63rd Annual

Northwest Fish Culture

Conference Proceedings

DECEMBER 11-13, 2012

Portland Downtown Marriot Waterfront

Portland, Oregon

As hosts of the 63rd Annual Northwest Fish Culture Conference, The United States Fish and Wildlife Service invites you to Portland, Oregon.

This conference brings together fish culturists, scientists and interested individuals from private, state/provincial, native, and federal finfish hatchery facilities in the Pacific Northwest and elsewhere in North America to exchange information and ideas about all aspects of fish culture. These conferences are hosted on a rotating basis by the various fish resource agencies in the Pacific Northwest. The subject matter generally focuses on topics directly applicable to fish culture, but will include topics in fisheries management, research and other disciplines that are directly related to the science of fish culture.

This conference is also an opportunity to renew old friendships, begin new ones, and develop personal contacts between those with common interest. All persons interested are invited to attend and to actively participate.

DAY 1: Tuesday, December 11, 2012

9:00 Registration

1:00 Welcome/Announcements: Doug Olson

1:10 Keynote Speaker: Charlie Smith

SESSION #1: RECIRCULATING AQUACULTURE AND HATCHERY INNOVATIONS

Session Chair: Chris Starr

1:30 **Tristan Robbins.** Freshwater Fisheries Society of BC Advanced, Delayed and Out of Season Spawning Dates in Rainbow Trout

1:50 **Chris Jeszke,** IDFG Ashton Fish Hatchery. Development of Daughterless Technology (Trojan Sex Chromosomes) for Control of Introduced Brook Trout.

2:10 **Todd Pearsons,** Grant County PUD, Ephrata WA. Hitting the Right Target: Rearing Innovations

2:30 **KC Hosler,** PR Aqua Supplies Ltd., Nanaimo, BC. Progressive Water Use Strategies Conserve Water and Meet Production Goals.

2:50 **Ray Billings,** Freshwater Fisheries Society of BC, Victoria BC. Utilizing Airlift Water Reuse Technology to Help Achieve Electrical Energy Savings.

3:10-3:30 Afternoon Break / Raffle Drawing * (3:25)

SESSION #2: RECIRCULATING AQUACULTURE AND HATCHERY INNOVATIONS

Session Chair: Matt Hall

3:30 **Jeff Milton,** ADFG Sports Fish Hatchery Program Supervisor, Anchorage AK. Cold Water RAS Hatchery Construction and Operation: Challenges and Successes

3:50 **Steve Sharon,** Wyoming GFD, Use of RAS Technology in Serial Re-Use Fish Culture – Why?

4:10 **Ian Adams,** Partial Water Re-Use Systems, Operations and Maintenance.

4:30 **Brian Vinci,** The Freshwater Institute, Shepherdstown, WV. Water Re-Use Systems, Water Velocities and Fish Fitness – What is the Connection?

4:50 **Grace Karreman,** Aquatic Life Sciences, Nanaimo BC. Biosecurity and Recirculating Systems.

5:10-10:00 Trade Show, Round Table, and Poster Session Social

DAY 2: **Wednesday, December 12, 2012**

8:00 Announcements: Larry Telles

8:05 Raffle Drawing*

SESSION #3: PROGRESSIVE FISH CULTURE

Session Chair: Jim Bowker

8:10 **Chris Tatara,** NOAA Manchester. Transition to a Locally Adapted Steelhead Stock.

8:30 **Deborah Harstad,** NMFS Seattle, WA. Variation in Early Male Maturation and Smolting of Juvenile Summer Chinook Salmon and Varying Over-winter Temperature Regimes.

8:50 **Eric D. Lauver,** Grant County PUD, Ephrata WA. Precocious Male Straying: A Case Study of Spring Chinook Mini-jack Straying and Distribution from a Captive Brood Program.

9:10 **Brian Beckman,** NOAA Seattle, WA. Stuck in the Middle: Contrasting Effects of Release Size on Early Male Maturation and In-river Survival of SCS Smolts.

9:50-10:20 Morning Break / Raffle Drawing* (10:15)

SESSION #4: PROGRESSIVE FISH CULTURE

Session Chair: Travis Collier

10:20 **Josh Marauskas,** Chelan County PUD, Wenatchee WA. Increased Performance of Spring Chinook Salmon Reared in Partial Re-Use Circular Vessels Compared to Flow Through Raceways.

10:40 **Dina Spangenberg,** NOAA Seattle, WA. Environmental Effects on Smolt Quality and Early Male Maturation in Spring Chinook Salmon.

11:00 **Andrew Dittman,** NOAA Seattle WA. Early Imprinting of Hatchery-reared Salmon to Targeted Spawning Locations: A New Imprinting Paradigm for Supplementation Programs?

11:20 **Don Larson,** NOAA Fisheries, Seattle WA. The Effect of Modulating Ration and Dietary Lipid on Growth, Smolting and Early Male Maturation in Yearling Umatilla River Fall Chinook Salmon.

11:40 **Lance Clarke,** ODFW LaGrande, OR. Acclimation Strategies Improve Post-release Performance of Hatchery Salmon and Steelhead in NE Oregon.

SESSION #5: HATCHERY OPERATIONS

NEW TECHNOLOGY

Session Chair: David Hand

1:10	**Douglas Munson,** IDFG, Eagle Fish Health Laboratory. Renovations at Niagara Springs Hatchery – Benefits and Challenges.
1:30	**Becky Johnson,** Nez Perce Tribe, Integrating Conservation Hatchery Principles with Tribal Treaty Reserved Harvest Opportunities
1:50	**Christina Iverson,** WDFW, Lower Columbia River Hatchery Program Modifications Using Modeling Technology.
2:10	**Tom Flagg,** NOAA Manchester, Hatcheries and Management of Aquatic Resources (HaMAR).
2:30	**Patrick Luke,** Yakama Nation. Artificial Propagation of Pacific Lamprey: Lessons Learned and Path Forward.
2:50 - 3:20	Afternoon Break / Raffle Drawing* (3:15)

SESSION #6: FISH HEALTH AND NUTRITION

Session Chair: Ann Gannam

3:20	**Mary Peters,** USFWS, Successful Disease Management of Spring Chinook Captive Broodstock at Little White National Fish Hatchery.
3:40	**Guppy Blair & Sonia Mumford**, USFWS. What Every Fish Culturist Should Know About Antibiotics.
4:00	**Ray Brunson,** Retired USFWS, Controlling Bacterial Coldwater Disease with Fish Culture Methods.
4:20	**Ken Cain,** UofI, Coldwater Disease Research: Update on Vaccine Licensing and Commercialization Status.
4:40	**David Thompson.** USFWS, Larval Pacific lamprey *Entosphenus tridentatus* are not susceptible to common fish rhabdoviruses of the Pacific Northwest.
5:00	**Bonnie Johnson,** USFWS, Aquatic Animal Drug Approval Program, Bozeman MT. National INAD Program Overview.
5:20	Announcements/Adjourn (Raffle Drawing*)
5:30	Portland Room: NWFCC Ex-Com Meeting

DAY 3: **Thursday, December 13, 2012**

8:00 Announcements: Doug Olson

SESSION #7: MISCELLANEOUS TOPICS IN FISH CULTURE

Session Chair: Nate Wiese

8:10 **John Holmes.** USFWS, Differences in Egg Size Between Natural-origin and Genetically Similar Hatchery-origin Winter Steelhead in Abernathy Creek.

8:30 **Dan Magneson,** USFWS Quilcine NFH, Hoover, Bonneville, Shasta, Grand Coulee Dams – The Great Depression, WWII, and Fishery Resources

8:50 **Mitch Combs,** WDFW Sherman Creek Hatchery. White Sturgeon US Conservation Aquaculture on the Trans Boundary Reach.

9:10 **Mike McLean,** CTUIR. Practical Application of Electro-Narcosis in the Field.

9:30 **Maureen Kavanagh,** U.S. Fish and Wildlife Service, Columbia River Fisheries Program. Does the Use of Electronarcosis on Adult Coho Salmon Prior to Spawning Affect Mortality and Fry Growth?

9:50 – 10:20 Morning Break / Raffle Drawing* (10:15)

SESSION #8 MISCELLANEOUS TOPICS IN FISH CULTURE

Session Chair: Robbette Schmit

10:20 Fish Culture Hall of Fame Induction

10:40 **Michael Gauvin,.** Utilizing Round Butte Hatchery in the Reintroduction of Anadromous Fish in the Deschutes River.

11:00 **James D. Bowker,** U.S. Fish and Wildlife Service, Bozeman MT. Sedating Fish with AQUI-S20E: Will My Fish Still Be Alive if I Take Time for Another Cup of Coffee?

11:20 **Beau J. Gunter,** IDFG, Grace Fish Hatchery, ID. Effects of Initial Feed Timing on Triploid Rainbow Trout Fry at Grace Fish Hatchery

11:40 **Helena E. Christiansen**. Identifying an Optimal Anesthetic for Juvenile Pacific Lamprey.

12:00 Closing Remarks / Adjourn / Grand Prize Drawing* Next Years Meeting

Northwest Fish Culture Conference Hall of Fame

Member	Affiliation	Host Agency	Induction Date
Dr. Theordore Perry	USFWS	USFWS	1999
Roger Burrows	USFWS	USFWS	1999
Dr. Lauren Donaldson	Univ. of Wash	USFWS	1999
James Wood	Wash Dept of Fish	USFWS	1999
Robert Piper	USFWS	USFWS	1999
Dr. George W. Kontz	Univ of Idaho	CDF&G	2000
Earl Leitritz	CDF&G	CDF&G	2000
Ernest r. Jeffries	ODF&W	ODF&W	2001
Wallace F. Hublou	ODF&W	ODF&W	2001
Jerry A. Bauer	ODF&W	ODF&W	2001
Dr. John E. Halver	Univ. of Wash	ODF&W	2001
Laurie Fowler	USFWS	WDF&W	2002
Robert R. Rucker	USFWS	WDF&W	2002
Einar Wold	NMFS	NOAA	2003
R.A.H. Hugh Sparrow	BC Fisheries	FFSBC/DFO	2004
Jim Van Tine	DFO	FFSBC/DFO	2004
Bud Ainsworth	IDF&G	IDF&G	2005
Charlie Smith	USFWS	IDF&G	2005
Harry Bennett	USFWS	USFWS	2006
Richard A. Holt	ODF&G	ODF&G	2007
Howard Fuss	WDFW	WDFW	2008
Alvin D. Johnson	CDFG	CDFG	2009
John Modin	CDFG	CDFG	2009
Bruce G. Barngrover	CDFG	CDFG	2009
R.Z. Smith	NOAA	NOAA	2010
Michael r. Delarm	NOAA	NOAA	2010
Donald G. Peterson	FFSBC	FFSBC/DFO	2011
Dr. Craig Clarke	DFO	FFSBC/DFO	2011
Joe L. Banks	USFWS	USFWS	2012
Wesley H. Orr	USFWS	USFWS	2012
Gary A. Wedemeyer	USFWS	USFWS	2012

John Emil Halver III

April 21, 1922 - October 24, 2012

Dr. John Emil Halver III, world-renowned scientist, passed away suddenly and peacefully on Oct. 24, 2012. A Celebration of Life was held on Saturday, Nov. 10, at 1:30 p.m. at Bothell United Methodist Church, 18515 92nd Ave. N.E., Bothell, Wash.
He was born April 21, 1922.

Dr. Halver was married to Jane Loren of Tacoma, Wash., his bride for over 68 years, and together they have five children, 12 grandchildren and four great-grandchildren. Throughout the years, John and Jane also opened their home to numerous international students.

Dr. Halver was an eminent nutritional biochemist who was honored as "One of the Leading Scientists of the World" in 2005, for a lifetime of research in nutritional biochemistry, by the International Biographical Center in Cambridge, England. At the time of his death at age 90, he was still actively lecturing and consulting around the world.

A devout, lifelong Christian, John spent his life confirming his belief that "There is no conflict between science and theology. Science is pursuing truth, and God is the author of Truth."

John Halver received a Bachelor of Science degree in chemistry from Washington State College in 1944. He then was called to active duty in Europe with the U.S. Army as an infantry officer, returning from World War II as a captain and a decorated soldier, having earned a Bronze Star with Oak Leaf Cluster, Purple Heart, American Theatre Service Medal, European African Middle Eastern Service Medal with 2 Bronze Stars, World War II Victory Medal, Army of Occupation (Germany), Combat Infantry Badge, and the Croix d Honneur from France. Later he also received the Citoyen d'Honneur from France.

After World War II, Dr. Halver earned a Master of Science degree in organic chemistry from Washington State College and a Ph.D. in medical biochemistry from the University of Washington, after studies in nutrition at Purdue University.

Dr. Halver was the director of research for the National Fish and Wildlife Service, and as such, built and oversaw five laboratories throughout the Northwest. Using aquaculture (fish) as his experimental animal, he developed the standard test diet H440 (which stood for Halver, 440th try) resulting in the nutritional standards used worldwide for salmonids and all fish. He also worked on nutritional studies for other animals, including humans.

Dr. Halver was promoted to senior scientist in nutrition for the Fish and Wildlife Service, and in 1976 he joined the faculty at the University of Washington as professor of nutrition. He served as U.S. Science Ambassador to the World under four U.S. presidents, as well as a private consultant to more than 90 countries throughout the world.

Dr. Halver was inducted into the National Academy of Sciences of the United States, the New York Academy of Sciences, the Washington State Academy of Science and the Hungarian Academy of Sciences, and received numerous accolades from around the world, including the Makila d'Honeur from Spain. He published more than 200 scientific articles and wrote several scientific books and was inducted into the Fisheries Hall of Fame as "The Father of Fish Nutrition."

He was an avid hunter, a member of Rotary, the United Methodist Church, and Reserve Officers Association. In his spare time he loved producing and perfecting his hybrid merlot wine.

Memorials may be sent to the charity of your choice, or to the John E. Halver Fellowship, School of Aquatic & Fishery Sciences, 1120 Boat St., University of Washington; Seattle, WA 98195. For the full obituary and guestbook, see online at www.funerals.coop.

2012 Inductee Biography
Northwest Fish Culture Conference Hall of Fame

Name of Nominee: Joe L. Banks

Descriptive Biological Sketch and Career Contribution

Colorado State University, 1962 BS Fisheries Science
Colorado State University, 1964 MS Fisheries Science

U. S. Fish and Wildlife Service, 1965-1994,

Positions held, Fishery Research Biologist at Abernathy Fish Technology Center, Longview, Washington.

Locations worked, Retired after 30 years of fish cultural research at Abernathy FTC.

Streamlined the data recording protocols resulting in a custom-programmed computer system used by all hatcheries in the Fish and Wildlife Service's Pacific Region.

Demonstrated that use of substrate in vertical incubator systems to significantly reduce losses from coagulated yolk disease and the production of larger, more healthy fry at swim-up.

Defined the optimum temperature regime for growth of fall Chinook salmon.

Documented the implications of accelerated rearing of Spring Chinook Salmon on post-release survival and adult hatchery returns; results underscored the sensitivities of some populations to high-density rearing environments.

Identified suitable methods and protocols for the handling and transport of salmon gametes and newly fertilized eggs. .

Served on the editorial board of The Progressive Fish-Culturist for several years and has published several peer-reviewed articles related to his research and its management implications for culturists and managers.

Documented the effects of raceway loading and fingerling rearing density on post-release survival and adult returns of Pacific salmon to the fishery. His well documented reports and publications on this subject have become the standard and a basis for the rearing criteria used in both established and newly designed coho, spring, and fall Chinook salmon hatcheries on the West Coast.

2012 Inductee Biography
Northwest Fish Culture Conference Hall of Fame

Name of Nominee: Wesley H. Orr

Descriptive Biological Sketch and Career Contribution

Colorado State University, 1962 BS Fisheries Science

U. S. Fish and Wildlife Service, 1962-2000

Positions held, Hatchery Manager

Locations worked, Gavins Point NFH (1962- 1964), Hebron NFH (1966 – 1968), Manchester NFH (1968 – 1969), Fairport NFH (1969 – 1973), and Ennis NFH (1973 – 2000)

While at Ennis NFH, developed a broodstock program that provided over 30 million rainbow trout eggs per year to hatcheries throughout the country. During his tenure, he was responsible for shipping 438,780,605 eggs and 1,331,152 pounds of fish.

Developed spawning protocols to reduce inbreeding and maintaining genetic health of the six strains of rainbow trout held at the Ennis NFH. Worked with others and preserved the genetic integrity of the all rainbow trout strains held on station.

Provided leadership in broodstock programs throughout the U. S.; fisheries professionals from many states as well as New Zealand, Japan, Canada, Mexico, Norway, and Iceland visited the Ennis NFH and learned from Wes.

Developed systems to breed a variety of strains of rainbow trout that spawn from June through February,

Developed a system for rapid incubation followed by use of chilled water that allowed eggs to be held for an additional 60 d before they need to be shipped.

Innovated and modernized techniques for incubating, packing, and shipping eggs.

Instructor: USFWS Broodstock Management (1990 – 1993) and Coldwater Fish Culture Course (early 1980's to late 1990's – taught sections on broodstock management, spawning, egg incubation and distribution, and overall fish culture practices).

After his retirement, Wes got involved in efforts to restore native westslope cutthroat trout in the streams of the privately owned Sun Ranch in Montana. He converted an old log cabin into a hatchery and built a three-acre pond, harvested eggs from wild populations to establish future brood, and has become arguably the best westslope cutthroat trout culturist in the country.

2012 Inductee Biography
Northwest Fish Culture Conference Hall of Fame

Name of nominee: Gary A. Wedemeyer

Descriptive Biographical Sketch & Career Contributions:

University of Washington: PhD, 1965 Fisheries Biology/Fish Physiology

Positions Held:
-- US Fish and Wildlife Service, Western Fisheries Research Center, Research Fishery Biologist, 1965- until retirement in 1998; (33+ years) (Due to confusing agency reorganization, was transferred from the FWS to the NBS 1993-1996, then to the USGS 1996- present.)

-- After I retired, appointed Senior Scientist Emeritus and have served in that capacity from 1998-present (14 years)

-- Adjunct Professor, 1972- 1998, University of Washington
-- Visiting Professor, Zulu University of South Africa, Summer quarter 1989

Locations Worked:
Western Fishery Research Center, Seattle, WA. (Research Fishery Biologist for 33 years, Senior Scientist Emeritus for 14+ years)

Contributions to Fish Culture:

- Research and development of methods to improve the health, physiological quality, and seawater survival of anadromous salmonids released from mitigation hatcheries
    - Methods to mitigate the physiological stress of intensive fish culture.
        - Water quality factors: hardness (alkalinity), dissolved oxygen, carbon dioxide, temperature, ammonia, nitrite, nitrate
        - Fish cultural procedures: crowding, handling, transport, mineral salt additions to mitigate hauling stress
        - Biological interactions: interactions between fish and aquatic pathogens (fish/pathogen/environment relationship), and interactions between fish, i.e., stress caused by aggression, social dominance hierarchies during hatchery rearing, clarified the role of hatchery rearing conditions in outbreaks of stress-mediated fish diseases.
    - Methods to minimize adverse effects during hatchery rearing on smolt development and early sea water survival of anadromous salmonids
        - Safe exposure limits for water quality factors such as pesticides, sediments, temperature, contaminants such as selenium exposure on delayed mortality after seawater entry
        - Developed methods to improve smolt survival during fish transport operations (barging, trucking).
    - Research and development of ozone for hatchery water treatment systems to prevent fish diseases; recirculation systems, single pass raceways.

- Communicated research findings to hatchery biologists by teaching FWS short courses:
    - Instructor, Cold Water Fish Culture Culture Short Course, FWS, Spearfish NFH, 1975-1985 (with Bob Piper, Charlie Smith, Laurie Fowler et al.)
    - Instructor, Cold Water Fish Culture Short Course, Bozeman Tech. Center, then Fisheries Academy, Leetown, 1985- till I retired in 1998 (with Piper, Smith, Fowler et al.)
    - Instructor, Cold Water Fish Culture Short Course, FWS National Conservation Training Center, Shepherdstown, West Virginia, after I retired 1998- 2005. Then Piper, Smith, Fowler and I all retired.

- Author and editor of textbooks widely used in fish culture:

    - Textbook: Wedemeyer, G., Meyer, F. and Smith L. 1976. Environmental Stress and Fish Diseases, TFH Publications. Translated into Russian by the Soviet Academy of Science in 1981 for use by the Ministry of Fisheries
    - Textbook: Wedemeyer, G. Physiology of Fish in Intensive Culture. 1996. Chapman & Hall, NY.
    - Textbook. Wedemeyer, G. (editor). 2000. Fish Hatchery Management, 2nd edition. American Fisheries Society, MD. (was asked by the AFS to bring out the 2nd edition of Piper's classic book)

- Also communicated research findings to students at University of Washington College of Fisheries/College of Fisheries-Oceanography: 1973- 1998

- Served for many years on the editorial boards of:
    - Progressive Fish-Culturist (now North American Journal of Aquaculture)
    - Transactions of the American Fisheries Society

- Published about 100 papers in the TAFS, PFC, and other Fish Biology/Aquaculture journals. Continued publishing after retirement, most recent paper was in AFS, North American Journal Fishery Management in 2008.

Northwest Fish Culture Conference Vendor Contact List, 2012				
Booth	**Company Name**	**Contact**	**Phone**	**email**
1,2	Bio- Oregon Inc	Marte Vassbotten	604-301-2334	Marte.Vassbotten@skretting.com
3	Canada Cryogenetics Services	Maureen Ritter	250-203-0333	mgritter@telus.net
4	Point Four Systems	Claudia Hazelwood	604-759-2114	CHazelwood@pointfour.com
5	Akva Group	Keith Richford	250-286-8802	krichford@akvagroup.com
6	Hatchery International	Jeremy Thain	250-474-3982	Jeremy@capamara.com
7	Ewos Canada Ltd.	Gregg Bonacker	604-592-8994	Gregg.Bonacker@ewos.com
8	Water Management Technologies	Terry McCarthy	225-755-0026	terry.mccarthy@w-m-t.com
9	Smith-Root	Sean Janson	360-573-0202 ext 136	sjanson@smith-root.com
10	Magic Valley Heli-Arc	Louie Owens	208-733-0503	louie@aqualifeproducts.com
11	Redd Zone	Todd Jones		tod_j@hotmail.com
12	Raincountry Refrigeration Inc.	Mark Vondrachek	360-671-9165	raincountryrefrigeration@comcast.net
13	Harper Brush Distributor's, Inc.	Ken Taylor	425-255-2074	kwt2432@hotmail.com
14	AquaTactics Fish Health	Hugh Mitchell	425-922-4208	hughm@aquatactics.com

Booth	Company Name	Contact	Phone	Email
15	Jensorter LLC	Kurt Stelk	541-408-6455	kurt@jensorter.com, jensorter@jensorter.com
16	Merck Animal Health	Kasha Cox	662-907-0692	kasha.cox@merck.com
17	AIRSEP Corp.	James Klein, Jr	716-691-0201	jklein@airsep.com
18	Hydrolox	Cindy Foremaster	866-586-2825	Cindy.Foremaster@laitram.com
19, 20	PR Aqua/In-Situ Inc	Monique Lanphear	970-498-1645	mlanphear@in-situ.com
21	Marisource	David Heutmaker	877-735-8910 x106	davidh@marisource.com, davidh@flex-a-lite.com
22	Western Chemical Inc.	Jason Montgomery	360-384-5898	jasonm@wchemical.com
23	Rangen Inc.	Leon Klimes	208-308-7406	lklimes@rangen.com
24	The Lynch Co.	Pat Prentice	503-863-5035	pat@thelynchco.com
28	Xpertsea Solutions Inc.	Valerie Robitaille	(581) 998-9529	valerie.robitaille@xpertsea.com
29	Christensens Networks	David Berggren	(800)459-2147	dave@cnwnetting.com
30	Octaform	Yuliya Koverko	(604) 408-0558 ext. 241	ykoverko@octaform.com

63rd Annual

Northwest Fish Culture

Conference Abstracts

DECEMBER 11-13, 2012

Portland Downtown Marriot Waterfront

Portland, Oregon

A Fish Farming Odyssey: where we've been - where we are now: An "old fellow's" perspective

Charlie E. Smith, USFWS, Retired

Abstract:

A wandering overview of changes in fish culture practices I have seen take place over the past 50 years.

Advanced, Delayed and Out of Season Spawning Dates in Rainbow Trout

Tristan Robbins and Jim Powell
Freshwater Fisheries Society of British Columbia
101-80 Regatta Landing
Victoria, BC V9A 7S2

To optimize rearing for catchable Rainbow trout destined for fall (Fca) and spring (Sca) release, adult fish were given photoperiod treatments to advance (ADV), continue natural photoperiod (NP) and induce out of season (OS) spawning.

For ADV Fca production, 50 female and 10 male three-year old fish (avg 3.1kg) were segregated in October from the population into an $8m^3$ circular fibreglass tank (11.2°C; flow 160lpm; feed rate 0.8 – 1.0 %BW/d). Fish were subjected to NP October to April and continuous light April – July when photoperiod was changed to 8L:16D and feeding stopped thereafter. Fish were induced to ovulate Sept 7th by administering a LHRHa implant, spawned on Sept 18th and finished spawning Sept 28th. Peak spawning for cohort, untreated NP fish was Oct 25th. After ADV spawning, fish for OS Sca egg production (45 female; 5 male) were returned to the circular tank under continuous light conditions for 5 months at the previous water flows and feeding rate to initiate out of season maturation. On Mar 15th, photoperiod was changed to 8L:16D, the fish were induced to spawn again on April 21st, spawning commenced May 1st and finished May 15th.

Survival to first feeding did not differ between ADV, NP and OS spawned fish. Photoperiod treatment of spawners optimized rearing time for both Sca and Fca production without affecting stock performance in the hatchery. Cost savings were realized in water pumping, labour and feed.

Development of *Daughterless Technology* (Trojan sex chromosomes) for Control of Introduced Brook Trout in Idaho

*Chris Jeszke

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The interface of Hatchery, Management and Research in the control of Invasive Fish

We discuss the initial development of a "daughterless" line of brook trout that may provide additional management options for control of invasive fish species.
If successful in development and application, repeated introductions of hatchery-produced individuals that are phenotypically sex reversed from that of their genotype will provide a disproportionate influx of one sex chromosome into subsequent generations, biasing sex ratios, and leading to potential population extinction. This technology could be used to control feral brook trout populations in Idaho without the collateral damage to native species that is associated with other management techniques, such as chemical removal.

Hitting the Right Target: Rearing Innovations for Conservation Aquaculture

Todd N. Pearsons[1*], Joshua Murauskas[2], Don Larsen[3], and Brian Beckman[3]

[1]Grant County Public Utility District, P.O. Box 878, Ephrata, Washington 98823. (509) 859-2862 (tel), tpearso@gcpud.org

[2]Chelan County Public Utility District, 327 N. Wenatchee Ave. Wenatchee, Washington 98801

[3]NOAA Fisheries, Northwest Fisheries Science Center, 2725 Montlake Blvd. Seattle, Washington 98112

Hatchery reform of salmon and steelhead hatcheries on the West Coast of North America has focused on achieving metrics that occur outside of the hatchery environment. For example, conservation aquaculture programs typically attempt to match the adult genotypes and phenotypes of natural-origin fish, reduce straying, and reduce undesirable ecological interactions. However, despite a change in the target of conservation aquaculture programs hatchery rearing practices have not kept pace to achieve these new targets. For example, the stated and unstated target of many fish culturists is to produce a given number of big healthy fish of similar size that migrate and survive well. This target may not produce the results that are desired for integrated hatchery programs. For example, production of big fish may result in accentuated precocious maturation (e.g., mini-jacks and jacks), high proportion of hatchery origin spawners, high stray rates, high nutrient discharges, and undesirable ecological interactions with other taxa. Some of these unintended consequences can be reduced by rearing fish differently than current practices. We present a conceptual approach to align hatchery rearing practices with reformed targets and suggest methods to meet these targets.

Progressive Water Use Strategies Conserve Water and Meet Production Goals

KC Hosler, P.Eng.

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Nanaimo, BC, V9X 1T4 Canada
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In order to raise fish in a progressive manner, we need to think about how we use water in fish hatcheries. The demands of increased fish production and the equal demands on water consumption are not sustainable. We can meet production goals and growth requirements by paying attention to water usage at fish hatcheries. Traditional flow-through systems are becoming less common in new construction and planners are beginning to adopt water reuse strategies that help them conserve water and meet production demands.

The technology that can be incorporated into an existing flow-through system is not complicated. As more pilot systems are tested and as the results of these pilot studies are evaluated, fish hatchery managers, culturists, and maintenance staff are gaining confidence in the benefits that these conversions can provide. Improved fish health and growth will become evident.

Recent interest in some federal facilities, as well as State and Tribal hatcheries, is encouraging and demonstrates that decision makers are thinking progressively. More education and proven systems will be the key to moving these water use strategies forward.

There are several ways to get creative when water reuse strategies are employed. For example, by enhancing water quality, less water is required to raise fish, and in many instances, more fish can be raised. Varying degrees of technology are available for integration into an existing system, depending on budgets and production and water use goals. Adding oxygen to a system is the most rudimentary method used to improve water quality. Advanced recirculating systems offer the most comprehensive and controlled method for raising fish in a sustainable manner. Several mid-level forms of water reuse can be developed, depending on the facility particulars.

This presentation will discuss case studies that demonstrate the effectiveness of moving to various levels of water reuse.

Utilizing Airlift Water Reuse Technology to Help Achieve Electrical Energy Savings in Fish Hatcheries

Ray Billings [1]*, Jim Bomford [2], Duaine Hardie [3]

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The Freshwater Fisheries Society of BC (FFSBC) has been working closely with BC Hydro, British Columbia's public electrical utility corporation to help reduce energy consumption and costs in its fish culture activities. Benefits of doing so include reduced annual and long term operating and maintenance costs and reduced impacts on the environment. Detailed energy audits undertaken at all FFSBC hatcheries clearly showed that reducing water pumping would be the single most effective means to achieve energy reduction goals.

Converting hatcheries to a full water recycle system was expected to be relatively complex and expensive so a less costly water reuse system was considered. A number of water reuse devices and processes were designed, tested, and modified over the past several years to achieve best performance in both raceways and circular rearing tanks. FFSBC has now begun installing airlift pumps into raceways and circular tanks in its various hatchery operations and is achieving water flow reductions of up to 75% and resulting electrical energy savings of 50% and even greater.

The design and operating performance of these relatively inexpensive airlift pumping systems and resulting water quality will be discussed in this presentation as will some changes to how fish culture staff work with these systems to make hatchery operations even more energy efficient. A number of other energy reduction strategies will also be discussed including pump efficiency studies, pump upgrade projects, energy metering and management systems and the establishing of an energy mandate and energy reduction goals.

ADF&G - Cold Water RAS Hatchery Construction and Operation: Challenges and Successes Experienced

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During the mid 1980's and 1990's as Alaska's Sport Fish hatcheries became less productive due to limited water supplies, several attempts were made to improve efficiency and functionality. Early on, effluent from one rearing area was simply pumped to another with limited treatment (solids settling and aeration) in order to achieve system design flows. This led to poor water quality and in many cases had significant impact on fish health. Consulting engineers were then hired to design a partial recirculation/reuse system to take advantage of alternative water sources. This effort took 4 years and more than $2 million to complete and was eventually abandon as it could not be operated as designed. Hatchery staff had few options at this point and decided to take systems originally designed to operate as flow through and convert them to 75% partial recirculation. While some actions failed others worked well and provided temporary relief along with valuable information and experience informing subsequent decision making. Ultimately limited water supplies and loss of free heat from adjacent power plants rendered the facilities incapable of meeting production goals.

Alaska Department of Fish and Game Sport Fish Hatchery staff became familiar with cool/cold water RAS concepts and worked with PR Aqua to design, construct and operate a pilot scale RAS as proof of concept. For more than 5 years, this pilot RAS has been used to rear Arctic char, Arctic grayling and rainbow trout broodstock through their first year and a half of life. This is the primary reason the state's captive rainbow trout brood stock program has remained viable.

Pilot System

Production System

Owing to the success of this and other pilot projects, the State of Alaska decided to invest in the development of two new cold water RAS based hatcheries. The Ruth Burnett (RBSFH, Fairbanks) and William Jack Hernandez (WJHSFH, Anchorage) Sport Fish hatcheries were designed to produce 11 stocks of fish comprised of 7 species including coho salmon, Chinook salmon, rainbow trout, Arctic char, lake trout and Arctic grayling. Production at these hatcheries began in mid 2011 and early 2012. To date more than 3 million Chinook, coho, rainbow trout, Arctic Char and Grayling have been incubated, reared and released from the facilities.

Use of RAS Technology in Serial Re-Use Fish Culture – Why?

Steve Sharon

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The Wyoming Game and Fish Department presently operates ten fish culture facilities to manage diverse salmonid sport fisheries as well as restoration efforts for four sub-species of native cutthroat. Prior to the introduction and spread of *Myxobolus cerebralis*, the causative agent of whirling disease, the department managed fish culture facilities with a mixture of surface and closed water systems. Traditional water supplies drastically dropped as the parasite infected four hatchery water supplies from 2000 to 2010. To counter this loss, Recirculating Aquaculture Systems (RAS) technology has been incorporated within serial re-use systems statewide to improve fish quality and meet production requirements. This presentation provides an overview of the types of RAS technology employed, the resulting benefits, and the pros and cons resulting from the addition of this technology.

Harvesting RAS system at Dan Speas Fish Hatchery, Casper, Wyoming.

Partial Water Reuse Systems, Operation & Maintenance

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The Chelan County Public Utility District No. 1 (CCPUD) owns and operates three hydroelectric projects in the mid-Columbia river that deliver clean, renewable, low-cost energy to local residents and to other utilities serving millions of Pacific Northwest residents. Operating requirements stipulate that CCPUD mitigate for hydroelectric impacts on anadromous fish by species supplementation. CCPUD annually release more than 3.7 million juvenile fish with an annual hatchery operation & maintenance budget of over 10-million dollars.

CCPUD began piloting partial water reuse systems in 2008; first at Eastbank Fish Hatchery in East Wenatchee, WA and again in 2009 at the Chiwawa Rearing Facility, located near Leavenworth, WA. Through trial and error, while piloting the systems, CCPUD learned the keys to operating successful partial water reuse systems are though properly trained personnel, robust alarming and backup systems detailed documentation and a scheduled preventative maintenance program.

Water Reuse Systems, Water Velocities and Fish Fitness – What is the Connection?

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The Chelan County Public Utility District No. 1 (Chelan PUD) has been evaluating water reuse systems using circular fish culture tanks at two locations: Eastbank Fish Hatchery (East Wenatchee, WA) and Chiwawa Fish Hatchery (Leavenworth,WA). The Eastbank water reuse system is used for rearing chinook salmon and the Chiwawa reuse system is used for rearing steelhead. Both water reuse systems reuse approximately 75% of their water by treatment for solids removal, carbon dioxide removal and oxygen addition. The reuse systems utilize Cornell-type dual drain fish culture tanks to fractionate waste solids rapidly into two flows: a clean flow for reuse that is 75% of the flow and an effluent flow with solids concentrated into 25% of the flow. Operation of the fish tanks to attain the self-cleaning effect results in a range of water velocities available to the fish. Water velocities within the fish tanks of the reuse systems can be changed through an adjustable water inlet, but are typically set once and then left alone for an entire rearing cycle. Water velocity data was measured in both of Chelan PUD's water reuse systems during operation with fish in 2008, 2009 and 2010. Water velocity measurements indicated that fish were able to select swimming speeds from 0.5 to 4 body lengths per second, providing an exercise regime that may be beneficial to downstream migration and overall fitness.

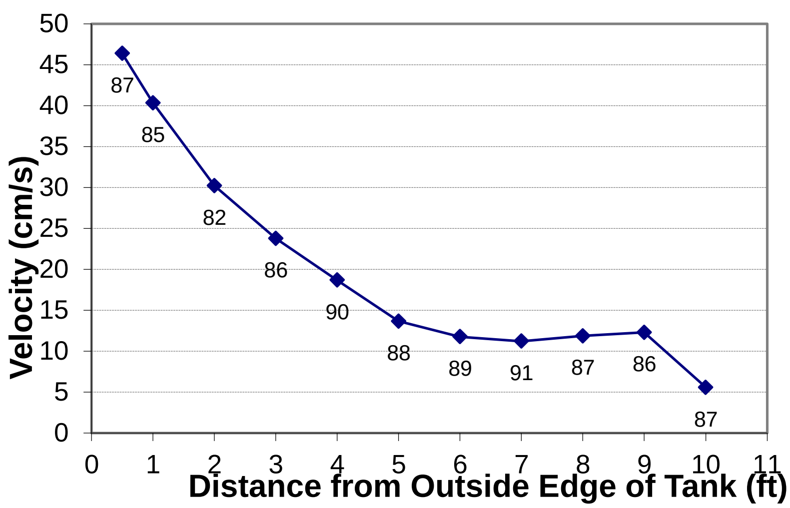

Figure 1. Water velocity data from a 20-ft diameter circular fish tank in the Chelan PUD's Chiwawa water reuse system. Numbers next to each data point indicate the angle of the velocity with 90º being perfectly tangent to the tank wall along the radius at which the data was taken.

Biosecurity and Recirculating Systems

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A working definition of biosecurity is a system of measures and procedures that, taken together, minimize the risk of introduction and spread of infectious organisms *within* or *between* aquatic animal populations. Biosecurity involves creating barriers to pathogen movement by keeping pathogens out (bioexclusion), keeping pathogens from spreading within a population (biomanagement) and keeping pathogens from spreading outside of a population (biocontainment). For Recirculating Aquaculture Systems (RAS's) systems the implications of introduction of pathogens and managing disease can be catastrophic. As a result there is a heavy focus on bioexclusion to keep pathogens out of the system. This presentation will use a generic biosecurity analysis to illustrate how bioexclusion can be applied to an RAS facility. This will include identifying potential pathways for pathogen entry as well as control points for pathogen exclusion.

Evaluation of Rearing and Releasing Age-two Steelhead Smolts at Winthrop National Fish Hatchery to Support Transition to a Locally-sourced Broodstock

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Historically, the Winthrop National Fish Hatchery (NFH), operated by the US Fish and Wildlife Service raised yearling steelhead smolts (hereafter 'S1') sourced from broodstock collected in the Columbia River at Wells Dam. The Winthrop NFH is transitioning to a locally-sourced broodstock for its steelhead program. Later spawn timing of natural- and hatchery-origin broodstock returning to the Methow River combined with the cold water temperatures at Winthrop NFH may preclude successful production of yearling smolts from Methow River broodstock.

The Winthrop NFH is currently raising both S1 smolts from Wells broodstock and S2 smolts from adults returning the upper Methow River and assessing the performance of both groups. We compared survivals and travel times of PIT-tagged S1 and S2 smolts as they migrated through the Columbia River and tested for size-selective and gender-biased migration in 2010 and 2011. Survival of S1 steelhead from Winthrop NFH to Rocky Reach Dam was significantly lower than for S2 steelhead in both years. Travel times from Winthrop NFH to Rocky Reach and McNary Dams were significantly greater for S1 steelhead than for S2. In 2011 S1 fish were smaller than S2 fish at the time of release, and S1 fish also experienced greater size selection than S2 fish. We developed morphological and physiological indicators of male maturation to determine the proportion of males that might mature (and residualize) after release. In 2011, the S1 group had a significantly greater proportion of males expected to mature a year after release (in 2012 at age 2) than the S2 fish (in 2012 at age 3). We sampled index sites in the Methow River near Winthrop NFH and in Spring Creek for residual steelhead on two occasions in 2011. The majority (79.6%) of the residuals were recaptured in Spring

Creek near the outfall of Winthrop NFH. Residual steelhead were primarily S1 smolts (82.6%). Males were overrepresented in the residual population compared to their representation in the population at the time of release.

Additional experiments on these same populations of S1 and S2 steelhead are underway at the NOAA Northwest Fisheries Science Center's Manchester Research Station to attempt to determine how the S1 and S2 rearing strategies select for traits and behaviors that influence smoltification and survival after release.

Variation in early male maturation and smolting of juvenile summer Chinook salmon and varying over-winter temperature regimes

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We collected data on several juvenile summer Chinook salmon populations in the upper Columbia River Basin over brood years 2006-2009. We conducted screens for minijack abundance for four consecutive years at Dryden, Carlton and Similkameen Acclimation Ponds, and for two years at Bonaparte Acclimation Pond. In addition, we collected monthly size and smoltification (ATPase) profiles for Wells stock fish acclimated at net pens near Chelan Falls (BY08), Methow/Okanogan stock fish acclimated at Carlton Pond (BY08), and Wenatchee stock fish acclimated at Dryden Pond (BY09). The summer Chinook populations appear variable in minijack rates, size at release, and timing of smoltification. One potential driving force behind these differences may be the water temperature regime during winter rearing. These populations provide an interesting opportunity to examine winter growth regime differences on resulting smolt quality, as they begin rearing at Eastbank Hatchery under similar rearing temperatures but spend different amounts of time at their acclimation sites and have different overwinter temperature regimes. In this talk, I will compare smolt patterns, growth and minijack rates across the populations in the context of overwintering differences.

Precocious Male Straying: A Case Study of Spring Chinook Mini-jack Straying and Distribution from a Captive-brood Program

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Precocious maturation and straying of male salmon can cripple the success of salmon hatchery programs, particularly captive-brood salmon hatchery programs that are intended to provide a rapid short-term boost to populations at high risk of extinction. I present a case study of male precocious maturation and straying from the White River, WA (Wenatchee River Basin) spring Chinook (*Oncorhynchus tshawytscha*) captive-brood program using PIT-tag detections, including presentation of straying and quasi-residualization rates, and distribution. Approximately 71% of male spring Chinook salmon in the White River captive-brood program are maturing precocially, and are straying to seven Wenatchee River Basin tributaries in some years. Columbia River mainstem reascention rates vary and will be presented.

Stuck in the middle: contrasting effects of release size on early male maturation and in-river survival of spring Chinook salmon smolts

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Managers of spring Chinook salmon hatchery programs are challenged with a biologically complex animal and varied and potentially conflicting rearing and performance goals. The age of maturation for spring Chinook salmon varies from one to five years, with males maturing at younger age classes than females. Variation in maturation age (between years and between programs) has implications for a variety hatchery performance metrics, including perceived smolt survival, reproductive success in conservation programs, and quality of commercial, tribal, and recreational harvest. Over the past decade there has been increasing evidence that seasonal growth rate and smolt release size affects age at maturation. In particular, faster growth and bigger smolts are directly correlated with higher rates of early male maturation. This might suggest that it would be advantageous for hatchery programs to release smaller smolts and consequently produce a greater proportion of full-size anadromous adults. However, smaller smolts may survive down-river migration at lower rates than larger smolts. Thus optimal release size requires a calculus including both smolt survival and population age structure. There is no simple solution to this equation; instead, each program must consider rearing facility limitations, stock specific genetic effects, and release location survival rates, among other factors. This talk will consist of several specific examples illustrating the conundrum facing program managers and lay out an approach to collecting the data needed to clearly present the trade-offs related to differing release sizes.

Increased performance of Chinook salmon reared in partial water reuse circular vessels compared to traditional flow-through raceways

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Partial water reuse in circular vessels was evaluated as a means to decrease water use while maintaining the performance of yearling summer run Chinook salmon relative to standard flow-through raceways. Test fish were reared in two 9.1 m-diameter dual-drain Cornell circular vessels installed at Eastbank Hatchery near Wenatchee, Washington. The system was designed to rear 150,000 smolts to 14 fish per pound at a density index of 0.25 lb/ft^3-inch. With water treatment and reuse, influent water to the circular vessels was only 12.5 % of that consumed by flow-through systems. The control fish were reared in two 30.5 m × 3.0 m raceways designed to rear 102,000 smolts under the same size and density criteria as test fish. Approximately 10,000 passive integrated transponder (PIT) tags were implanted in test and control fish for the 2009-2011 releases. Travel time and survival to McNary Dam (> 260 km downstream) averaged 72 hours faster and 10% greater in reuse fish, respectively, though differences in travel time were only significant ($p \leq 0.05$) in 2009 and 2011, and survival in 2009. Adult (≤ 3-salt) returns from 2009 test fish releases were over 200% greater and comprised of older age classes in reuse fish compared to raceway cohorts ($p < 0.01$). Logistic regression further demonstrated that smolts from circular reuse vessels were able to be reared to larger sizes without the consequences of mini-jacking as observed in raceway cohorts ($p < 0.01$). Collectively, these results indicated that partial water reuse with circular rearing vessels is an effective approach to minimize water use while increasing performance of hatchery-reared smolts.

Environmental effects on smolt quality and early male maturation in spring Chinook salmon

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This talk will give a summary of a three year study that was initiated to assist managers with determining rearing strategies for in-basin production of Hood River spring Chinook salmon. Hood River stock of spring Chinook salmon, BY08-BY10, were assessed for smolt quality and early male maturation while being reared at three different hatcheries in the greater Hood River area. Each facility combines a unique set of rearing conditions with differences in temperatures, feeding regimes, water flow and raceway design. These circumstances allow us to directly examine the impacts of this environmental variation on growth and development. The sampling occurred as follows; every year an initial size check (n=300) was conducted in October and more in depth monthly physiology sampling started in January and continued up until release in April. At each of these sampling points 25 fish from each treatment group were sacrificed. Size data, gill tissue (for determination of ATPase activity) and plasma (for the determination of IGF1 levels) were collected. In addition, a large collection of fish (n=300) were sacrificed just prior to release for assessment of plasma 11KT levels to determine rates of early male maturation. Differences were observed, and were often consistent, between the treatment groups for most of these endpoints indicating that the external rearing environment does significantly affect smolt quality.

Early imprinting of hatchery-reared salmon to targeted spawning locations: a new imprinting paradigm for supplementation programs?

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The need to rear salmon at large centralized hatcheries and then release them offsite to supplement specific populations or fisheries is a practical reality of artificial production in the Pacific Northwest. However, this practice can dramatically increase stray rates. Homing is governed by the olfactory discrimination of home-stream water and exposure to the home stream during appropriate juvenile stages is critical for olfactory imprinting and successful completion of the adult homing migration. In particular, the parr-smolt transformation has been demonstrated as a critical period for olfactory imprinting and most hatchery programs use this as a guiding principal for designing release strategies that will return fish to targeted locations. Smolt acclimation and imprinting facilities have been developed as part of most hatchery supplementation programs in the Pacific Northwest and hundreds of millions of dollars have been spent for construction, operation and maintenance of these facilities. However, several recent studies of the efficacy of these facilities have indicated that physical and logistical constraints on where these facilities must be sited relative to appropriate spawning habitat can result in a large percentage of fish spawning in non-target or inappropriate locations.

In this presentation, we propose a novel, cost-effective, approach for achieving successful imprinting and homing fidelity to target spawning locations without moving fish from their central rearing hatchery prior to release. This new imprinting paradigm is based on the observation that most salmon species imprint to their natal sites during early development and we hypothesize that hatchery-reared adult salmon will seek their earliest detectable olfactory imprint as the appropriate location to terminate their spawning migration. Under this scenario, natural waters would be collected from targeted spawning areas and transported to a central rearing hatchery where embryos would be initially incubated in target waters during critical periods for imprinting. We believe that if successful, this approach could be used to facilitate re-establishment of sustainable natural populations of upper Columbia River spring and summer Chinook, steelhead, coho and sockeye salmon spawning without the need for expensive and logistically challenging acclimation facilities.

Here we describe initial experiments demonstrating that salmon embryos can learn and discriminate the olfactory signatures of natural waters. Furthermore, we demonstrated that stream waters can be collected, transported and stored without compromising their olfactory integrity. Finally, we describe potential applications of this imprinting paradigm for several ongoing supplementation programs in the Northwest.

The Effect of Modulating Ration and Dietary Lipid on Growth, Smolting and Early Male Maturation in Yearling Umatilla River Fall Chinook Salmon

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In the Columbia and Snake River basins a significant number of fall Chinook salmon hatchery programs use yearling, as opposed to sub-yearling, rearing regimes for smolt production. This strategy produces large smolts capable of avoiding predation, but mounting evidence suggests that these programs experience high rates of early male maturation (age-1 microjacks and age-2 minijacks). High rates of early male maturation are symptomatic of an imbalance in the life-history composition of a population, may have negative ecological impacts, reduce the number of full size adults and are a waste of program resources. Several studies have confirmed that age of maturation in Chinook salmon is influenced by dietary lipid and autumn growth rate. Here we report early results from a multi-year production scale 2x2 factorial experiment being conducted with Umatilla River fall Chinook salmon at Bonneville Hatchery, OR examining the effect of High (18%) and Low (12%) lipid diet and High (7 days/wk) and Low (4 days/wk) ration on growth, smolting, demographics and smolt-to-adult returns (SARs). Treatments were differentially coded-wire and PIT tagged for subsequent post release evaluation. We monitored bi-monthly length, weight, *K*, body lipid, gill Na^+/K^+-ATPase activity (smolt index), and final microjack and minijack rates. The treatments successfully altered growth rate, and body lipid levels. Based on gill ATPase activity all treatments, except LoFat-LoRation, smolted in the first fall and then again in the spring with spring levels being highest in the LoFat-LoRation and lowest in the HiFat-HiRation. Early male maturation rates (microjacks + minijacks) ranged from 60-70% of all males in HiFat-HiRation and HiFat-LoRation, 53% in the LoFat-HiRation and 36% in the LoFat-LoRation. Taken together, these data suggest that reducing autumn size and lipid level

had a significant impact on optimizing smolt development and decreasing early male maturation at a reduced feed cost. However, this outcome came at the expense of smolt size and future adult return data will confirm which rearing strategy may be optimum for improving SARs in this and other yearling fall Chinook salmon hatchery programs.

Acclimation Strategies Improve Post-Release Performance of Hatchery Salmon and Steelhead in Northeast Oregon.

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Acclimation of hatchery salmon and steelhead is a common practice in the Pacific Northwest; however, studies that quantify the post-release benefits of an acclimation period have yielded mixed results. Here we report on two acclimation studies conducted in northeast Oregon to determine if an acclimation period could increase survival and reduce straying of hatchery steelhead, and to understand whether extended rearing in acclimation ponds would improve the performance of spring Chinook salmon.

From years 1987 through 1996 we released 14 paired groups of yearling steelhead smolts into the Grande Ronde River that were either acclimated (AC) for 16 to 57 d in ponds supplied with ambient stream water or trucked from a groundwater-supplied hatchery and directly-released (DR). Upon release we monitored outmigration travel times and survival to Lower Granite Dam (LGD) on the Snake River using freeze brand marks or implanted Passive Integrated Transponder (PIT) tags in a sample of each release group. Across all release groups, travel time was significantly slower for AC groups (34.7 d) than for those that were DR (31.8 d); however, there was no significant difference in outmigration survival probabilities to LGD between AC and DR groups. We used recoveries of coded-wire tags (CWT) to estimate smolt-to-adult survival (SAS) and a stray rate index. Across all release groups, SAS was 33% higher, and straying was 42% lower for AC steelhead.

In a second study conducted from release years 2000 through 2005, hatchery spring Chinook salmon were transferred from a groundwater-supplied hatchery to acclimation ponds supplied with stream water either in November (November transfer; NT) or January (JT) for rearing at ambient water temperatures prior to release into the Umatilla River in early March. After stream release, PIT tag data indicated that median travel time to John Day Dam on the Columbia River was slower for NT groups (51 d) than for JT groups (46 d), with significant differences in five of six release years. Average outmigration survival probabilities were 15% higher for NT groups, though this difference was not significant. Based on CWT recoveries we found that NT groups had a significantly higher SAS than JT groups, with an average difference of 27%. However, little or no straying occurred for both strategies.

Acclimation benefits in our two studies appear to be associated with amelioration of a variety of stressors from fish loading and transport on liberation trucks, and with increased duration for imprinting on release waters. Additionally, hatcheries in our experiments are sourced from groundwater with relatively stable water temperatures. In such instances, acclimation may increase exposure to important seasonal water temperature cues that benefit smolting.

Renovations at Niagara Springs Hatchery: Benefits and Challenges

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Niagara Springs Hatchery is funded by Idaho Power Company and operated by the Idaho Department of Fish and Game. This hatchery produces full term steelhead smolts to be released into Salmon and Snake rivers to provide angling opportunities. Eggs for this program are taken from Oxbow and Pahsimeroi hatcheries. In the past 22 years, Idaho Power Company has financed two hatchery renovations at this hatchery. The first renovation, completed in 1997, cost 3.2 million dollars and the current project estimated to cost over 10 million dollars. This presentation will document the impediments to fish culture that provided the need for hatchery renovation and the benefits gained from each project.

The Idaho Department of Fish and Game and Idaho Power Company have worked together in identifying impediments to fish culture and making the necessary changes in the program or facility structure to improve steelhead production at this facility. In the early 1990's, the steelhead production was plagued with many etiologic agents such as IHN, IPN, furunculosis, coldwater disease, motile aeromonad septicemia, and enteric redmouth disease (ERM). It was decided that density issues were the predisposing factor. A multi-million dollar renovation to expand rearing space and put in bird exclusion netting was completed in 1997. Other management practices that were implemented were vaccination programs for furunculosis and ERM. Eagle Fish Health Laboratory, for three consecutive years, sampled every female steelhead spawned for viral replicating agents. All eggs from IPN positive females were culled. These renovations and management practices have successfully controlled IPN, ERM, and furunculosis.

In the spring of 2010, after over 10 years of no IHNV detections in broodstock at Oxbow Hatchery, 51% of the broodstock were found to be IHNV positive. At that time, fry shipments from Oxbow Hatchery were breaking with IHN at Niagara Springs Hatchery. A shipment of fry was sampled between Oxbow and Niagara Springs. All twelve pools (60 fish) were positive for IHNV. At that time, approximately 300,000 steelhead fry were destroyed. A second renovation of the egg incubation and early rearing nursery area was deemed necessary. This second renovation will allow Niagara Springs Hatchery to receive only eyed eggs and discontinue all fry shipments upon completion of this project. We are projecting better control of mortalities from IHN by limiting outbreaks to the local IHN genotypes. Furthermore, by receiving only eggs, we reduce the risk of introducing exotic IHNV genotypes to this hatchery and the Hagerman Valley.

Integrating Conservation Hatchery Principles with Tribal Treaty Reserved Harvest Opportunities

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In an effort to provide opportunities for Tribal members to harvest salmon and restore populations throughout their usual and accustom lands, as guaranteed under the Treaty of 1855, the Nez Perce Tribe Department of Fisheries Resources Management has taken an active leadership role in hatchery management actions. The Nez Perce Tribe manages several salmon hatchery programs throughout the Snake River Basin. In addition to providing harvest opportunities, a majority of these programs also have supplementation objectives to boost natural population abundance. Key implementation principles include: 1) Documentation of program purpose in terms that can be measured ("pre"establish expectations); 2) Initiation of programs prior to population reaching functional extirpation; 3) Managing natural and hatchery-origin broodstock composition; 4) Careful consideration of marking strategies; 5) Prioritization of facility designs related to water source and adult return management; and 6) Establishment of monitoring and evaluation processes for hatchery adaptive management. Hatcheries in the Snake Basin are operated to mitigate for limiting factors. In all cases, limiting factors leading to population decline must be acknowledged and addressed; hatchery programs should not be viewed as an alternative to restoring ecosystem function. Utilization of harvest sliding scales have proven to be a useful tool in maintaining treaty and non-treaty harvest opportunities of natural and hatchery-origin fish.

Cowlitz Hatchery Program Modifications Using Modeling Technology

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The Lower Columbia River Mitchell Act Hatchery programs play an integral role in salmon recovery and sustainable fisheries in the Columbia Basin. These programs have historically provided important fisheries in the lower river and coastal fisheries in Oregon and Washington. The economic benefits associated with these lower river hatchery programs produces over $29M in annual economic benefit to Washington communities alone. In 2009 the Hatchery Scientific Review Group (HSRG) and Lower Columbia River Salmon Recovery planning process began to shape a new regional approach forward, which lead to both the continued recovery of salmon and steelhead populations, and delivery of sustainable fisheries for local communities. The subsequent development of management tools to support the application of these principles included a scientific framework for artificial propagation of salmon and steelhead, benefit/risk assessments tools; hatchery operational guidelines; and monitoring and evaluation criteria. The primary analytical tool used was the "All-H Analyzer" (AHA), a Microsoft Excel-based application that allows managers to explore potential outcomes of alternative strategies in balancing hatcheries, harvest, habitat and hydroelectric system constraints. The HSRG set standards to limit impacts of hatchery programs on naturally produced populations, and provided suggested solutions. WDFW utilized the AHA tool to analyze additional alternatives for program modifications, and to develop a comprehensive plan that strategically redesigned hatchery production programs in the lower Columbia River to achieve both HSRG standards and support sustainable freshwater and ocean fisheries. The comprehensive plan developed by WDFW from 2006-2009 was a clear demonstration that hatchery programs could be redirected to better meet both conservation and harvest goals by 2012.

Hatcheries and Management of Aquatic Resources (HaMAR)

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Over the last few decades the American Fisheries Society (AFS) has authorized a series of symposium to advance questions regarding approaches and concerns for the use of propagated animals. The current symposium series will focus on hatcheries and management of aquatic resources. Sessions for this symposium series will take place at 1) the Aquaculture 2013 meeting in Nashville, TN, and 2) the AFS 2013 annual meeting in Little Rock, AR. The previous iterations of this series of meetings ("Roles of Fish Culture in Fisheries Management" [Lake of the Ozarks, 1983], "Uses and Effects of Cultured Fishes in Aquatic Ecosystems," [Albuquerque, 1993], and "Propagated Fish in Resource Management" [Boise, 2003]) had as their initial purpose the goal of linking fish culture (i.e. hatchery programs) with fisheries management (i.e. harvest and conservation benefits). While acknowledging that hatchery programs could provide benefits, there was considerable concern that they may also cause some harm, so there was much discussion about genetic, ecological, and demographic impacts and their mitigation. Previous cycles largely focused on whether stocking hatchery-origin fish was appropriate and whether the risks outweighed the benefits. Today, it's clear that hatcheries aren't going anywhere and hatchery-origin fish are going to continue to be a part of fisheries management activities. It seems that the focus now is less on "Is the release of cultured fish beneficial?" and more on "What kinds of cultured fish are the best kinds to release" and "How to reform hatchery management and operation to address both sustainable fisheries and conservation objectives". The presentation will discuss the relevance of the current symposia series to fish culturists in the Pacific Northwest.

Artificial Propagation of Pacific lamprey: Lessons Learned and Path Forward

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Many of the northern hemisphere lamprey species are either threatened, endangered, or extinct, and Pacific lamprey (*Entosphenus tridentatus*) is one of the anadromous species that have experienced a substantial decline in the past 40 to 50 years. Native Americans of the northwestern USA have depended on Pacific lamprey as a key food source and medicine for over 10,000 years, and many stories and legends passed down from generation to generation portray lamprey as a crucial cultural icon. Because Pacific lamprey in some of the upper Columbia and Snake River watersheds are at alarmingly low numbers, lamprey culture has been explored more recently as a tool to evaluate serious threats and to potentially supplement wild populations. We experimented with the artificial propagation of Pacific lamprey from adult holding to larval rearing stages. Pacific lamprey adults were collected in summer 2011 and held over winter at ambient water conditions. Eggs and milt were stripped from anaesthetized fish (N=30) after they reached sexual maturity in April – June 2012. Eggs were immediately mixed with the milt, allowed to harden in water, rinsed, and housed at two Yakama Nation facilities (Marion Drain Hatchery and Prosser Fish Hatchery). Five egg incubation methods were tested: 1) McDonald jars, 2) upwelling jars, 3) modified Heath trays, 4) down-welling buckets, and 5) plastic tubs [flow-through and still water]. All eggs were held in water at 14-15°C throughout the incubation period except for those in still water plastic tubs. For all treatments, eggs were checked periodically throughout the incubation period by viewing a subsample using a dissecting microscope. Fertilization and hatching success varied widely (0-99%) and highly depended on the incubation methods as well as water, egg, and milt quality. Cell division was first observed seven hours (± 1 hour) after fertilization, and hatching was observed 14 days (±2 days) after fertilization. After hatched larvae absorbed their yolk and were ready to feed (approximately 20 days after hatching), we transferred them to 4.9m (L) x 0.4m (W) x 0.4m (D) trough tanks (between 10,000 and 25,000 larvae in each tank) and fed one of the following four types of feeds at a rate of 30g/week: 1) hatchfry encapsulon, 2) artificial plankton, 3) spirulina, 4) active dry yeast. Larvae that were fed hatchfry encapsulon had the most growth and highest

survival rates compared to the other feeds. Three types of natural and artificial substrate (clay/silt [<63 microns], fine sand [>63 microns, <500 microns], and filter media with interstitial spaces) is currently being evaluated to house the burrowing larvae for long-term rearing. Although there are many similarities between salmon and lamprey culturing, the unique biological features of lamprey require new, innovative ideas and methods to improve the culturing of these species.

Successful Disease Management of spring Chinook captive broodstock at Little White Salmon National Fish Hatchery.

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In 2008, Little White Salmon National Fish Hatchery took on a captive broodstock program for an endangered run of spring Chinook salmon from the White River in the Wenatchee River basin of north-central Washington. The captive broodstock program is part of the Grant County Public Utility District's Biological Opinion (2004) for mitigation for their dams on the mid-Columbia River, one of which is Priest Rapids dam. At the recommendation of the Priest Rapids Coordinating Committee-Hatchery Subcommittee, the captive broodstock program was moved from a private aquaculture facility to Little White Salmon NFH. This stock had a fish health history of high incidence and severity of bacterial kidney disease (BKD), therefore an intensive plan for azithromycin treatments was adopted to control the causative agent, *Renibacterium salmoninarum*. We have observed a dramatic decrease in clinical signs of BKD since the inception of the program at Little White Salmon NFH. The decrease in BKD is reflected in results from the Enzyme-Linked Immunosorbent Assay (ELISA). Optical densities (O.D.) of spawning females in the high risk category (O.D. ≥ 0.5) have decreased from 71% in 2007, to 3% in 2011 and 1% in 2012. We hypothesize the decrease in BKD could be attributed to azithromycin treatments, low rearing densities (≤ 0.1), and minimizing handling events.

To add a little complexity to this program, while the BKD was decreasing, the captive broodstock became infected with the gill copepod *Salmincola*. Treatments with SLICE (emamectin benzoate, 50 µg/kg/day) under INAD #11-370 have been effective in controlling the gill copepods.

Controlling Bacterial Coldwater Disease with Fish Culture Methods

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Several papers at this workshop address specific control measures for "Bacterial Cold Water Disease" (BCWD). Several fish cultural procedures and physical alterations at hatcheries have already been developed which can help prevent or eliminate this and other diseases. A checklist of these control measures and concepts will be reviewed and listed that will be helpful for the fish culturist, fishery managers and engineers designing hatchery systems for the rearing of fish that are susceptible to the disease. The presenter will recount his and others experiences and observations in the successful reduction of disease problems at hatcheries.

Coldwater Disease Research: Update on Vaccine Licensing and Commercialization Status

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Coldwater Disease (CWD), also referred to as Rainbow Trout Fry Syndrome (RTFS), is associated with the ubiquitous gram negative bacterium *Flavobacterium psychrophilum*. The University of Idaho has developed a live attenuated vaccine effective against CWD and this is being evaluated for widespread use. We have been working with Aquatic Life Sciences to complete laboratory and field trials to obtain USDA licensing of the vaccine. Once a conditional license is obtained, the vaccine will be commercially available. Field and lab trials have indicated that the vaccine is effective in rainbow trout (*Oncorhynchus mykis*) and Coho salmon (*O. kisutch*). In addition to licensing efforts, our lab is attempting to develop an immersion challenge model that mimics natural exposure to *F. psychrophilum*. Such a tool is highly desired for laboratory challenge trials aimed at vaccine and other testing. To improve our challenge model, a virulent *F. psychrophilum* strain (CSF 259-93) was produced in iron limited media (ILM) and fry were challenge by immersion in high bacterial concentrations for 1 hr. Results suggest that pathogenicity of the virulent *F. psychrophilum* strain can be increased if trout fry are scarred or adipose fin clipped and immersed in virulent *F. psychrophilum* grown in ILM. In summary, we have now developed a challenge model to better evaluate a live attenuated CWD vaccine, which has proven to provide disease protection in rainbow trout and Coho salmon. This vaccine is expected to be conditionally licensed and available to the public in early 2013.

Larval Pacific lamprey *Entosphenus tridentatus* are not susceptible to common fish rhabdoviruses of the Pacific Northwest

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Pacific lamprey *Entosphenus tridentatus* have experienced population declines in recent years and efforts to develop captive rearing programs are under consideration. There is limited knowledge of the potential for lamprey to harbor or transmit pathogens but is a risk to consider (Ward et al. 2012). The rhabdovirus infectious hematopoietic necrosis virus (IHNV) is a viral pathogen causing disease in hatcheries (Kurath et al. 2003). Viral hemorrhagic septicemia virus (VHSV), endemic to marine and estuarine fish of the Pacific coast, has been associated with several disease outbreaks in wild populations of fish (Meyers and Winton 1995; Hedrick et al. 2003). To our knowledge there are no reported detections of IHNV or VHSV in Pacific lamprey, and they have not been experimentally challenged with these pathogens. The goal is to determine if Pacific lamprey can be biological hosts or carriers for these viruses.

What Every Fish Culturist Should Know About Antibiotics

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Just about every fish culturist uses antibiotics to treat their fish at some point in their careers. This presentation will provide valuable information for fish culturists in gaining a better understanding of how the antibiotics they use to treat their fish work, how bacteria such as the causative agent of Bacterial Cold Water Disease (Flavobacterium psychrophilum) can develop resistance mechanisms to the antibiotics they use, and how this resistance can spread from one bacteria to another, and throughout the environment. In addition, tips and items to consider before making a decision to treat with an antibiotic will be given. This talk will provide the background for another presentation to be given by Ray Brunson on alternative methods to antibiotic use.

AADAP's National INAD Program Meets the 21st Century

Bonnie Johnson*

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The acronym "INAD" stands for Investigational New Animal Drug exemption, a U. S. Food and Drug Administration (FDA) process that authorizes and controls the transport, possession, and use of certain unapproved drugs. The National INAD Program (NIP) is administered by the U.S. Fish and Wildlife Service's (Service) Aquatic Animal Drug Approval Partnership Program (AADAP). The NIP provides the means, under INAD exemptions, through which Federal, State, Tribal, and private organizations are allowed to use certain unapproved drugs to maintain the health and fitness of aquatic species. INAD exemptions are granted by FDA, and are a critical tool used by aquaculturists to meet management objectives. INAD exemptions also contribute drug effectiveness and safety data that may be used to support the future approval of new drugs for use in aquatic species. INADs are granted by FDA with the expectation that information will be generated to support a New Animal Drug Approval. INADs are not a "use permits."

Key personnel involved in the INAD process include the study investigator, the study monitor, and the field trial coordinator. The study investigator is the NIP-enrolled facility's person designated as being responsible for implementing the INAD study protocol, making observations, collecting data, and recording and reporting data during a field trial. The study monitor can be a Service or non-Service employee, and is responsible for supervision of the trial, adherence of the investigator to the study protocol, and inspection of the site. The field trial coordinator is a Service employee and is responsible for monitoring and administering all INAD drug use. The field trial coordinator is also responsible for analyzing and summarizing data, as well as annual reports that are submitted to FDA.

The NIP is operated on a cost-reimbursable basis with an annual cost of $400.00 per INAD per facility per year. All money collected is directed towards funding the operational needs of this important program. Participation in the NIP and all INAD data reporting is accomplished via the INAD Program Management System (IPMS; on-line data reporting). The IPMS was developed to allow participants to enter all data directly into an on-line database. It is anticipated that the new on-line data reporting will be less labor intensive than dealing with hand-entered hard copy data, and also allow for the collection of more accurate/complete data packages. NIP participants must recognize the responsibilities incumbent on all parties to properly use, account for, and safe-guard investigational new animal drugs and to comply with study protocol requirements in the collection and submission of data. For more information on the NIP please visit the AADAP website (http://www.fws.gov/fisheries/aadap/home.htm).

Differences in egg size between natural-origin and genetically similar hatchery-origin winter steelhead in Abernathy Creek, Washington

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Data from an ongoing steelhead conservation hatchery evaluation project indicate that egg size, which has been shown to be positively correlated to fry size and survival, may be influenced by early rearing. Average egg weight for comparably sized returning adult winter steelhead that had spent 2 years in salt water differed between genetically similar hatchery- and natural-origin steelhead. Hatchery-origin steelhead had much smaller eggs (77% of natural) than the natural-origin steelhead did. Hatchery-origin steelhead are released at one year of age and most females out-migrate upon release. However, variable growth in the freshwater phase results in multiple ages of natural-origin steelhead smolts, with smolts in Abernathy Creek out-migrating at one (19%), two (65%), and three (16%) years of age. Studies with Atlantic salmon, which have a life history similar to that of steelhead, show a decrease in egg size with rapid freshwater growth. A homogenous adult growth history, comprised of one year of high growth freshwater rearing and two years in saltwater, resulting from an inflexible conservation hatchery program, may result in reduced egg size and fry survival of steelhead under a naturally changing environment.

Hoover, Bonneville, Shasta and Grand Coulee Dams: The Great Depression, World War II, and Fishery Resources

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These four major dams were constructed as large-scale public works projects that provided jobs for many thousands of desperate and destitute people during the Great Depression of the 1930's. Hoover Dam itself had actually been authorized prior to the Stock Market Crash of 1929 – and the Great Depression that followed in the wake of that crash.Construction of the other three dams began as "New Deal" projects undertaken during the Franklin D. Roosevelt administration, although Shasta Dam had originally been authorized as a state undertaking.

Besides the more immediate effects of providing employment to such large numbers of men and thus aiding their families during the construction phase, the finished dams would later provide such economic benefits as electrical power generation, improved inland navigation, flood control, and the creation of reliable water supplies in arid regions of the American west.

Hoover Dam marked the first time that any country in the entire world had attempted to dam and control a river as large as the Colorado. Hoover Dam was by far the most ornate of the dams of this era and seems as close to being a cathedral as a dam can possibly be, an important consideration during the depths of the Great Depression.

It was the early success at Hoover Dam that gave us the assurance to tackle large rivers such as the Columbia.The crucial role that these dams would later play in assuring an Allied victory during World War II was just a stroke of sheer luck!

The negative impact that these dams would ultimately have on the fishery resources of these rivers, and especially upon anadromous species such as salmon, was recognized – and then largely dismissed. Harnessing and developing these rivers for agricultural, municipal and industrial expansion was perceived as being a greater good to the American public and vital to the nation's future security and economic well-being, and the adverse effects upon the respective aquatic ecosystems of the rivers involved was simply viewed as the price we paid for such progress.

This presentation will focus upon the historical significance of these dams and some of the detrimental environmental consequences that followed their construction.

White Sturgeon US Conservation Aquaculture on the Transboundary Reach

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The Lake Roosevelt White Sturgeon Recovery Project (LRWSRP) is a cooperative effort by the Washington Department of Fish and Wildlife, Spokane Tribe of Indians, and the Colville Confederated Tribes to identify the factors limiting white sturgeon recruitment in the Transboundary Reach of the Columbia River. As an interim measure, the project also began operation of a conservation aquaculture program to produce juvenile white sturgeon for Lake Roosevelt. The conservation Aquaculture program was developed with two primary goals, (1) to restore recruitment of white sturgeon to the river, and (2) to ensure preservation (to the greatest degree possible) of genetic diversity currently found in the wild population. This program was designed as a stop-gap measure to prevent further decline of the population until factors affecting natural recruitment are identified and corrected.

The culture program has evolved from outsourcing eggs in the beginning to current operations which consist of rearing wild larvae that are collected each July. Larvae are reared at Sherman Creek Hatchery until large enough for tagging and release into Lake Roosevelt. While the culture is intensive, the duration is short with only four months elapsing between collection and release (20 to 30 grams). Initial results have been positive for both survival of conservation aquaculture-released fish and genetic representation, as indicated by the ongoing testing of adults and hatchery releases.

Practical Application of Electro-Narcosis in the Field

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Electro-Narcosis (EN) for fish has been around for hundreds of years. Our inability to use drugs at our facilities due to harvest and the withdrawal period prompted us to explore this technique. We found that the EN system was cheap and easy to build, worked well on the fish, reduced handling time, and made working up the trapped fish much easier on the operator. This presentation/video will show the practical application of EN at our remote broodstock collection facility on Catherine Creek as well as its use at Lookingglass Hatchery.

Does the use of electronarcosis on adult Coho salmon prior to spawning affect embryo mortality and fry growth?

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The use of electronarcosis as a fish immobilization technique has re-emerged in recent years. Previous studies have investigated behavioral effects of the technique. But, physical and physiological effects to fish from electrical immobilization have focused on alternate electrical waveforms or higher power densities than used for electronarcosis. This study was designed to determine if there was a significant negative effect on embryo survival or fry growth from adult fish immobilized using electronarcosis prior to spawning. The results indicate no statistically significant negative effect when compared to adult fish immobilized using MS-222 or not immobilized at all. These finding support the continued use of electronarcosis as a fish immobilization technique.

Utilizing Round Butte Hatchery in the Reintroduction of Anadromous Fish in the Deschutes River

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For nearly 50 years, anadromous fish have been disconnected from their historic range in the Deschutes River Basin. With the relicensing of the Pelton Round Butte Hydroelectric Project (PRB), a fish passage program is now being implemented. The program is centered upon the construction of the Selective Water Withdrawal (SWW) and associated Fish Passage Facility.

A Reintroduction Plan was also developed by ODFW and the Confederated Tribes of Warm Springs. The plan discusses species and stocks to be reintroduced above PRB, and provides general guidance on methods, release locations, numbers, timing, and adjustments in hatchery supplementation as populations become re-established. *The goal of reintroduction is to restore self-sustaining and harvestable populations of native summer steelhead, Chinook salmon, and sockeye salmon in the Deschutes River and its tributaries upstream from PRB, and to reconnect native resident fish populations that are currently fragmented by PRB.*

Uncertainties regarding reintroduction remain and will only become resolved as the effort moves forward. In particular, the concerns regarding the ability to effectively collect and pass juvenile fish downstream through the SWW project and potential risks of introducing new diseases to resident fish populations. Partly due to these concerns, managers began the reintroduction program by outplanting disease free summer steelhead and spring Chinook salmon fry above PRB that were raised at ODFW's Round Butte Fish Hatchery.

To initiate the reintroduction effort, ODFW and stakeholders have been outplanting over a million spring Chinook and summer steelhead fry annually, into the tributaries above the PRB. Since December of 2009, tens of thousands of migrating spring Chinook, summer steelhead, and "sockeye" smolts have been collected and passed downstream through the SWW providing them the first opportunity to complete an anadromous life cycle in decades. In 2011, the first adult spring chinook, summer steelhead, and sockeye salmon returned to the Deschutes River from the 2009 and 2010 outmigration. These fish were spawned and incubated at RBH and released as fry. In 2012, adults that returned from the "known origin" fry were released into the upper basin to spawn naturally.

Sedating Fish With Aqui-S20E: Will My Fish Still be Alive if I Take Time for Another Cup of Coffee?

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Fisheries professionals routinely have a need to handle fish for purposes such as collecting morphometric data, spawning, sorting, or implanting tags. Currently, the MS-222 products are the only sedatives/anesthetics approved by the U.S. Food and Drug Administration (FDA) for use on fish. However, legal use of MS-222 is restricted to four families of fish and a 21-day withdrawal period is required for fishes intended for human consumption or which may be caught and consumed. For many applications, holding fish post-sedation is not practical, particularly in field settings. To avoid these complications, an approved immediate-release sedative is desperately needed.

Carbon dioxide (CO_2), which is not approved by FDA but is considered to be a drug of low regulatory priority (LRP), can be used as an immediate-release fish sedative. However, to sedate fish with CO_2, hypercapnia must be induced, which affects all major organ systems and can induce the generalized stress response. Depending on the exposure conditions, full recovery from these disturbances can take hours or days, and in some instances morbidity and mortality are observed. Clearly, better alternatives are needed for fisheries professionals needing to sedate and release fish.

Consequently, efforts are underway in the U.S. to gain FDA approval of AQUI-S®20E (10% eugenol; developed by AQUI-S New Zealand, Ltd., Lower Hutt, New Zealand) as an immediate release fish sedative. Eugenol is the major active ingredient (85-95%) of clove oil, which has been used as a mild topical anesthetic for the treatment of toothache, headache, and joint pain since antiquity, and has been used throughout the world as a fish sedative. Recently, the staff at the USFWS Aquatic Animal Drug Approval Partnership (AADAP) Program completed studies to demonstrate that AQUI-S20E is effective at sedating a variety of freshwater finfish species to handleable. Next, AADAP research staff conducted studies to determine how long fish can remain in AQUI-S20E sedative solutions and survive after being transferred back to fresh, flowing water (i.e., margin of safety). After considerable debate with FDA regarding the definition of an 'adequate' margin of safety, we were able to launch a series of safety studies. Preliminary results from these studies show that there is an 'adequate' margin of safety associated with sedating rainbow trout and yellow perch with AQUI-S20E at the highest proposed efficacious dose and an 'overdose' concentration. For example, fingerling rainbow trout (tested at a water temperature of 15°C) survived (98% survival) for an additional 2.5 min after the group had become sedated with 40 mg/L eugenol, but survival decreased to 96% if fish were left in the sedative solution for 5.5 min after the group had become sedated. Results from these studies will be summarized, an adequate margin of safety for each fish species/dose tested will be reported, as well as the exposure duration breakpoint (where mortality becomes unacceptable).

Effects of Initial Feed Timing on Triploid Rainbow Trout Fry at Grace Fish Hatchery

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The timing of initial feeding for trout fry varies greatly among hatchery professionals. Literature pertaining to initial feeding time of trout fry also varies with a wide range of recommendations provided for initial feed timing. Managers at Grace Fish Hatchery sought to reduce the variability of initial feed timing for triploid rainbow trout (*Oncorhynchus mykiss*) fry. The purpose of this study was to determine if there is a number of days post hatch to begin feeding triploid rainbow trout fry where they will experience the least mortality and most favorable growth factors. Treatment groups of triploid rainbow trout fry were fed for 30 days with initial feeding times of 13, 15, 17, 19, 21 and 25 days post hatch on 12.2^{o} C water. Variations in mortality, condition factor, size and feed conversions between initial feed times were evaluated. The results of this study not only provide fish culturists at Grace Fish Hatchery with the optimal number of days post hatch to begin feeding triploid rainbow trout fry, but they also eliminate the variability that is common among hatchery professionals in regards to initial feed timing of triploid rainbow trout.

Identifying an optimal anesthetic for juvenile Pacific lampreys

Helena E. Christiansen, Lisa P. Gee, and Matthew G. Mesa

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Effective anesthetics are a critical component of safe and humane fish handling procedures. We tested three concentrations each of four anesthetics—MS-222 (tricaine methanesulfonate), BENZOAK® (20% benzocaine), AQUI-S® 20E (10% eugenol), and Aquacalm® (metomidate hydrochloride)—for efficacy and safety in metamorphosed, outmigrating juvenile Pacific lampreys *Entosphenus tridentatus*. MS-222 (100 mg/L) and BENZOAK® (60 mg/L) were the most effective for anesthetizing juvenile lampreys to handleable while minimizing irritation. Fish anesthetized with BENZOAK® also had lower rates of fungal infection than those anesthetized with MS-222 or AQUI-S® 20E, suggesting that BENZOAK® exposure may not compromise the immune system to the same extent as exposure to MS-222 or AQUI-S® 20E. AQUI-S® 20E exposure severely irritated juvenile lampreys, and Aquacalm® anesthetized fish to handleable too slowly and incompletely for effective use with routine handling procedures. Our results indicate that MS-222 and BENZOAK® are effective anesthetics for juvenile lampreys but field studies are needed to determine if exposure to MS-222 increases disease risk in juvenile lampreys released to the wild.

63rd Annual

Northwest Fish Culture

Conference Poster Abstracts

DECEMBER 11-13, 2012

Portland Downtown Marriot Waterfront

Portland, Oregon

DAY 1: Tuesday, December 11, 2012

5:10-10:00 Trade Show, Round Table, and Poster Session Social

Rod Engle and Mark Ahrens, USFWS, **Techniques for Evaluating a Fry Release Strategy for Tule Fall Chinook Salmon at Spring Creek National Fish Hatchery**

Bellingham Technical College, **Fisheries and Aquaculture Science Program Bellingham Technical College**

William R. Brignon, Columbia River Fisheries Program Office, USFWS, **Captive rearing of bull trout within the framework of adaptive resource management and Strategic Habitat Conservation.**

Tuianna Moliga, Michael Bisbee Jr. and Steve Coomer, Nez Perce Tribe, **Clearwater Coho (Oncorhynchus kisutch) Restoration Project Restoring and Extirpated Stock via Supplementation**

Mike Key, Austin Samuels, Tish Whitman, Nez Perce Tribe, **Nez Perce Tribe Fisheries Fall Chinook Acclimation Project**

Neil Ashton, Shawn Young, and Ken Cain, University of Idaho, **Advancements in Aquaculture and Supplementation of Imperiled Burbot in the Kootenai River**

Gary Marston and Beata Dymowska, Washington Department of Fish and Wildlife, **Washington State Hatcheries Fisheries Contribution derived from Code Wire Tag data**

Mary Moser, Aaron Jackson, Jerrid Weaskus and Ralph Lampman, NOAA Fisheries, **Egg Incubation Methods for Pacific Lamprey: A Brave New World**

Jennifer Poirier, USFWS, **New Zealand Mudsnail Surveys at National Fish Hatcheries within the Lower Columbia River Basin**

Techniques for Evaluating a Fry Release Strategy for Tule Fall Chinook Salmon at Spring Creek National Fish Hatchery

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Since its inception in 1901 and through the 1970's Spring Creek National Fish Hatchery (NFH) performed fry releases which usually occurred in January or February within the Columbia River. In recent years, releases of smolts occurred in March, April and May. The fry-release practice was curtailed in 1974 due to inadequate adult returns and reinstituted in the 1990's when the hatchery again experienced surplus returns. Past evaluations suggested that the fry releases Spring Creek NFH survived at a rate of 0.0022% during a study in the late 1950's and early 1960's. The addition of a warm water well provided the ability to manipulate incubation water temperature and use otolithography to mark fry destined for early release and assess their survival compared to later juvenile releases that were assessed using coded wire tags. Over 3.0 million otolith-marked fry were released during 1999, 2001, and 2002 in addition, approximately 7.5, 4.3 and 3.2 million smolts followed in March, April and May, respectively. Survival of standard smolt production releases that occurred during March, April and May were significantly higher than fry releases for the years analyzed. Fry releases of tule fall Chinook salmon at Spring Creek NFH do contribute to adult returns but at a much lower rate than the standard production releases and should not be used in lieu of traditional production releases to meet the goals of Spring Creek NFH.

Table 1. Return of adults by age from a fry release of 3,116,006 during December 1999 at Spring Creek National Fish Hatchery. Adult tule fall Chinook salmon return to Spring Creek NFH during August and September. Survival of standard juvenile production during 1999 is given for comparison.

Age at Return	Return Years	Samples Collected	Fry Release Returns	Total Adult Return	Est. Fry Release Returns	Survival Rate of Fry Release	Survival of Standard Production
Age 2	2001	998	4	12,037	47	0.0015%	0.0749%
Age 3	2002	2,106	17	60,634	476	0.0153%	0.3774%
Age 4	2003	635	3	28,719	132	0.0042%	0.1788%

Fisheries and Aquaculture Science Program: Bellingham Technical College

The Fisheries and Aquaculture Science Program at Bellingham Technical College is ideal for students interested in a fisheries career involved with fish culture, aquaculture, aquatic sciences and fisheries techniques, habitat restoration, and working in a varied and challenging outdoor environment. The program operates the Whatcom Creek Hatchery at the Maritime Heritage Park as well as Bellingham Trout Hatchery in Whatcom Falls Park in Bellingham, Washington. These hatcheries provide an actual work site for the instructional "laboratory." This workplace complements classroom theory and related instructional components.

The Fisheries and Aquaculture Science Program operates in partnership with several regional and statewide industries and agencies such as Washington Department of Fish and Wildlife, the City of Bellingham, and local Regional Enhancement Groups. In coordination with these organizations, Fisheries students have the opportunity to participate in activities such as: all aspects of finfish hatchery operation, spawning grounds surveys, biological sampling, smolt trap operation, stream habitat assessment, and water quality monitoring. Recently, both Western Washington University and Northwest Indian College signed articulation agreements with Bellingham Technical College. The agreements will allow students to transfer Fisheries credits into specified programs and start at the four-year institutions with junior status.

This program is dynamic and adapts to current industry standards and new technology entering the field. Lately, the program has been focused on emphasizing shellfish aquaculture by teaming with local shellfish farms to gain valuable field experience. We have also expanded our curriculum to include habitat restoration, studies of rivers, lakes, and streams, and aquatic invertebrate biology.

A new state-of-the-art classroom and hatchery building is now under construction. The Perry Center for Fisheries and Aquaculture Sciences will replace the old Whatcom Creek Hatchery. The new facility will be 8,000 square feet, and function as an instructional space, production hatchery, and community education center.

Captive rearing of bull trout within the framework of adaptive resource management and Strategic Habitat Conservation.

William R. Brignon*

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Poster abstract: There are 4 primary strategies in species reintroduction: natural recolonization, translocation, captive rearing, and artificial propagation. Each strategy has variable risks to donor populations and variable probability of success and there is a need to understand the pros and cons of all reintroduction strategies for threatened and endangered species. The draft bull trout recovery plan suggests captive rearing is a potential reintroduction strategy for bull trout. However, life in captivity has been linked to a suite of negative genetic, physiologic, morphologic and behavioral effects that results in uncertain outcomes of captive rearing programs. My goal is to compare the value of all bull trout reintroduction strategies with the development of a structured decision support tool. Focusing on captive rearing, I will evaluate how the hatchery environment influences bull trout development, specifically morphology and brain development, and determine how these developmental metrics affect behaviors that are crucial for post-release survival of reintroduced individuals. Rearing a fish in captivity that is phenotypically similar to wild fish should improve the success of any reintroduction program. Thus, I will combine phenotypic and behavioral research with theoretical impacts to donor populations and predicted population dynamics of reintroduced individuals to compare the value of all bull trout reintroduction strategies. This work will serve as an example of how to evaluate conservation hatchery programs within the framework of adaptive resource management and Strategic Habitat Conservation (Figure 1).

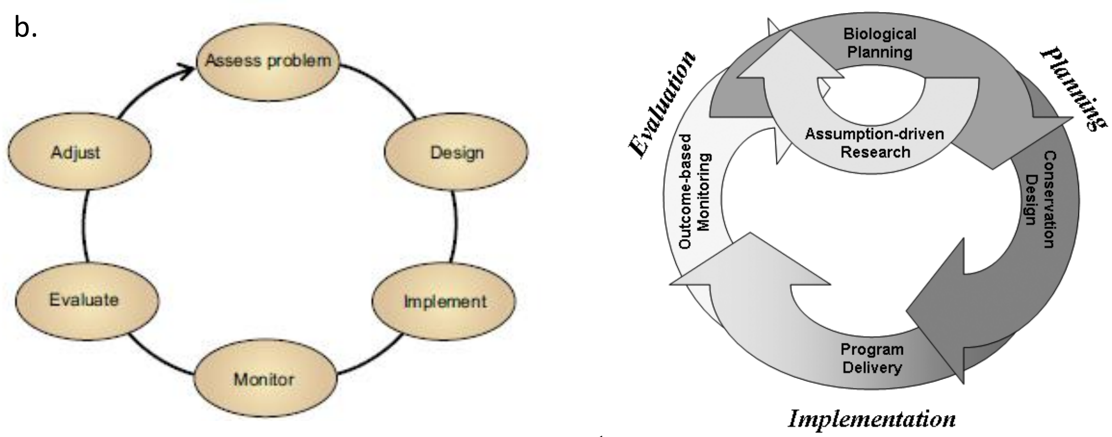

Figure 1. The sequence of adaptive management (a[1]) mirrors that of Strategic Habitat Conservation (b). These are iterative processes of developing and refining a conservation strategy, making efficient management decisions, and using research and monitoring to assess accomplishments (or failures) and inform future iterations of the conservation strategy[2].

[1]Williams, B. K., R. C. Szaro, and C. D. Shapiro. 2009. Adaptive Management: The U.S. Department of the Interior Technical Guide. Adaptive Management Working Group, U.S. Department of the Interior, Washington, DC.

[2]U.S. Fish and Wildlife Service. 2008. Strategic Habitat Conservation Handbook: A Guide to Implementing the Technical Elements of Strategic Habitat Conservation (Version 1.0). U.S. Fish and Wildlife Service, Washington, D.C.

Clearwater Coho (*Oncorhynchus kisutch)* Restoration Project Restoring and Extirpated Stock via Supplementation

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K'állay or Coho Salmon (Oncorhynchus kisutch) were exterminated in Idaho's Clearwater subbasin following the construction of the Harpster Dam in 1910 and the Washington Water Power Diversion Dam in 1927. Early restoration attempts by the Idaho Department of Fish and Game (1962-1968) were unsuccessful. In 1986, Coho were officially declared extirpated from the Clearwater and Snake River subbasins. This loss was unacceptable to the Nez Perce Tribe, which recognized the cultural and ecological significance of Coho to the Clearwater subbasin. In 1995, the Nez Perce Tribal Fisheries Department initiated a Coho restoration program for the Clearwater River. The goal of the Nez Perce Tribe's Coho restoration project is to reestablish a localized Coho stock in the Clearwater subbasin at levels of abundance and productivity sufficient to support sustainable runs and annual harvest. Using excess Coho eggs from lower Columbia River hatcheries, the Nez Perce Tribal Fisheries Department started the Clearwater River Coho Project. Increased adult returns have allowed the project to phase out the need of Lower Columbia River surplus eggs. Eggs from Clearwater River returning adults are incubated, reared, and released as Coho juveniles into Clearwater tributaries historically known to contain Coho. These supplementation efforts have generated a progressive increase in adult Coho returns to the Clearwater River. To date, the highest return of adult Coho occurred in 2011 when 5,057 adults and 291 jacks crossed Lower Granite Dam (LGD). In 2009, 4,629 adult and 283 jack Coho crossed LGD, marking the second highest return of adult Coho since restoration efforts began in 1995. As a result, Clearwater broodstock have provided 100% of the egg take in three of the last four years. This is a significant advance towards establishing a localized Clearwater Coho stock, and demonstrates that restoring an extinct salmon species is possible.

Nez Perce Tribe Fisheries Fall Chinook Acclimation Project

Mike Key*, Austin Samuels, Tish Whitman

This program involves acclimation of fall Chinook at three acclimation facilities operated by the Nez Perce Tribe. The Fall Chinook Acclimation Project (FCAP) facilities receive 450,000 yearling smolts and upwards of 1.4 million sub-yearling smolts from Lyons Ferry Hatchery annually. Juvenile fall Chinook are acclimated for 4-6 weeks and released directly into the Snake & Clearwater Rivers at the acclimation site. Acclimation sites include; Captain John Rapids and Pittsburg Landing facilities which are located on the Snake River between Asotin, WA and Hells Canyon Dam and Big Canyon facility which is located on the Clearwater River.

Juvenile releases from the FCAP facilities began in 1996 and the first adult returns were observed in 1998. Thereafter, the number of fall Chinook returns at Lower Granite Dam increased from less than 1,000/year to over 55,000 in 2012. Adult fall Chinook salmon that were released as juveniles from the FCAP facilities are displaying a strong homing fidelity to their acclimation sites - they return to, and spawn in an area of the river near where they were acclimated and released. Redd counts in the Snake and Clearwater rivers have increased substantially since the initiation of the FCAP project. Adult fish that spawn naturally will aid in increasing the abundance of the natural-origin population and assisting in recovery of Snake River fall Chinook salmon.

Not only will the fish released from FCAP facilities aid in ESA recovery of the Snake River fall Chinook, they also help support Columbia River and ocean fisheries. Recent coded wire tag recoveries of FCAP adults show that about 30% are harvested in the mainstem Columbia River and ocean fisheries. Adult returns have been so encouraging that a tribal and sport fishery has occurred for the past three years in the Snake River.

Advancements in Aquaculture and Supplementation of Imperiled Burbot in the Kootenai River

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A conservation program developed by regional stakeholders incorporates aquaculture as one of several approaches to restore an imperiled burbot (Lota lota) population native to Idaho and British Columbia. Burbot are the only freshwater member of the cod family and populations are declining across the Northern Hemisphere. Research at the University of Idaho has focused on advancements in egg incubation, larviculture, juvenile propagation, and tagging that demonstrate the feasibility of large-scale production and stocking of burbot. Through collaborative efforts with tribal, state, federal, and provincial agencies, the production and experimental release of hatchery burbot has increased tenfold each year between 2009 and 2012. Over 16,000 burbot fingerlings were propagated, PIT tagged, and released into the lower Kootenai River last year. The use of genetic markers for parentage-based tagging of burbot recently enabled the release of 340,000 larvae and 28,000 juveniles without the need to physically mark individual fish. The Kootenai Tribe of Idaho is planning construction of a new hatchery facility for native fish conservation; burbot aquaculture could expand from an experimental research phase to population-level production necessary to re-establish the lower Kootenai stock. Aquaculture of burbot is also developing in other regions of the world in response to population declines, extirpations, and commercial interests. An opportunity exists for the NW region to establish a lead role in restoring the ecological and cultural significance of this unique species.

Washington State Hatcheries Fisheries Contribution derived from Code Wire Tag data

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Each year millions of Coded Wire Tagged (CWT) salmon are released from hatcheries operated by the Washington Department of Fish and Wildlife. These tagged salmon provide a useful tool for managing fisheries and gauging the performance of hatcheries based off of smolt to adult survival and contributions to specific fisheries. CWT recoveries were analyzed for brood year 2000 to 2004 Chinook salmon derived from harvest programs across four production regions in Washington State (Puget Sound, Coast, Lower Columbia River and Interior Columbia). This data was used to determine smolt-to-adult survival rates for each program, where fisheries benefits are achieved and the value of mark selective fisheries. To investigate the effectiveness of mark selective fisheries, the Wallace River summer Chinook double index tag (DIT) groups was used. The CWT only releases from Wallace showed a lower contribution to sport fisheries, as well an increase in escapement to the hatchery when compared those fish that also received an adipose clip. Hatcheries across these regions contributed to fisheries in very different ways, with coastal hatcheries primarily benefiting northern fisheries (49% intercepted in Canada and Alaska), while Puget Sound and Columbia River hatcheries showed stronger contributions to sport and commercial fisheries within Washington and Oregon. Smolt to adult survivals ranged from 0.26% for coastal programs, which strictly release sub-yearling Chinook to 0.60% for interior Columbia programs, which release a mix of yearling and sub-yearling Chinook. Yearling programs showed a smolt-to-adult survival benefit of over sub-yearling Chinook, (0.71% to 1.48% for yearlings and 0.21% to 0.51% for sub-yearlings), as well as an increased benefit to sport fisheries. The information provided by these tag recoveries is an important step in assuring that informed decision are made regarding the management the State’s hatchery system and this valuable resource.

Egg Incubation Methods for Pacific Lamprey: A Brave New World

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[2]DNR Fisheries Program, Confederated Tribes of the Umatilla Indian Reservation, 46411 Timine Way, Pendleton, OR, 97801

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Pacific lamprey (Entosphenus tridentatus) is of great cultural importance to Native Americans of the interior Columbia Basin. With declines in lamprey abundance, tribal treaty fisheries have been curtailed and a key component of tribal culture may be lost to future generations. While efforts to conserve lamprey are underway, alarmingly low adult returns to the upper Columbia and Snake rivers have prompted managers to investigate opportunities for lamprey culture. For this study, Pacific lamprey adults were collected in summer 2011 and held over winter at ambient water conditions. Eggs and milt were stripped from anaesthetized fish after they reached sexual maturity in early June 2012 (two females and three males). The eggs from both females were combined in a plastic container, and the milt samples were combined in a separate container. A sample of the eggs was immediately mixed with the milt, allowed to harden in water, rinsed, and housed in upwelling jars (Eager Inc.) at the Prosser Fish Hatchery. These eggs were held at ambient water temperature throughout the incubation period. Some of the remaining eggs and milt were transferred to separate sealed plastic containers and maintained at approximately 14°C for 7 h during transport to the Mukilteo Research Station (MUK). These eggs were then fertilized using the same methods used at Prosser. Three egg disinfection methods were tested at MUK: no disinfection, disinfection on day 1 only, and disinfection every 3 d for the first week of development. Disinfection involved gentle transfer of fertilized eggs into a 100 ppm iodophor (Argent Argentyne) solution for 10 min followed by gentle rinsing. All treatments were held in 10-L chambers with recirculating, UV-irradiated water at 14°C throughout incubation. For all treatments, eggs were checked regularly throughout the incubation period by viewing a subsample using a dissecting microscope. Fertilization success for the Prosser culture was high and 99% survived to hatching. However, only about 50% of the transported eggs were successfully fertilized. Of these, nearly all of the non-disinfected and one-time disinfection treatments survived to hatching. However, the eggs disinfected at later stages of development exhibited very high mortality. These results indicate that: 1) both re-circulating and flow-through culture options worked equally well for lamprey egg incubation, 2) delayed fertilization of eggs resulted in lower survival, and 3) if egg disinfection is employed, it should not be done after approximately day 5 of embryo development.

New Zealand Mudsnail Surveys at National Fish Hatcheries within the Lower Columbia River Basin

Jennifer Poirier

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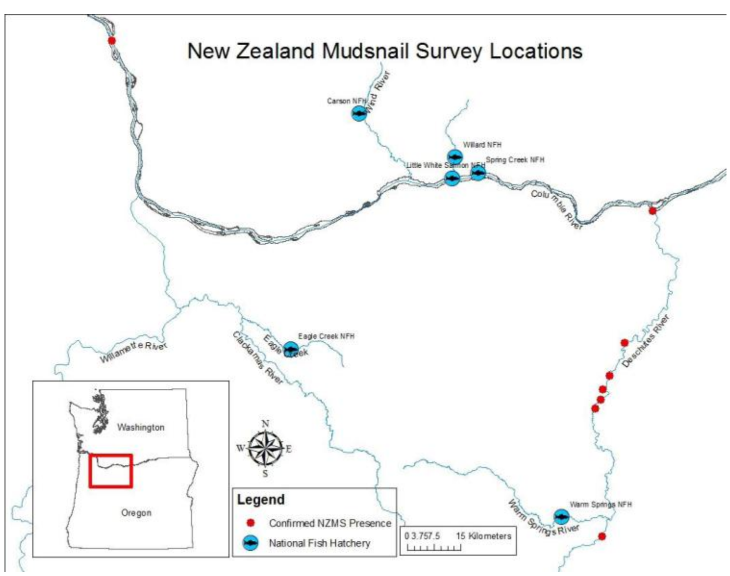
The New Zealand mudsnail (NZMS), *Potamopyrgus antipodarum* is a tiny exotic snail species that has invaded brackish and freshwater habitats of at least ten states in the western U.S. including a number of private, state and federal fish hatcheries. Fish hatcheries may be more vulnerable to invasion because NZMS are known to thrive in the stable aquatic conditions of the hatchery environment (i.e., temperature, flow and nutrient load). Many hatcheries are located on rivers that support popular sport fisheries or receive heavy recreational usage where NZMS may be introduced or transported by a multitude of pathways (e.g., boats, trailers, fishing gear, waders), and fish hatchery operations such as fish stocking and the transfer of live fish or eggs are a major vector of spread given the potential for NZMS to pass through the gut of fish alive and intact. For facilities with no known NZMS infestation, performing a simple yet thorough annual inspection of abatement ponds, raceways, intake and effluent sites may detect the arrival of NZMS before they can be inadvertently spread to new areas. The Columbia River Fisheries Program Office has been intermittently monitoring for NZMS at six lower Columbia River Basin National Fish Hatcheries since 2006, including: Carson, Eagle Creek, Little White Salmon, Spring Creek, Warm Springs and Willard National Fish Hatcheries. The primary objective of these surveys is to determine visually identifiable NZMS presence. Surveys are performed at hatchery facilities in late summer when NZMS densities are generally at their highest and low flow conditions provide the greatest chance of finding the snail. In general, one to two field personnel perform a 15 minute visual inspection of all hatchery intake and outflow sites including surface substrate, aquatic vegetation and hatchery structures such as pipes, grates, concrete walls, dam boards and log booms. Aquatic snail closely resembling NZMS are collected and preserved for closer examination under a dissecting microscope. To date, no NZMS have been found in the six lower Columbia River Basin National Fish Hatcheries included in the survey.



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Hat Shop & Wood Shop	Schocolate Leavenworth WA
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Northwest Fish Culture Conference Historical Record

YEAR	LOCATION	HOST AGENCY	CHAIRMAN
1950	Portland, OR	U.S. Fish and Wildlife Service	Ted Perry
1951	Wenatchee, WA	U.S. Fish and Wildlife Service	Roger Burrows
1952	Seattle, WA	Washington Department of Fisheries	Bud Ellis
1953	Portland, OR	Fish Commission of Oregon	Fred Cleaver
1954	Seattle, WA	U.S. Fish and Wildlife Service	Bob Rucker
1955	Portland, OR	Oregon Game Commission	John Rayner
1956	Seattle, WA	Washington Department of Game	Cliff Millenbach
1957	Portland, OR	U.S. Fish and Wildlife Service	Harlan Johnson
1958	Seattle, WA	Washington Department of Fisheries	Bud Ellis
1959	Portland, OR	Fish Commission of Oregon	Ernie Jeffries
1960	Olympia, WA	Washington Department of Game	John Johansen
1961	Portland, OR	Oregon Game Commission	Chris Jensen
1962	Longview, WA	U.S. Fish and Wildlife Service	Roger Burrows
1963	Olympia, WA	Washington Department of Fisheries	Bud Ellis
1964	Corvallis, OR	Oregon State University	John Fryer
1965	Portland, OR	U.S. Fish and Wildlife Service	John Halver
1966	Portland, OR	Fish Commission of Oregon	Wally Hublou
1967	Seattle, WA	University of Washington	Loren Donaldson
1968	Boise, ID	Idaho Department of Fish and Game	Paul Cuplin
1969	Olympia, WA	Washington Department of Game	John Johansen
1970	Portland, OR	Oregon Game Commission	Chris Jensen
1971	Portland, OR	U.S. Fish and Wildlife Service	Marv Smith
1972	Seattle, WA	Washington Department of Fisheries	Dick Noble
1973	Wemme, OR	Oregon Fish Commission	Ernie Jeffries
1974	Seattle, WA	University of Washington	Ernie Salo
1975	Otter Crest, OR	Oregon State University	Jack Donaldson
1976	Twin Falls, ID	University of Idaho	Bill Klontz
1977	Olympia, WA	Washington Department of Game	Jim Morrow
1978	Vancouver, WA	U.S. Fish and Wildlife Service	Dave Leith
1979	Portland, OR	Oregon Department of Fish and Wildlife	Ernie Jeffries
1980	Courtenay, B.C.	Fisheries & Oceans, Canada	Keith Sandercock
1981	Olympia, WA	Washington Department of Fisheries	Will Ashcraft
1982	Gleneden Beach, OR	National Marine Fisheries Service	Einar Wold

YEAR	LOCATION	HOST AGENCY	CHAIRMAN
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1985	Tacoma, WA	U.S. Fish and Wildlife Service	Ed Forner
1986	Eugene, OR	Oregon Department of Fish and Wildlife	Chris Christensen
1987	Tacoma, WA	Washington Department of Fisheries	Will Ashcraft
1988	Richmond, B.C.	B.C. Ministry of Environment	Don Peterson & Peter Brown
1989	Gleneden Beach, OR	National Marine Fisheries Service	RZ Smith
1990	Boise, ID	Idaho Department of Fish and Game	Bill Hutchinson
1991	Redding, CA	California Department of Fish and Game	Ken Hashagen
1992	Wenatchee, WA	Washington Department of Wildlife & Alaska Department of Fish and Game	John Kerwin & Irv Brock
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1994	Sunriver, OR	Oregon Department of Fish and Wildlife	Rich Berry
1995	Fife, WA	Washington Department of Fish and Wildlife	Larry Peck
1996	Victoria, B.C.	B.C. Ministry of Environment, Lands and Parks & DFO Canada	Don Peterson & Greg Bonnell
1997	Gleneden Beach, OR	National Marine Fisheries Service	RZ Smith
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2000	Sacramento, CA	California Department of Fish and Game	Judy Urrutia
2001	Portland, OR	Oregon Department of Fish and Wildlife	Trent Stickell & George Nandor
2002	Bellingham, WA	Washington Department of Fish and Wildlife	John Kerwin
2003	Portland, OR	NOAA Fisheries-NW Region & NW Fisheries Science Center	RZ Smith & Tom Flagg
2004	Victoria, B.C.	Freshwater Fisheries Society of BC & DFO Canada	Ray Billings & Roberta Cook
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2006	Portland, OR	U.S. Fish & Wildlife Service	Doug Olson Craig Martin & Amy Gaskill

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2010	Portland, OR	NOAA Fisheries Services Salmon Recovery Division & NW Fisheries Science Center	Rich Turner & Tom Flagg
2011	Victoria, B.C.	Freshwater Fisheries Society of BC & Department of Fisheries and Oceans Canada	Tim Yesaki & Adrian Clarke & Glen Graf
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