR 97470

In 1992, non-native tui chub *Gila bicolor* were found in Diamond Lake and presumed to have been illegally introduced. Within a few years, tui chub caused poor survival and growth of hatchery rainbow trout fingerling releases that resulted in a popular trout fishery to decline, and water quality issues from toxic algae blooms to restrict recreational boating and swimming. The Oregon Department of Fish and Wildlife (ODFW) began efforts in 1994 to initiate the public process at federal and state levels to complete restoration that could involve applying rotenone. During this process, supplemental and experimental stocking programs were initiated to keep angling interest high and determine if predatory fish could regulate the chub population. Mechanical removal of fish was conducted pre-treatment in 2006 by commercial fishermen with the objective to reduce chub biomass by half to limit the number of nutrients and dead fish post-treatment. Prior to treatment, the lake was drawn down over a 12 month period to 8 feet below normal full pool to two-thirds (approximately 43,000 acre-feet) of its normal volume, divided up into grids, and sampled for fish distribution in tributaries and along the shoreline. The lake outlet head gates were closed and secured to contain all surface water flows during rotenone application and until the lake was rotenone free. The lake was treated with rotenone on September 13-15, 2006 using 9 custom fitted pontoon boats to distribute the majority of the product into the lake, with 2 smaller boats, drip stations, and backpack applicators doing specialized treatment on shore. ODFW crews, specifically trained and licensed in pesticide application, distributed a total of 107,141 lbs of powdered rotenone and 71,990 lbs of liquid rotenone safely in a time period of 12 hours. The resulting formulation of rotenone after thoroughly mixed in the lake was 2.2 ppm (0.11 ppm active). Since treatment, the ecosystem has rebounded with higher zooplankton and benthic macroinvertebrate biomass, lowered pH, and increased transparency. Stocking resumed in spring 2007 with a reduced fingerling release of 100,000 fish, along with various catchable and trophy fish. The abundance of prey items available (60-200 lbs/acre) resulted in above average trout growth and condition factors, greatly increasing the number of angler trips and catch rates for 2007.

Nechako White Sturgeon Fish Culture Recovery Initiative

Ken Scheer*

Freshwater Fisheries Society of BC (FFSBC), Fraser Valley Trout Hatchery, 34345 Vye Road, Abbotsford, BC V2S 7P6. Tel: (604) 557-0665. Email Ken.Scheer@gofishbc.com

The Nechako White sturgeon (Acipenser transmontanus) population, like many others in the Pacific Northwest, has been in serious decline for several decades. In fact this sturgeon population was recently listed under federal Species at Risk (SARA) legislation. While there are many factors contributing to this decline river impoundment for hydroelectric generation is likely the greatest contributor. The Nechako white sturgeon population has seen virtually no natural recruitment since the 1960s with only a handful of juveniles having been captured during this period. Without significant intervention, this small aging population will face certain extinction in less than 30 years time

Field work starting in the mid 1990's confirmed the population was in trouble. A recovery plan for the Nechako White Sturgeon was completed in 2004. During this period researchers identified potential causes for recruitment failure in an effort to determine what corrective measures would be required on a short, medium and long term scale. Given the lack of juvenile fish and the reality of an ever shrinking window of opportunity in which spawning adults, and unique genetic material, would be available, it was decided that the highest priority to help recover this population would be the implementation of a conservation based fish culture program.

In 2006 a small pilot hatchery program was constructed in a very short period of time. The hatchery program had a target of releasing 5,000 fall release juvenile sturgeon from two genetically distinct families. The first year of operation had its exciting moments because of extremely low river flows and poor water quality but ultimately produced 4,200 tagged fish which were released in late October and early November. Many of these fish were released in a very public event where school children assisted with the release of their very own tagged fish.

In 2007 funding was secured for an "enhanced pilot hatchery" program where hatchery staff would learn from their experiences in 2006 and implement an even better culture program. One key improvement would be an improved water intake and water treatment system. Unfortunately 2007 river conditions were a polar opposite to that of 2006. Extremely high flows resulted in the flooding of many areas of the Nechako Valley causing all sorts of problems not seen in 2006. Adaptability, perseverance and good fortune eventually prevailed and 4,500 fish were tagged and released in the fall of 2007.

With bookend river flow years now behind us, a "super enhanced hatchery" program is envisioned for 2008!

This presentation will highlight some of the challenges experienced along the way and the ad hoc solutions staff implemented to achieve success. A look into the future needs of this program will also be presented.

An Overview of the Deconstruction of Marmot Dam

Nicklaus K. Ackerman*

Portland General Electric, 33831 S. Faraday Rd., Estacada, OR. 97023. nick.ackerman@pgn.com

In 1999, Portland General Electric (PGE) made the decision to decommission their Bull Run Hydroelectric Project in the Sandy River Basin, Oregon. As part of decommissioning, PGE committed to removing Marmot Dam located on the mainstem Sandy River which had been in place since 1913. Deconstruction of Marmot Dam was carried out in 2007 and represented a significant moment in the history of hydropower in the Pacific Northwest. This presentation will provide an overview of deconstruction activities with emphasis on fisheries and geomorphological issues. Specifically, the presentation will cover removal of the dam, fish passage during deconstruction, and an up-to-date picture of the river's response to the release of sediment trapped behind the former dam. Finally it will summarize changes to hatchery and fisheries management within the basin stimulated by removal of the dam.

Sterile Fish Production for Lake Stocking Programs - Using Hydrostatic Pressure to Induce Triploidy in Five Salmonid Species

Diane P. Loopstra*

Alaska Department of Fish and Game, Sport Fish Division, 333 Raspberry Road, Anchorage, AK 99518. diane.loopstra@alaska.gov

Stocking sterile, triploid fish in lakes for sport fishing reduces the genetic impact hatchery fish could have on native fish populations. From 2002 to 2006 Alaska Department of Fish and Game tested pressure shock procedures for inducing triploidy in Arctic char (*Salvelinus alpinus*), Arctic graying (*Thymallus arcticus*), Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kitshuch*), and rainbow trout (*O. mykiss*). We tested different pressures, shock durations, and shock initiation times (Centigrade Temperature Minutes (CTMs) = water temperature x minutes from fertilization to shock initiation). We achieved the highest triploid and survival rates with the following procedures:

- Arctic char eggs pressure shocked for 5 minutes with 9,500 psi of pressure at 250 CTMs post fertilization achieved a 100% (n=45) mean triploid rate and a 97.5% mean survival rate to emergence relative to the mean control survival rate.
- Coho salmon eggs pressure shocked for 4 minutes with 10,000 psi of pressure at 360 CTMs post fertilization achieved a 100% (n=45) mean triploid rate and a 100.3% mean survival rate to emergence relative to the mean control survival rate.
- Chinook salmon eggs pressure shocked for 4 minutes with 10,000 psi of pressure at 400 CTMs post fertilization achieved a 100% (n=45) mean triploid rate and a 95.4% mean survival rate to emergence relative to the mean control survival rate.
- Rainbow trout eggs pressure shocked for 5 minutes with 9,500 psi of pressure at 375 CTMs post fertilization achieved a 99.1% (n=45) mean triploid rate and a 100% mean survival rate to emergence relative to the mean control survival rate.
- Arctic grayling eggs pressure shocked for 5 minutes with 8,500 psi of pressure at 175 CTMs post fertilization achieved a 100% (n=55) mean triploid rate and an 87.2% mean survival rate to emergence relative to the mean control survival rate.

We released our first production groups of triploid Arctic char and triploid Arctic grayling in 2006 and our first production group of triploid coho salmon in 2007. We will release our first production group of triploid Chinook salmon in 2009 (brood year 2007). We have produced triploid rainbow trout (heat shock induction) since 1989. Ploidy is verified with flow cytometry. All-female triploid populations (rainbow trout) must achieve a 90% triploid rate with 95% CI (n=150), and mixed-sex triploid populations (all other species) must achieve a 99% triploid rate with 95% CI (n=300) to be stocked into lakes permitted for triploid fish only.

Select Area Fisheries Enhancement Program

Tod Jones[1], Roger Warren[2] and Chris Rodriguez[2]

[1]Clatsop County Fisheries, 2001 Marine Dr., Rm 253, Astoria, OR 97103. tjones@co.clatsop.or.us
[2]Oregon Department of Fish and Wildlife, Gnat Creek Hatchery, 92645 Gnat Hatchery Rd., Clatskanie, OR 97016. gnatcr@dialoregon.net, christopher.g.rodriguez@state.or.us

The Select Area Fisheries Enhancement Program is a collaborative program between Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife and Clatsop County Fisheries. The project is designed to allow for maximum harvest of known hatchery stocks while minimizing impacts on listed wild salmon.

Various sites on the Oregon and Washington side of the lower Columbia River were intensely analyzed in the early 1990's to determine the best sites for harvest of fish off channel and for utilizing the floating net-pen systems to rear and/or imprint salmonids. Three sites in Oregon and one on the Washington side have been developed with a total of nearly two hundred net pens.

The majority of the project costs are underwritten by Bonneville Power Administration, with significant matching funds and in-kind contributions by both states and from a voluntary assessment by commercial harvesters and local processors. Conceived as off-site mitigation for the impacts of hydroelectric dams on the mainstem Columbia River for commercial harvest, fish reared and released by the project contribute heavily to both recreational and commercial harvesters. Over 200 million salmonid smolts are released by hatcheries in the Columbia River Basin. About two percent of those are released in the select areas, yet typically over fifty percent of non-tribal commercial harvest on the Columbia River is accounted for in the select areas. Spring chinook from Willamette River stocks, fall chinook originally from the Rogue River and lower Columbia River hatchery coho make up the production.

The economic impact of the program is felt from Brookings, Oregon to Ilwaco, Washington as well as the Buoy 10 sport fishery. The program has the potential of much greater harvest without increasing impacts on wild stocks.

Applied Hatchery Research II

Don Larsen, NOAA, High Rates Of Age-2 Precocious Male Maturation. Minijacks In Spring Chinook Salmon Hatchery Programs: Prevalence, Causes, And Potential Solutions.

Brian Beckman, NOAA, Variation In MiniJack Production Among Columbia River Chinook Salmon Hatcheries

Brent Young, Great Lakes Institute for Environmental Research, Supportive Breeding Programs: Genetic Diversity vs. Genetic Quality, And The Inclusion Of Jacks.

Barry Berejikian, NOAA, The Reproductive Behavior And Breeding Success Of Jack And Adult Chinook Salmon

Tim Hoffnagle, ODFW, The Imnaha River Chinook Salmon Supplementation Program After Twenty-five Years: A Model Program In Need Of Reform?

High Rates of Age-2 Precocious Male Maturation, "Minijacks", in Spring Chinook Salmon Hatchery Programs: Prevalence, Causes, and Potential Solutions.

D. Larsen[1*,] B. Beckman[1], C. Strom[2], P. Parkins[3], K. Cooper[3], M. Johnston[4], D. Fast[4],

and W. Dickhoff.[1,3]

[1]NOAA Fisheries, Northwest Fisheries Science Center, 2725 Montlake Boulevard East, Seattle, Washington 98112. don.Larsen@noaa.gov, brian.Beckman@noaa.gov, Walton.w.dickhoff@noaa.gov
[2]Cle Elum Supplementation and Research Facility, Yakama Nation, 800 Spring Chinook Way, Cle Elum, Washington 98922. osprey@eburg.com
[3]School of Aquatic and Fisheries Science, University of Washington, Seattle Washington 98195 kathy.cooper@noaa.gov, paul.parkins@noaa.gov
[4]Yakama Nation Fisheries, Nelson Springs Research Center, 771 Pence Road, Yakima, WA 98902. markJ@yakama.com, fast@yakama.com

For over a decade we have conducted research to characterize the physiology and development of wild and hatchery-reared Spring Chinook salmon (*Oncorhynchus tshawytscha*) in the Yakima River Basin including studies aimed at understanding the prevalence, causes, and consequences of precocious male maturation in this species. Through analysis of plasma levels of the reproductive steroid 11-ketotestosterone (11-KT) in Yakima River hatchery fish prior to release as smolts we have revealed that approximately 30-50% (depending on brood year) of the male fish from this program mature precociously at age-2 (commonly referred to as minijacks) rather than the more typical age 3-5 for the natural parent stock. We have also found high minijack rates in other Columbia River stocks as well. Instead of migrating to the ocean for long-term rearing and growth, many precocious males remain in headwater streams or undertake a short-term migration downstream, turn around, and attempt to migrate back upstream to complete the maturation process. Precocious maturation is poorly characterized in wild stocks, but believed to be less than 5%. Age of maturation in salmon is influenced by genetic, biotic, and abiotic factors including energy stores, size and/or growth rate at specific times of year. Studies in salmonids have shown that maturation for each age class is physiologically initiated approximately 10-12 months prior to spermiation or ovulation and growth rate during this period significantly influences the physiological "decision" to mature in a given year. Our studies have demonstrated that hatchery growth profiles are not well matched to that of wild fish, suggesting that rearing practices are a key component of the altered life-history pattern we have observed. Alterations in the normal life-history composition of salmon populations are undesirable in supplementation and production hatcheries, resulting in loss of potential returning anadromous adults, biasing of gender ratios, and negative genetic and ecological impacts on wild populations and other native species. Both laboratory and production scale studies in this project aimed at more closely matching growth profiles of wild fish in the hatchery have met with mixed success in that growth regimes that suppress early maturity often produce smaller fish at release. Release of smaller smolts typically results in lower rates of survival to adulthood. Future studies are aimed at reconciling the trade-offs between matching the "wild-like" phenotype, and the survival advantages gained through larger body size at release in salmon hatchery programs.

Funding provided by Bonneville Power Administration under contract number 200203100 and the NOAA Fisheries Biop funding program.

Variation in miniJack production among Columbia River Chinook salmon hatcheries

Brian Beckman* and Don Larsen

Northwest Fisheries Science Center, NOAA Fisheries, Seattle WA 98112 Brian.Beckman@noaa.gov

Recent studies have documented high rates of early male maturation (age 2 mature male parr – ie "minijacks") in spring chinook salmon populations reared in the Cle Elum Hatchery program. This has caused concern among project managers and generated curiosity among researchers. Perhaps the most obvious question is: are minijack production rates at the Cle Elum facility different from that found at other hatcheries? There are very limited reports of minijack production rates from any hatchery in the Columbia River Basin. Therefore we compared detection of PIT-tagged minijacks in adult ladders of dams on the mainstem Columbia and Snake Rivers from selected hatcheries. Fifteen hatcheries released at least 7500 PIT-tagged spring chinook salmon smolts in 2002 and 2003. Minijacks were detected from all these release groups at Bonneville Dam. Minijacks were detected as early as June and numbers migrating upstream past Bonneville Dam peaked in July. Estimated number of minijacks migrating up-stream past Bonneville Dam from these hatcheries varied by two orders of magnitude (100 – 10,000). Estimated minijack production rate (% of release detected migrating upstream at Bonneville Dam) also varied greatly (0.01 – 0.79%). PIT-tagged minijacks were detected in upstream ladders of all dams (Bonneville, McNary, Priest Rapids, Rock Island, Well, Ice Harbor, Lower Granite) on the Columbia and Snake rivers fitted with PIT-tag detectors. Detection rates of minijacks at these dams varied among hatcheries according to the hatcheries geographic location. Overall, difference in detection rates of upstream migrating minijacks from different hatcheries suggests minijack production varies between hatcheries. In particular, hatchery programs using native broodstocks appeared to have relatively high rates of minijack production.

Supportive Breeding Programs: Genetic Diversity vs. Genetic Quality, and the Inclusion of Jacks.

Brent W. Young*

PhD. Candidate, University of Windsor, Oregon Department of Fish and Wildlife, Stock Identification, 17330 SE Evelyn Street, Clackamas, Oregon 97015, evogenetics@hotmail.com.

Conservation and supplementation programs routinely employ captive reared individuals or their offspring to augment declining populations. The majority of these programs either mate individuals randomly or attempt to mate 'dissimilar' individuals in an effort to increase/maintain genetic diversity and thus, mitigate inbreeding depression. However, genetic diversity is not equivalent to genetic quality. Recently, several researchers have demonstrated that the inclusion of genetic quality in supportive breeding programs can significantly increase fitness and survival of the resultant offspring. In particular, substantial evidence suggests that variation at the IIB locus of the major histocompatability complex (MHC) can confer significant fitness benefits related to disease resistance. In Chinook salmon (*Oncorhynchus tshawytscha*), the jack phenotype has been shown to possess both higher levels of overall genetic diversity and, in particular, significantly higher diversity at the important MHC IIB locus, relative to the hooknose phenotype. An inexpensive method of screening brood stock for MHC diversity at the IIB locus is discussed. Additionally, I will demonstrate how the simple inclusion of jacks in supplemental breeding programs can substantially increase the overall genetic quality of offspring, leading to significant increases in offspring growth and survival.

The Reproductive Behavior and Breeding Success of Jack and Adult Chinook Salmon

Barry Berejikian[1*], Tim Hoffnagle[2], Rob Endicott[1], Skip Tezak[1], Megan Petrie[1], Jeff Atkins[2]

[1]/NOAA Fisheries, Northwest Fisheries Science Center, Manchester Research Station, P.O. Box 130, Manchester, WA 98353

[2]/Northeast Region Fish Research
Oregon Department of Fish and Wildlife, 203 Badgley Hall, Eastern Oregon University
La Grande, OR 97850

[3]/Pacific States Marine Fisheries Commission, 205 SE Spokane Street, Suite 100 • Portland, OR 97202

Unintended genetic changes can occur as a result of broodstock management practices and these constitute a major concern with the use of conventional hatchery and captive broodstock programs for supplementing endemic populations. Broodstock management plans now frequently emphasize maintaining natural run timing and body size in hatchery broodstocks and implementing spawning practices to maintain a high level of genetic variability in the offspring. However, it is well recognized that hatchery spawning practices cannot exactly mimic the natural selection that occurs leading up to and during natural spawning, including selection on male life history strategies. This study was a first step in developing an empirically derived strategy for incorporating jack Chinook salmon males into spawning matrices for artificial propagation programs that aim to maintain natural genetic variation by mimicking as closely as possible the natural breeding success of alternative male phenotypes.

To assess the breeding success of jack and adult males, we introduced six females and 16 males (Trask River Hatchery stock) into each of four experimental stream channels at the Oregon Hatchery Research Center. We varied the ratio of jack (J) to adult (A) males among the four channels (8J:8A; 6J:10A; 5J:11A; 4J:12A) We recorded spawning behaviors associated with each nesting female from dawn to dusk every day during the spawning season. We observed a total of 26 spawning events in all four channels combined, most observations (N = 21) coming from either the highest jack ratio (8J:8A; n = 12) or the lowest jack ratio (4J:12A; n = 9). For both jack and adult males, the ability to compete for either the dominant (courting) position next to the female or a satellite (sneaker) position was positively correlated with the number of times they were observed participating in spawning events (highest jack ratio: $r^2 = 0.54$, $p < 0.05$; lowest jack ratio: $r^2 = 0.65$, $p < 0.05$). Male participation in spawning events was consistent with the hypothesis of negative frequency-dependent selection. That is, when jack males were least abundant (4J:12A) a greater percentage (100%) were observed participating in spawning events than when they were most abundant (25%; 8J:8A). Consistently, when adult males were least abundant (8J:8A), a greater percentage (88%) were observed participating in spawning events than when they were most abundant (42%; 4J:12A). However, jack males had a significantly lower social rank and lower rank order of nest entry under both conditions, which should result in lower reproductive success than adult males.

DNA pedigree analyses will assign offspring that emerge from the four stream channels in 2008 to their male and female parents to estimate actual reproductive success under each of the four male ratios. These data should assist in developing a foundation for hatchery mating protocols for Chinook salmon populations to minimize divergence in life history patterns from the natural state.

The Imnaha River Chinook Salmon Supplementation Program After Twenty-five Years: A Model Program in Need of Reform?

Tim Hoffnagle* and Rich Carmichael

Oregon Department of Fish and Wildlife, N.E. Region Fish Research, 203 Badgley Hall, Eastern Oregon University, La Grande, OR 97850. tim.hoffnagle@eou.edu

The Chinook salmon *Oncorhynchus tshawytscha* of the Imnaha River of northeast Oregon are an unique spring/summer race that migrates and matures later than other Oregon Snake River populations. The Imnaha River Chinook Salmon Supplementation Program has been conducted since 1982 and an annual mean of 148 adults have been spawned, 241,554 smolts released and 1,117 adults returned.

We examined similarities and differences in smolt and adult characteristics between hatchery and natural Imnaha River Chinook salmon to determine whether the program has been successful in accomplishing its goal to produce hatchery salmon with the same genetic and life history characteristics of natural salmon. We have found that hatchery adults return at an earlier age, with both males and females showing a pronounced younger age at return and that fecundity is decreasing. Hatchery salmon typically return later than natural salmon, they spawn later, and are distributed more downstream near the smolt release location. We have also found that natural females are beginning to spawn later, which may be a result of hatchery females spawning in nature.

We also compared abundance and productivity of Chinook salmon in the Imnaha River with similar but unsupplemented Snake River Basin streams to evaluate whether abundance and productivity of the Imnaha River have increased above that which might have been expected if the river was never supplemented. We have achieved a significant life cycle survival advantage for hatchery salmon with a recruit per spawner advantage of 7:1. Mean recruit per spawner ratio for naturally spawning salmon (hatchery and natural) has been <1 and has exceeded replacement for only 4 of 20 brood years. We have not increased natural origin abundance with supplementation, nor have we observed a trend of increased number of natural-origin adults since supplementation began, despite having increased the total number of salmon spawning in nature.

The supplementation program has not achieved all of its goals, particularly those related to enhancing abundance and maintaining productivity of natural origin salmon, and maintaining the genetic and life history characteristics of hatchery salmon so that they mimic wild salmon. It appears to be time to substantially modify the management of this program, such as changes in weir management, broodstock collection, hatchery rearing, and smolt releases.

Fish Health

John Kaufman, ODFW, Infectious Hematopoietic Necrosis Virus (IHNV) In Oregon

Erik Withalm, ODFW, Managing for IHNV In Rainbow Trout At Leaburg Hatchery

Doug Munson, IDFG, Hatchery Management Strategies for *Ichthyophthirius multifilis* At Idaho Department Of Fish And Game Hatcheries

Skip Thompson, NC State University, Aquaflor® Efficacy For The Treatment Of Bacterial Coldwater Disease On North Carolina Trout Farms

Sherry Mead, FW Fisheries Society of BC, Flavobacterium psychrophilum: A Holistic Management Approach

David Lovetro, Eka Chemicals, 35% PEROX-AID ® Some Safety And Handling Considerations For The Recently FDA Approved Veterinary Drug

Infectious Hematopoietic Necrosis Virus (IHNV) In Oregon

John Kaufman*

Oregon Department of Fish and Wildlife, Fish Health Services, Department of Microbiology, Oregon State University, Corvallis, Oregon 97331-3804 kaufmanj@onid.orst.edu

IHNV was first recognized as a viral disease in Oregon in 1958 at Oakridge Hatchery. Reports of losses due to a pathogen of suspected viral etiology were documented as early as 1953 in Washington from Leavenworth and Winthrop Hatcheries. The disease was also called Sacramento River Chinook Disease and Oregon sockeye disease until the late 60's when it was found that all of these 'diseases' were caused by the same pathogen, which was officially termed Infectious Hematopoietic Necrosis Virus.

Since that time, IHNV has become the number 1 fish virus pathogen of concern in Oregon, if not the Northwest. In Oregon in 2004 and 2005, IHNV was responsible for the destruction of approximately 350,000 fish in each of those years. In 2006 losses in Oregon soared to 1.6 million. 2007 has showed a dramatic decline in losses most likely due to environmental factors beyond our understanding, however improvements in virus identification and management strategies based on strain types have also significantly contributed to the decline in yearly mortality.

Isolates of IHNV are identified by sequencing a 303 nucleotide base pair section of the G protein gene. This section was chosen because it is one of few sections that can easily show nucleotide changes between strains; most of the virus genome is conserved

Characterization of hundreds of IHNV isolates from the Pacific Northwest have shown that IHNV can generally be divided into 3 main groups or clades based on similarity: U, M, L (upper, middle, lower). These differing clade types show some level of species specificity – U and L clade viruses are typically associated with true salmon, while M clade viruses appear to primarily affect steelhead and trout. This is not a hard and fast rule.

The distribution of U and M clade IHNV in Oregon will be addressed. Introductions of new strains into endemic areas, displacement of viral strains by new types, and how these may affect fish health and management decisions will be explored.

Managing for IHNV in Rainbow Trout at Leaburg Hatchery

Erik Withalm*

Leaburg Hatchery, Oregon Department of Fish and Wildlife, 90700 Fish Hatchery Road, Leaburg, OR 97489. E-mail: erik.j.withalm@state.or.us

Leaburg Hatchery is located along the McKenzie River in the Willamette Basin, producing 700,000 legal sized rainbows for stocking throughout the northwest region of Oregon. Since the first major outbreak of infectious hematopoietic necrosis virus (IHNV) in rainbow trout at Leaburg in 2002, a variety of changes to the trout stocking program have been implemented. Stocking locations are limited to waterbodies designated as having already found IHNV in the system. Rearing pond densities have been dramatically decreased. All trout, with the exception of sentinel fish, are raised at other facilities and brought on site as fingerlings already fin-clipped, graded, and at final pond densities. By transferring the fish in late fall, water flows are higher, diluting the concentration of viral particles present in the river.

A number of experiments are being performed including a vaccine trial, the use of feed additives, and a very promising accelerated growth program. Through the use of heated well water and an aggressive feeding schedule, legal rainbows were produced at 3 fish/lb. in 7.5 months instead of 14-16 months.

Since 2004, losses from IHNV outbreaks at Leaburg have gradually decreased. Although no single change can be credited with this decline, they are meant to minimize stress and exposure times to IHNV, giving our trout the best possible chance for survival. Until a whole hatchery ultraviolet disinfection system is installed, Leaburg Hatchery will continue to adapt to the challenges of IHNV in order to meet annual production goals.

Hatchery Management Strategies for *Ichthyophthirius multifilis* at Idaho Department of Fish and Game Hatcheries

Douglas Munson*

Idaho Department of Fish and Game, 1800 Trout Rd, Eagle, ID 83616, dmunson@idfg.idaho.gov

Idaho Department of Fish and Game has a long history of disease management with *Ichthyophthirius multifilis,* the etiologic agent of "Ich" or white spot disease. *Ichthyophthirius multifilis* is a holotrichous ciliate about 1.0 mm in diameter. This parasite has a direct life cycle and an explosive ability to generate the infective theront stage once water temperatures are above 65ºF. Disease and mortality can be caused in most freshwater fish when environmental conditions are favorable to the parasite. This parasite is probably the leading cause of mortality in cultured fish worldwide.

The Idaho Department of Fish and Game has "managed around" this parasite at Crooked River and Red River, satellites to the Clearwater Hatchery, by starting fall acclimations in mid-September. Lower water temperatures slow the life cycle of *Ichthyophthirius* to such an extent that the parasite is not detected during preliberation sampling. We have been successful in treating juvenile Chinook salmon at Pahsimeroi and Sawtooth hatcheries with one hour flow through treatments of formalin at 170 mg/l, but have experienced high losses in adult Chinook salmon (51%) being held at Sawtooth hatchery in 2006, and rainbow trout at Nampa Hatchery (250,000 +fish lost) in 2006-2007. This presentation will discuss strategies that we have used to minimize losses to "Ich" such as extended formalin treatments by veterinary extra-label prescription, and our surveillance program at Nampa Hatchery.

Aquaflor® Efficacy for the Treatment of Bacterial Coldwater Disease on North Carolina Trout Farms

Skip Thompson*, Kasha Cox**

*NC Cooperative Extension – NC State University, P.O. Box 308, Waynesville, NC 28786. Skip_Thompson@ncsu.edu
** Schering-Plough Animal Health Corporation, Summit N.J. 07901

Aquaflor® (florfenicol), an antibiotic produced by Schering-Plough Animal Health Corporation was approved for the control of mortality in freshwater-reared salmonids due to coldwater disease (BCWD) associated with *Flavobacterium psychrophilum* in March of 2007. To date, there have been 30 applications of Aquaflor® at North Carolina trout farms with excellent results. Daily mortality data for 10 days pre-treatment, 10 days during antibiotic application and 10 days post-treatment generally indicate a considerable decrease in daily mortalities by the fifth day of the ten-day treatment with Aquaflor. Prior to treatment with Aquaflor®, daily mortality due to BCWD had escalated to as high as 1200 fish per day. Recurrence of BCWD has not been seen in trout that have been treated with Aquaflor in North Carolina. The use of Terramycin® for control of BCWD in trout in North Carolina has had almost no effect. Epizootics of BCWD where Aquaflor® has not been applied have resulted in poor trout growth and performance with notably increased fish size variation throughout the life of the trout. The use of Aquaflor® at North Carolina trout farms in 2007 has resulted in an estimated savings of approximately $245,000 as a result of improved survival and performance.

Flavobacterium psychrophilum
A Holistic Management Approach

Sherry L. Mead*

Freshwater Fisheries Society of BC (FFSBC), Fish Health Lab, 2080A Labieux Rd., Nanaimo BC, V9G 2B1.
sherry.mead@gofishbc.com

The yellow pigmented bacteria *Flavobacterium psychrophilum* emerged as a problem within the FFSBC hatchery system about 3 years ago, expressing itself in both the Rainbow Trout Fry Syndrome (RTFS) form in newly ponded fry and in the cold water disease (CWD) form in sub yearling rainbow trout stocks. Over the past 3 years heavy losses have been sustained to the bacteria in some stocks at three of our five production facilities. After initial attempts to eliminate the problem were less than successful, the Freshwater Fisheries Society decided to take a holistic approach and form a sub-committee comprised of representatives from Fish Health, Research and Development, hatchery staff and management to identify problem areas, focus research needs and develop management tools to combat the bacteria. In 2006 and 2007 several key projects were completed, including: a new apparatus and protocol for disinfecting eggs, a prime ovulation research project on one of our key rainbow trout stocks, some preliminary UV water treatment trials, well water testing for bacterial loadings and a review and upgrade of Bio-security procedures utilized at the facilities. Although the Society continues to live with the bacteria in some of our facilities we've had some positive outcomes at others. Our holistic management process has allowed us to identify key problem areas and stocks, and develop new techniques which we hope will reduce future problems with the disease. Activities for 2008 include a starter diet comparison study, strain variance and drug sensitivity work, study comparisons in hatching out and larval clean up methods, facility disinfection including pipes, more structural bio-security upgrades within facilities and developing bio standards for specific stocks and genotypes.

We would also like to encourage feedback and input from other organizations on how they are managing for *Flavobacterium psychrophilum.*

35% PEROX-AID ® Some Safety and Handling Considerations For the Recently FDA Approved Veterinary Drug

David C. Lovetro*

Eka Chemicals Inc., 1775 West Oak Commons Court, Marietta, GA 30062-2254; Dave.Lovetro@Eka.com

While some public and private fish culturists were familiar with the use of Hydrogen Peroxide (35%) in aquaculture use, an increasing number of public and private hatchery operations are learning about its use since the recent FDA approval of 35% PEROX-AID ® as a veterinary drug. This new drug product gained OTC marketing approval from the Center for Veterinary Medicine on January 11, 2007, and is now gaining a wider audience throughout both the public and private aquaculture arena. This new drug approval is exciting news for aquaculture in that it represents many new firsts …

- First new water immersion drug approval in 20 years since formalin!
- First approved drug with a broad set of claims for two major hatchery diseases including bacterial gill disease and external *columnaris* disease!
- First new drug approval to include species groupings by temperature!
- First drug approval to implement new Federal water quality benchmarks!
- Now the second drug designated under the provisions of the Minor Use Minor Species (MUMS) Act!

As this drug gains an expanding visibility and takes on even more uses in public and private aquaculture, many new users will have questions regarding the safe and efficacious use of the drug as an external microbicide on fish and their eggs. This brief presentation will offer interested users some highlights and tips on safety and effective handling of hydrogen peroxide. The presentation will highlight human and environmental considerations, safe storage and use considerations, as well as important considerations for use on finfish and their eggs.

Co-Tribal Management: Snake River Fall Chinook

Bradley Hostetler, WDFW, Lyons Ferry Hatchery: General Practices For Rearing Fall Chinook

Scott Everett, Nez Perce, Nez Perce Tribal Hatchery Fall Chinook Supplementation

Mike Key, Nez Perce, Nez Perce Tribe Fisheries Fall Chinook Acclimation Project

Deborah Milks, WDFW, Lower Granite Dam run reconstruction: Anyone Have An Easy Button?

Mark Schuck, WDFW, Lyons Ferry Hatchery Production of Snake River Fall Chinook: A Qualified Success Story.

Co-Management of the Snake River Fall Chinook: Lyons Ferry Fish Hatchery - General Practices for rearing Fall Chinook Salmon

Bradley O. Hostetler*

Washington Department of Fish and Wildlife, Lyons Ferry Fish Hatchery, 13780 Hwy 261, Starbuck, WA 99359. hosteboh@dfw.wa.gov

Lyons Ferry Fish Hatchery fulfills a key role in rearing ESA-listed Snake River fall Chinook salmon. A complex spawning matrix is used to minimize the introduction of stray salmon into the broodstock and rebuild the run at large and returns to Lyons Ferry while maintaining the genetic integrity of the run. Rearing space issues are constantly present to ensure that fish size and densities are not exceeded. Multiple co-managers are involved with this particular stock of fish, and they must work closely together to ensure success of the programs in the Snake River basin. I will present some of the unique challenges that we as culturists are faced with to produce a quality product with everyone's best interest in mind.

Co-Management of the Snake River Fall Chinook: Nez Perce Tribal Hatchery Fall Chinook Supplementation

Harold Harty, Scott Everett* and Shawn Wheeler

Nez Perce Tribe, Department of Fisheries Resources Management, Nez Perce Tribal Hatchery, 18985 Hubbard Gulch, Juliaetta, ID 83535. scotte@nezperce.org

The Nez Perce Tribal Hatchery Complex (NPTHC) responds directly to the need to mitigate the effects of the Federal Columbia River Hydropower System on naturally-reproducing salmon. The National Marine Fisheries Service (NMFS) listed the Snake River fall Chinook salmon as "threatened" in 1992 in accordance with provisions of the Endangered Species Act. Snake River fall Chinook salmon are considered part of a single genetically similar aggregate and managed as a single population. NMFS included the Clearwater River Subbasin fall Chinook salmon as part of the evolutionarily significant unit (ESU).

The NPTHC was approved for construction to rear and release sub-yearling fall Chinook salmon in the Clearwater River Subbasin. Funding for operation is provided by Bonneville Power Administration. The overall goal is to produce and release fish that will survive to adulthood, spawn in the Clearwater River subbasin and produce viable offspring that will support future natural production and genetic integrity. The original design target production for NPTHC was 2.8 million fall Chinook sub-yearlings. A two phase development process was approved by the Northwest Power Planning Council. Phase I production goals were set at 1.4 million fall Chinook sub-yearlings and biological triggers established for the implementation of Phase II.

The NPTHC program is integrated with production at Lyons Ferry Hatchery, the Fall Chinook Acclimation Program, and the Idaho Power Company's mitigation project. Currently, broodstock for the fall Chinook program is obtained from two primary sources: volunteers to the ladder/trap at NPTHC and adults collected at Lower Granite Dam. The Nez Perce Tribe and Lyons Ferry Hatchery share adults collected at Lower Granite Dam, annually working out an allocation and transport schedule.

The NPTHC central incubation and rearing facility is located on the mainstem Clearwater River. In addition, the fall Chinook program utilizes one early/intermediate rearing facility and three remote acclimation sites for final rearing and release. Juvenile releases of fall Chinook salmon began in 2003. During the first four years of operation, several factors have restricted production. Limiting factors include broodstock shortage, system operation failures, construction modifications to the surface water intake and filter systems, and ground water and chilled surface water yield has been below their initial output estimate.

Adult returns from NPTHC releases began with jacks returning in 2004, and the first adults observed in 2005.

Co-Management of the Snake River Fall Chinook: Nez Perce Tribe Fisheries Fall Chinook Acclimation Project

Mike Key*

Nez Perce Tribe, Department of Fisheries Resources Management, Nez Perce Tribal Hatchery, 18985 Hubbard Gulch, Juliaetta, ID 83535.

Snake River Fall Chinook Salmon are listed as a threatened species under the Endangered Species Act. As late as the 1930's, fall Chinook returns numbered 70,000 adults and were widely distributed from the mouth of the Snake River upstream to Shoshone Falls in southern Idaho (615 miles). Construction of the Hells Canyon Dam Complex and the Lower Snake River dams eliminated or severely degraded 530 miles of habitat resulting in an abrupt decline and the threat of extinction. From the mid 70's to the mid 90's fewer than 1,000 fall Chinook adult returned over Lower Granite Dam each year (only 78 wild adults returned in 1990).

A hatchery program for Snake River fall Chinook salmon was started at Lyons Ferry Hatchery (near Little Goose Dam) in the 1980's. This program served to prevent the extinction of fall Chinook in the Snake River but it did not increase adult returns above Lower Granite Dam because all of the juvenile releases occurred at Lyons Ferry Hatchery – 37 miles downstream of Lower Granite Dam and 70 miles downstream of Lewiston. The Nez Perce Tribe along with their co-managers, the Confederated Tribes of the Umatilla Indian Reservation, Washington Department of Fish and Wildlife, Idaho Department of Fish and Game, Oregon Department of Fish and Wildlife, and U.S. Fish and Wildlife Service, have developed a hatchery supplementation program for Snake River fall Chinook upstream of Lower Granite Dam. This highly coordinated program involves acclimation of fall Chinook at three acclimation facilities operated by the Nez Perce Tribe; Captain John Rapids and Pittsburg Landing facilities, which are located on the Snake River between Asotin, WA and Hells Canyon Dam and Big Canyon facility is located on the Clearwater River. Funding for operation of the Fall Chinook Acclimation Project (FCAP) is provided by Bonneville Power Administration. The FCAP facilities receive 450,000 yearling smolts and upwards of 1.4 million sub-yearling smolts from Lyons Ferry Hatchery annually. Juvenile fall Chinook are acclimated for 4-6 weeks prior to their release.

Juvenile releases from the FCAP facilities began in 1996 and the first adult returns were observed in 1998. Thereafter, the number of adult fall Chinook returns at Lower Granite Dam increased from less than 1,000/year to over 14,000 in 2006. Adult fall Chinook salmon that were released as juveniles from the FCAP facilities are displaying a strong homing fidelity to their acclimation sites - they return to, and spawn in an area of the river near where they were acclimated and released. Redd counts in the Snake and Clearwater rivers have increased substantially since the initiation of the FCAP project. Adult fish that spawn naturally will aid in increasing the abundance of the natural-origin population and assisting in recovery of Snake River fall Chinook salmon.

Not only will the fish released from FCAP facilities aid in ESA recovery of the Snake River fall Chinook, they also help support Columbia River and ocean fisheries. Recent coded wire tag recoveries of FCAP adults show that about 30% are harvested in the mainstem Columbia River and ocean fisheries. Adult returns have been so encouraging in recent years that co-managers are considering a fishery in the Snake River - something that has not occurred in over 20 years.

Co-Management of the Snake River Fall Chinook: The Reconstruction of the Fall Chinook Run at Lower Granite Dam: Anyone have an Easy Button?

Deborah J. Milks*

Washington Department of Fish and Wildlife, Snake River Lab, 401 S. Cottonwood, Dayton, WA 99362. milksdjm@dfw.wa.gov

Fall Chinook salmon trapped at Lower Granite Dam are not only used for broodstock they are also used to estimate the run composition (age and origin) of fish returning to spawn above Lower Granite Dam. Fish Trapped at the dam are shipped to Lyons Ferry Hatchery, Nez Perce Tribal Hatchery, or they are released to continue their journey upstream. An accurate accounting of each fish trapped at the dam is not only important for documentation of the status of ESA listed fish, it is important for determining the numbers of fish returning from the LSRCP and Idaho Power mitigation programs. To accomplish these tasks coordination occurs between WDFW, NPT, NOAA, IPC, and the USCOE. I will describe the challenges and methodologies involved in estimating the run composition of fall Chinook to a large river system.

Co-Management of the Snake River Fall Chinook: Lyons Ferry Hatchery Production of Snake River Fall Chinook: A Qualified Success Story.

Mark L. Schuck*

Washington Department of Fish and Wildlife Snake River Lab., 401 South Cottonwood, Dayton, Washington, 99328. schucmls@dfw.wa.gov.

The Lower Snake River Compensation Plan (LSRCP) includes production and release of yearling and subyearling fall Chinook smolts from several sites throughout the lower Snake River. This program was designed to mitigate for losses to the fall Chinook population because of construction and operation of the four Lower Snake River power dams. The now ESA listed natural population, and the hatchery population that was built from native fish trapped within the basin, are a high priority for state, federal and Tribal managers. Hatchery programs have increasingly come under scrutiny as fishery managers and researchers consider whether they are part of the problem or part of the solution. Management and determining the best actions to recover these fish has often been contentious, but cooperative efforts within the basin have resulted in a management plan for the hatchery program, and regularly scheduled coordination meetings of the involved parties to discuss and resolve production, management and research issues. I present a background and current status for the program, the challenges that have been over come through cooperation, and the complex suite of problems that remain to be solved if these great fish are to be preserved under the ESA, and more importantly, available for harvest far into the future.

Co-Tribal Management: Grande Ronde Spring Chinook

Diane Deal, ODFW, Lookingglass Fish Hatchery Operations

Michael McLean, Confederated Tribes Of The Umatilla Indian Reservation, The Captive and Conventional Production Components

Peter Cleary, Nez Perce, Monitoring And Evaluation Of The Supplementation Strategy

Brad Smith, ODFW, Fishery Management And Evaluation Plan

Co-Management of the Grande Ronde Endemic Spring Chinook Supplementation Program: Lookingglass Fish Hatchery Operations

Diane E. Deal

Oregon Dept. of Fish & Wildlife/Lower Snake River Compensation Plan, 76657 Lookingglass Rd.Elgin, OR 97827, Diane.E.Deal@state.or.us

Lookingglass Fish Hatchery, operated by the Oregon Department of Fish and Wildlife (ODFW), was constructed in 1982 as part of the Lower Snake River Compensation Plan. The Grande Ronde hatchery program was to mitigate for lost production caused by the four lower Snake River dams.. Co-managers modified the program through the Bonneville Power Administration's Fish and Wildlife program to include supplementation components, and initiated the Grande Ronde endemic spring Chinook supplementation program. In 1995, the first juvenile spring Chinook salmon were collected for use in the captive broodstock component of the program. In1997; the first adults were collected for broodstock in the conventional hatchery component. Currently, co-managers use Lookingglass Hatchery to produce Lookingglass Creek, Lostine River, Catherine Creek, and Grande Ronde River spring Chinook salmon, as well as the Imnaha River. Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and Nez Perce Tribe (NPT) operate adult collection and acclimation facilities on the tributaries of the Grande Ronde River were the adults were collected. The CTUIR primary focus is on Catherine Creek and upper Grande Ronde River, while the NPT focus is on the Lostine River. All co-managers assist with spawning, marking, and other miscellaneous tasks and Lookingglass Hatchery. I present a brief description of Lookingglass Fish Hatchery operations, describe hatchery responsibilities in context with the larger Grande Ronde spring Chinook endemic supplementation program, and provide release summaries of captive brood and conventional brood production for Catherine Creek, Lostine River, and Upper Grande Ronde.

Co-Management of the Grande Ronde Endemic Spring Chinook Supplementation Program: The Captive and Conventional Production Components

Michael L. McLean*

Confederated Tribes of the Umatilla Indian Reservation Department of Natural Resources Fisheries Department, 62415-A Hwy 82, La Grande, OR 97850. mmclean@uci.net

The spring Chinook salmon supplementation program in northeastern Oregon is very complex and requires the cooperation of State and tribal governments, as well as the federal government. Captive broodstock production is one of the two components of the supplementation program. Parr are collected from Catherine Creek, Lostine River, and upper Grande Ronde River for the program. The collection is a coordinated effort by the Oregon Department of Fish and Wildlife (ODFW), the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), and the Nez Perce Tribe (NPT). The rest of the captive broodstock rearing process is accomplished with cooperation from all of the entities involved. The second component of the program is the conventional hatchery production. Adult collection weirs, which are operated by the CTUIR on the upper Grande Ronde River and Catherine Creek, and by the NPT on the Lostine River, collect adult broodstock from adult returns and monitor the escapement into the tributaries. The adults are transported to Lookingglass Hatchery operated by ODFW for holding and spawning. The tribes and the state work together to spawn the adults held for the program. Smolts from Lookingglass Hatchery are trucked to the tributary acclimation facilities which are operated by the CTUIR on the upper Grande Ronde River and Catherine Creek, and by the NPT on the Lostine River. The fish are held for a week before they are allowed to volitionally leave the facility. The fish are forced from the facility after about one month of total acclimation time.

Co-Management of the Grande Ronde Endemic Spring Chinook Salmon Supplementation Program: Monitoring and Evaluation of the Supplementation Strategy

Peter J. Cleary and James R. Harbeck*

Nez Perce Tribe, Department of Fisheries Resources Management, Enterprise Field Office, 612 SW 2nd Street, Enterprise, Oregon 97828. peterc@nezperce.org and jimh@nezperce.org

Chinook salmon (*Oncorhynchus tshawytscha*) serve as a powerful cultural and social symbol for tribal and non-tribal people of the Pacific Northwest. Yet despite the significance of this icon, there have been widespread and dramatic declines in Chinook salmon populations over the last century. These declines were also witnessed in the salmon populations of northeast Oregon. In response, co-managers of this resource have used several management strategies to help reverse the decline including the use of supplementation. The Nez Perce Tribe, Confederated Tribes of the Umatilla Indian Reservation, and the Oregon Department of Fish and Wildlife believe that supplementation may be capable of increasing natural production, but the recovery benefits of supplementation are not universal and can be highly uncertain. Therefore, monitoring and evaluation are integral in managing the risks associated with supplementation and are the mechanisms whereby managers and policy makers are informed of results.

Supplementation activities began in the 1990s in the Grande Ronde Subbasin to assist ESA listed populations of Chinook salmon. Co-managers use a two-strategy approach to supplementation; a captive broodstock program and a conventional style hatchery program. Monitoring and evaluation coincide with both supplementation strategies. The objectives of the Grande Ronde program are to increase abundance and productivity of the target populations without altering life history traits that allow adaptation to the local environment. Abundance, productivity and life history are assessed during supplementation efforts comparing the performance of natural and hatchery origin salmon. Here, we present results specific to the Lostine River as an example of monitoring and evaluation in the Grande Ronde Subbasin. Similar methods are used by co-managers in the upper Grande Ronde River and Catherine Creek with comparable results.

The number of hatchery Chinook salmon juveniles released in the Lostine River from 1999 to 2007 ranged from 11,738 to 250,251. Juvenile hatchery Chinook salmon were larger than juvenile natural Chinook salmon. Natural Chinook salmon survival from the Lostine River to Lower Granite Dam ranged from 51.5 % to 77.2%, while estimates for hatchery Chinook salmon ranged from 43.2% to 70.2%. Prior to adult returns of hatchery Chinook salmon, escapement in the Lostine River ranged from 100 to 160 Chinook salmon from 1997 to 1999. After supplementation, adult escapement ranged from 390 to 1,555 Chinook salmon from 2000 to 2007. The age structure of hatchery Chinook salmon from brood years 1997 to 2002 was similar to natural Chinook salmon. However, the average proportion of age 3 hatchery Chinook salmon returning from brood years 1997, and 2000 to 2002 for the conventional program, and of age 3 hatchery Chinook salmon returning from brood years 1998 to 2002 for the captive program was higher (26.0% and 15.5%, respectively) than the average composition of age 3 natural Chinook salmon (5.6%) returning from brood years 1997 to 2002.

Co-Management of the Grande Ronde Endemic Spring Chinook Supplementation Program: Fishery Management and Evaluation Plan

Brad Smith, District Biologist, Enterprise

Oregon Dept. of Fish & Wildlife, 65495 Alder Slope Road, Enterprise, OR 97827, Brad.Smith@state.or.us

The Grande Ronde endemic spring Chinook hatchery program is managed under a complex framework that includes US vs. OR court decisions, co-manager agreements, and congressional legislation. The program currently attempts to integrate recovery of Chinook populations and provide fishery mitigation. Recently, the program has expanded to provide small C/S fisheries to both the Nez Perce Tribe and Confederated Tribes of the Umatilla Indian Reservation. The expectation of program is to provide larger tributary fisheries to both Tribal and non-Tribal fishers.

I present data for Catherine Creek, Upper Grande Ronde, and Lostine River populations in terms of "critical" and "viable" thresholds that I used to determine surplus and identify potential harvest opportunities. In addition, the presentation will identify non-tribal fishery areas, seasons, harvest monitoring plans, and proposed impacts to hatchery and wild origin spring Chinook at various population thresholds.

Applied Aquaculture II

Michael Hogansen, ODFW, Rearing Wild Bull Trout Fry At Leaburg Hatchery

Tyler LeBard, ODFW, Lightweight, Portable Scale Hanger: Sampling Made Simple

Anitra Firmenich, ODFW, Use Of Flow-Thru Heated Water Method For Shocking Rainbow Trout Eggs To Induce Triploidy

Matthew Bleich, HDR FishPro, Development Of A Model For Predicting Effluent And Treatment Options In Flow-Through Hatchery Systems

Charles Pratt, ADFG, Artemia And Cyclopeeze Fill Void Left By BioKyowa In The Intensive Early Rearing Of Arctic Grayling (Thymallus Arcticus).

Steve Reifenstuhl, NSRAA, Alaska Enhancement Program

Jim Seeland, Consultant, Innovative Chinook Rearing Strategies at the Medvejie Salmon Hatchery / Sitka, AK

Rearing Wild Bull Trout Fry at Leaburg Hatchery

Michael Hogansen*, Mark Wade, Vince Tranquilli and Timothy Wright

Oregon Department of Fish and Wildlife, Leaburg Hatchery, 90700 Fish Hatchery Road, Leaburg, OR 97489.
Michael.J.Hogansen@state.or.us

The Upper Willamette Bull Trout Working Group coordinated a multi-year effort to reestablish a viable population of bull trout in the Middle Fork Willamette Basin. As one element of that effort, we transferred a total of 10,408 bull trout fry from the McKenzie River into the Middle Fork Willamette upstream of Hills Creek Reservoir. Although transfers of fry produced some adults, concern about the status of bull trout in Anderson Creek limits the number we of fry we can take, and snow often blocks access to some desired release sites when the fry are available. To overcome these limitations, we developed a new approach in 2007. Instead of a direct release, we reared the bull trout fry at Leaburg Hatchery to increase their survival and so that we could release them when the desired locations were accessible. We brought 300 wild fry from Anderson Creek to Leaburg hatchery in March and April 2007, and released 231 into Swift and Bear creeks in the Middle Fork Willamette Basin in October 2007. This presentation will discuss the collection, rearing techniques, growth, tagging and liberation of these bull trout.

Lightweight, Portable Scale Hanger: Sampling Made Simple

Tyler LeBard*

Oregon Department of Fish and Wildlife, Roaring River Fish Hatchery, 42279 Fish Hatchery Dr. Scio OR 97374.
tyler.lebard@state.or.us

At Roaring River Hatchery when pond sampling needed to be done that meant lugging around from pond to pond a heavy steel ladder with a scale hanger attachment built onto it. I saw a need to simplify and speed up our fish sampling procedures. My answer was to fabricate a new type of scale hanger. This new hanger is lightweight, less than 4 pounds yet it can support loads in excess of 200 pounds. It locks into grip strut which allows it to be placed anywhere along the pond. It can also be moved from one pond to another without detaching the scale from the hanger. The design is simple and it can be affordably fabricated from materials some hatcheries may already have.

Use of Flow-Thru Heated Water Method for Shocking Rainbow Trout Eggs to Induce Triploidy

Anitra Firmenich*

Oregon Department of Fish and Wildlife, Roaring River Fish Hatchery, 42279 Fish Hatchery Drive, Scio, OR 97374.
Anitra.Firmenich@state.or.us

One of the greatest challenges of working in fisheries science is finding a balance between producing a great fishery for anglers while protecting the integrity of native species of fish. For some time, researchers have been experimenting with triploid induction in an attempt to achieve this balance. There are a number of methods employed to induce triploidy yet none, to date, have yielded consistent enough results for standardization. This barrier to consistency exists because a multitude of environmental, biological, social, and economic variables are at play. At Roaring River Fish Hatchery, we have been experimenting with triploid induction utilizing heat shock in the Cape Cod stock of rainbow brood trout eggs for 4 years. Overall, we have seen inconsistent triploid induction rates with the low being 80% and the high being 98% with approximately 39% mortality rates to fry stage. Although these statistics do not warrant the use of heat shock for inducing triploidy, considerable research on methods for producing sterile fish continues. Therefore, the staff at Roaring River Hatchery has chosen to share a unique heat shock method, the flow through method. Traditionally, heat shock has occurred in a hot water bath in which the eggs are submerged. At Roaring River Hatchery, a hot water heater and a standard garden hose hooked to a river water spigot bring hot and cold water to a mixing box. The cold water can be adjusted until the desired heated water temperature for shocking is reached. A pump moves the heated water into a hose hooked up to a manifold which in turn sends heated water into three separate hoses which can than be placed into an incubation stack at desired locations. The staff at Roaring River Hatchery believes that there are a number of benefits to utilizing this method over the heated bath method. The benefits include: allowing large scale production to continue at a fast pace, providing continual hot water movement through the eggs, enabling less handling and possibly decreasing handling-caused mortality to the eggs, and saving space as well as money. The future of fisheries depends on finding a way to lessen the negative impacts of human interference on natural systems while taking into account human needs. Producing sterile fish may be one of the ways we can help.

Development of a model for predicting effluent and treatment options in flow-through hatchery systems

Matthew D. Bleich,* Keith Underwood and Jason Hill

HDR|FishPro, 4717 97th Street NW, Gig Harbor, Washington 98332, matthew.bleich@hdrinc.com

Aquaculture based water pollution is currently under considerable scrutiny by state environmental authorities and the U.S. Environmental Protection Agency. Aquaculture effluents contain solid and dissolved wastes, which may harm sensitive receiving waters. However, the economic effects of treating effluents can impose high costs on aquaculture businesses, depending upon the treatment options selected. In this study a model was generated to predict waste load entering the outfall of a typical flow-through hatchery under various treatment alternatives, taking into account inputs from the water sources and feed introduced to the hatchery. Treatment alternatives considered included: vacuuming raceways once every seven days; removing settled waste from raceways once per day using a self cleaning system such as baffles; filtering waste from the water column using 60 µm pore size disc filters in conjunction with vacuuming once every seven days; deposition of solids removed from raceways in a clarifier; and secondary polishing of decanted water from the clarifier in an engineered wetland.

The model was developed for evaluation of treatment options and took into account Best Management Practices recognized by hatchery operators worldwide. It incorporates the most recent published findings on waste generated in soluble and solid forms for nitrogen and phosphorus and relates these measures to current regulatory standards. Additionally, the model includes a metric to predict the effects of the rate of decomposition of settled solids and the resulting effectiveness of the alternatives considered. Using Chinook salmon as an example, and the model to predict waste load entering the outfall, we have found that even under conditions in which no treatment alternative is used the concentration of wastes is below (2.17 mg/L) current, concentration based, state regulatory standards (5.0 mg/L of TSS produced for a monthly average). This is mostly due to the fact that Chinook salmon require a large volume of water to meet minimum biological requirements, resulting in a higher level of dilution for wastes produced. Waste predicted to enter the outfall using treatment options of vacuuming once every seven days, solid waste removal once per day (using a system such as baffles), and using disc filters combined with vacuuming once every seven days are 1.45, 0.91 and 0.72 mg/L of TSS for a maximum monthly average, respectively. Overall, the most efficient waste removal alternative as predicted using the model is the combination of vacuuming once every seven days and using 60 µm disk filters. However, for slightly less waste removal benefit, a once daily settled solids removal system such as baffles presents a better benefit when considering the capitol and operation and management costs.

Artemia And Cyclopeeze Fill Void Left By BioKyowa In The Intensive Early Rearing Of Arctic Grayling (Thymallus Arcticus).

Chuck Pratt*

Alaska Department of Fish and Game, Fort Richardson Hatchery, Broodstock Development Center, Box 5267, Fort Richardson, AK 99508 charles.pratt@alaska.gov

Early rearing is a critical time during the intensive aquaculture of Arctic grayling (*Arcticus Thymallus*). Due to their small size (.01g) at hatch, it is vital that during the first few days of swim up Arctic grayling receive proper feeds. Kindschi and Barrows (1990) identified BioKyowa B as the feed of choice. At Fort Richardson Hatchery, while using BioKyowa B the ponding to fry survival rate from 2000 to 2003 averaged 66% (56% to 79%). Unfortunately, the importation of BioKiowa feeds to the United States was stopped in early 2002 due to mad cow disease in Japan. The feed was available in limited sizes and quantities for the rearing seasons of 2002 and 2003. The use of Moore Clark's Nutra Plus Mash in 2004 and Skretting's Gemma feeds in 2005 resulted in poor (17% and 7% respectively) ponding to fry survivals. In 2006 and 2007, the use of live, newly hatched Artemia and freeze-dried Cyclop-eeze® during the first 10 days of feeding before introducing Skretting's BioVita yielded improved (49% and 60% respectively) survivals. This paper discusses a brief history of the Alaska Department of Fish and Games' Arctic grayling culture for the sport fish enhancement program, reviews historic survivals, discusses the culture techniques currently in use and outlines areas for future investigations.

Diets for the Intensive Culture of Arctic Grayling in Montana GREG A. KINDSCHI and FREDERIC T. BARROWS *The Progressive Fish-Culturist*
Volume 52, Issue 2 (April 1990) pp. 88–91

Alaska Enhancement Program

S. Reifenstuhl*

Northern Southeast Regional Aquaculture Association (NSRAA) 1308 SMC Rd., Sitka, Alaska, 99835 email: steve_reifenstuhl@nsraa.org

Modern-day enhancement in Alaska was initiated in the early 1970's by the Alaska Department of Fish and Game (ADF&G), facilitated by an infusion of tens of millions of dollars during the peak of the oil boom. As oil revenue diminished in the mid-1980's the state legislature shut off the money spigot to ADF&G; cutting the entire division running the fifteen hatcheries ($15 million operating budget). The department offered the programs to the recently formed nonprofit enhancement organizations or in some cases mothballed the multimillion dollar facilities. Since the mid-80's, regional not-for-profit associations with oversight boards of commercial fishermen have been conducting the enhancement programs; a public function performed by federal, state, or provincial governments elsewhere in the United States and Canada. Funding for the programs is generated by a 1% to 3% self imposed tax on all commercially landed salmon and sale of hatchery generated salmon. In the past twenty years this unique program has provided salmon worth over a billion dollars to commercial fisheries, hundreds of millions of dollars in value to sport fisheries, and untold enjoyment to personal and subsistence users.

There are 30 non-profit hatchery facilities throughout Alaska, primarily concentrated in Prince William Sound and Southeast Alaska. Most facilities are located at ocean tidewater adjacent to a high volume, barriered, non-anadromous stream with high elevation lake for gravity flow water supply. The program is regulated by ADF&G with stringent genetics, pathology, sustainable salmon, and fish transport policies. For example, release sites are located away from wild stock systems to allow 100% harvest of the returning salmon in terminal areas, all releases must be discretely marked for identification, and only local stocks may be used in the development of the hatchery broodstock. Transport of stocks across regional geographic areas is prohibited.

ADF&G managers are statutorily mandated to manage for wildstock escapements on a maximum sustained yield basis without consideration of the hatchery programs. Since the mid-1970's when wildstocks were at an all time low, harvest and escapement of wild salmon has increased to record levels in the mid-1990's and 2000's. Enhanced salmon harvests have increased dramatically during this same period. In 2005, 200 million salmon were harvested statewide, with 27% from the enhancement program. The world renowned Alaska salmon management system garnered the London based Marine Stewardship Council's (MSC) sustainable fisheries label in 2000, which not inconsequentially is the largest geographic area under certification.

A specific area of discussion in this talk is the development of the Chinook enhancement program. In 1985 the U.S./Canada Salmon Treaty was signed, in which the Alaska Troll fleet gave up future harvest opportunities to conserve Chinook salmon bound for Canada and the Pacific Northwest states. Mitigation came in the form of funds over the next 10 years to develop enhancement programs with a goal of producing 100,000 chinook; a number estimated to be commensurate with the lost harvest.

Innovative Chinook Rearing Strategies at the Medvejie Salmon Hatchery / Sitka, AK

Jim Seeland*

Fisheries consultant, 312 Cascade St., Sitka, AK 99835; phone: 907-738-1190; email: jseeland@gci.net

Federal, State and PNP hatcheries worked cooperatively during the 1970 and 1980's to develop Chinook enhancement in Alaska. Using technology developed at NMFS's Little Port Walter (LPW) facility, Northern Southeast Regional Aquaculture Association (NSRAA) embarked upon a program to enhance chinook salmon stocks in 1981. Sitka was a logical base of operations due to the presence of NSRAA's newly-established Medvejie Salmon Hatchery. Sitka was also the center of the Alaska Power Troll fleet for chinook salmon.

The community of Sitka is located on the outer coast of Baranof Island in southeast Alaska. There are no river systems large enough to support a wild chinook stock on Baranof Island so initially NSRAA worked with two mainland stocks, Chickamin River (available from NMFS) and Andrews Creek (available from AK Dept. of Fish and Game). The first Andrews Creek gametes were taken in 1981 and flown to the Medvejie Hatchery.

The initial release of 25,000 smolts in 1983 has grown to releases of nearly 5 million in 2007. Through the years many new techniques and rearing strategies were developed to attain the current release numbers. Some examples of these techniques are: ultraviolet sterilization units, recirculation systems, use of a saltwater lensing system, otolith marking, use of Marical's SeaReady process, use of alternative rearing sources to promote fall smolting and many varieties of incubation and rearing strategies.

Throughout the development of the program, the private non-profit system acted as a stimulus for innovation and rapid project completion which in turn provided a sense of fiscal awareness and project ownership among those involved. Extensive use of local knowledge as well as networking with other agencies doing similar work in Alaska, British Columbia, Washington and Oregon has been and will continue to be fundamental to the program's success.

The Alaska Department of Fish and Game (ADFG) provides extensive support to PNP operations in many areas. Charged with protecting wildstocks throughout the state, ADFG reviews all permits and holds private non-private agencies accountable. Additional assistance comes from the ADFG Fish Pathology division which provides routine diagnostics for all PNP's. The ADFG Pathology Department has been highly supportive over the years and encourages communication from those in the field. The ADFG Tag and Otolith Lab are fundamental to the success of NSRAA's chinook program by providing rapid and highly accessible data to evaluate the various programs. ADFG also helps evaluate the interaction of hatchery and Wildstock. Since most PNP's generate operating revenue from the sale of returning adult salmon, cooperation with ADFG is critical.

NWFCC 2007 Enhancing Fisheries Creating Opportunities

Posters

Ron Twibell, USFWS, Evaluation of Commercial Diets for First-Feeding Spring Chinook Salmon (Oncorhynchus tshawytscha)
Ewann Berntson, NOAA, Salmon Populations Dance The Metapopulation Limbo: How Low Can They Go?
Mike Grover, ODFW, Diamond Lake Restoration Project - Post treatment public education for prevention of invasive species and the tui chub monster.
Glenda O.Connor, ODFW, Use of ELISA for Monitoring Bacterial Kidney Disease in Naturally Spawning Chinook Salmon
Roger Warren, ODFW, Gnat Creek Hatchery Low Cost Oxygen Supplementation
Melissa Baird, NOAA, Conclusions about relative reproductive success in captive Chinook salmon are tempered by spatial and temporal variability: Finding the appropriate scale for interpretation
Clint Bentz, OAA, Oregon Aquaculture Association
Todd Hanna, MHCC, Mt. Hood Community College Fisheries Technology Program
Mike Mclean, Confederated Tribes of the Umatilla Indian Reservation, Spring Chinook Salmon Broodstock Marking Techniques Used In Northeast Oregon
John Schmitz, ODFW, Revisiting the Salt Floatation Method for Eyed Egg Picking Activities
Larry Ward, Lower Elwha Klallam Tribe, Use Of Native-Origin Brood For Winter Steelhead Restoration In the Elwha River Watershed
Larry Ward, Lower Elwha Klallam Tribe, The Elwha River Fish Restoration Plan: What are we going to do once the dams are gone?
Don Hair, ODFW, Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program: Cooperation at Work . A Multi-agency, Hatchery, Research and Management Project (Project Overview)
Tim Hoffnagle, ODFW, Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program: ODFW Fish Research
Chad Aschenbrenner, ODFW, Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program: Initiation of Feeding and Pre-Smolt Rearing at Wallowa Hatchery
Carlin McAuley, NOAA, Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program: Smolt to Adult Rearing
Marla Chaney, ODFW, Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program: Matrix Spawning at Bonneville Hatchery and Incubation of Eggs at Oxbow Hatchery
Peter J. Cleary, Nez Perce, Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program: Lostine River Spring Chinook Salmon F1 Smolt Stocking and Adult Returns
Mike McLean, Confederated Tribes of the Umatilla Indian Reservation, Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program: Upper Grande Ronde River and Catherine Creek Spring Chinook Salmon Juvenile Acclimation and Adult Collection
Derek Gibbs, ODFW, Leading Causes of Mortality for Oregon Captive Broodstock 1994-2002 Cohorts with an Emphasis on Bacterial Kidney Disease

Evaluation of Commercial Diets for First-Feeding Spring Chinook Salmon (Oncorhynchus tshawytscha)

Ron Twibell*, Ann Gannam, Susan Ostrand, John Holmes, Jeff Poole

U.S. Fish and Wildlife Service, Abernathy Fish Technology Center, 1440 Abernathy Creek Road, Longview, WA 98632. ronald_twibell@fws.gov

In 2006, the only commercial producer of a moist diet (~22-27% moisture) formulated for salmonids announced that it was being purchased by another fish feed company and this moist diet would no longer be produced. As this was the primary starter diet used in many Chinook salmon (*Oncorhynchus tshawytscha*) hatcheries, a feeding trial was conducted at Abernathy Fish Technology Center to identify an alternative starter diet. Five commercial diets, including Skretting BioVita, EWOS Micro, Rangen Starter, Rangen Soft-Moist starter and Silver Cup Soft-Moist starter were evaluated. Each dietary treatment was fed to quadruplicate groups of 200 randomly selected first-feeding spring Chinook fry reared in fiberglass tanks. Initial weight of the fish was 0.34 g/fish. The flow-through water supply was 12C throughout the 8-wk feeding trial. At the end of the study, fish fed Skretting BioVita exhibited significantly higher weight gain (1142%) and feed efficiency (1.9) compared with fish fed the other diets. Fish fed Rangen Soft-Moist exhibited significantly lower weight gain (541.7%) and feed efficiency (1.2) compared with fish fed all the commercial diets, with the exception of fish fed Rangen Starter (667% and 1.6, respectively). Survival rates were high (97-99%) and not significantly affected by dietary treatment. Carcass moisture and fat concentrations were significantly affected by dietary treatments. Generally, carcass fat concentrations were significantly higher and carcass moisture concentrations significantly lower in fish fed Skretting BioVita or EWOS Micro, compared with fish fed Rangen Starter, Rangen Soft-Moist or Silver Cup Soft-Moist and could be related to the proximate composition of each diet. Results of this study indicate that a moist starter diet is not needed to start spring Chinook or to obtain rapid weight gain and high survival rates of first feeding fry.

Salmon Populations Dance The Metapopulation Limbo: How Low Can They Go?

Ewann Berntson[1]* and Paul Moran[2]

[1]NOAA Fisheries, Northwest Fisheries Science Center, 7305 Beach Dr E, Port Orchard, WA 98366. ewann.berntson@noaa.gov
[2]NOAA Fisheries, Northwest Fisheries Science Center, 2725 Montlake Blvd E., Seattle, WA 98112. paul.moran@noaa.gov

Metapopulation structure and connectivity among breeding aggregates is fundamental to conservation genetics and the recovery and management of imperiled populations. Increasingly powerful suites of genetic markers are now available for fine scale studies of salmonid population structure. With this increasing power comes the ability to differentiate very closely related populations and to estimate gene flow and other population parameters at very fine geographic scales. Against such enormous statistical power, you must balance the reality of managing biological entities, both in terms of practical application (how does artificial propagation change relationships among natural populations) and in assessing the biological consequences of disrupting natural patterns of gene flow and population structure (how does natural productivity respond to such changes). In this study, we used a powerful microsatellite data set collected over multiple years to examine fine scale population genetic parameters in an *Oncorhynchus mykiss* population that includes anadromous and resident life histories. We find evidence of genetic subdivision at a scale of only a few kilometers rather than the tens or hundreds of kilometers that typically separated genetically isolated salmon populations. Although the biological significance of these statistical differences remains unclear, these data provide fundamental new insight into metapopulation structure and suggest population differentiation at geographic scales not previously recognized.

Use of ELISA for Monitoring Bacterial Kidney Disease in Naturally Spawning Chinook Salmon

Glenda O'Connor[1]* and Tim Hoffnagle[2]

[1]Oregon Department of Fish and Wildlife, Fish Health, 219 Badgley Hall, Eastern Oregon University, La Grande Oregon 97850. goconnor@eou.edu
[2]Oregon Department of Fish and Wildlife, N.E. Region Fish Research, 203 Badgley Hall, Eastern Oregon University, La Grande, OR 97850. tim.hoffnagle@eou.edu

Bacterial kidney disease (BKD), caused by *Renibacterium salmoninarum* (Rs), is a serious problem among Pacific Northwest salmon hatcheries. One concern, of many, is that salmon reared in hatcheries may spread BKD to natural populations when they return and spawn in nature. In order to monitor the potential spread of this disease to salmon spawning in nature, a method must be available to collect and analyze tissues from naturally spawning salmon. In this study, we document the ability to use enzyme-linked immunosorbent assay (ELISA) on kidney tissue collected from carcasses recovered from naturally spawning Chinook salmon.

Kidney tissue analyzed by ELISA is the standard method to detect the presence of Rs in salmon sampled in hatcheries. We compared ELISA optical density (OD) values from paired kidney tissue samples: one subjected to conditions that simulated decomposition in a carcass and collection during a spawning ground survey versus one treated as it would be if freshly collected from salmon at a hatchery. The simulated spawning ground survey sample was incubated at 16.0° C for 48 h to simulate the maximum temperature to which a salmon carcass in northeast Oregon is likely to be exposed prior to recovery (1 – 4 days in a stream with diel temperature fluctuating between 6-20° C), followed by 6 h in a drying oven at 27.8° C ($\pm$1.0° C) to simulate the time that a sample might spend in a backpack on a warm day while the survey was being conducted. Hatchery spawning samples were kept frozen until they were analyzed by ELISA.

Mean ELISA OD levels were 1.060 for the samples prepared by the normal preparation and 1.115 for samples prepared by simulating spawning ground survey collection. There was no significant difference in mean ELISA OD values between the two sample preparations. The relationship between the two samples was highly significant ($P < 0.0001$) and highly correlated ($r^2 = 0.925$), and the slope of the line (=0.946) did not significantly differ from 1:1 (P=0.3509).

These results demonstrate that BKD prevalence in naturally spawning salmon can be monitored using ELISA conducted on samples collected from intact (body cavity not exposed to the environment) carcasses recovered on spawning ground surveys. This will be an important tool for monitoring the effect of hatchery supplementation on naturally spawning salmon populations.

Gnat Creek Hatchery Low Cost Oxygen Supplementation

Roger Warren, Tod Jones

Oregon Department of Fish and Wildlife, Gnat Creek Hatchery, 92645 Gnat Hatchery Rd. Clatskanie, OR 97016
Clatsop County Fisheries, 2001 Marine Dr. Rm. 253 Astoria, OR 97103

Low cost oxygen supplementation of hatchery raceways allows for maintaining and even increasing pre-smolt production when raceway waters are reduced in flow and elevated in temperatures. Previous O2 supplementation programs have been too expensive and inflexible to allow for its application at facilities that experience constraints due to inadequate water supplies. This system is low cost for capital outlay and very inexpensive to operate.

Conclusions about relative reproductive success in captive Chinook salmon are tempered by spatial and temporal variability: Finding the appropriate scale for interpretation

Melissa Baird[1]*, Ewann A. Berntson[1], Timothy L. Hoffnagle[2], Steve Boe[3], Jim Harbeck[4], Peter Cleary[4], Richard W. Carmichael[2], and Paul Moran[1]

[1]National Marine Fisheries Service, Northwest Fisheries Science Center, Conservation Biology Division, 2725 Montlake Blvd E, Seattle, WA, 98112, Melissa.Baird@noaa.gov
[2]Oregon Department of Fish and Wildlife, LaGrande, Oregon
[3]Confederated Tribes of the Umatilla Indian Reservation, LaGrande, Oregon
[4]Nez Perce Tribe, Enterprise, Oregon

Captive broodstock propagation is an intensive intervention measure that was implemented in the 1990s to conserve and help recover three northeast Oregon populations of Snake River Chinook salmon (Oncorhynchus tshawytscha). Once productive and culturally important salmon populations had experienced a period of sustained declines and potential bottlenecks in naturally-spawning populations. This study seeks to understand the relative reproductive success of naturally- and artificially-produced fish of various classes and different ages (including jacks and precocial parr). We use microsatellite DNA markers to examine, not only average relative reproductive success for hatchery and wild fish, but also the specific matings that contributed to each cohort. The latter helps us infer mechanisms of any differential reproductive success we observe. Previous results showed much better success for artificially produced Chinook salmon than reported for steelhead (O. mykiss) in this system, but substantial variability between Chinook salmon populations and between years within rivers. In this phase of the study we add 2 more years of sampling in hope of clarifying early, highly variable results. Despite the potential management importance of relative reproductive success (to broodstocking, rearing and release strategies, allowable straying, etc), the variability of our results dictate that they be taken in an appropriate spatial and temporal context. On-going examination of ecological correlates may reveal relationships that explain variability observed here.

Oregon Aquaculture Association

Clint Bentz*

Clint Bentz, President 503-769-2186, Ext. 17, Kathy Bridges, Secretary 503-743-2931, www.oregonaquaculture.org

Oregon freshwater aquaculture producers formed this non-profit organization, 501(c)(4), for the following purposes:

- provide a medium of exchange of experiences and discussions of industry problems
- to promote public education
- to advocate just and proper laws and regulations that impact aquaculture
- to recommend research and education initiatives to research facilities and universities that will meet the current and future needs of the aquaculture industry
- to conduct any and all activities necessary for the advancement, promotion, expansion and well-being of the aquaculture industry in Oregon

Goals since its creation in 2004 include:

- sponsorship of four bills at the 2005 legislative session. One bill, SB 346, was enacted and modifies the definition of Exclusive Farm Use as including aquaculture as an agriculture activity
- helped create the Private Hatchery Committee with ODFW focusing on fish health, transportation permits and allowable species
- co-sponsored two statewide workshops about pond maintenance at Oregon Garden (2006) and OSU LaSells Stewart Center (2007). With OSU Extension Service, we will co-sponsor the 2008 Pond School in Sisters
- received $9,500 match from USDA Rural Business Enterprise Grant to complete a marketing analysis of freshwater aquaculture in Oregon. The study is being done by Dr. Ed Schmisseur, retired professor of agriculture economics from OSU and should be completed by early 2008
- co-sponsored fish disease workshop with ODFW fish pathology department at Oregon State University (2007)
- maintain web page highlighting producers for fish pond stocking, U-catch and fly-fishing

Mt. Hood Community College Fisheries Technology Program

Todd Hanna* and Tom Worchester

Mount Hood Community College, 2600 S.E. Stark Street, Gresham, OR 97030, 503-491-7163 hannat@mhcc.cc.or.us

The Mt. Hood Community College Fisheries Technology program has been training fish culturists for careers with the states of Oregon and Washington, the U.S. Fish and Wildlife Service, several Native American tribes as well as various other public and private entities for the past 35 years. Interest and enrollment in the program continues to be strong with approximately 15 graduates per year. Graduates of the program continue to be very successful in obtaining employment in the fish culture arena. The program continues to evolve, with the assistance of an active Advisory Committee, to meet the needs of the fish culture profession in the Pacific Northwest. This display will highlight and provide information on the Fisheries Technology program at Mt. Hood Community College.

Spring Chinook Salmon Broodstock Marking Techniques Used In Northeast Oregon

Mike McLean, Ryan Seeger, Laurie Hewitt

Confederated Tribes of the Umatilla Indian Reservation Department of Natural Resources Fisheries Department, 62415-A Hwy 82, La Grande, OR 97850. mmclean@uci.net

There is continual scrutiny being placed on hatchery programs in areas where listed stocks of fish are present. More and more hatchery programs are moving to endemic stocks for supplementation efforts. With this move comes more data collection and importance of tracking the broodstock from capture to spawning. In northeast Oregon we have made the switch to endemic broodstock with our spring Chinook salmon program. We have tried two methods of marking the broodstock collected for the program, PIT tags and Flex tags™. This poster describes some of the pros and cons with each method.

We injected the PIT tag into the cheek muscle of the fish. Tag loss for the PIT tag was minimal at 3%. Once the tag was injected there was no obvious sign that the tag was even in the fish. This was good as there was nothing that could get ripped off while the fish was in a net or a colorful tag hanging from the fish that could possibly change the behavior of the fish or others in the tank that are curious about the tag. The bad thing about the PIT tag was the lack of the immediate feedback you get from the fish. In order to read the tag you need a reader which can be difficult to setup and sometimes would not read the tag immediately. Overall the PIT tag is fairly expensive, requires a sharp needle to insert the tag, and requires the extra steps with computers and electronics to read the tag.

We applied the Flex tag to the opercle plate with a staple gun. Tag loss for the Flex tag was minimal at 2%. The Flex tag performed well, but some of the tags were in rough shape by the time of spawning after about three months and some fish had slight gill irritation. The Flex tags are relatively cheap and easy to apply to the fish. Since there are no electronics involved with the tag, there are no problems reading the tag but data must be hand entered and there would be a delay if you needed immediate recapture information. The biggest selling point for the Flex tag is the immediate feedback you can receive from the fish. In our case we had both hatchery and natural fish that were not finclipped. We used two different colors of tags for the fish so we could tell at a glance what the origin of the fish was. This was invaluable during the spawning process.

Revisiting the Salt Floatation Method for Eyed Egg Picking Activities

John Schmitz*

Oak Springs Hatchery, 85001 Oak Springs Road, Maupin, OR 97037 (541) 395-2546

The use of the salt bath floatation method has been a time proven, though somewhat forgotten, method of removing infertile eggs at the eyed egg stage. The proliferation of the mechanical egg picker has largely eliminated this alternative technique from the fish culture scene. However, with increasing emphasis on creating sterile, or triploided eggs; some facilities are finding a use for this alternative egg picking method.

The Oregon Department of Fish and Wildlife Oak Springs Fish Hatchery, located in Central Oregon, produces approximately 6 million rainbow trout eyed eggs for distribution throughout the state, supporting the bulk of fingerling plants in State lakes and reservoirs. The brood stock for these plants is a heavily domesticated captive stock, that was selected for fall spawning adults that produced fast growing juveniles, able to be out-planted as moderately large sized fingerlings (35-50 fish/lb.) the following spring. The egg quality from this stock has been mediocre, at best, throughout recent history, and has further deteriorated with the expanding emphasis being put on transferring more of the production to a triploided end product. This reduction in quality is not only shown by significant increases in egg loss to the eyed stage, post triploiding, but also by the dramatic increase in weak eyed eggs mixed in the population. Failure to remove these weak eyed eggs at this stage would likely increase the amount of chronic drop-out throughout the early rearing stage, and likely increase the potential for disease outbreaks.

The embryonic development in these eggs eliminates their ability to “shock out”, thereby rendering the electronic egg pickers’ advantage in their removal. Because of their large numerical presence post triploiding, hand picking has proven to be overly time consuming to achieve desired results. By placing the eyed eggs into a proper concentration salt solution (post shocking and mechanical egg picking), the weak-eyed or blank eggs will float on the surface of the solution, while the good eggs sink to the bottom. The bad eggs can then be skimmed off the surface and removed. This process greatly reduces the amount of time and labor required for hand picking or siphoning of eggs.

Use Of Native-Origin Brood For Winter Steelhead Restoration In the Elwha River Watershed

Larry Ward[1], Mike McHenry[1], Raymond Moses[1,] Marcia House[2] Gary Winans[3]

[1] Lower Elwha Klallam Tribe, 51 Hatchery Road, Port Angeles, WA 98363, larry.ward@elwha.nsn.us

[2] Northwest Indian Fisheries Commission, 6730 Martin Way East, Olympia, WA 98516, mhouse@nwifc.org

[3] NOAA Fisheries, Northwest Fisheries Science Center, 2725 Montlake Blvd East, Seattle, WA 98112 gary.winans@noaa.gov

Development of a new restoration population using natural-origin winter steelhead in the Elwha River is currently underway. This population is intended to replace supplementation efforts that have previously used a *naturalized* stock of steelhead originating from the Chambers Creek Hatchery (Washington Department of Fish and Wildlife, South Puget Sound). This new stock will be used to promote recovery of winter steelhead in the Elwha River following removal of the Elwha and Glines Canyon dams in 2012 and represents one of the first efforts on Washington State's North Olympic Peninsula to manage steelhead enhancement efforts on a watershed basis. Broodstock development will involve a minimum of four year-groups and will take up to 16 years to fully develop a new hatchery program. All enhancement and supplementation efforts will be terminated once naturally spawning populations reach self-sustainable levels.

The Elwha River Fish Restoration Plan (U.S. Dept. of Commerce, NOAA Tech. Memo, NMFS-NWFSC-00, 000 p. - *in press*) identifies this stock as best suited for restoration of winter steelhead in the Elwha River watershed. Design of protocols for capture, fish culture and releases has been developed through consultation and partnerships between the Lower Elwha Klallam Tribe, USFWS, NOAA, WDFW, NWIFC and NPS.

Steelhead redds are identified annually in April and May. Embryonic development is thermally tracked and redds are selected to be hydraulically pumped in June and July of the year. Harvested eggs and fry are transported to the Lower Elwha Hatchery where they are incubated and reared.

Each fish is photographed to document pigmentation and receives a PIT tag used to track the fish throughout its stay at the hatchery. A fin clip taken from each fish provides tissue for genotyping and parental lineage analysis. Fish health status is monitored at critical life history stages by staff from the NWIFC and routine diagnostic examinations coupled with rearing condition recommendations provide staff with critical direction to insure that stock quality is maintained throughout hatchery rearing.
Upon completion of parental lineage analysis, the number of fish reared at the hatchery is reduced to 300 fish per brood year. Fish excess to program goals are released into the Elwha River and 40 fish per release group receive radio telemetry tags to track post-release movement and behavior.

At age 4 fish will be spawned, their eggs incubated and reared to release as 1+ or 2+ smolts, depending upon maturation rates. Post-spawn adults will be reconditioned and released into the Elwha River.

Annual production goals for this program following dam removal range between 100,000 and 535,000 fish (age-1 smolts, age-2 smolts, eyed egg outplants, fry, and pre-smolts).

The Elwha River Fish Restoration Plan: What are we going to do once the dams are gone?

Larry Ward[1], Pat Crain[2]

[1] Lower Elwha Klallam Tribe, 51 Hatchery Road, Port Angeles, WA 98363, larry.ward@elwha.nsn.us

[2] Olympic National Park, 600 East Park Avenue, Port Angeles, WA 98362, Patrick_Crain@nps.gov

The Elwha River Fish Restoration Plan is a collaborative, multi-agency management plan written to achieve the goals of the Elwha River Ecosystem and Fisheries Restoration Act, *Public Law 102-495*. The *Fish Plan* is a comprehensive road map that describes how restoration of anadromous fish populations in the Elwha River basin will occur following the removal of the Elwha and Glines Canyon dams in 2012.

The *Fish Plan* establishes a dynamic framework for implementing, monitoring and adapting management actions to both physical and biological ecosystem responses in the Elwha River watershed. The stated objectives of the *Fish Plan* are:

- Reestablishing self-sustaining anadromous salmonid populations that can support identified levels of recreational, ceremonial and commercial harvest activities,
- Restoring the physical and biological processes of the ecosystem,
- Ensuring that the integrity and diversity of existing salmonid genetics and fish health is not altered adversely,
- Maintaining a rich diversity of observed life history strategies.

The *Fish Plan* chronicles the development of the plan and the stages that it passed through on it's way to becoming a formal NOAA Fisheries Technical Report. The *Fish Plan* presents the criteria used in the selection of stocks and the goals and strategies developed for implementation for fish restoration. Additionally, the *Fish Plan* discusses the rationale, design and use of hatcheries for stock supplementation.

Restoration strategies for fish restoration are divided into three phases: Before, during and after dam removal, with the emphasis and implementation of strategies varying from phase to phase and species to species. Strategies described in the *Fish Plan* are intended to be adaptive, changing based on observed responses of the various populations. Strategies found to be unsuccessful may be discontinued in favor of alternate options in an effort to assist in the production of healthy, naturally spawning populations. Restoration strategies identified in the plan include:

- Promote the natural spawning by adults,
- Production and release of age 0, age 1, and age 2 smolts for release in-basin and out of basin,
- Eyed egg outplants,
- Production and release of fry and age 0 smolts/presmolts upstream.

Identification and selection of fish stocks to be used in restoration efforts has been based on:

- Local availability within the watershed,
- Stock history and genetic composition,
- Current population size and,
- Availability of spawners.

Contingency plans for stocks extirpated from the watershed include the identification of potential donor populations in adjacent watersheds that may be mined to provide founder populations to the Elwha River if deemed appropriate.

The *Fish Plan* includes a strong monitoring component that identifies a suite of hypotheses used to test whether the plan's objectives listed above are being met. All management actions will be scrutinized regularly (annual/semi annual) to evaluate their effectiveness and determine if the actions are leading to objectives being met.

Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program: Cooperation at Work – A Multi-agency, Hatchery, Research and Management Project (Project Overview)

Don Hair* and Tim Hoffnagle

Oregon Department of Fish and Wildlife, N.E. Region Fish Research, 203 Badgley Hall, Eastern Oregon University, La Grande, OR 97850. dhair@eou.edu

This poster is an overview for a group of posters, each displaying information from specific portions of the Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program. This program was initiated in response to a sudden decline in spring Chinook salmon in the Grande Ronde Basin, including the program streams: Catherine Creek, the Lostine River, and upper Grande Ronde River. We have collected natural spring Chinook salmon parr from each of these three streams each year (except for 1996 and 2000 for the upper Grande Ronde River, when no fish were found) and reared them to maturity in captivity, at which time they are spawned. The resulting offspring are reared to the smolt stage, when they are released into the natal streams of their parents and allowed to complete their lives in nature. The success of the F_1 and F_2 generations is also monitored because the ultimate goal of the Captive Broodstock Program is to restore self-sufficient and naturally reproducing Chinook salmon populations to the program streams. The Captive Broodstock Program is a cooperative program between state (Oregon Department of Fish and Wildlife), federal (NOAA Fisheries), and tribal (Nez Perce Tribe and the Confederated Tribes of the Umatilla Indian Reservation) organizations that is funded by the Bonneville Power Administration and the Lower Snake River Compensation Plan (U. S. Fish and Wildlife Service). This presentation displays the geographical and organizational extent of the project, which includes four agencies in two states, and approximately 16 individual facilities or organizational units. Other posters present data from individual aspects of this collaborative program.

Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program: Initiation of Feeding and Pre-Smolt Rearing at Wallowa Hatchery

Chad Aschenbrenner

Oregon Department of Fish and Wildlife, Wallowa Fish Hatchery, 82119 Fish Hatchery Lane, Enterprise, Oregon. 97828. Chad.Aschenbrenner@state.or.us

The Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program is designed to rapidly increase numbers of salmon in stocks that are in imminent danger of extirpation. Parr are collected from 3 streams and reared to adulthood in captivity. The initial stage of this program occurs at Wallowa Fish Hatchery (WFH) where parr are reared until smoltification. Soon after collection the parr are introduced to pelletized feed. All groups are placed on Skretting Nutra Plus and Nutra Fry immediately upon receipt and remain on this food throughout rearing. To make the food more desirable we top coat the pelletized feed with Cyclopeeze (Artemia, with high concentrations of Astaxanthene) and freeze dried krill. WFH noticed decreased percent loss from drop-outs when the addition of Cyclopeeze and freeze dried krill was used in feeding initiation.

While at WFH the parr are PIT-tagged for individual identification and fin clips are taken for genetic monitoring.

In addition to the wild collected parr, eggs from wild parents are hatched and reared to smoltification at WFH. Adult Chinook are collected from the upper Grande Ronde River and held at Lookingglass Hatchery (LGH) until spawning. After spawning and initial incubation, eyed eggs are selected and transported to WFH for hatching and rearing. Comparisons will be made between the wild collected parr group and the hatched egg group.

WFH has two water sources, upper spring mean temp 47.3 °F, and well water mean temp 52.8° F. Programs were initially established using the different temperature profiles to manipulate growth; Natural Growth and Accelerated Growth protocols respectively. Currently parr are reared on upper spring water (Natural Growth) profile for the entire period at WFH.

All groups are subjected to a simulated natural photoperiod throughout rearing by using fluorescent lights with programmable timers. Two timers control the lighting to represent civil twilight (four lights in the room) and sunset/sunrise (twelve lights directly over the tanks).

At the time of smoltification fish are transferred to Bonneville Fish Hatchery for freshwater rearing and Manchester Marine Lab for saltwater rearing.

Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program: Smolt to Adult Rearing

Marla Chaney[1], Tim Hoffnagle[1], Carlin McAuley[2 *], Des Maynard[2], Tom Flagg[2]

[1]Oregon Department of Fish and Wildlife, Bonneville Fish Hatchery, 70543 NE Herman Loop, Cascade Locks, OR 97014.

[2]NOAA Fisheries, NWFSC, Manchester Research Station, 7305 Beach Dr E, Port Orchard, WA 98366. carlin.mcauley@noaa.gov, 360.871.8314

The Smolt-to-Adult Rearing component of the Chinook Captive Broodstock Program evaluated the effects of freshwater vs seawater environments on this phase of the life cycle. Included in the evaluation were parameters such as growth, survival, disease vectors, maturation rates, and reproductive success.

Rearing of the marine life history phase was conducted at two facilities: ODFW's Bonneville Fish Hatchery, located on the lower Columbia River, for freshwater rearing; and NOAA's Manchester Research Station, located on Puget Sound, for seawater rearing. Each facility utilized 20' diameter by 5' deep fiberglass tanks supplied with pathogen-free water. The freshwater at Bonneville Hatchery (10°C) was pumped from wells and the effluent was UV treated prior to discharge. The seawater at Manchester Research Station (7 - 13°C) was pumped from Puget Sound, filtered, and UV treated. Effluent was treated with ozone prior to discharge. Each facility reared three brood years of three 3 stocks each annually, with each brood year and stock reared separately.

In May of each year, 1996 - 2007 (BYs 1994 - 2005), smolts were transferred to Bonneville and Manchester facilities. Fish were fed a commercial diet 7 days/week. Handling was kept to a minimum due to the threatened status of these stocks. Twice yearly antibiotic (erythromycin) feedings and occasional injections were administered for disease control. Maturity sorts were conducted twice yearly, in April & May for yearling (age 3) and older (age 4 - 6) adults and in late July for precocial males (age 2). Beginning in 2002 ultrasound technology was utilized for early identification of maturation and gender. Maturing adults were immediately transferred to freshwater holding tanks at Bonneville for final maturation and spawning. Maturing adults were not fed from May to September and were held on fluctuating temperature surface water.

Survival, growth, and maturation rates, while generally similar, varied between the two rearing environments. Common to both, however, were reduced growth (adult size) compared to ocean returning stocks. Survival in both environments, while much higher than migratory stocks, was similarly and primarily affected by Bacterial Kidney Disease (BKD).

Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program: Matrix Spawning at Bonneville Hatchery and Incubation of Eggs at Oxbow Hatchery

Marla Chaney[1] *, Duane Banks[2], Mary Edwards[3]

[1]Oregon Department of Fish and Wildlife, Bonneville Fish Hatchery, 70543 NE Herman Loop, Cascade Locks, Oregon 97014, Marla.J.Chaney@state.or.us, 541-374 – 2255

[2]Oregon Department of Fish and Wildlife, Oxbow Fish Hatchery, 1200 SE Frontage Rd., Cascade Locks, OR 97014, Duane.D.Banks@state.or.us, 541-374-8540

[3]Nez Perce Tribe Department of Fisheries Resources Management, Enterprise Field Office, 612 SW 2nd Street, Enterprise, Oregon 97828. marye@nezperce.org, 541-426 – 6223

In 1995 a spring Chinook salmon captive broodstock program was initiated for three threatened populations in the Grand Ronde Basin: the Lostine River, Catherine Creek and upper Grande Ronde River. Each stock is reared and spawned separately. The first females spawned in captivity (age 4) in 1998, proceeded by the cryopreservation of ripe male sperm in 1996 and 1997.

Maturity sorts are conducted twice yearly, in April and May for yearling (age 3) and older (age 4 - 6) adults and in late July for precocial males (age 2). Beginning in 2002 ultrasonic imaging was employed to evaluate gonad development and gender identification. Fish identified as maturing are transferred to separate ponds, where they were transitioned from well water to Tanner Creek water and taken off feed. Maturing saltwater fish are transferred to Bonneville Fish Hatchery at this time and held with maturing freshwater fish through spawning.

Beginning in late August the mature fish are checked for ripeness with the first spawn generally occurring the first week of September and concluding the second week of October. Spawning matrices are developed to maximize diversity and minimize sibling crosses by utilizing males and females from different brood years. The optimal matrix is a 4 X 4 cross yielding 16 different matrix cell combinations. Gametes from males not incorporated into spawning matrices during the spawn season are cryopreserved and stored in an on site repository for future use when fresh males are limited. Sperm from each male is examined for motility prior to fertilization, ripe females are anesthetized, killed, racked and their caudal vein cut to minimize the presence of blood in the eggs. Females are spawned into a colander, ovarian fluid drained and the eggs divided into paper buckets according to the matrix design. Sperm is then added and activated with well water for 30 seconds. Eggs and sperm are rinsed with a 75 ppm solution of iodophore and allowed to water hardened for 45 minutes prior to transfer to Oxbow Fish Hatchery for incubation.

At Oxbow, the eggs are transferred from buckets to isolettes and incubated in separated matrix cells to eye up. Eyed eggs are shocked, picked and enumerated by matrix cell before being combined by female. The eggs of females are then grouped by BKD ELISA values and the higher value eggs are culled. Low ELISA value eggs are shipped to Lookingglass Fish Hatchery for rearing to smolt. The smolts are then transferred to acclimation facilities on their respective natal streams and released.

Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program: Lostine River Spring Chinook Salmon F_1 Smolt Stocking and Adult Returns

Peter J. Cleary* and James R. Harbeck

Nez Perce Tribe Department of Fisheries Resources Management, Enterprise Field Office, 612 SW 2nd Street, Enterprise, Oregon 97828. peterc@nezperce.org

The Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program was initiated in 1995 as a safety net measure to prevent extirpation of Chinook salmon in the subbasin after significant declines in the number of returning adults were observed over a period of five decades. This program collected and reared Lostine River juveniles in captivity to the adult life stage and released F_1 offspring back into their natal stream. The Nez Perce Tribe conducted monitoring of F_1 offspring in conjunction with monitoring and evaluation of a conventional hatchery program to quantify the benefits of the captive broodstock program as a safety net measure. The first release of 34,977 F_1 offspring into the Lostine River occurred in 2000 and subsequent releases of 24,604 to 141,860 smolts occurred from 2001 to 2007. Abundance, productivity, and life history traits of the returning F_1 captive broodstock Chinook salmon were recorded and compared to their natural Lostine River counterparts. The number of returning F_1 adults captured at the weir from 2001 to 2007 ranged from 25 adults in 2001 to 532 adults in 2004 and exceeded the number of returning natural Chinook salmon captured at the weir in 2004 and 2005. F_1 smolt-to-adult return rates were estimated as ranging from 0.19% for brood year 2002 to 1.65% for brood year 1998 and were lower than smolt-to-adult return rates estimated for natural Lostine River Chinook salmon. The average adult run timing of retuning F_1 adults at the weir was similar to the average run timing of adult natural Chinook salmon from 2001 to 2007. The average brood year age class structure of returning F_1 adults was similar to the age class structure of returning natural Chinook salmon in that the majority of adults returned at age 4. However, the proportion of returning age 3 natural Chinook salmon averaged only 5.6% for brood years 1998 to 2002 where as returning captive broodstock F_1 adults averaged 15.5% for brood years 1998 to 2002. As a safety net measure, the program demonstrated that it is possible to produce large numbers of hatchery smolts for release from a captive broodstock source that generate abundant adult returns with similar life history traits to that of the founding population.

Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program: Upper Grande Ronde River and Catherine Creek Spring Chinook Salmon Juvenile Acclimation and Adult Collection

Mike McLean

Confederated Tribes of the Umatilla Indian Reservation Department of Natural Resources Fisheries Department, 62415-A Hwy 82, La Grande, OR 97850. mmclean@uci.net

Juvenile spring Chinook salmon acclimation and adult broodstock capture facilities were built on Catherine Creek and the upper Grande Ronde River as part of the Grande Ronde Endemic Spring Chinook Salmon Supplementation Program. The acclimation facilities are release points for smolts produced by the captive broodstock program. The facilities became operational in 2000 for the first release of captive broodstock smolts from the 1998 brood year. A total of 466,565 and 688,847 captive broodstock smolts have been released from the Grande Ronde River acclimation facility and Catherine Creek acclimation facility respectively. During the volitional release period the captive broodstock smolts for both stocks tended to leave the facility between 1200 and 2300 hours and most fish left the first 7 to 9 days of the release. Smolt survival to Lower Granite Dam has ranged from 21.5% to 49.7% and 16.0% to 49.7% for Grande Ronde River and Catherine Creek respectively.

The adult capture facilities became operational in 1997. The main purpose of the weirs was to provide broodstock used to continue the supplementation effort through a conventional hatchery program. The adult weirs also provide a means to monitor the adult returns of the captive broodstock releases, as well as controlling the hatchery:wild ratios above the weirs. The upper Grande Ronde River returning captive broodstock adults typically arrived at the weir beginning the week of 3 June and ended 5 August compared to the natural fish arrival beginning the week of 27 May and ending 5 August. The week of peak arrival for both groups was 24 June. The Catherine Creek returning captive broodstock adults typically arrived at the weir beginning the week of 13 May and ended 12 August compared to the natural fish arrival beginning the week of 6 May and ending 12 August. The week of peak arrival for both groups was 17 June. Captive broodstock and natural adults from both upper Grande Ronde River and Catherine Creek typically return as 4-year-old adults. The natural fish for both stocks tended to return more 5-year-old and less 3-year-old adult than the captive broodstock. The size of the captive broodstock adults for both stocks was similar to that of the natural adults. The smolt to adult survival of both stocks of captive broodstock was lower than that seen for the natural stocks.

Leading Causes of Mortality for Oregon Captive Broodstock 1994-2002 Cohorts with an Emphasis on Bacterial Kidney Disease

Derek Gibbs[1]*, Glenda O' Connor[1]*, Sam Onjukka[1]*, Ramsey Edwards[1], Sharon M. Vendshus[2], Lee Harrell[3] and Leslie Lindsay[4]

[1]Oregon Department of Fish and Wildlife (ODFW) – Fish Health Services, 217 Badgley Hall, Eastern Oregon University, La Grande, Oregon 97850 odfwfp@eou.edu

[2]Oregon Department of Fish and Wildlife – Fish Health Services, 17330 SE Evelyn Street, Clackamas, Oregon 97015

[3]Manchester Research Station – NOAA Fisheries, 7305 Beach Drive East, Port Orchard, Washington 98366

[4]Oregon Department of Fish and Wildlife – Fish Health Services, Department of Microbiology, 220 Nash Hall, Oregon State University, Corvallis, Oregon 97331

Intensive Fish Health monitoring has been an integral component of the Oregon Spring Chinook Salmon Captive Broodstock Program since the beginning of wild parr collections in 1995. Comprehensive examinations are given to all mortality to determine specific cause of death. Surveillance for disease problems has enabled Fish Health Specialists to make prudent recommendations to maximize the health and survival of these captive fish. Fish Health support for this program has come from ODFW laboratories in La Grande, Clackamas and Corvallis. For fish being reared in salt water, support has come from the NOAA fisheries laboratory at Manchester Research Station and at the Northwest Fisheries Science Center in Seattle. The focus of our Fish Health poster is to share information from the completed data sets for the first nine cohorts (1994-2002). The top five leading causes of mortality have accounted for 84.6%, 84.8% and 90.3% of all the loss for the Lostine River (N=2,003), Catherine Creek (N=1,944) and Grande Ronde River (N=1,519) stocks, respectively. Bacterial kidney disease (BKD) has been the leading cause of mortality for all three stocks. Infection by *Renibacterium salmoninarum* (the causative agent of BKD) caused 58.6%, 54.1% and 65.2% of Lostine River, Catherine Creek and Grande Ronde River loss. The second leading cause of mortality for all stocks has been the unknown category with 16.4%, 17.6% and 13.7% of all loss from the three captive populations being attributed to this. Other leading causes of mortality have been fungus, senescence (general physical decline associated with sexually maturity in *Oncorhynchus* sp.), experiment (removed for experiment due to BKD problems), jumpout and fish that were killed due to an oral tumor problem with the Grande Ronde River 2000 cohort. Handling was the fifth leading cause of mortality for all three stocks with 2.9%, 3.9% and 2.2% of all loss being attributed to this. Parr captured in nature have provided an opportunity to detect other pathogens acquired from natal streams and then carried into the Captive Broodstock program. One example of this is *Myxobolus cerebralis*, the causative agent of whirling disease. The Lostine River and Catherine Creek Captive Broodstocks have been positive for *M. cerebralis,* though this has not caused any deleterious effects to the captive fish or the systems from which they were collected. By far the most serious Fish Health issue has been BKD, where collectively 3,214 fish have been lost out of a total of 12,074 wild parr collected (26.6% loss) for all stocks combined from the 1994-2002 cohorts. This has happened despite aggressive measures to combat BKD including erythromycin medicated feedings, multiple antibiotic injections, and attempts to prevent BKD problems using the BKD vaccine RENOGEN with some cohorts. At spawning, BKD ELISA testing has shown an extremely high proportion of females with elevated *R. salmoninarum* antigen (≥ 0.800 OD units). Overall, the Lostine River, Catherine Creek and Grande Ronde River females surviving to maturity have had 28.4%, 19.4% and 16.6% with BKD ELISA values ≥ 0.800 OD units.

List of Participants

Name	Affiliation	Email
Adam Elbrecht	Puget Sound Energy	adam.elbrecht@pse.com
Adam Izbicki	USFWS-Kooskia National Fish Hatchery	adam_izbicki@fws.gov
Al Edsall	EWOS Canada Ltd	
Albert Santos	Confederated Tribes of Warm Springs Oregon	parkdale@gorge.net
Alex Baker	Muckleshoot Indian Tribe	alex.baker@muckleshoot.nsn.us
Alexander Munson	Idaho Dept. of Fish and Game	dmunson@idfg.idaho.gov
Allen Jensen	Leavenworth NFH	al_jensen@fws.gov
Andria Hoffman		andria.hoffman@state.or.us
Andy Reeves	WDFW	chiwawa@wdfw.wa.gov
Anitra Firmenich	Oregon Department of Fish and Wildlife	anitra.firmenich@state.or.us
Anna Kastner	California Department of Fish and Game	akastner@dfg.ca.gov
Anthony Cleveland	Colville Confederated Tribes	loni.seymour@colvilletribes.com
Arron Colwill	wdfw	colwill@olypen.com
Ashley Shaffer	ODFW	randy.shaffer@state.or.us
Bakhshish Dosanjh	EWOS Canada Ltd	bakshish.dosanjh@ewos.com
Barry Berejikian		barry.berejikian@noaa.gov
Ben Kennedy	Abernathy Fish Tech Center - USFWS	benjamen_kennedy@fws.gov
Bill Alexander	Suquamish Tribe	walexander@suquamish.nsn.us
Bill Cox	California Dept of Fish and Game	wtcox@dfg.ca.gov
Bill Haugen	ODFW	bill.haugen@state.or.us
Bill Krise	USFWS	bill_krise@fws.gov
Bill Otto	ODFW	bill.k.otto@state.or.us
Bob Hudspeth	ODFW	robert.a.hudspeth@state.or.us
Bob Larson	Hydrolox	bob.larson@intralox.com
Bob Snyder		bsnyder@mt.gov
Brad Babiar	WDFW	
Brad Hostetler	WDFW	hosteboh@dfw.wa.gov
Brad Smith	Oregon Dept of Fish and Wildlife	brad.smith@state.or.us
Brent Young	ODFW	brent.young@state.or.us
Brett Boyd		brett.a.boyd@state.or.us
Brett Requa	ODFW	brett.requa@state.or.us
Brian Beckman	NOAA Fisheries, NWFSC	brian.beckman@noaa.gov
Brian Clifford	DOI / USFWS - Hagerman National Fish Hatchery	brian_clifford@fws.gov
Brian Daggett		cowboy007@qwest.net
Brian D'Aoust	Common Sensing Inc	bdaoust@comsen.com
Brian Davis	Mount Hood Community College	broadwaybrian@gmail.com
Brian Hirsch		sales@pointfour.com
Brian Hudson		damienjamesh@hotmail.com
Brian Rockwell		bar88@aol.com
Brian Zimmerman	CTUIR Fish and Wildlife Programs	brianzimmerman@ctuir.com
Bruce Dahne		mckenzie.hatchery@state.or.us
Bruce Erickson	MariSource	
Bruce Stewart	Northwest Indian Fisheries Commission	bstewart@nwifc.org
Bryan DeBerry	ODFW	
Bryan Ludwig	FFSBC	bryan.ludwig@gofishbc.com
Bryon Kluver		bryon.kluver@noaa.gov
Bud Young		coho@embarqmail.com
Butch Harty	Nez Perce Tribal Hatchery	
Calv in Lehman	WDFW	ilikecalvin@yahoo.com

Cameron Decker		candcdecker@msn.com
Camilla Timm	AquaSeed Corporation	cam@aquaseed.com
Carl East	Nez Perce Tribe	carle@nezperce.org
Carl Westby	Fisheries and Oceans Canada. Pacific Biological Station	westbyc@pac.dfo-mpo.gc.ca
Carlin McAuley	NOAA Fisheries	carlin.mcauley@noaa.gov
Caroline Peterschmidt	USFWS	caroline_peterschmidt@fws.gov
Cassie Sundquist	Idaho Department of Fish and Game	csundquist@idfg.idaho.gov
Chad Aschenbrenner	ODFW	chad.aschenbrenner@state.or.us
Chad Fritz	Freshwater Fisheries Society of BC	chad.fritz@gofishbc.com
Charlene Ives	Confederated Tribes of the Colville Reservation	charives@nc.data.com
Charles Andres	WDFW/Winthrop	aandres@windermere.com
Charles Baker		charles.a.baker@state.or.us
Charles Cutting	MWH Americas, Inc.	charles.w.cutting@mwhglobal.com
Charles Pratt	Alaska Department of Fish and Game	charles.pratt@alaska.gov
Charles Strom	Yakama Nation	
Chip Moller	Wyoming Game & Fish	chip.moller@wgf.state.wy.us
Chris Brun	The Confederated Tribes of Warm Springs	cbrun@hrecn.net
Chris Carlson	Grant County PUD	jyount@gcpud.org
Chris Cena	Freshwater Fisheries Society of BC	chris.cena@gofishbc.com
Chris Jones	Bellingham Technical College	profetik25@yahoo.com
Chris Ketcham	CEDC Fisheries	tmiethe@co.clatsop.or.us
Chris Lauman	ODFW	dadx4chris@hotmail.com
Chris Nelson	Nelson & Sons/ Silver Cup Feed	
Chris Starr	U.S. Fish and Wildlife Service, LSRCP Office	chris_starr@fws.gov
Christa Strickwerda	Yakama Nation	
Christie Scott	Oregon Department Fish & Wildlife	christie.scott@state.or.us
Christopher Boyd	ODFW	chris.d.boyd@state.or.us
Cliff Miller		cliff.miller@state.or.us
Colleen Weiss	Bonneville Fish Hatchery	colleen.j.weiss@state.or.us
Collin Imus	ODFW	collin.imus@state.or.us
Corey Polum		lluckee253@yahoo.com
Cory Cuthbertson	WDFW	cory_c@hotmail.com
Craig Banner	ODFW	bannerc@onid.orst.edu
Craig Martin	US Fish and Wildlife Service	craig_martin@fws.gov
Crystal Schoonover	Bellingham Technical College	crystal78dawn@yahoo.com
Curtis Dearing	Jensorter, LLC	
Dan Green	IDFG	dgreen@idfg.idaho.gov
Dan Meyer	ODFW	dan.meyer@state.or.us
Dan Peck	ODFW	dan.peck@state.or.us
Dan Warren	D.J. Warren & Associates Inc.	warrenasc@comcast.net
Daniel Brownlee	Yakama Nation YKFP Fisheries Project	charlotte@yakama.com
Daniel Evans	WDFW	chelan@dfw.wa.gov
Darin Combs	FHS4 Cascade Complex, WDFW	combsdmc@dfw.wa.gov
Darlene Krake	ODFW	darlene.c.krake@state.or.us
Dave Lovetro	Eka Chemicals Inc.	dave.lovetro@eka.com
David Baldwin	ODFW	david.a.baldwin@state.or.us
David Brock	Rangen	aquaculture@rangen.com
David Brown	WDFW	
David Byrnes	BPA	dmbyrnes@bpa.gov
David Costas	ODFW	
David Hand	USFWS-Columbia River Fisheries Program Office	david_hand@fws.gov

David Heutmaker	Marisource	bruce@flex-a-lite.com
David Whitmer	WDFW	davidwhitmer1@comcast.net
Deborah Milks	Washington Department of Fish and Wildlife	milksdjm@dfw.wa.gov
Debra Eddy	ODFW	deddy@eou.edu
Dell Warren	Warren Water Broom LLC Mfg	
Dennis Moore	Muckleshoot Tribe	dennis.moore@muckleshoot.nsn.us
Derek Gibbs	Oregon Department of Fish and Wildlilfe	derekgibbs@hotmail.com
Derek Gloyn	Lyon's Ferry, Wash. Dept. of Fish & Wildlife	
Diana Bondurant		diana.bondurant@state.or.us
Diane Deal	ODFW, Lookingglass FH	dideal@msn.com
Diane Loopstra	Alaska Department of Fish and Game	diane.loopstra@alaska.gov
Don Hair	ODFW - NE Region - Fish Research	dhair@eou.edu
Don Peterson	Freshwater Fisheries Society of BC	marla.zarelli@gofishbc.com
Donald Larsen	NOAA Fisheries	don.larsen@noaa.gov
Doug Bruland	PSE	doug.bruland@pse.com
Doug Curtis	odfw	doug.curtis@state.or.us
Doug Hatfield	WDFW	hatfidgh@dfw.wa.gov
Doug Kelley	Inland Environmental Resources, Inc.	
Doug Nolan	Suquamish Tribe	dnolan@suquamish.nsn.us
Doug Olson	US Fish & Wildlife Service	doug_olson@fws.gov
Douglas DeHart	U.S. Fish and Wildlife Service	douglas_dehart@fws.gov
Duane Banks	Oxbow Hatchery ODFW	duane.d.banks@state.or.us
Earl Steele	Bellingham Tech College	esteele@btc.ctc.edu
Ebenezer Frimpong	university of cape coast	dad7772003@yahoo.com
Ed Hamilton	Muckleshoot Indian Tribe	ed.hamilton@muckleshoot.nsn.us
Ed Jouper	Washington Department of Fish and Wildlife	ejouper@hctc.com
Edward Eleazer	WDFW	eleazeje@dfw.wa.gov
Eric Kinne	WDFW	kinneebk@dfw.wa.gov
Eric Kroeger	NMFS	eric.kroeger@noaa.gov
Eric Losch	ODF&W	eric.w.losch@state.or.us
Eric Martin	ODFW	alsea.hatchery@state.or.us
Eric Mattson	Washington Dept. Fish & Wildlife	mattsenm@dfw.wa.gov
Eric Thompson	Northwest Fluid Solutions	eric.thompson@nw-fluid.com
Eric Willet	DOI / USFWS - Hagerman National Fish Hatchery	eric_willet@fws.gov
Erik Withalm	ODFW	erik.j.withalm@state.or.us
Erin Andyke	ODFW	erin.t.andyke@state.or.us
Eugene Umtuch Jr.	Yakama Nation	
Ewann Berntson	Northwest Fisheries Science Center	ewann.berntson@noaa.gov
Felipe Muller		fmuller@alitec.cl
Forrest Walling	AquaSeed Corporation	forrest.walling@aquaseed.com
G Martin Smith	ODFW - Rock Creek Hatchery	marc.garst@state.or.us
Gabe McGuire	Puget Sound Energy	gabriel.mcguire@pse.com
Gail Larsen	Muckleshoot Indian Tribe	gail.larsen@muckleshoot.nsn.us
Gary Gaston	Umatilla Hatchery	
Gary Ives	Confederated Tribes of the Colville Reservation	garyives@ncidata.com
Gary Vander Laan	Trojan Technologies Inc,	gvanderlaan@trojanuv.com
Gary Williams	California Department of Fish and Game	glwilliams@dfg.ca.gov
Genny West	PR Aqua	
Geoff Giesbrecht	Freshwater Fisheries Society of BC	geoff.giesbrecht@gofishbc.com
George Nealeigh		
George Ray	ODFW	george.h.ray@state.or.us
Gerald Creasy	SSRAA	jsbc@kpunet.net
Gerald Jones	Oregon Department of Fish and Wildlife	jonesge@onid.orst.edu
Gina Stewart	ODFW	gina.m.stewart@state.or.us

Ginette Lacasse	Puget Sound Energy	ginette.lacasse@pse.com
Glen Pearson	Washington Dept of Fish and Wildlife	priest@dfw.wa.gov
Glenda O'Connor	Oregon Department of Fish and Wildlife	goconnor@eou.edu
Greg Beekman	Water Management Technologies	
Greg Grenbemer	ODFW	greg.a.grenbemer@state.or.us
Greg Hudson	AquaSeed Corporation	gregh@aquaseed.com
Gregg Bonacker	EWOS Canada Ltd	
Gregory Baesler		gdbaesler@bpa.gov
Gregory Strom	Yakama Nation	
Gregory Taylor	US Army Corps of Engineers	gregory.a.taylor@usace.army.mil
Guy Chilton	ODFW	guy.s.chilton@state.or.us
H. Mark Engelking	Oregon Dept. Fish and Wildlife	henry.m.engelking@state.or.us
Holly Truemper	ODFW	holly.truemper@oregonstate.edu
Ian Race	PR Aqua	
Isaac Queral	WDFW--Cowlitz Hatchery	queral@comcast.net
J. T. Williams	Nez Perce Tribal Fisheries	jamiew@nezperce.org
Jack Hurst		jack.b.hurst@state.or.us
James Crook	BTC Fisheries Tech.	jscrook@comcast.net
James Gidley	Confederated Tribes of Warm Springs, Oregon	jwg@gorge.net
James Jenkins	WDFW	djpjjj@earthlink.net
Jared Fronk	WDFW	
Jason Cox	WDFW-Cowlitz Hatchery	
Jason Hill	HDRFishPro	
Jason Mann	EWOS Canada Ltd	jason.mann@ewos.com
Jason Radany		fairbear79@yahoo.com
Jason Rau	Yakama Nation Fisheries	jayrau@ykfp.org
Jason Rothermel	WDFW Garrison Springs Salmon Hatchery	coonhound49@hotmail.com
Jason Smith	Washington Dept of Fish and Wildlife	reiter@dfw.wa.gov
Jay Jacobson	Jay A Jacobson Architect	jj@scrserv.com
Jay Kidder	Chinook Engineering	jay@chinook-engineering.com
Jayson Wahls	WDFW--Arlington Hatch.	wahlsjcw@dfw.wa.gov
Jeannie Ortiz	BTC	bleurose13@earthlink.net
Jeff Poole	US Fish & Wildlife Service	jeff_poole@fws.gov
Jeff Seeger	ODFW	jeff.seeger@state.or.us
Jeff Stewart	ODFW	jeff.r.stewart@state.or.us
Jeffrey Gislason	Bonneville Power Administration	jcgislason@bpa.gov
Jennifer Hopper	Bellingham Technical College	hopperj2@cc.wwu.edu
Jennifer Hulett-Guard	ODFW-LEABURG	jennifer.e.hulett-guard@state.or.us
Jens Lovtang	Confederated Tribes of Warm Springs	jlovtang@wstribes.org
Jeremy Thain	Hatchery International	
Jerry Zinn	Nelson & Sons/Silver Cup Fish Feed	
Jesse Miller	WDFW	
Jim Brackett	Western Chemical	
Jim Robinson	ODFW	james.a.robinson@state.or.us
Jim Seeland	Alitec, Inc.	jseeland@gci.net
Jim Terry	AquaSeed Corporation	jimterry@aquaseed.com
Jim Trammell	Washington Dept of Fish and Wildlife	
Jim Wierson Jr.		
Jim Wierson Sr.		resa@wierson.com
Joe Botta	Bellingham Technical College	drifter78@gmail.com
John Halver	University of Washington	halver@u.washington.edu
John Hicks		flip8424@hotmail.com
John Hitron	USFWS Carson National Fish Hatchery	john_hitron@fws.gov

John Holmes	U.S Fish and Wildlife Service	toni_scholder@fws.gov
John Kaufman	Oregon Department of Fish and Wildlife	kaufmanj@onid.orst.edu
John Leppink	ODFW	john.d.leppink@state.or.us
John Schmitz	Oregon Department of Fish and Wildlife	oak.springs.hatchery@state.or.us
John Thorpe	ODFW	
Jordan Nielson	University of Idaho	jnielson@vandals.uidaho.edu
Jorge Villarreal	WDFW	zygoma@hctc.com
Joseph Badoni	U.S. Fish & Wildlife, Warm Springs NFH	joseph_badoni@fws.gov
Joseph O'Neil	ODFW-OHRC	joseph.p.oneil@state.or.us
Josh Morris	WDFW--Cowlitz Hatchery	hesofly@toledotel.com
Joshua Rist	ODFW	joshua.r.rist@state.or.us
Joy Lee Waltermire	Long Live the Kings	jlee@lltk.org
Joyce Mahr	ODFW	oregonhatchery.researchcenter@state.or.us
Judy Ackinclose		ackinclose@shaw.ca
Judy Urrutia	California Dept. of Fish and Game	jurrutia@dfg.ca.gov
Julianna Hooff	Washington Department of Fish and Wildlife	hooffjh@dfw.wa.gov
Karl Waterbury		karl_waterbury2000@yahoo.com
Kasha Cox	Schering-Plough Animal Health	kasha.cox@spcorp.com
Kathy Bridges		kathybridges@aol.com
Keith Underwood	NWIFC	keith.underwood@hdrinc.com
Ken Phillipson	Freshwater Fisheries Society of BC	kenp@nwifc.org
Ken Scheer	Harper Brush Distributors Inc	ken.scheer@gofishbc.com
Ken Taylor		
Kenneth Kirkman	ODFW, Lookingglass FH	kckirkman@bpa.gov
Kenneth Loffink	ODFW	ken.j.loffink@state.or.us
Kenneth Taber	Washington Department of Fish and Wildlife	bigcreek.hatchery@state.or.us
Kenny Jackson	U.S. Fish & Wildlife Service	sleepypersons@hotmail.com
Kevin Blueback		kevin_blueback@fws.gov
kiefer jones	ODFW	kiefer614@gmail.com
Kurt Cummings	odfw	kurt.a.cummings@state.or.us
kurt kremers	Jensorter, LLC	kurt.kremers@state.or.us
Kurt Stelk		kurt@jensorter.com
Laia Robichaux	FRESHWATER FISHERIES SOCIETY OF BC	robichal@onid.orst.edu
Laird Siemens	Leavenworth NFH, US Fish and Wildlife Service	laird.siemens@gofishbc.com
Lance Schott	Lyon's Ferry, Wash. Dept. of Fish & Wildlife	lance_schott@fws.gov
Larrabee Miller	WDFW	
Larry Durham	ODFW	
Larry Funston		larry.funston@state.or.us
Larry Holliday	Spring Creek NFH	lholliday@wstribes.org
Larry Marchant		larry_marchant@fws.gov
Larry Peltz	Lower Elwha Klallam Tribe	larry_peltz@fws.gov
Larry Ward	Idaho Department of Fish and Game	larry.ward@elwha.nsn.us
Lars Alsager	CTUIR Fish & Wildlife Program	lalsager@idfg.idaho.gov
Laurie Hewitt	US Fish & Wildlife Service	lhewitt@uci.net
Lawrence (Larry) Telles		larry_telles@fws.gov
Lee Pilon		lmpilon@comcast.net
Leon Klimes	ODFW	
Leslie Lindsay	Nez Perce Tribe Fisheries - FCAP	smitlesl@onid.orst.edu
Letitia Whitman		tishw@nezperce.org
Linda Owens	WDFW	
Lloyd Myall	Dworshak Nat'l Fish Hatchery/Nez Perce Tribe	omak@dfw.wa.gov
Lou Ann Lasswell	Magic Valley Heli-Arc Mfg	louann_lasswell@fws.gov
Louie Owens	Yakama Nation	linda@aqualifeproducts.com
Louis Sweowat	ODFW	jrlouissweowat@gmail.com

Luke Allen	Suquamish Tribe	luke.s.allen@state.or.us
Luke Williams	Oregon Department of Fish and Wildlife	lwilliams@suquamish.nsn.us
Lyle Curtis		lyle.d.curtis@state.or.us
Mandi Danielson	ODFW	mandi775@hotmail.com
Manny Farinas	Washington Dept. of Fish and Wildlife	manny.a.farinas@state.or.us
Marianne Binkley	Spring Creek NFH	siamese55@juno.com
Mark Ahrens	Bonneville Fish Hatchery	mark_ahrens@fws.gov
Mark Harvey	City of Tacoma	mark.l.harvey@state.or.us
Mark LaRiviere	Washington Fish and Wildlife	ldill@cityoftacoma.org
Mark Schuck	Bonneville Power Administration	schucmls@dfw.wa.gov
Mark Shaw	Oregon Department of Fish & Wildlife	mashaw@bpa.gov
Mark Traynor	ODFW Bonneville Hatchery	mark.e.traynor@state.or.us
Marla Chaney	The Lynch Company	marla.j.chaney@state.or.us
Martin Ralston	Nez Perce Tribe Fisheries Research	pchurchill@lynchcompany.net
Mary Edwards	USFWS - Mid-Columbia River FRO	marye@nezperce.org
Matt Cooper	ODFW	matt_cooper@fws.gov
Matt Hanson	Muckleshoot Indian Tribe	matthew.d.hanson@state.or.us
Matt McDaniel		
Matt McGregor	Aquatic Eco-Systems, Inc	mattm_killer666@hotmail.com
Matt Rayl	HDR/Fish Pro	jocelynh@aquaticeco.com
Matthew Bleich	USFWS-Columbia River Fisheries Program Office	matthew.bleich@hdrinc.com
Maureen Kavanagh	WDFW - Eastbank Hatchery	maureen_kavanagh@fws.gov
Mauro Solorio	Northwest Fisheries Science Center	
Melissa Baird	Yakama Nation	melissa.baird@noaa.gov
Michael Fiander	PSE	
Michael Ficklin	US Fish & Wildlife Service	michael.ficklin@pse.com
Michael Lotspeich	WDFW	galamikeis_or@yahoo.com
Michael Lucero	Long Live the Kings	merwin@dfw.wa.gov
Michael O'Connell		moconnell@lltk.org
Michael Schmidt	Nez Perce Tribe Fisheries - FCAP	mschmidt@lltk.org
Micheal Key	PR Aqua	mikek@nezperce.org
Michelle Swift	The Lynch Company	info@praqua.com
Mike Fruitiger		
Mike Gauvin	Oregon Fish & Wildlife	mgauvin@wstribes.org
Mike Grover	HDRFishPro	mike.c.grover@state.or.us
Mike McGowan	CTUIR Fish & Wildlife Program	mike.mcgowan@hdrinc.com
Mike McLean	Idaho Fish and Game	mmclean@uci.net
Mike Peterson		mpeterson@idfg.idaho.gov
Mike Shelton	Lyon's Ferry Hatch., Wash. Dept. of Fish & Wildlife	mike.shelton@state.or.us
Mike Sutterfield	US Army Corps of Engineers	
Mindy Simmons		mindy.m.simmons@usace.army.mil
Nadine Hurtado	ODF&W	hurtadon@onid.orst.edu
Neal Johnson	ODFW	salmonriver.hatchery@state.or.us
Nick Gilbo	Argent Chemical Laboratories	
Noi Soutavong		
Otis Hartle	Bellingham Technical College	otishartle@yahoo.com
Patricia Smith	Bonneville Power Administration	prsmith@bpa.gov
Patty Michak	MarineView Fisheries Consutling	patty@marineviewfisheries.com
Patty Muncell	AquaSeed Corp	pattym@aquaseed.com
Paul Graham	WDFW	grahap@dfw.wa.gov
Paul Parkins		paul.parkins@noaa.gov
Peter Chettleburgh	Hatchery International	
Peter Cleary	Nez Perce Tribe	peterc@nezperce.org
Peter McCully		salmonrule@shaw.ca

Rahmi Aiken	WDFW	hunter9988@comcast.net
Randall Winters	ODFW	randy.l.winters@state.or.us
Randy Johnson	ODFW	randy.johnson@state.or.us
Ray Billings	Freshwater Fisheries Society of BC	ray.billings@gofishbc.com
Ray Brunson	Olympia Fish Health Center	ray_brunson@fws.gov
Ray Jones	Idaho FRO	joan_sperber@fws.gov
Reid Miltenberger	Washington Fish and Wildlife	reidmilt@hotmail.com
Rhonda Dasher	Colville Confederated Tribes	rhonda.dasher@colvilletribes.com
Rich Schneider	Clear Springs Foods, Inc	rich@clearsprings.com
Richard Black	ODFW	richard.l.black@state.or.us
Richard Eltrich	WDFW	eltrirje@dfw.wa.gov
Richard French	WDFW	lyonsferry@dfw.wa.gov
Richard Handley	Inland Environmental Resources, Inc.	kstrong@inlande.com
Richard Johnson	Muckleshoot Indian Tribe	richard.johnson@muckleshoot.nsn.us
Richard Moore	WDFW	heavyjunk28@tds.net
Richard Stocking	Oregon Department of Fish and Wildlife	richard.w.stocking@state.or.us
Richard Turner	NOAA Fisheries	rich.turner@noaa.gov
richard yang		skrappa212@hotmail.com
Rick Alford	Yakama Nation	rick@mid-columbia-coho.net
Rick Grimsley	WDFW	dungeness@dfw.wa.gov
Rick Pace	ODFW	
Rob Dietrichs	Sandy Fish Hatchery	sandy.hatchery@state.or.us
Rob Hill	Nez Perce	robh@nezperce.org
Robert Gleason, Jr.	Yakama Nation	
Robert Glidewell	ODFW	rob.t.glidewell@state.or.us
Rod Litton	Clatsop County	harley011@centurytel.net
Rod Neterer		neterer@ssraa.org
Roger Warren	ODFW	gnatcr@dialoregon.net
Ron Harrod	ODFW	clackamas.hatchery@state.or.us
Ron Malnor	Western Chemical	ronm@wchemical.com
Ron Twibell	US Fish & Wildlfie Service	ronald_twibell@fws.gov
Ron Wong	United States Fish & Wildlife Service	ron_wong@fws.gov
Roy Skendzel	ODFW	renee@eotitle.com
Russ Rodriguez	Muckleshoot Indian Tribe	
Ryan Couture	Oregon Department of Fish & Wildlife	ryan.b.couture@state.or.us
Ryan Fenwick		ryan.fenwick@state.or.us
Ryan Queen	ODFW	ryan.m.queen@state.or.us
Ryan Regner		ryanregner@hotmail.com
Sam Dilly		sam.dilly@chelanpud.org
Sam Onjukka	Oregon Department of Fish & Wildlife	sonjukka@eou.edu
Sarah Branum	BPA	stbranum@bpa.gov
Scott Everett	Nez Perce	scotte@nezperce.org
Scott Gibson	City of Tacoma	sgibson@cityoftacoma.org
Scott Johnston	ODFW	scott.s.johnston@state.or.us
Scott Patterson	ODFW	scott.d.patterson@state.or.us
Scott Zirjacks	Spring Creek National Fish Hatchery	scott_zirjacks@fws.gov
Sean Henderson	Ennis National Fish Hatchery	sean_henderson@fws.gov
Sean Wilson	ODFW	sean.c.wilson@state.or.us
Seth Alexander		treesprite70@hotmail.com
Seth Morgan	ODFW	seth.e.morgan@state.or.us
Shari Beals	Oregon Dep't Fish & Wildlife	shari.r.beals@state.or.us
Sharon Vendshus	ODFW	sharon.m.vendshus@state.or.us
Shaun Clements	ODFW	shaun.clements@oregonstate.edu
Shawn Wheeler	Nez Perce	shawnw@nezperce.org

Sherman Davis	WDFW	shermaaanw@aol.com
Sherry Mead	Freshwater Fishereis Society of BC	sherry.mead@gofishbc.com
Simon Goudy	Yakama Nation	
Skip Thompson	Schering-Plough Animal Health	
Sonia Mumford	Olympia Fish Health Center	sonia_mumford@fws.gov
Speros Doulos	USF&WS / Little White Salmon/Willard NFH Complex	speros_doulos@fws.gov
Stan Brzycki	ODFW	stanley.brzycki@state.or.us
Steve Sharon	Wyoming Game and Fish Department	steve.sharon@wgf.state.wy.us
Steven Jones	WDF&W	jonesslj@dfw.wa.gov
Talbert Looking Elk	The Confederated Tribes of Warm Springs	tllelk@juno.com
Tami Edmunds	ODFW	tami.d.edmunds@state.or.us
Taylor Hendricks	PWSAC	taylorjh22@yahoo.com
Taylor Scott	WDFW	fishtaylor27@hotmail.com
Terry McCarthy	Water Management Technologies	terry.mccarthy@w-m-t.com
Tim Hoffnagle	ODFW	tim.hoffnagle@eou.edu
Tim Summers	Washington Dept Fish and Wildlife	summerset77@hotmail.com
Tim Wright	ODFW-Leaburg Hatchery	timothy.c.wright@state.or.us
Tim Yesaki	Freshwater Fisheries Society of BC	tim.yesaki@gofishbc.com
Timothy Helwick	ODFW Lookingglass FH	tim.r.helwick@state.or.us
Tod Jones	CEDC Fisheries	tjones@co.clatsop.or.us
Todd Bruhn	Zero Gravity Filter	
Todd Hanna	Mt. Hood Community College	todd.hanna@mhcc.edu
Todd Hansen	Oregon Department of Fish & Wildlife	todd.hansen@state.or.us
Tom Flagg	NOAA Fisheries, Manchester Research Station	tom.flagg@noaa.gov
Tom Frew	Idaho Dept. of Fish and Game	tfrew@idfg.idaho.gov
Tom Pruitt	Ennis National Fish Hatchery	tom_a_pruitt@fws.gov
Tom Rogers	Idaho Dept of Fish and Game	trogers@idfg.idaho.gov
Tom Rumreich	Oregon Dept. of Fish and Wildlife	thomas.j.rumreich@state.or.us
Tom Sawtell	Argent Chemical Laboratories	email@argent-labs.com
Tom Worcester	Mt. Hood C. C.	
Tony Amandi		amandia@onid.orst.edu
Tracy Crews	Oregon Department of Fish & Wildlife	tracy.d.crews@state.or.us
Travis Collier	U.S. Fish & Wildlife	travis_collier@fws.gov
Travis Schneider	Oregon Department of Fish and Wildlife	travis.schneider@state.or.us
Trevor Clark	Oregon Department of Fish and Wildlife	clarktre@hotmail.com
Troy Tisdale	WDFW	elwha@dfw.wa.gov
Tyler Lebard	Oregon Department of Fish and Wildlife	tyler.lebard@state.or.us
Victor Baca	Bellingham Technical College	photomarine@earthlink.net
Vivian Whitton	Puget Sound Energy	vivian.whitton@pse.com
Walt Beer	California Dept of Fish and Game	wbeer@dfg.ca.gov
Walter Volberg	Point Four Systems Inc.	
Wayne Hamilton	Dworshak NFH	wayne_hamilton@fws.gov
William Gale	U.S. Fish and Wildlife Service	william_gale@fws.gov
Zephyr Warren	Warren Water Broom LLC Mfg	