

PROCEEDINGS

59TH Annual Northwest Fish Culture Conference



*Responsible Stewardship
for a Sustainable Future*

Doubletree Inn - Spokane Washington, December 2-4, 2008

HOSTING AGENCY

**Washington Department of Fish and Wildlife
600 Capital Way N.
Olympia, WA. 98501**





*Responsible Stewardship
for a Sustainable Future*

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Mark Kimbel, Craig Busack

Poster Displays:

Guy Campbell

Session Chairs

**1. Hatchery Design, Development
and Renovation:**

Denis Popochock

2. Hatchery Design...Fish Health:

John Kerwin

3. Salmon and Steelhead Recovery:

Aaron Roberts

**4. Salmon and Steelhead Culture
and Management I:**

Neil Turner

**5. Salmon and Steelhead Culture
and Management II:**

Jill Rossmann

**6. Trout and Kokanee Culture
and Management:**

Mitch Combs

**7. Non-Salmonid Culture and
Management:**

Bruce Bolding

8. Hatchery Science:

Andy Appleby

Table of Contents:

Hatchery Design, Development And Renovation.....	9
Hatchery Design cont. and Fish Health.....	13
Salmon and Steelhead Recovery.....	18
Salmon and Steelhead Culture and Management I.....	22
Salmon and Steelhead Culture and Management II.....	26
Trout and Kokanee Culture and Management.....	30
Non-Salmonid Fish Culture and Management.....	34
Hatchery Science.....	36
Poster Presentations.....	40

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Hosted By:

Washington Department of Fish and Wildlife

http://wdfw.wa.gov/fish/management/fish_culture_conference/index.html



Responsible Stewardship
for a Sustainable Future

Day 1: Tuesday, December 2, 2008

- 9:00 AM Registration
12:15 PM Opening Remarks: **Doug Hatfield**, WDFW Hatchery Complex Manager
12:20 PM Welcome: **Ron Warren**, Hatchery Division Manager, WDFW
12:35 PM Keynote Address:

Session 1 Hatchery Design, Development and Renovation

Session Chair: **Denis Popochock**, WDFW, Hatchery Complex Manager

- 1:05 PM **Cory Cuthbertson**, WDFW, Building a Better Fish Trap
1:20 PM **Nathan Jensen**, University of Idaho, Burbot Hatchery Design, Development and Renovations at the University of Idaho
1:40 PM **Bill Phillips**, WDFW, Planning, Engineering and Construction Support For WDFW Hatcheries
2:00 PM **Lars Alsager**, IDFG, The Construction and Development of the New Pahsimeroi Fish Hatchery as a Summer Chinook and Summer Steelhead Facility
2:20PM **Steve Sharon**, WGFD, Renovation of Wyoming Game and Fish Department's Dubois Hatchery
2:40 PM **Jason Rothermel**, WDFW, The Relative Value of a Hatchery Remodel
3:00 PM Break
3:25 PM Door Prize Drawing

Session 2 Hatchery Design cont.....Fish Health

Session Chair: **John Kerwin**, WDFW, Fish Pathologist

- 3:30 PM **Jason Hill**, From Hatcheries to Community Centers
3:45 PM **Les Perkins**, Improved hatchery efficiency through fish screen improvements at the Lower Herman Creek Ponds at the Oxbow Hatchery
3:55 PM **Mark Polinski**, University of Idaho, Disease Susceptibility of Burbot (*Lota lota maculosa*) Following Challenge with Specific Fish Pathogens
4:15 PM **Martin Chen**, WDFW, Experimental Use of Isomet Amidium Chloride Hydrochloride (Trypamidium¹) to Control Mortality of Adult Chinook Salmon *Oncorhynchus tshawytscha* Due to *Cryptobia salmositica*

- 4:30 PM **Steve Roberts**, WDFW, Fifteen Years Without An IHN Outbreak At Lyons Ferry Hatchery ... Just Good Luck?
- 4:50 PM **Seth Morgan**, ODFW, UV Disinfection at Leaburg Hatchery
- 5:05 PM **John Kerwin**, WDFW, Case History – Infectious Hematopoietic Necrosis Virus in the Chehalis and Queets River Basins
- 5:30 PM Announcements/Door Prize Drawing
- 5:45 PM Trade Show/Poster Session/Social

Day 2: Wednesday, December 3, 2008

- 7:00 AM Continental Breakfast
- 8:00 AM Door Prize Drawing
- 8:10 AM Introduction/Messages: Doug Hatfield, WDFW

Session 3 Salmon and Steelhead Recovery

Session Chair: **Aaron Roberts**, WDFW Hatchery Complex Manager

- 8:15 AM **Barry Berejikian**, NOAA Fisheries, And The Hood Canal Steelhead Project: An Overview and Evaluation of Hydraulic Redd Sampling
- 8:40 AM **Ed Jouper**, WDFW, Implementation and Operation of an ESA-listed Hood Canal Summer Chum Recovery Project: The Nuts and Bolts
- 9:00 AM **Thom Johnson**, WDFW, ESA-listed Hood Canal Summer Chum Salmon: A brief update on supplementation programs, natural-origin vs. supplementation-origin returns, and recovery
- 9:20 AM **Jeff Grimm**, WDFW, Otolith Thermal Mass Marking
- 9:40 AM **Genny West**, PRAqua, Progressive Efforts to Conserve Water at State Fish Hatcheries
- 10:00 AM Break
- 10:25 AM Door Prize Drawing

Session 4 Salmon and Steelhead Culture and Management I

Session Chair: **Neil Turner**, WDFW, Hatchery Complex Manager

- 10:30 AM **Jon Lovrack**, WDFW, FishBooks: A New Age Approach for Washington State Fish Hatchery Data
- 10:45 AM **Greg Wolfe**, WDFW, Fish Growth Management Methods; Planning and Implementation
- 11:00 AM **Don Larsen**, NOAA Fisheries, Monitoring for Precocious Male Maturation (minijacks) in Hatchery Programs: A case study of upper Columbia River summer Chinook salmon.
- 11:20 AM **B. Beckman**, NOAA Fisheries, Unexpected Effects and Unintended Consequences: Altering Emergence Timing Induces Variability in Chinook Salmon Life History
- 11:40 AM **Samuel Dilly**, Chelan County Public Utility District No. 1, A Comparison of the Health and Performance of Chinook Salmon Reared in Partial Reuse Circular Tanks and Flow-Through Raceways

12:05 PM Lunch
1:15 PM Door prize Drawing

Session 5 Salmon and Steelhead Culture and Management II

Session Chair: **Jill Phillips**, WDFW, Fish Hatchery Manager

1:20 PM **Jeremy Trimpey**, USFWS, Reducing Soreback Mortality in Summer Steelhead at the Hagerman National Fish Hatchery
1:40 PM **R.E. Dasher**, Colville Confederated Tribes, Feeding a Natural Marine Based Diet to Improve Quality and Survival of Reconditioned Kelt Steelhead at Cassimer Bar Hatchery
2:00 PM **John Silva**, CDFG, The Use of Formalin in a Safe and Cost Efficient Manner
2:20 PM **Chad Herring**, WDFW, Application and Use of Ultrasound to Determine Gender Composition of Spring Chinook Salmon (*Oncorhynchus tshawytscha*) Broodstock for Mitigation Programs in the Wenatchee River Basin
2:40 PM **A.H. Dittman**, NOAA Fisheries, Using off-site Acclimation/Release Facilities to Expand the Spawning Distribution and Minimize Straying of Supplemented Salmon Populations: Lessons from the Yakima River Spring Chinook Program
3:05 PM Break
3:20 PM Door Prize Drawing

Session 6 Trout and Kokanee Culture and Management

Session Chair: **Mitch Combs**, WDFW, Fish Hatchery Manager

3:25 PM **Theresa I. Godin**, Freshwater Fisheries Society of BC, Development of Sterile and All-Female Kokanee *Oncorhynchus nerka* for Recreational Fisheries in British Columbia
3:45 PM **Guy Campbell**, WDFW, Kokanee Captive Brood Stock Program at Spokane Hatchery
4:05 PM **Steven Stout**, WDFW, Marblemount Hatchery Production of Ross Lake Wild Rainbow Trout
4:20 PM **Doug Crawley**, Freshwater Fisheries Society of BC, Rainbow Trout Alevin Clean-Up Method for Fungus Control
4:35 PM **Keith Underwood**, HDR Engineering, Factors Limiting Wild and Hatchery Kokanee in Washington
5:00 PM Session End
5:10 PM Door Prize

Day 3: Thursday, December 4, 2008

- 7:00 AM Continental Breakfast
- 7:40 AM Door Prize Drawing
- 7:45 AM Introduction/Messages: Doug Hatfield, WDFW

Session 7 Non-Salmonid Fish Culture and Management

Session Chair: **Bruce Bolding**, WDFW, Warmwater Fisheries Manager

- 7:50 AM **Bruce Bolding**, WDFW, Use of Hatchery Reared Warmwater Fish in Washington
- 8:10 AM **Tammy Gish**, WDFW, Warm and Cool Water Culture and Production Activities at Meseberg Hatchery
- 8:25 AM **Mike Erickson**, WDFW, Walleye Culture and Extended Rearing Techniques at Meseberg Hatchery
- 8:40 AM **Mike Rust**, NOAA Fisheries, Lingcod Culture
- 9:00 AM Session End

Hall of Fame Presentation

Presenter: **Craig Busack**, WDFW, Science Division Manager

Recipient: **Howard Fuss**, WDFW Research Scientist

- 9:05 AM Award Ceremony
- 9:25 AM Break

Session 8 Hatchery Science

Session Chair: **Andy Appleby**, WDFW Hatchery Biologist

- 09:45 AM Andy Appleby, WDFW, Columbia River Hatchery Scientific Review Group Overview of Process, Principles, Methods and Observations
- 10:15 AM **Craig Busack**, WDFW, The proportionate natural influence (PNI) statistic: a tool for management of integrated hatchery programs
- 10:35 AM **Kent Dimmit**, WDFW, The Puget Sound and Washington Coast Hatchery Action Implementation Plan or “Hatchery 2020”
- 10:50 AM **James Dixon**, WDFW, Hatchery Reform, Willapa Bay
- 11:05 AM **Ed Eleazer**, WDFW, Summer Chinook Stock Collection and Integration Efforts at Wallace River Hatchery
- 11:25 AM Session End

11:45 AM Scholarship Award

Presenter: **Pat Phillips**

- 11:50 AM Closing Remarks – Doug Hatfield
- 11:55 AM Grand Prize Drawings – Pat Phillips and Crew

Poster Session (5:40-7:30, Tuesday December 2nd)

Session Chair: Guy Campbell, WDFW, Fish Hatchery Manager

1. **Mark Polinski**, IDFG, Evaluation of Formalin and Hydrogen Peroxide Use during Egg Incubation of Burbot (*Lota lota maculosa*)
2. **Martin Chen**, WDFW, Experimental Use of Isomet Amidium Chloride Hydrochloride (Trypamidium¹) to Control Mortality of Adult Chinook Salmon *Oncorhynchus tshawytscha* Due to *Cryptobia salmositica*
3. **Jeff Lombard**, WDFW, Production of Triploid Trout at Washington Department of Fish and Wildlife Hatcheries
4. **Brian Lyon**, WDFW, Rearing the Ancient Giants – Washington Department of Fish and Wildlife White Sturgeon Conservation Aquaculture at Columbia Basin Hatchery
5. **Joshua Benton**, WDFW, Use of Modern and Technologically Advanced Equipment and their advantages.
(Matsusaka Ltd. Electronic Juvenile Fish Pump & Cana-Vac Adult Fish Pump)
6. **Kent Dimmit**, WDFW, The All-H Hatchery Analyzer (AHA)
7. **Travis Maitland**, WDFW, Evaluating the spawning distribution and timing of spring Chinook salmon in the Chiwawa River using carcass recovery data
8. **Robert Hoover**, History and the Mystery
9. **Nathan Jensen**, Development of Intensive Culture Methods for Burbot *Lota Lota*

Session 1. Hatchery Design, Development And Renovation

Building a Better Fish Trap

Cory Cuthbertson*, Paul Faulds, Gary Sprague

WDFW Cedar River Hatchery, PO Box 829, Ravensdale, WA 98051,
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For the past 17 years the WDFW has been operating an interim hatchery on the Cedar River in the Lake Washington basin near Seattle. For 15 of those years WDFW's Cedar River Hatchery has been collecting its sockeye broodstock with a temporary, rigid panel weir and trap in the middle stretch of the Cedar River (RM 6.4). This old weir and trap required heavy machinery for installation and removal, was subject to being blown-out by high water events, and, because it was farther upstream, didn't catch any of the fish that spawned in the lower river. This year Seattle Public Utilities and WDFW have used a new floating resistance-board weir and newly designed trap in the lower Cedar River (RM 1.8) to improve the percentage of overall escapement collected, eliminate the use of heavy machinery in the river for installation and removal, and extend broodstock collection deeper into the season. The new weir and trap did accomplish some of those goals but also presented some unexpected challenges and required a number of adaptations to achieve those goals. From the lessons learned in the operation of the new weir this year the WDFW and SPU look optimistically at the potential for increasing the program's production in the future.

Burbot Hatchery Design, Development and Renovations at the University of Idaho

Nathan Jensen^{1*}, Susan. Ireland², John Siple², Matt Neufeld³, Kenneth Cain¹,

1. Department of Fish and Wildlife Resources and Aquaculture Research Institute,
University of Idaho, Moscow, ID 83844-1136, njensen@uidaho.edu.
2. Kootenai Tribe of Idaho, P.O. Box 1269, Bonners Ferry, ID 83805.
3. British Columbia Ministry of Environment, 401-333 Victoria St., Nelson, BC,
V1L4K3, Canada.

Burbot *Lota lota* are freshwater cod native to Idaho, USA and near demographic extinction from Idaho's Kootenai River and British Columbia's Kootenay River/Lake. Idaho burbot were denied federal listing in 2000 and remain a species of concern. The Kootenai Tribe of Idaho, the University of Idaho and the British Columbia Ministry of Environment collaborated ca. 2003 and brought wild adult burbot into captivity to develop suitable rearing systems and fundamental hatchery methods as an option should

hatchery burbot be needed to replenish the Kootenai(y) stocks. Over the last five years, observational studies into adult gender segregation and hormone analog (sGnRha) use has occurred in attempt to control spawning, an optimal egg incubator design was determined, larval weaning from live diets to commercial larval diets and semen cryopreservation methods were tested 2004-2006. Since 2003, facility renovations have occurred annually. The current burbot culture systems in use consist of full or partial recirculation water systems designed to conserve water and maintain critical water temperatures for spawning (2-5°C), egg incubation (3-5°C), larval feeding and juvenile grow-out (8-20°C). Additionally, six 8000L fiberglass tanks are kept outdoors for semi-intensive pond style rearing. Results of spawning observations revealed that volitional (in tank) spawning is common and fine mesh screens (0.5mm) are needed to keep eggs (typically 1 mm in diameter) within adult spawning tanks. The optimal egg incubator design is 1L conical bottom upwelling incubators suspended overtop a screened (0.5mm) 1m circular tank where larvae hatch and collect, develop and begin feeding on live prey. Live prey feeding begins with brackish (10ppt NaCl) rotifers *Brachionus plicatilis* mass produced in closed recirculation systems and is followed by *Artemia* hatched in 19L water containers (5ppt NaCl). When rotifer feeding ends commercial larval weaning diet (200-600 micron) feeding begins. Weaning larval burbot to commercial diets, while keeping the rearing environment clean, is the foremost bottleneck to successful production of healthy juveniles. Therefore, semi-intensive extensive rearing methods are being developed. All burbot culture system designs and method developments discussed will be applied to create a burbot hatchery manual and used to design a future conservation breeding program facility aimed at revitalizing burbot populations in Idaho's Kootenai River and British Columbia's Kootenay River/Lake.

Planning, Engineering and Construction Support For WDFW Hatcheries

Bill Phillips^{1*}

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Capital Planning and Facilities Management (CPFM, formally known as Engineering) is the primary support to the Fish Program for physical plant improvements and maintenance. CPFM provides a menu of services ranging from facilities planning to construction and maintenance services. As the funding for the agency continues to get squeezed by economic hardship, the division is looking at all opportunities to reduce cost of services while at the same time increase the quality of service to the customer.

The discussion will cover what is in the future for planning activities (of which Fish Program is the largest stakeholder). The discussion will include information related to maintenance management systems. The system is intended to streamline the programs ability to control activities and to focus on the biggest problems. We will also talk about what's in the future for capital planning and development.

The Construction and Development of the New Pahsimeroi Fish Hatchery as a Summer Chinook and Summer Steelhead Facility: Update and Progress

Lars R. Alsager*

Idaho Department of Fish and Game, Pahsimeroi Fish Hatchery, 71 Hatchery Lane, May, ID 83253, lalsager@idfg.idaho.gov

Pahsimeroi Fish Hatchery is located in the Pahsimeroi River Valley, approximately seven miles upstream from confluence of the Pahsimeroi and Salmon Rivers. The hatchery also consists of a satellite trapping and spawning facility approximately one mile upstream on the Pahsimeroi River. Pahsimeroi Fish Hatchery is funded through mitigation money by Idaho Power Company due to the impacts of the Hells Canyon Complex on the Snake River. In 2006, construction commenced to revamp rearing facilities, bringing them up to date with state of the art design and equipment. This new equipment and technology has brought Pahsimeroi Fish Hatchery to the for front as a Summer Chinook and Summer Steelhead facility.

Renovation of Wyoming Game & Fish Department's Dubois Hatchery

Steve Sharon*, Travis Trimble, Jeff Stafford

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The Wyoming Game and Fish Department operates ten fish culture facilities to manage Wyoming's sport fisheries and cutthroat trout restoration programs. Dubois Hatchery is a small station located along the east side of the Wind River Mountains in the northwest corner of the state, responsible for local and statewide stocking as well as a major incubator. In May 2000, the hatchery was closed after the causative agent for whirling disease, *Myxobolus cerebralis*, was confirmed in its open water supply and fish production. From the 2001 to December 2005, the facility underwent numerous projects to isolate and renovate water supplies, enhance water chemistries, and replace aging facilities with various technologies. Present day Dubois Hatchery is capable of quality production not typical for it warm water temperatures and multiple reuse processes. This presentation will chronicle the transition of the facility, the technologies implemented, and changes in production.

The Relative Value of a Hatchery Remodel

Jason Rothermel*

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This research project looks into the effects of two hatcheries in western Washington, which underwent a complete hatchery remodel. These two hatcheries are Issaquah and Minter Creek Salmon Hatchery. This research project was initiated to make one primary conclusion; “What is the economic impact of undergoing a hatchery remodel”. The post-remodel performance will be examined using multiple key points of interest. These include hatchery adult escapement, disease outbreak frequency, cost of operation, time efficiency in regards to labor (staff time allotment to specific tasks), economic activity associated to each hatchery. The next step is to find a way to equate an economic value to the positive changes, which have been shown to be connected to these hatchery remodels. One way that economic value can be measured is to use the “National Survey of fishing, hunting, and wildlife associated recreation census”, to identify the economic activity that is generated from recreational fishing. This census is published annually by a joint effort of multiple federal government agencies, which includes U.S. Dept of Interior, USFWS, U.S. Dept of Commerce, and the U.S. Census Bureau. With the help of this data, we are able to put a numerical dollar figure for each Chinook salmon that is caught in the State of Washington. With this value measured in \$/fish caught, we can begin to put a value on the data collected for adult salmon returns for these two hatcheries being discussed.

The results of this project show a positive trend between hatchery remodel and adult escapement returns. Before the Hatchery remodel, Minter Creek hatchery had an average adult return of 0.26%. After the Hatchery remodel, the average adult escapement increased to .95%. This is an average increase of 265% or 5,861 fish per year. Issaquah hatchery also showed a direct increase in adult escapement as well. Before the remodel, the average adult return was .17%. After the hatchery remodel, the average adult escapement increased to .41%. This is an average increase of 141% or 5,111 fish. According to the National Survey of fishing, hunting, and wildlife associated recreation census, the average fisherman generates \$1,900 of economic activity per each Chinook Salmon that is caught. Finding an actual way to evaluate the exact economic impact that these two hatcheries have had on recreational and commercial fishing can be difficult, however it is safe to assume that each have contributed positively to the region’s sport fishery.

The theoretical potential is huge for other hatcheries with similar characteristics to follow suit and be remodeled. Setting aside the economic hurdles and budget problems that most of our hatcheries face on an annual basis, a person could imagine the increase in productivity that could potentially be seen throughout the Northwest region without making any increases in the number of fish planted. WDFW has plans to continue to make improvements and renovations to the states hatcheries as time and money allows. With future hatchery remodels, hopefully our agency will continue to see improvements to our hatchery programs.

Session 2: Hatchery Design cont. and Fish Health

Hatcheries to Watershed Centers

Jason Hill, P.E.*

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The definition of a well-designed and operated hatchery is changing and the Washington Department of Fish and Wildlife is leading the way with a new facility that will be known as the Deschutes Watershed Center. The use of the word hatchery is beginning to be filtered out with the up and coming new concept titled Watershed Center. With a new title "Watershed Center" new ideas are being explored and integrated into how future hatcheries may operate.

For example, the process of developing a new facility considers more complicating aspects than then ever before by addressing: water quality restrictions (TMDL's), limiting water rights, accessible land, climate change, intake screen criteria, effluent management, public education, Leaders in Energy and Efficient Design (LEED), production goals, disease control/prevention, and flood plain management, and permitting are a few of the concerns that face all and new facilities.

HDR believes the "Watershed concept" will produce the next level of hatchery innovations that helps improve the performance of hatchery fish and reduces environmental impacts. We will discuss how this fish concept is affecting hatchery design and future operations

Improved hatchery efficiency through fish screen improvements at the Lower Herman Creek Ponds at the Oxbow Hatchery

Les Perkins*, Duane Banks

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The Oxbow Hatchery is located in the State of Oregon, 1 mile east of Cascade Locks, just south of the Columbia River. The Lower Herman Creek Pond site at the Oxbow Hatchery is a satellite facility comprised of rearing ponds sited on Herman Creek, a tributary to the Columbia River. The Lower Herman Creek Ponds utilize approximately 10 CFS of water diverted directly from Herman Creek. The Oxbow Hatchery produces Grande Ronde Basin Spring Chinook, Idaho Sockeye, Umatilla River Coho, and Tanner Creek Coho.

The Lower Herman Creek intake consists of a low diversion structure across Herman Creek that directs water into an intake with a trash rack. The former fish screen consisted of a horizontal screen that required constant maintenance in order to ensure consistent flow to the ponds. The by-pass system on the old screen created attraction issues for returning salmonids. During the late fall, a hatchery employee had to sleep in a truck next to the screen in order to clean the screen every 10 to 15 minutes. The screen no longer met criteria and was a serious maintenance problem.

The screen was replaced in June of 2007 with a new Farmers Screen. The Farmers Screen is a horizontal flat plate fish screen with no moving parts that requires little to no maintenance. The screen was designed to fit into the existing concrete structure in order to reduce construction costs. The design was a joint effort between ODFW fish passage and screening staff, FCA, and hatchery staff. The construction was a joint effort between FCA, private contractors, and the ODFW The Dalles Screen Shop. The result is a screen that provides consistent flows to the ponds, protects fish in Herman Creek, and provides for substantially reduced operation and maintenance costs for the hatchery. The new by-pass system minimizes attraction issues.

Disease Susceptibility of Burbot (*Lota lota maculosa*) Following Challenge with Specific Fish Pathogens

Mark P. Polinski^{1*}, Keith A. Johnson², Kevin R. Snekvik³, Susan C. Ireland⁴, Kenneth D. Cain¹

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² Idaho Department of Fish and Game, Eagle Fish Health Laboratory, Eagle, ID 83616

³ Washington Animal Disease Diagnostic Laboratory and Department of Veterinary Microbiology and Pathology, College of Veterinary Medicine, Washington State University, Pullman, WA 99164-7034

⁴ Kootenai Tribe of Idaho, Bonners Ferry, ID 83805

To assist in the development of a conservation aquaculture program for burbot (*Lota lota maculosa*) disease susceptibility of this species is being investigated. *In vivo* challenges have been conducted with juvenile burbot to four select pathogens; infectious pancreatic necrosis virus (IPNV), infectious hematopoietic necrosis virus (IHNV), *Flavobacterium psychrophilum*, and *Aeromonas salmonicida*. Immersion challenges of 2g juvenile burbot with IHNV revealed a significant ($p < 0.05$) increase in mortality rate for infected groups. Although physical indications of disease were not externally visible, the pathogen was re-isolated by cell culture from mortalities throughout the challenge, indicating this species is susceptible to IHNV and can act as a carrier for this virus. In contrast, similar immersion challenges with IPNV produced neither clinical signs of disease nor significant changes in mortality rate, and cytopathic effect (CPE) was not observed in diagnostic cell culture. Interestingly, a follow up intra-peritoneal (IP) injection challenge with a high dose of IPNV in 0.5g burbot resulted in isolation of low levels of virus in cell culture from all challenged mortalities. However, no increase in mortality rate or clinical

signs of disease was observed. This indicates that although burbot have the potential to be carriers of this virus, waterborne exposure alone does not appear to be sufficient to induce viral uptake. The bacterial IP injection challenge of *A. salmonicida* in 5g burbot resulted in an increase in mortality rate ($p < 0.05$) and infected fish showed reddening of the abdomen near the injection site. The pathogen was re-isolated from kidney, liver, and spleen tissues on tryptic soy agar from challenge mortalities and macroscopic signs of tissue damage were observed, demonstrating *A. salmonicida*'s ability to cause disease in this species. Lastly, intra-muscular (IM) injection challenges with *F. psychrophilum* did not result in increased mortality. Fish showed no sign of disease and bacteria was not re-isolated from any challenged mortality. Taken together this would indicate that burbot do not appear susceptible to this pathogen. Results from this study provides baseline information important for future recover efforts of this species in the Kootenai River of Idaho or else ware.

**EXPERIMENTAL USE OF ISOMETAMIDIUM CHLORIDE
HYDROCHLORIDE (TRYPAMIDIUM^h) TO CONTROL MORTALITY OF ADULT
CHINOOK SALMON *Oncorhynchus tshawytscha* DUE TO *Cryptobia salmositica***

Martin F. Chen*, Henry Y.W. Cheng, Denis Popochock, Brian Russell, Jim Bertolini and Jan Gleckler.

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Cryptobia salmositica is a protozoan parasite of blood that infects all five Pacific salmon species and rainbow trout. At Solduc Hatchery in Washington, prespawning losses of adult spring chinook salmon due to cryptobia have been 50-60% annually for most of the preceding two decades. Isometamidium chloride (IMC) was injected into adult spring chinook salmon at Solduc Hatchery in 2007 to control mortality due to *Cryptobia*. In May 2007, 29 adult salmon were injected (dorsal sinus) twice with 1 mg/kg IMC at 5-week intervals with equivalent controls. Survival to spawning in September 2007 was 38% in the treated group vs 21% in controls (significant at 95% cl). Eggs were obtained from 4 treated females but no untreated females survived.

Ten adult salmon were injected in July once with 2 mg/kg with an equal number of controls. Survival to spawning was 8/10 treated vs 7/10 controls. Gamete quality from 2 mg/kg-injected adults was equivalent or better than controls, measured in survival of fertilized eggs and juveniles to the first feeding stage.

For 2008, adults were injected once with 2 mg/kg. Mortality data shown below:

	Males dead	Females dead	mortality/n	% loss
Tank C1 (IMC)	3	16	19/70	27%
C5 (H ₂ O)	8	31	39/60	64%
Tank C2 (IMC)	2	4	6/64	9.4%

We estimate that 14 IMC treated fish died from the injection process, 10 fish in C1 and 4 in C2. These fish are included in the above mortality data; the data shows that with IMC treatment, early-run chinook can be held with survival comparable to spring chinook hatcheries that do not have *Cryptobia* problems. An INAD exemption (file # 011685) has been received from FDA/CVM, which permits the release of progeny of injected adults into public waters.

Fifteen Years Without An IHN Outbreak At Lyons Ferry Hatchery.... Just Good Luck?

Steve Roberts^{1*} and Joan Thomas²

⁽¹⁾ Washington Department of Fish and Wildlife, 2315 N Discovery Pl., Spokane Valley, WA 99216, robersdr@dfw.wa.gov

⁽²⁾ Washington Department of Fish and Wildlife, 600 N Capitol Way, Olympia, WA 98501, thomajbt@dfw.wa.gov

Infectious Hematopoietic Necrosis (IHN) epizootics occurred in juvenile summer steelhead *Oncorhynchus mykiss* at Lyons Ferry Hatchery located in Starbuck, WA in 1989 and 1992. The details from the 1989 and 1992 IHN epizootics including fish affected, source of the virus and IHN virus management strategies will be discussed.

Since 1992, IHN virus management at Lyons Ferry Hatchery includes viral testing of the ovarian fluid of all female spawners along with quantifying virus levels. Management actions included destruction of eggs from IHN positive females with virus levels in excess of 10³ pfu/ml. Segregation rearing of progeny of low level IHN (less than 10³ pfu/ml) virus positive females was accomplished on three occasions when overall IHN virus prevalence exceeded 25%. Additional IHN virus management strategies have included strict equipment disinfection; rinsing and water hardening newly fertilized eggs in iodophor solution, isolation egg incubation and segregation rearing.

Four stocks of summer steelhead are currently reared at Lyons Ferry Hatchery utilizing a well water supply. With the Lyons Ferry steelhead stock, over 3,000 females were tested from 1993 to 2007 with IHN virus detected in 5 out of 15 years. IHN virus prevalence in Lyons Ferry female spawners ranged from 0 to 67%. Progeny of low-level IHN virus positive females were successfully reared in 1995 and 1998. With the Wallowa steelhead stock, over 1,500 females were tested from 1992 to 2007 with IHN virus detected in 8 out of 16 years. IHN virus prevalence in Wallowa female spawners ranged from 0 to 41%. Progeny of low-level IHN virus positive Wallowa females were successfully reared in 1998. With the endemic Touchet steelhead stock, 120 females were tested from 2000 to 2007 with IHN virus detected in 2 out of 8 years. IHN virus prevalence in the Touchet female spawners ranged from 0 to 28%. All progeny of IHN positive females were released as swim-up fry. Finally, with the endemic Tucannon steelhead stock, 100 females were tested from 2000 to 2008 with no IHN virus detected. Despite the isolation

of IHN virus in steelhead broodfish and two previous outbreaks, no IHN epizootics have been observed at Lyons Ferry Hatchery for the last 15 years. Is the lack of IHN epizootics a result of management strategies or just good luck?

UV Disinfection at Leaburg Hatchery

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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. Because of IHN in the water supply, Leaburg hatchery only hatches about 80,000 sentinel fish and 100,000 experimental Shasta rainbow trout.

In December 2007, the crew installed an ultraviolet disinfection system rated at 500 gpm and 45,000 μ w-sec/cm² in the hatch house. Since June 2008, pathology has been testing the water pre filter and post filter, only finding bacteria in the pre-filtered water. Prior to installing an ultraviolet disinfection system we had major losses due to internal fungus and coldwater disease in the hatch house, making the trout more susceptible to IHN infection. With a pathogen free water supply and the availability of heated water, our hatch house mortality has decreased significantly. 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.

Case History – Infectious Hematopoietic Necrosis Virus in the Chehalis and Queets River Basins

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Infectious Hematopoietic Necrosis Virus (IHNV) is serious fish pathogen that occurs naturally in salmonids throughout the Pacific Northwest. While IHNV has likely been around longer, the first reports of severe mortality, now attributed to IHNV, occurred in British Columbia in 1925. Severe mortalities also attributed to IHNV occurred at Coleman National Fish Hatchery in chinook fingerlings from the time the station was established in 1941. During the 1970's there were numerous reports of IHNV from throughout the Pacific Northwest including the Washington, Oregon, California, Alaska, and British Columbia. In 1995 IHNV was isolated from adult and juvenile winter steelhead and juvenile chinook at the Cole River Hatchery (ODFW) in the Rogue River

Basin. In 1997 and again in 2006 IHNV was isolated from juvenile winter steelhead being reared in the Queets River (at the Salmon River Hatchery) Basin. Until 2006, IHNV had not been found in the Chehalis River Basin. In 2006 IHNV was isolated from several adult and juvenile hatchery salmon and steelhead stocks at multiple facilities in the Chehalis River Basin. Genotyping of the isolates from these river basins has found that the strain present in all of these isolations is a strain labeled “M-D”. This strain was previously confined to the Columbia River Basin and is particularly pathogenic to steelhead and rainbow trout. This presentation will trace the Washington isolations and the actions taken.

Session 3: Salmon and Steelhead Recovery

The Hood Canal Steelhead Project: An Overview and Evaluation of Hydraulic Redd Sampling

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In 2006, NOAA Fisheries, Northwest Fisheries Science Center initiated a large-scale, long-term test of supplementation for ESA-listed steelhead in Hood Canal. The study involves supplementing three populations with locally derived fish collected as embryos from natural redds. Three additional populations are monitored with equal intensity. The abundance, productivity, and genetic and life history diversity of treatment and control populations are being monitored in the pre-supplementation phase. Beginning in 2010, hatchery fish will begin spawning and the during-supplementation phase will last approximately eight years. After that, supplementation will be terminated and the longer-term effects of the supplementation programs on natural populations will be monitored through the subsequent post-supplementation generation.

Conservation hatcheries, such as this one, that include captive rearing from egg to the smolt or adult stage require the development of new approaches to balance specific production targets and genetic factors. The collection of eyed eggs from naturally produced redds represents one approach that has been implemented for Hood Canal steelhead and ESA-Threatened Chinook salmon in Idaho. The numbers of eggs collected for four Hood Canal steelhead populations and two Salmon River Chinook salmon populations were very close to the goals set for the programs. A high percentage of the eggs (mean \pm SD) collected from individual redds were viable (steelhead: 94.5% \pm 11.6%; Chinook: 94.8% \pm 5.8%), reflecting high natural fertilization success and viability to the eyed stage. Eggs collected from individual redds were infrequently damaged

(steelhead: $0.2\% \pm 0.6\%$; Chinook: $4.5\% \pm 6.8\%$) as a result of the hydraulic sampling process. The mean survival of eyed eggs to first feeding in the hatchery was very similar for steelhead (94.6%) and Chinook salmon (95.6%). Approximately 70% of the eggs not collected during hydraulic sampling in a spawning channel were collected as emergent fry, further suggesting a low impact to eggs remaining in the redds. However, the potential mortality of eggs remaining in hydraulically sampled redds has not been experimentally evaluated under natural conditions. For several recent captive populations of Chinook salmon and steelhead a much larger proportion of the wild parent population has been represented in the captive population than would have been achieved by artificial spawning to produce the same number of eggs. The egg collection approach was used in the Hamma Hamma River steelhead hatchery program. Genetic analyses of naturally produced parr have indicated that the genetic variability in the natural population has been maintained after one generation of supplementation.

Implementation and Operation of an ESA-listed Hood Canal Summer Chum Recovery Project: The Nuts and Bolts

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In March of 1999, the National Marine Fisheries Service (NMFS) determined that the summer chum originating from Hood Canal and the Strait of Juan de Fuca represented an Evolutionarily Significant Unit (ESU), and formally listed these fish under the Endangered Species Act (ESA) as a threatened species. In August of 1999, the Summer Chum Salmon Conservation Initiative (SCSCI) identified Tahuya River summer chum as one of four extirpated stocks in the Hood Canal summer chum ESU and as a potential future candidate for a summer chum reintroduction project. The Union River Supplementation/ Tahuya River Reintroduction Project was implemented in June of 2000 as a cooperative project between Washington Department of Fish and Wildlife (WDFW) and the Hood Canal Salmon Enhancement Group (HCSEG). The following is a Power Point Presentation of what is entailed in implementing and operating a summer chum recovery project in compliance with the protocols set forth in the SCSCI and the Union/Tahuya River Hatchery and Genetic Management Plan (HGMP) and the results that have been achieved to date.

**ESA-listed Hood Canal Summer Chum Salmon:
A brief update on supplementation programs,
Natural-origin vs. supplementation-origin returns, and recovery**

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Hood Canal summer chum (including the eastern Strait of Juan de Fuca) were listed as threatened under the Endangered Species Act in 1999. Recovery planning and implementation were underway prior to the listing, with harvest reductions and supplementation programs enacted in the early 1990's. The Washington Department of Fish and Wildlife and Point No Point Treaty Tribes distributed the Summer Chum Salmon Conservation Initiative (SCSCI) in April 2000. The initiative described a comprehensive plan for the implementation of summer chum salmon recovery in Hood Canal and eastern Strait of Juan de Fuca. The Summer Chum Recovery Plan, prepared by the Hood Canal Coordinating Council, incorporated the harvest and artificial production management provisions of the SCSCI and also addressed habitat protection and restoration. The Recovery Plan was formally adopted by National Marine Fisheries Service (NMFS) under rule 4(f) of the Endangered Species Act in March 2007.

Run sizes of summer chum have been on the rise since the mid-1990's, with some of the highest returns on record occurring in recent years. Supplementation programs have succeeded in reducing the extinction risk of several stocks that were at critically low levels prior to supplementation and these stocks have demonstrated strong returns of both supplementation-origin and natural-origin fish in recent years. Reintroduction programs also appear to be succeeding, with natural-origin spawners returning to three streams where summer chum had been extinct for more than 10 years.

Interim recovery goals for summer chum have been developed by the Washington Department of Fish and Wildlife and the Point No Point Treaty Tribes – the fish resource co-managers in the summer chum region - based on historic population sizes, and include abundance, escapement, productivity, and diversity targets. Summer chum populations are not yet meeting the Co-managers' abundance-based recovery goals, due in part to the requirement that all stocks must meet recovery abundance thresholds over a period of 12 years. The outlook for summer chum, however, is much brighter than it was just 10 years ago, based on recent increased abundances and other indicators.

Progressive Efforts to Conserve Water at State Fish Hatcheries

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The conference is a perfect forum to emphasize progressive changes being made in many States to increase fish production without increasing water demand. Over the years we have accumulated proven case studies where fish production can be increased and the water being used to rear the fish is not increased. It isn't magic; it is the simple technique of re-using water. Skeptics are abound but hopefully with enough proof the skeptics will give it another look.

If your water is plentiful, contains the ideal amount of oxygen and nitrogen, is at the perfect pH and temperature, is pathogen free, and there are no effluent discharge restrictions, then there is no need to recycle your water. Chances are it isn't ideal. One of the biggest concerns raised by skeptics is the ability to maintain fish health standards within a recycle system. Alaska, Wyoming and Utah are some of the States that are successfully recycling water in their hatcheries and meeting the high fish health standards.

In Washington State, the Chelan Public Utilities District has operated a very successful, full-scale pilot system incorporating circular tanks and partial reuse technologies. Mandated to increase fish production but faced with limited water resources, the Chelan PUD found that water reuse technology is a practical and economical solution. The pilot system, which is operated by WDFW employees at the Eastbank Hatchery in Wenatchee, WA, has been deemed a success based on results from both extensive fish health and water quality-monitoring programs.

There are many other successful case studies for water recycling in aquaculture. The State of Alaska is currently executing projects to build two new, large-scale, recirculating fish hatcheries for sport fish production in Fairbanks and Anchorage. In order to go ahead with these projects, years of piloting was conducted. The State of Wyoming is upgrading many hatcheries to incorporate circular tanks water reuse systems. The State of Utah is operating a highly successful recirculating fish hatchery at the Fisheries Experiment Station in Logan to rear the endangered June Sucker which could not have been accomplished economically with a traditional flow-through system.

For facilities faced with limited water resources, sustainability issues, or a requirement for improved control over culture conditions, recycle technology is the next step in the evolution of modern aquaculture systems. Compared to flow-through aquaculture systems, recycle systems offer significant reductions in water consumption, effluent discharge volumes, and energy consumption. Recycle technology allows existing facilities to increase production despite limited water resources. Disinfection of influent water for biosecurity protection becomes possible when supply is reduced. Water quality and temperature become easier to control which may have significant production benefits.

With more State hatcheries incorporating water recycle systems using circular tanks instead of the traditional high water usage flow-through raceway systems there is hope for the future fish production to continue to increase without depleting very valuable and life sustaining water resources.

Session 4: Salmon and Steelhead Culture and Management I

FishBooks: A New Age Approach for Washington State Fish Hatchery Data

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FishBooks is a Washington Department and Fish and Wildlife web-based application for hatchery data (or records). The application has been in development for three years and was officially launched in August 2008 at hatcheries throughout Washington State. FishBooks was designed for hatchery workers to record fish rearing and adult activities, and for agency staff to access the same information through the application. Historically (and presently at some remote facilities) hatchery workers fill out paper forms. This ends up causing problems, such as two or more sets of records, duplication, someone in headquarters filling in the blanks, and errors. Not to mention, fish guts and coffee stains on reports. Washington State hatcheries generate a lot of paperwork in a year. FishBooks is a centralized data system for collection and storage of hatchery information. FishBooks will make record keeping more streamlined, and information will be readily available without making a bunch of phone calls. FishBooks will reduce data entry errors and make information sharing more efficient and streamlined. At the same time, FishBooks is standardizing hatchery data- workers can move between facilities and the paperwork will be the same. FishBooks keeps the agency on top of production; goals are spelled out in the Future Brood, while workers and managers can use the information to stay on track.

Fish Growth Management Methods; Planning and Implementation

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Beginning the rearing season with a plan is the best way to stay organized, produce quality fish, and insure that you meet your release goals. A contemporary, formulated spreadsheet designed to project fish growth can help the culturist map out feed requirements. In addition, this process can assist in scheduling rearing events. Marking, splitting, and feed size changes are just some of the actions that can be predicted and prepared for in advance. Information from this growth projection is inserted into a corresponding weekly feed sheet. The feed sheet also contains formulas that adjust the ration according data entered by the culturist. Routinely sampling fish growth and calculating the feed conversion is significant to success with this system. As the fish develop, it is necessary to input small amounts of information to insure that the program is accurately able to predict the eventual ending biomass. Benefits of this strategy are vast. Examples include the ability to catch up several different egg takes for eventual amalgamation or cutting rations to slow fish growth without sacrificing the coefficient of variation. The fundamental theory behind this rearing process is predicting, observing, and responding accordingly. The results will enhance the quality of your fish populations and insure the success of your program.

Monitoring for precocious male maturation (minijacks) in hatchery programs: A case study of upper Columbia River summer Chinook salmon.

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In spring and summer Chinook salmon, male maturation can occur at age 1 (precocious parr), 2 (minijacks), 3 (jacks) 4 or 5 years post fertilization; the age being influenced by both genetic and environmental factors including body size, growth rate, and body lipid level. Precocious male maturation is not considered common in wild populations of Chinook salmon but may be prevalent in some hatchery stocks. Thus, the hatchery-rearing regime can have a significant impact on rates of phenotypic expression. Unnaturally high rates of precocious male maturation are undesirable in both production and supplementation programs as these fish may compete with native stocks, influence domestication selection, bias gender ratios and reduce production in anadromous adults, and alter the accuracy of SAR estimates. In an on-going monitoring effort at the Cle

Elum Supplementation Hatchery on the Yakima River, WA we reported average minijacks rates over 10 yrs exceeding 40% of male fish at the time of release and we have confirmed moderate to high rates in other Columbia River stocks including, Leavenworth, Entiat, Methow and Lookingglass (Lostine, Imnaha) Hatcheries. In these studies, we measured plasma levels of the reproductive androgen 11-ketotestosterone (11-KT) in fish just prior to release in March-April to identify male fish maturing as minijacks. This hormone signals the initiation of spermatogenesis and provides a reliable indicator of the earliest signs of maturation. In 2008, we expanded this monitoring effort to three summer Chinook stocks in the mid- and upper-Columbia River: Carlton Pond on the Methow River, Dryden Pond on the Wenatchee River and Similkameen Pond on the Similkameen River. We found variable minijack rates ranging from 37% at Carlton Pond, 17% at Dryden Pond and 10% at Similkameen Pond. The variation in minijack rates corresponded with significant differences in both average size and variance in size; being highest at Carlton Pond, lowest at Similkameen, and intermediate at Dryden Pond. Interestingly, both the Similkameen and Carlton Pond stocks are sourced from the same composite population of hatchery and natural-origin Methow and Okanogan River adults collected at Wells Dam, but the SAR's for the Similkameen stock are approximately 3-fold higher than that of the Carlton stock. This is surprising in light of the fact that the Carlton Chinook have a shorter juvenile migration distance and are larger at release; a factor generally shown to improve juvenile salmonid survival rates. The rearing regimes for these two hatchery stocks are different which likely has an impact on growth profiles, size and minijack rates. While other factors (i.e., disease history) may influence the difference in SAR between these two programs, the 2.5-fold difference in minijack rate is likely to be a significant contributor. This and previous case studies in spring Chinook salmon programs illustrate the need for pre-release life-history monitoring in hatchery programs. This information can then be used to make programmatic decisions on rearing regimes and obtain more accurate SAR data to better optimize supplementation and conventional production programs throughout the Columbia Basin.

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Unexpected effects and unintended consequences: altering emergence timing induces variability in Chinook salmon life history

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Perhaps the most manipulated; yet, least evaluated aspect of salmon rearing is the seasonal timing of ponding (1st feeding, emergence). Pond timing is easily manipulated in hatcheries because it is simple to either heat or chill egg incubation water and early salmon development is directly related to temperature. A general hatchery practice is to chill early egg takes and/or warm later egg takes to synchronize pond timing across the population. In some facilities, where both spring Chinook salmon and steelhead are reared, the early development of Chinook salmon is accelerated so that salmon fry can be

ponded before incubator space is needed for eggs produced by steelhead spawning in late December and early January. Alternatively, at facilities that use surface water for juvenile fish rearing, early development of embryos is slowed using chilled water and ponding does not occur until March or April, thus avoiding issues with run-off and silting of raceways. The consequences of compression, acceleration or retardation of emergence timing in Chinook salmon hatchery populations have almost been ignored.

We conducted a laboratory experiment using Yakima River spring run Chinook salmon to explore the effects of altered ponding time on life history patterns. We observed two major life history shifts: 1). male maturation at age 1 (precocious parr) was suppressed by ponding later in the year (May) and 2). autumnal smolting (under-yearling) was stimulated by ponding earlier in the year (December). These experiments were specifically designed to eliminate potentially confounding effects of age, size (growth) or genetic differences. Differences among experimental groups in the propensity to either mature or smolt were solely due to the photoperiod fry 1st experienced at ponding. The implications of these findings with regard to hatchery rearing, domestication selection and hatchery reform will be discussed.

A comparison of the health and performance of Chinook salmon reared in partial reuse circular tanks and flow-through raceways

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Modern partial reuse aquaculture systems have the capacity to reuse 80% of their water while maintaining water quality parameters (e.g. DO, CO₂, ammonia) within safe limits, and are therefore of interest to those who are investigating methods to reduce water usage. In order for partial reuse systems to be deemed acceptable as replacements to traditional flow-through rearing, fish health and welfare, among other things, should be comparable between the two system types, if not improved by partial reuse technology. However, limited observational research has been conducted in this area. The study presented here was conducted to investigate fish health and welfare between partial reuse and flow-through systems in a full-scale field setting.

A full-scale partial water reuse system was constructed at the Eastbank Hatchery (Wenatchee, WA) to rear approximately 120,000 Chinook salmon for a 5-month early rearing period (June 2008–November 2008) while the remainder of this population (60,000) was raised for the same period at Eastbank Hatchery in a traditional flow-through raceway. Our hypothesis was that fish will have comparable, if not improved, growth, health and welfare in the new partial reuse system relative to those in flow-through rearing units. The study followed a prospective cohort epidemiological design, and assessed specific health and welfare indicators between two cohorts of fish of the

same background (genetic strain, early rearing environment, etc.) exposed to two different rearing systems, with all other exposures (water source, management, rearing densities, feeding rates, etc.) being equal. The methodology focused on three areas: performance, health, and welfare. For performance comparison, fish were sampled from both cohorts at regular monthly intervals for length and weight data to determine growth rate and feed conversion. For health comparison, samples of 60 fish from each cohort (120 fish total per sampling event) were collected at the start, middle, and end of the study period. Fish were screened for listed viral, bacterial, and parasitic pathogens, following USDA APHIS Blue Book protocols. At the end of the study, 50 fish from each cohort were assessed to determine the extent of organ pathology within each cohort. For welfare comparison, 50 fish from each cohort had their fin condition assessed at the end of the study.

Initial results indicate that the Chinook salmon reared in the partial reuse system have comparable growth, feed conversion, and health status as those Chinook salmon reared in the traditional flow-through raceway. Future detailed data analysis will show whether there were statistically significant differences over the study period between the two cohorts. Initial results show that partial water reuse is an acceptable and potentially preferred method of rearing these fish because of the many benefits that partial water reuse systems provide over traditional flow-through raceways. Partial water reuse systems use significantly less water than raceways while providing excellent water quality and a uniform rearing environment. Because these systems use less water, the wastes generated by the fish are concentrated in a smaller flow resulting in more effective treatment of the effluent. In this study the water flow used per kg of fish reared was 0.7 lpm/kg in the partial reuse system and 2.0 lpm/kg in the traditional raceway, a difference of 285%.

Session 5: Salmon and Steelhead Culture and Management II

Reducing Soreback Mortality in Summer Steelhead at the Hagerman National Fish Hatchery

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The Hagerman National Fish Hatchery (Hatchery) reported soreback as far back as 1962. Soreback is characterized by a focal lesion at the anterior base of the dorsal fin that usually progresses into the underlying muscle and other tissues. The condition usually occurs in juvenile rainbow trout and steelhead fingerlings at water temperatures above 54 F and under restricted feeding regimes. The lesions are caused by nipping and are

typically found on the largest and most competitive fingerlings. There is no treatment for soreback, but isolated fish can heal in 5 – 7 days.

Numerous researchers examined the effects of diet, chemotherapeutants, and raceway alterations on fin erosion and soreback at the Hatchery since the 1960's. These studies suggested dorsal fin erosion was the precursor to soreback and that fin erosion began by aggressive nipping behavior in fingerlings. Chemotherapeutants and raceway alterations including shading, baffles, and substrate additions had limited success relieving fin erosion problems. However, rearing fish individually did eliminate fin erosion. In addition, rearing fish in low dissolved oxygen conditions, feeding to satiation, feeding krill/squid diets, and feeding diets with wheat middling fillers reduced fin erosion.

During Brood Year 2007, the Hatchery observed soreback mortality of 4 – 5” Dworshak “B” steelhead in late October and November. Mortality rates were higher in Dworshak “B” steelhead groups fed at a Hatchery Constant below 6.8. Steelhead fed below a Hatchery Constant of 6.8 exhibited more aggressive behavior and increased soreback mortality. The soreback inflicted steelhead healed in December 2007 as total biomass increased, dissolved oxygen decreased, and smoltification reduced aggressive behavior. During Brood Year 2008, the Hatchery shifted release dates so that all Dworshak “B” steelhead will be fed at a Hatchery Constant greater than 7.0 and still meet size at release goals of 8.66” to reduce soreback mortality.

Feeding a natural marine based diet to improve quality and survival of reconditioned kelt steelhead at Cassimer Bar Hatchery

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Cassimer Bar Hatchery is located near the confluence of the Okanogan and Columbia Rivers in Okanogan County. The facility is dedicated to the Locally Adapted Steelhead and Kelt Reconditioning programs for the Colville Confederated Tribes. The kelt reconditioning program began in 2004 as part of a reproductive success study being conducted by the Columbia River Inter-Tribal Fish Commission (CRITFC). The nutritional program was initially developed through the Yakama Nation portion of the reproductive success study and used as a guideline for the Colville Tribes program. In 2006, we began conducting complete necropsies on our mortalities to see if we needed to modify our program to help increase survival. The information we compiled from our examinations made us rethink our feeding protocols. Numerous fish examined in 2006 had large amounts of undigested feed in their guts. The fish were taking in the food but it was not being processed through their system. After talking with WDFW Fish Pathologist Robert Rogers, we decided to let the fish tell us what they needed. Primarily, we asked ourselves: what foods would these fish feed on in the estuary and ocean environments? There is a huge diversity of food sources that contribute to the overall well being of salmon and steelhead. We searched for a distributor that could supply us with a

variety of marine based foods. Finally, we found a small business in Ilwaco, Washington that had just what we needed.

We purchased krill, shrimp, prawns, mussels, squid, anchovies and herring. During 2007 we initiated our new feeding program and were pleasantly surprised with the results. During our necropsies we found no problems with fish being unable to process the food. The kelts that survived to release gained an average of 100% of their incoming body weight. Overall health of the fish improved, including skin and fin condition. Additional data was collected in 2008, supporting the benefits of feeding a marine based diet to improve quality and survival of steelhead kelts.

The Use of Formalin in a Safe and Cost Efficient Manner

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Coleman Fish Hatchery produces 13 million Chinook salmon and 600,000 steelhead smolts annually. The facility is located 150mi. north of Sacramento. Ralph and John will co-present a different method of dispersing formalin to control fungus on salmon eggs. This new method is very effective, a time saver for staff, and most importantly also minimizes the contact staff have with formalin.

Application and use of ultrasound to determine gender composition of spring Chinook salmon (*Oncorhynchus tshawytscha*) broodstock for mitigation programs in the Wenatchee River Basin

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Broodstock collection protocols routinely assume an equal sex ratio. Without such an assumption a greater proportion of the returning adults would need to be collected in order to make egg production goals (i.e., unequal sex ratios). Alternatively, if this assumption is not valid, egg production goals will not be achieved. The ability of personnel collecting broodstock to estimate the gender of individual fish directly influences the egg production goals. Spring Chinook salmon (*Oncorhynchus tshawytscha*) migrate into spawning tributaries between May and August. These early run fish do not exhibit pronounced secondary sexual characteristics, thus making it difficult to make correct sex determinations. Historically, error rates associated with gender determinations for broodstock collections were 95% and 92% for females and males

respectively. In order to reduce error associated with observer bias in determining the gender of individual fish, a portable ultrasound machine was used to identify gonads of fish being collected for the 2008 brood spring Chinook salmon for Eastbank Fish Hatchery occurring at Tumwater Dam, WA. A passive integrated transponder tag (PIT) tag is implanted in all spring Chinook either collected or passed thru Tumwater Dam. Gender determinations made at collection via ultrasound were then compared to those verified at spawning and necropsies conducted on mortalities. Observer efficiency associated with the 2008 brood spring Chinook was 100% for both males and females. The effectiveness of ultrasound technology, when used correctly, can remove observer error when targeting specific gender compositions when collecting broodstock, ensuring mitigation egg production can be met or maximized in most years. This can ultimately result in fewer adults being required to meet mitigation goals, making more adults available for harvest and/or ensuring a greater number of natural origin adults will be available for spawning in a given population.

Using off-site acclimation/release facilities to expand the spawning distribution and minimize straying of supplemented salmon populations: Lessons from the Yakima River Spring Chinook program

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Homing to the natal site to spawn is fundamental to the unique biology and management of salmon. Exposure to home stream odors during appropriate juvenile stages is critical for olfactory imprinting and successful completion of the adult homing migration. A number of supplementation hatchery programs utilize acclimation facilities to reestablish natural spawning in underutilized stream reaches. These programs seek to exploit the tendency of salmon to imprint and return as adults to the site(s) from which they are released as outmigrating smolts. The final choice of spawning location within a watershed, however, involves complex tradeoffs between homing to the natal site, spawning habitat selection, and mate choice. This presentation describes the spatial patterns of homing and spawning by wild salmon and hatchery-reared salmon released from acclimation facilities in the upper Yakima River, Washington. Over six years (2002-2007), we comprehensively surveyed the spawning area of the Yakima River spring Chinook population and GPS mapped every carcass recovered (n=9214). The results of this ongoing study indicated that site of acclimation and release significantly affects the distribution of adult spawning within the sub-basin but a large percentage (55.1 %) of hatchery fish were recovered in areas far from their release sites (> 25 km away), often in spawning areas utilized by wild conspecifics. These data indicated that supplementation increased the spatial range of spawning in the upper Yakima River but tradeoffs between homing and selection for appropriate spawning habitat resulted in considerable overlap of hatchery and wild fish.

Session 6: Trout and Kokanee Culture and Management

Development of sterile and all-female kokanee *Oncorhynchus nerka* for recreational fisheries in British Columbia

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The province of BC is trying to reverse the downward trend in fishing license sales that has been occurring over the last fifteen years. One way to reverse this decline is to provide anglers with a diversity of angling opportunity. Kokanee are thought to be a good species to provide an alternative to brook trout and rainbow trout especially during the summer months when fishing for these other species becomes more difficult and when families take more time for recreational activities. Some of the challenges we face with current kokanee fisheries and with the development of new fisheries include high precocious male maturation rates, stunting in systems with spawning habitat and introgression into the wild. In an attempt to provide kokanee fisheries while minimizing some of these impacts, Freshwater Fisheries Society of BC (FFSBC) has been developing sterile and all-female kokanee stocks.

For the past six years, FFSBC has been producing sterile kokanee for stocking into a limited number of lakes for assessment purposes and to provide new fisheries. Performance data collected to age 4+ indicates that growth and survival of sterile kokanee is comparable to that of their 2n counterparts unless lake environments are harsh. Further, the use of sterile kokanee increases the proportion of immature older age class fish in the population, potentially improving fishing quality: over 80% of fish older than age 3 that are available to anglers were sterile females. Sterile males still develop secondary sex characteristics and exhibit false spawning behavior by age 2. For that reason, the use of mono-sex female sterile kokanee (AF3n) could improve the fishery, reduce maturation mortality and further reduce the risk of stunting and introgression.

Progress has been made in the development of an all-female kokanee stock. In December 2005 and 2006 trials were undertaken to masculinize kokanee, the first step in producing all-female fish. Three replicates of mixed sex eggs/alevins were immersed in one of four concentrations of α -methyltestosterone. Eggs/alevins were immersed at 75% hatch for two hours and then again one week later. All experimental groups showed 100% sex reversal. Next, these kokanee were reared to age 2 at Clearwater Trout Hatchery (CWH) where more than half of the fish matured. Some mature males from each experimental group were crossed with females from Meadow Creek (one to one crosses) in an attempt to produce some all-female kokanee families, verifying the existence of and the viability of XX males in the experimental groups. Family groups were reared separately until

they could be sexed. Results will be presented at the 2008 Northwest Fish Culture Conference.

Kokanee Captive Brood Stock Program at Spokane Hatchery

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Washington State's primary kokanee egg source has been the Lake Whatcom kokanee stock. This egg source will soon be lost due to the removal of the diversion dam and the reintroduction of the ESA listed early fall Chinook into the Middle Fork of the Nooksack River. As part of effort to replace Lake Whatcom source, a kokanee captive broodstock program was initiated at Spokane Hatchery. To increase the likelihood for success with this program, the Spokane Hatchery adopted age class target sizes that had been successfully used at the Creston National Fish Hatchery, Kalispell, Montana. These age class target sizes were closely projected and monitored throughout the lifecycle of the hatchery kokanee. Hatchery staff also strictly followed recommended fish health guidelines in regards to loadings, diet, cleaning, spawning procedures, etc. In 2007, the first group of captive brood sexually matured and spawned as three year old adults. The total egg take was 503,000 green eggs with an average fecundity of 566 eggs per female. The egg quality and viability were excellent. The only problem encountered was spinal deformities and elevated mortality in prespawning three-year-old fish. The results to date show that the Spokane Hatchery has the capability to successfully produce kokanee eggs that can be utilized throughout the state

Marblemount Hatchery production of Ross Lake Wild Rainbow Trout

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The Ross Lake wild Rainbow Trout program was developed in 1999. The project goal is to produce genetically wild Rainbow that are native to the North Cascades. There are two components to the adult portion of this project. The brood stock used for this project are a mix of wild fish collected from Ross Lake and fish that are raised at

Marblemount Hatchery. The fish are spawned as 3, 4 and 5 year old. Each age group at the hatchery is held separately from the other groups. Spawning for these fish starts in April and continues into July.

The first part of this is the brood stock that is used to for producing the fish for planting to the lakes. The eggs from each age group is spawned with the sperm from a different age class i.e. 5 year old female eggs are mixed sperm from 3 and 4 year old males. These fish will be used to plant Diablo Lake, Gorge Lake and other high Lakes in the North Cascades.

The other portion of the adult part of this project is the replacement brood stock. Each spawn day ripe fish from each age class are set aside for spawning with wild fish from Ross Lake. The next day after spawning at the hatchery a crew will hike into Ross Lake to collect eggs and sperm from spawning wild fish on creeks flowing into the lake. The eggs from the lake will be mixed with sperm from the fish at the hatchery and the sperm from the lake will be mixed with eggs from the hatchery. These fish will be held at the hatchery as replacement wild brood stock up to the age of 5. After the fish have been used as 5 year olds they are planted into low land lakes in the Skagit drainage. Fry from the Ross Lake brood stock are planted via airplane, truck, boat and boot. The airplane plants and the hike in plants are made during the late summer when the fish are about 1500fish/LB. The plants of Gorge and Diablo are made the next spring when the fish are about 100fish/LB.

This presentation will cover some of the history of Ross Lake and the North Cascade National park. It will give an overview of the Ross Lake wild Rainbow project. It will show how we protect the genetic integrate of a stock of fish while using a hatchery to increase production.

Rainbow Trout Alevin Clean-Up Method for Fungus Control

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Kootenay Trout Hatchery staff has developed a method for helping control fungus outbreaks on post hatch Rainbow Trout alevins. Under normal incubation conditions fungus begins to take hold within heath tray baskets after hatch and can be a large problem to control as well as causing serious health implications to producing healthy swim-up fry unless removed. The method involves removing alevins, unhatched and dead eggs, shells, and any fungused material from heath trays immediately after 100% hatch by the use of a special grading device. Alevins have proven hardy enough to withstand the use of the grading device without mortality. The method saves labour costs because heath trays can be cleaned much faster than standard methods. Another benefit to the method is that it removes alevins from normal water flow conditions for a much shorter period than what is the norm in standard clean-up methods. Since using

this method, Kootenay Trout Hatchery has significantly reduced flavobacterium outbreaks in rainbow trout stocks post troughing.

Factors Limiting Wild and Hatchery Kokanee in Washington

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Wild and hatchery kokanee populations face suboptimal conditions that limit population and fishery success in many lakes and tributaries of Washington. We review the factors limiting kokanee in two dissimilar environments: Lake Roosevelt and Lake Sammamish. Lake Roosevelt is a reservoir formed by Grand Coulee dam on the Columbia River. Lake Sammamish is a natural lake feeding into Lake Washington near Seattle. In Lake Roosevelt, factors limiting kokanee are entrainment downstream of a dam with no fish ladder, predation by fish and suboptimal water temperatures. In Lake Sammamish, factors limiting kokanee appear to be predation by fish, lake stratification and tributary habitat degradation. A hatchery program is in operating for Lake Roosevelt and being considered for Lake Sammamish. In Lake Roosevelt, hatchery fish have not met performance goals. We discuss potential reasons for the poor performance and identify how these issues may apply to the program being consider for Lake Sammamish.

Session 7: Non-Salmonid Fish Culture and Management

Use of Hatchery-Reared Warm Water Fish in Washington

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The use of hatchery-reared warm water fish in Washington varies significantly from that of hatchery-reared salmonids. The primary difference is that the stocking of warmwater fish attempts to mimic the natural densities of various warmwater fish communities with long-term management in mind, whereas the goal of trout stocking e.g. is usually to create a relatively short-term, more-immediately gratifying, put-and-take fishery. With long-term management goals in mind, the warmwater biological program supports the culture program with yearly surveys throughout the state. This provides area biologists and managers with information to customize plantings, which remain relatively small in number compared to our salmonid stocking program. Although Washington has had a warmwater management and culture program since the 1950's, the current iteration of the culture program began in the mid 1990's with the dedication of the Meseberg Facility at Ringold. The primary species reared and/or stocked, include black crappie, walleye, channel catfish and tiger muskie. Largemouth bass and bluegill are reared sporadically and in lower numbers to create replacement populations instead of the augmentation stockings of the other species. The future activities and output for the warmwater culture program in Washington will remain similar to its current status for the foreseeable future.

Warm and Cool Water Culture and Production Activities at Meseberg Hatchery

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Meseberg Hatchery was established to provide warm water culture and stocking of these fishes to Washington State lake and reservoirs. These fish are not only to provide sport harvest opportunities but also to provide warm water enhancement within those waters stocked. Meseberg Hatchery is the only hatchery operated by the WDFW that its focal point is warm and cool water fish production. Meseberg Hatchery cultures and rears a variety of warm and cool water fishes to include Large Mouth Bass, Crappie, Blue Gill, Walleye, Tiger Muskies and Channel Catfish.

Walleye culture and extended rearing techniques at Meseberg hatchery

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There has long been an interest in culturing Walleye to an acceptable size for stocking purposes for increased survival. Rathbun research facility in Iowa has been the leader in Walleye culture techniques and has published several papers on extended rear Walleye. Meseberg staff has attended several conferences where ease information has been passed on regarding some of those techniques required to achieve a larger size hatchery reared Walleye. Meseberg hatchery has implemented some of these techniques along with others provided by the Arkansas DNR and Indiana DNR and has thus far been successful in achieving a larger size extended rear Walleye. Some of the techniques have been modified to accommodate the facility and its current infrastructure, local brood stock and regional location.

Culture of lingcod (*Ophiodon elongatus*) for Potential Fisheries enhancement or commercial aquaculture

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We are developing rearing methods for lingcod following two separate conceptual approaches: intensive larval rearing in shore-based tanks and semi-intensive to intensive floating marine hatchery systems (FISH system). The concept of floating marine hatchery systems was developed to take advantage of the existing salmon net-pen infrastructure in Puget Sound, Washington. The shore-based system follows procedures that are commonly used with a variety of other marine fish species around the world. Initial work in 1997 established spawning methods for broodstock (tank spawning of paired adults) and environmental optima for egg incubation (9°C, at 24 ppt salinity). In 1998 larval rearing studies were initiated and approximately 70 juveniles were produced, representing approximately a 0.5 % survival rate over the two-month larval stage (hatch to metamorphosis). In 1999, approximately 2000 juveniles were produced representing a 5-20% survival rate (depending on treatment) during the larval stage. All juveniles in 1998-present were produced using the FISH system as "wall-nosing" has been severe in fish reared in the intensive shore-based system causing low feeding rates. Research on lingcod was then suspended or occurred at a low level until 2008 when work resumed to produce fish for release experiments in Puget Sound. For larvae which initiate feeding the highest mortality occurs near the end of the larval stage and appears to be related to diet quality. Following metamorphosis, lingcod are robust, but cannibalistic and need to be carefully fed and graded. This is especially important during weaning to pelleted

diets. Losses to cannibalism can exceed 70% if precautions are not taken to deter this behavior.

Session 8: Hatchery Science

Columbia River Hatchery Scientific Review Group Overview of Process, Principles, Methods and Observations

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The Columbia River Hatchery Scientific Review Groups (HSRG) review of Columbia River hatchery programs is nearing completion. The HSRG review process is presented as well as a brief discussion on guiding scientific principals, hatchery broodstock management strategies, and tools used for analysis (AHA) and general observations and significant findings. Results for several Lower Columbia River hatchery Chinook programs are provided.

The proportionate natural influence (PNI) statistic: a tool for management of integrated hatchery programs

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The proportionate natural influence (PNI) statistic has become a key concept in the management of integrated hatchery programs. A population influenced by an integrated hatchery program lives in two environments, and is affected both by the natural selective forces of the natural environment and the domesticating selective forces of the hatchery environment. This makes the population a generalist in the two environments, with its characteristics intermediate between what they would be in the pure hatchery or pure natural environment. The mean value of traits exhibited by the population will be determined by gene flow between the natural and hatchery environments, as indicated the proportions of natural-origin and hatchery-origin fish in the two environments: P_{NOB} , the proportion of broodstock consisting of natural-origin fish; and P_{HOS} , the proportion of fish on the spawning grounds consisting of hatchery-origin fish. These two gene flow rates can be combined to form the proportionate natural influence (PNI) statistic:

$$PNI = \frac{P_{NOB}}{P_{NOB} + P_{HOS}}$$

PNI is actually just an approximation, but in general it is a very good one. It provides hatchery managers with much better advice on how to integrate natural and hatchery production than has been previously available. It also provides a framework for comparing all hatchery programs for their potential for domestication, regardless of the program intent.

The Puget Sound and Washington Coast Hatchery Action Implementation Plan or “Hatchery 2020”

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As part of the 21st Century Salmon and Steelhead Initiative, the Washington Department of Fish and Wildlife and western Washington treaty tribes are developing a “Hatchery 2020” implementation plan that will describe in a science-based, all-H framework a sequence of actions to align salmon and steelhead hatchery programs with: 1) objectives for the status of salmon and steelhead populations; 2) salmon recovery plans; 3) recommendations of the Hatchery Scientific Review Group (HSRG); 4) environmental regulatory requirements; 5) sustainable fishery benefits; and 6) the Puget Sound Salmon Management Plan’s Equilibrium Brood Document (where applicable). The deliverable is a report by watershed (e.g., Snohomish, Duwamish, etc) that will include such things as: 1) a list of artificial production programs in that watershed and the objective for each program (conservation, fisheries, research or educational); 2) broodstock management strategies (integrated or segregated); 3) benchmarks for the proportionate natural influence (PNI), proportion of natural-origin fish in hatchery broodstocks (pNOB), and proportion of hatchery-origin fish in natural spawning escapements (pHOS); 4) current status of each natural population in relation to objectives for abundance, productivity, diversity and spatial structure (viable salmonid population (VSP) parameters); and 5) a sequence of hatchery program changes and facility improvements to achieve population objectives, comply with regulatory requirements and provide sustainable fisheries.

Willapa Bay Hatchery Reform

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The Willapa Bay Salmon Resource Management Plan (in development) represents a long-term shift toward natural stock management in a basin that has primarily been focused on harvest production for decades. This change brings with it the need to examine how hatchery programs will fit into that goal are. Using Hatchery Reform concept, metrics and tools (AHA model), along with regional population viability structures developed in recovery plan throughout the state, we've attempted to design balanced hatchery programs that meet conservation and sustainable fisheries goals.

Summer Chinook Stock Collection and Integration Efforts at Wallace River Hatchery

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Recommended by the Hatchery Scientific Review Group (HSRG), Summer Chinook on-station program at Wallace River Hatchery is operated as Integrated. The protocols for developing a fully integrated program where outlined in "Upstream Passage and Broodstocking Protocols for Transitioning from Partially-to-Fully-Integrated Program at Wallace River Hatchery." The goal for stock collection is to have a proportionate natural influence (PNI) value of 0.5 for the short term, and 0.7 and above for the long term.

$$\text{PNI value} = \frac{\% \text{ Natural Origin Fish Spawned}}{\% \text{ Natural Origin Fish Spawned} + \% \text{ Hatchery Origin Spawners in Naturals}}$$

In order to accomplish these targets 300 to 700 natural origin fish must be included in to the hatchery brood stock (approximately 400 pairs are needed to reach on-station program). In 2007 both the hatcheries program and the short-term goal recommended by the HSRG of 0.5 were met and exceeded. The PNI was 0.56 assuming that 40% of the natural origin fish were of hatchery derivation. Overall this was achieved through 76.9% of natural origin fish coming from Wallace sites and 23.1% coming from the Sunset Falls Facility.

The natural origin fish are collected at three locations. They come from May Creek and Wallace River traps located at the hatchery and from Sunset Falls Fish Passage Facility

located on the South Fork of the Skykomish River. According to the HSRG recommendations, fish from the Sunset Falls Facility are not to exceed 20% of the total run representation as well as no more than 2% jacks in the total take.

For the three years this hatchery has operated as fully integrated, the occurrence of unmarked fish has ranged from 5.4-14.2% (230-504 fish). With these numbers at the hatchery and a much higher amount needed for integrations goals, the fish from Sunset Falls have been an integral part of reaching the short term goal of a 0.5 PNI value. However, the highest possible PNI in the three years has been 0.59, which 58% of the total brood stock collected was of natural origin. In order to collect enough total fish to meet hatchery goals of 4-4.5 million eggs as well as have a PNI above 0.7 seems not to be possible at present.

Beyond the broodstocking protocols the HSRG also recommended that 200 pairs be released above the weir for upstream passage. Releases preferably would be of natural origin but only if integration goals were already satisfied. Otherwise hatchery origin fish would be used to meet the target of 200 pairs passed upstream.

Poster Presentations

Evaluation of Formalin and Hydrogen Peroxide Use during Egg Incubation of Burbot (*Lota lota maculosa*)

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Investigations into controlling *Saprolegnia* spp. (aquatic fungi) during egg incubation have been conducted as part of a program aimed at developing aquaculture methods for burbot. It is anticipated that these efforts will lead to restoration of this species in the Kootenai River of Idaho and British Columbia. Concentration effectiveness of two antifungal control methods, formalin and hydrogen peroxide, were compared over two consecutive breeding seasons during egg incubation. Results indicated that daily 15 minute treatments of 1667mg/L formalin and 500mg/L hydrogen peroxide inhibited fungal growth on eggs and increased egg survival by up to 200% during the incubation period relative to the untreated controls. Reduced concentrations of 1000mg/L formalin and 250mg/L hydrogen peroxide also yielded increased survival, but were not sufficient to completely inhibit fungal growth on eggs in certain cases.

EXPERIMENTAL USE OF ISOMETAMIDIUM CHLORIDE HYDROCHLORIDE (TRYPAMIDIUM¹) TO CONTROL MORTALITY OF ADULT CHINOOK SALMON *Oncorhynchus tshawytscha* DUE TO *Cryptobia salmositica*.

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Cryptobia salmositica is a protozoan parasite of blood that infects all five Pacific salmon species and rainbow trout. At Solduc Hatchery in Washington, prespawning

losses of adult spring chinook salmon due to cryptobia have been 50-60% annually for most of the preceding two decades. Isometamidium chloride (IMC) was injected into adult spring chinook salmon at Solduc Hatchery in 2007 to control mortality due to *Cryptobia*. In May 2007, 29 adult salmon were injected (dorsal sinus) twice with 1 mg/kg IMC at 5-week intervals with equivalent controls. Survival to spawning in September 2007 was 38% in the treated group vs. 21% in controls (significant at 95% cl). Eggs were obtained from 4 treated females but no untreated females survived.

Ten adult salmon were injected in July once with 2 mg/kg with an equal number of controls. Survival to spawning was 8/10 treated vs 7/10 controls. Gamete quality from 2 mg/kg injected adults was equivalent or better than controls, measured in survival of fertilized eggs and juveniles to the first feeding stage.

For 2008, adults were injected once with 2 mg/kg. Mortality data shown below:

	Males dead	Females dead	mortality/n	% loss
Tank C1 (IMC)	3	16	19/70	27%
C5 (H ₂ O)	8	31	39/60	64%
Tank C2 (IMC)	2	4	6/64	9.4%
C6 (H ₂ O)	6	22	28/60	47%

We estimate that 14 IMC treated fish died from the injection process, 10 fish in C1 and 4 in C2. These fish are included in the above mortality data. The data shows that with IMC treatment, early-run chinook can be held with survival comparable to spring chinook hatcheries that do not have *Cryptobia* problems. An INAD exemption (file # 011685) has been received from FDA/CVM which permits the release of progeny of injected adults into public waters.

**Production of Triploid Trout at
Washington Department of Fish and Wildlife’s Hatcheries**

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Stocking of sterile trout protects the genetic integrity of wild stocks. Due to the importance of the native red band rainbow in some of eastern Washington lakes and tributaries, Spokane Hatchery has been actively triploiding Spokane stock rainbow trout egg’s for the last six years. One method to produce sterile fish is to induce triplidy either by applying heat or pressure shock to newly fertilized eggs. Triploid organisms have cells with three sets of chromosomes unlike normal organisms with two sets of chromosomes (diploids). In 2007, using the heat shock method Spokane Hatchery produced 1.8 million green eggs for use in Washington waters. The Ford Hatchery has been triploiding brook trout for the last three years. In 2007, the Ford Hatchery produced 462,000 triploided brook trout eggs by using the pressure shock method. Both heat and

pressure methods will be described. Each year blood samples from fish lots are tested for triploidy at Washington State University. In 2007, the Spokane rainbow trout tested 100% triploidy and Ford brook trout were 98% triploidy. Large-scale production of triploid trout has provided a new product for use in fisheries management of Washington state lakes and streams.

**Rearing the Ancient Giants – Washington Department of Fish and Wildlife
White Sturgeon Conservation Aquaculture at Columbia Basin Hatchery**

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Washington's first aquaculture efforts to recover white sturgeon, the largest and oldest freshwater fish from the upper Columbia River were initiated in 2004. The sturgeon rearing is part of ongoing cooperative efforts of the Upper Columbia White Sturgeon Recovery Initiative, including U.S. and Canadian government agencies, tribes, industry and others. The goal of the initiative is to ensure the long term viability of naturally reproducing white sturgeon in the upper Columbia River. From 2004 to 2005, white sturgeon eggs or larvae were received from the Kootenay Sturgeon Conservation Hatchery, Fort Steele, British Columbia.

The fish originated from adult sturgeon captured from the upper Columbia River in British Columbia and spawned at Kootenay Sturgeon Conservation Hatchery. From 2006 to date, the fish were sourced from adults collected from the upper Columbia River in Washington and transported to the Sherman Creek Hatchery, Kettle Falls, WA. The fish were spawned at Sherman Creek Hatchery and the newly fertilized eggs were transported to Columbia Basin Hatchery, Moses Lake, WA. At Columbia Basin Hatchery, eggs and fish were reared using 15 C spring water for 11 months. All fish were marked by removal of scutes and tagged with PIT tags before release. The fish were released in the upper Columbia River each spring. The number of fish released ranged from 1,880 to 4,350 per year with an average weight of 96 to 316 gms. A total of 17,230 fish were released in the last five years. WDFW fish biologists are currently monitoring the survival and growth of the released white sturgeon.

**Use of Modern and Technologically Advanced Equipment and their advantages.
(Matsusaka Ltd. Electronic Juvenile Fish Pump & Cana-Vac Adult Fish Pump)**

Joshua Benton*

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There are many advantages to introducing state-of-the-art equipment at older, more antiquated state-owned hatcheries. Nearly all state-owned facilities are much, much older than their privately owned counterparts. Some facilities are still using equipment and methods developed in the early 1900's. In contrast, the private industry has long used advanced technologies to increase their efficiency and lower operating costs. The one major benefit to having newer, more advanced equipment is money. Once the initial investment is made, the same tasks are completed as before but in a shorter time, with less man-hours and lower operating costs. In a field where budget constraints are an ever-present problem, it's imperative to make investments now in new technologies that will allow us to continue complete the tasks assigned us but with ever increasing efficiency.

Voights Creek Hatchery is a good case study of an older facility, originally built in 1917, benefiting from two pieces of new, technologically advanced equipment. Spawning techniques at Voights haven't changed much in over 50 years. The set-up that is used now is virtually the same that has been in place since the early 1960's and possibly even longer. One of new pieces of equipment is a "*Cana-Vac* Adult Fish Pump and the other is a "*Matsusaka Ltd* Live Fish Transfer Pump System" for juvenile fish.

The *Cana-Vac* pump is used during Coho spawning from October through November. It eliminates the need to remove fish from the pond by hand. It works in two stages: first, it sucks fish and water into a reservoir; second, it passes the fish over a bar screen allowing the water to be drained off and the adults to be dropped into a container. Each full cycle will move approximately 100 fish in only a few minutes. Even with the use of large nets and large pieces of equipment raise/lower the nets you may be able to match the numbers/speed of fish moved but you need the space to accommodate the equipment and it raises more safety issues than with a stationary pump.

The *Matsusaka Ltd.* Electronic juvenile fish pump is not much more efficient than equivalent gas powered pumps but its advantages are that is cheaper to operate, smaller, quieter and therefore safer. Although fuel prices have recently dipped, they are inevitably going to rise again and having less gas-powered equipment would be a big savings to any facility. The absence of the noise associated with a regular engine means that there is no hearing protection required and communication between workers is easy, no more shouting above the roar of an engine.

Nothing will replace a hard-working and dedicated Fish Culturist, but there is always new equipment available and new technologies are currently being developed that will make his (or her) job easier and allow the same job to be done quicker and cheaper.

The All-H Hatchery Analyzer (AHA)

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The “All-H Analyzer” or AHA is a Microsoft Excell-based hatchery management-planning tool built on recent work by the Hatchery Scientific Review Group (HSRG), Washington Department of Fish and Wildlife (WDFW), Northwest Indian Fish Commission (NWIFC), NOAA Fisheries and other scientists. AHA is used to project the effects of artificial propagation on the target stock, given details about brood sources, survival rates and general information about the productivity and capacity of natural habitat and overall harvest rates on natural – and hatchery origin fish.

Using the best available scientific information, AHA provides a way to explore the genetic implications of alternative broodstock management strategies and enables planners to compare alternative scenarios for incorporating natural-origin broodstock into hatchery programs, as well as different program sizes. AHA projects the effects of various hatchery scenarios, under differing harvest and habitat assumptions, on the productivity and abundance of associated natural spawners of natural and hatchery origin, in terms of whole population performance.

AHA was applied to 27 case studies in Puget Sound and coastal Washington in 2004 and presently being applied to the Columbia River-lower Snake River hatchery programs.

Evaluating the spawning distribution and timing of spring Chinook salmon in the Chiwawa River using carcass recovery data

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Spawning ground surveys are routinely conducted to assess the population status and trends for many Pacific salmon *Oncorhynchus* spp. populations. Biological data from carcasses recovered during spawning ground surveys are used for various stock assessment purposes, but may also be useful in comparing the spawning distribution and timing of hatchery and naturally produced fish. Spawn time of fish in natural environments is important to the survival of offspring because it affects what conditions embryos will experience (e.g., floods) as well as the conditions that newly emergent fry

will encounter. Any deviation from naturally produced fish by hatchery fish can be assumed to be maladaptive in natural environments. The reproductive success of hatchery origin fish may be lower than natural origin fish if hatchery origin fish spawn in suboptimal locations. For example, if acclimation ponds are located in suboptimal spawning locations and fish home back to these locations, then the reproductive success of hatchery origin fish may be compromised. The objective of this study was to measure the distance between redd and carcass locations of spring Chinook salmon *O. tshawytscha* in the Chiwawa River and assess if carcass location adequately represented spawning location. We also estimated the redd residence time (d) of hatchery and naturally produced spring Chinook and compared the spawn timing using both redd and carcass data for both hatchery and natural origin fish. We determined the redd location, spawn timing, and carcass location of individual hatchery and naturally produced spring Chinook salmon during spawn ground surveys using passive integrated transponder (PIT) tags. Differences in mean carcass drift (the distance between the redd and carcass location) was detected between male (4,465 m) and female (150 m) spring Chinook salmon ($P < 0.003$), but not hatchery and naturally produced females ($P = 0.32$). Comparison of the mean spawn date and the estimated spawn date derived from carcasses was not significantly different for either hatchery or natural origin spring Chinook salmon ($P > 0.05$). We concluded that the use of carcass data from female spring Chinook salmon to estimate the spawning location and timing is appropriate when surveys are conducted on a weekly schedule throughout the spawning period.

History and The Mystery

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Significant historical preservation of agency records, photographs, and equipment at Idaho Fish and Game began on a small scale at the Mackay State Fish Hatchery ten years ago. Potential artifacts were sought at other installations and the urgency of preservation became apparent. Combined with enlarged historical photographs of agency activities, obsolete items were first put on exhibit in 2000, eliciting positive public interest and feedback. The exhibitions continued through 2002 at state and county fairs and sportsmen's shows, illustrating state fish hatchery history. A 1957 hatchery truck was restored by a high school vocational program as a community project. Since 2006, the expanded collection was invited to the three largest museums in the state, culminating in 2007 with the "A Century of State Fish Hatcheries" exhibit still currently on display. These museum exhibits lead to the creation of a department policy to assure the preservation of its history for its employees and a public archive. Agency presence is expected at fairs and sportsmen's shows by the public, however the exhibit topic is not.

The reaction is one of curiosity, generating specific questions to better understand past activities. The historical photographs drew in the public that would not have otherwise entered fair booths. Furthermore, the public did not expect agency presence in the museums. In seven months with over 20,000 visitors to one museum, there were no negative comments and an unexplained increase in fishing license sales was observed in that area when license sales are normally decreasing. An agency's historical exhibit lends credibility to its actions and gives ownership to the public viewer on a personal level. History used as an outreach program can engage public interest through partnerships, and can create a dimension of support previously unseen for fisheries management as well as other agency programs.

DEVELOPMENT OF INTENSIVE CULTURE METHODS FOR BURBOT *Lota lota*

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Burbot *Lota lota* are freshwater cod native to Idaho, USA and near demographic extinction from Idaho's Kootenai River and British Columbia's Kootenay River/Lake. Idaho burbot were denied federal listing in 2000 and remain a species of concern. The Kootenai Tribe of Idaho, the University of Idaho and the British Columbia Ministry of Environment collaborated ca. 2003 and brought wild adult burbot into captivity to develop suitable rearing systems and fundamental hatchery methods as an option should hatchery burbot be needed to replenish the Kootenai(y) stocks. Over the last five years, observational studies into adult gender segregation and hormone analog (sGnRha) use have occurred in an attempt to synchronize and control volitional spawning. An optimal egg incubator design was determined and larval weaning from live diets to commercial larval diets was evaluated from 2004-2006. Since 2003, facility renovations have occurred annually. The current burbot culture systems in use consists of full or partial recirculation water systems designed to conserve water and maintain critical water temperatures for spawning (2-5°C), egg incubation (3-5°C), larval feeding and juvenile grow-out (8-20°C). Additionally, six 8000L fiberglass tanks are kept outdoors for semi-intensive pond style rearing. Results of spawning observations revealed that volitional (in tank) spawning is common and fine mesh screens (0.5mm) are needed to keep eggs (typically 1 mm in diameter) within adult spawning tanks. The optimal egg incubator design is 1L conical bottom upwelling incubators suspended overtop a screened (0.5mm) 1m circular tank where larvae hatch and collect, develop and begin feeding on live prey. Live prey feeding begins with brackish (10ppt NaCl) rotifers *Brachionus plicatilis* mass produced in closed recirculation systems and is followed by *Artemia* hatched in 19L water containers (5ppt NaCl). When rotifer feeding ends commercial larval weaning diet (200-600 micron) feeding begins. Weaning larval burbot to commercial diets, while keeping the rearing environment clean, is the foremost bottle neck to successful production of healthy juveniles. Therefore, semi-intensive extensive rearing methods are being developed. All burbot culture system designs and method developments discussed

will be applied to create a burbot hatchery manual and used to design a future conservation breeding program facility aimed at revitalizing burbot populations in Idaho's Kootenai River and British Columbia's Kootenay River/Lake. Such techniques have implications for recovery of burbot populations elsewhere in the world and have the potential for future commercial aquaculture development of this species.