62ND ANNUAL NORTHWEST FISH CULTURE CONFERENCE 2011

December 6-8 2011 Victoria Conference Centre, Victoria, BC, Canada
As hosts of the 62nd Annual Northwest Fish Culture Conference, the Freshwater Fisheries Society of BC (FFSBC) and Fisheries and Oceans Canada (DFO) welcome you to Victoria, British Columbia, Canada.

This informal 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 used to renew old friendships, begin new ones, and develop personal contacts between those of common interest. All persons interested are invited to attend and to actively participate.
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### Northwest Fish Culture Conference 2011 Program Overview

**Tuesday, December 6, 2011**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00 am – 4:00 pm</td>
<td>Registration Opens</td>
</tr>
<tr>
<td>1:00 pm – 1:15 pm</td>
<td>Welcome Address – Tim Yesaki, <em>Freshwater Fisheries Society of BC</em></td>
</tr>
<tr>
<td>1:15 pm – 1:35 pm</td>
<td>Keynote Speaker – Don Peterson, <em>Freshwater Fisheries Society of BC</em></td>
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#### SESSION #1: Stocking, Recreational Fishery Development, and Marketing

**CHAIR:** Adrian Clarke, *Freshwater Fisheries Society of BC*

<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:35 pm – 1:55 pm</td>
<td>Adrian Clarke <em>Science Division, Freshwater Fisheries Society of BC</em></td>
</tr>
<tr>
<td></td>
<td>BC licence sales data: reeling in the numbers</td>
</tr>
<tr>
<td>1:55 pm – 2:15 pm</td>
<td>Daniel Spencer <em>U.S. Fish &amp; Wildlife Service, Washington Fish &amp; Wildlife Office</em></td>
</tr>
<tr>
<td></td>
<td>Quilcene National Fish Hatchery’s centennial celebration event</td>
</tr>
<tr>
<td>2:15 pm – 2:35 pm</td>
<td>Scott Silvestri <em>Ministry of Forests, Lands, and Natural Resource Operations</em></td>
</tr>
<tr>
<td></td>
<td>The use of catchable trout, lake infra-structure and innovative monitoring techniques to develop urban fisheries</td>
</tr>
<tr>
<td>2:35 pm – 2:55 pm</td>
<td>Joe Chapman <em>Idaho Department of Fish and Game</em></td>
</tr>
<tr>
<td></td>
<td>Closing the Loop</td>
</tr>
<tr>
<td>2:55 pm – 3:15 pm</td>
<td><strong>Afternoon Break - Sponsored by Bio-Oregon Inc</strong></td>
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#### SESSION #2: Alternative Species for Fish Culture

**CHAIR:** Ken Scheer, *Freshwater Fisheries Society of BC*

<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker</th>
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<tbody>
<tr>
<td>3:15 pm – 3:35 pm</td>
<td>Cory Williamson <em>Operations Division, Freshwater Fisheries Society of BC</em></td>
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<tr>
<td></td>
<td>Nechako River white sturgeon: conservation fish culture as a tool to rebuild a threatened population in BC</td>
</tr>
<tr>
<td>3:35 pm – 3:55 pm</td>
<td>Theresa Godin <em>Research, Evaluation &amp; Development Section, Freshwater Fisheries Society of BC</em></td>
</tr>
<tr>
<td></td>
<td>Development of all-female sterile kokanee for recreational fisheries</td>
</tr>
<tr>
<td>3:55 pm – 4:15 pm</td>
<td>Shannon Balfry <em>UBC Centre for Aquaculture and Environmental Research</em></td>
</tr>
<tr>
<td></td>
<td>Development of wolf eel aquaculture in BC</td>
</tr>
<tr>
<td>Time</td>
<td>Speaker</td>
</tr>
<tr>
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<td>----------------------------------------------</td>
</tr>
<tr>
<td>4:15 pm - 4:35 pm</td>
<td>Ken Cain</td>
</tr>
<tr>
<td>4:35 pm - 4:55 pm</td>
<td>Tristan Robbins</td>
</tr>
<tr>
<td>4:55 pm - 5:15 pm</td>
<td>Marcus Boucher</td>
</tr>
<tr>
<td>5:30 pm - 6:30 pm</td>
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<tr>
<td>7:00 pm</td>
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**Wednesday, December 7, 2011**

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<tr>
<th>Time</th>
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<tbody>
<tr>
<td>9:00 am - 4:00 pm</td>
<td>Registration Opens</td>
</tr>
<tr>
<td>8:30 am - 8:40 am</td>
<td>Announcements</td>
</tr>
<tr>
<td><strong>SESSION #3: Fish Health and Disease</strong>&lt;br&gt;<em>CHAIR: Sherry Mead, Freshwater Fisheries Society of BC</em></td>
<td><strong>---</strong></td>
</tr>
<tr>
<td>8:40 am - 9:00 am</td>
<td>Douglas Munson&lt;br&gt;<em>Eagle Fish Health Laboratory, Idaho Department of Fish and Game</em>&lt;br&gt;The effectiveness of Aquaflor in controlling <em>Renibacterium salmoninarum</em>, the causative agent of bacterial kidney disease</td>
</tr>
<tr>
<td>9:00 am - 9:20 am</td>
<td>Jerry Zinn/Ken Cain&lt;br&gt;<em>Aquatic Life Sciences, Department of Fish and Wildlife and Aquaculture Research Institute, University of Idaho</em>&lt;br&gt;A potential vaccine to control bacterial coldwater disease</td>
</tr>
<tr>
<td>9:20 am - 9:40 am</td>
<td>Ken Cain&lt;br&gt;<em>Aquatic Life Sciences, Department of Fish and Wildlife and Aquaculture Research Institute, University of Idaho</em>&lt;br&gt;Identification of specific autochthonous probiotics capable of enhancing resistance to bacterial coldwater disease</td>
</tr>
<tr>
<td>9:40 am - 10:00 am</td>
<td>Nate J. Wiese&lt;br&gt;<em>Dworshak National Fish Hatchery</em>&lt;br&gt;Beating IHN at Dworshak National Fish Hatchery</td>
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<tr>
<td>10:00 am - 10:20 am</td>
<td>Morning Break – Sponsored by Nelson &amp; Sons, Inc <strong>---</strong></td>
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<tr>
<td>Time</td>
<td>Presenter</td>
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<tr>
<td>10:40 am – 11:00 am</td>
<td>Niccole Wandelear</td>
</tr>
<tr>
<td>11:00 am – 11:20 am</td>
<td>Jim Bowker</td>
</tr>
<tr>
<td></td>
<td><strong>SESSION #4: Water Recirculation, Reuse and Energy Conservation</strong></td>
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<tr>
<td></td>
<td><strong>CHAIR: Ray Billings, Freshwater Fisheries Society of BC</strong></td>
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<tr>
<td>11:20 am – 11:40 am</td>
<td>Steve Sharon</td>
</tr>
<tr>
<td>11:40 am – 12:00 pm</td>
<td>Ray Billings</td>
</tr>
<tr>
<td>12:00 pm – 1:15 pm</td>
<td><strong>Lunch</strong></td>
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<tr>
<td>1:15 pm – 1:35 pm</td>
<td>Guy Campbell</td>
</tr>
<tr>
<td>1:35 pm – 1:55 pm</td>
<td>Christopher Tatara</td>
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<tr>
<td>1:55 pm – 2:15 pm</td>
<td>Mark Hassebrock</td>
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<tr>
<td></td>
<td><strong>SESSION #5: New Fish Culture Technologies</strong></td>
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<tr>
<td></td>
<td><strong>CHAIR: Don Mackinlay, Fisheries and Oceans Canada</strong></td>
</tr>
<tr>
<td>2:15 pm – 2:35 pm</td>
<td>Barry Berejikian</td>
</tr>
<tr>
<td>2:35 pm – 2:55 pm</td>
<td>Tim Yesaki</td>
</tr>
<tr>
<td>Time</td>
<td>Event</td>
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<tr>
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<tr>
<td>2:55 pm –</td>
<td><strong>Afternoon Break and special session by Dr. John Halver of the</strong></td>
</tr>
<tr>
<td>3:15 pm</td>
<td><strong>University of Washington - Sponsored by EWOS Canada Ltd</strong></td>
</tr>
<tr>
<td>3:15 pm –</td>
<td>Tim Hoffnagle</td>
</tr>
<tr>
<td>3:35 pm</td>
<td>Oregon Department of Fish and Wildlife</td>
</tr>
<tr>
<td>3:35 pm –</td>
<td>Grande Ronde spring chinook salmon captive broodstock program: F₁</td>
</tr>
<tr>
<td>3:55 pm</td>
<td>Steve Arnold</td>
</tr>
<tr>
<td>4:15 pm</td>
<td>Operations Division, Freshwater Fisheries Society of BC</td>
</tr>
<tr>
<td>4:15 pm –</td>
<td>Building a tanker truck to meet stocking program demands</td>
</tr>
<tr>
<td>4:35 pm</td>
<td>Tod Jones</td>
</tr>
<tr>
<td>5:15 pm</td>
<td>Redd Zone, LLC</td>
</tr>
<tr>
<td>5:45 pm</td>
<td>Mathew Hall</td>
</tr>
<tr>
<td>8:30 am –</td>
<td><strong>Poster Session, Tradeshow and Evening Social - Sponsored by PR Aqua</strong></td>
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<tr>
<td>8:40 am</td>
<td>Supplies Ltd., AKVA Group and Western Chemical Inc./Syndel</td>
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**Thursday, December 8, 2011**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>8:30 am –</td>
<td>Announcements</td>
</tr>
<tr>
<td>8:40 am –</td>
<td><strong>SESSION #6: Optimizing Stocking Programs</strong></td>
</tr>
<tr>
<td>9:00 am</td>
<td>CHAIR: Sara Northrup, Freshwater Fisheries Society of BC</td>
</tr>
<tr>
<td>9:00 am –</td>
<td>Sara Northrup</td>
</tr>
<tr>
<td>9:15 am</td>
<td>Research, Evaluation &amp; Development Section, Freshwater Fisheries</td>
</tr>
<tr>
<td>9:15 am</td>
<td>Society of BC</td>
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<tr>
<td>9:15 am –</td>
<td>Does size really matter? The optimum release size of rainbow trout</td>
</tr>
<tr>
<td>9:35 am</td>
<td>fry for small BC lakes</td>
</tr>
<tr>
<td>9:35 am –</td>
<td>Debra Eddy</td>
</tr>
<tr>
<td>9:55 pm</td>
<td>Oregon Department of Fish and Wildlife</td>
</tr>
<tr>
<td>9:55 pm –</td>
<td>Comparing natural and hatchery Imnaha River chinook salmon after 20+</td>
</tr>
<tr>
<td>10:15 pm</td>
<td>years of supplementation: twin sons of different mothers?</td>
</tr>
<tr>
<td>10:15 pm</td>
<td>Carlin McAuley</td>
</tr>
<tr>
<td>10:15 pm</td>
<td>NOAA Fisheries, Manchester Research Station</td>
</tr>
<tr>
<td>10:15 pm</td>
<td>Captive broodstock program for endangered Nooksack River spring</td>
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<tr>
<td>10:15 pm</td>
<td>chinook</td>
</tr>
<tr>
<td>Time</td>
<td>Speaker</td>
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<tr>
<td>9:35 am – 9:55 am</td>
<td>Maureen Kavanagh</td>
</tr>
<tr>
<td>9:55 am – 10:15 am</td>
<td><strong>Morning Break - Sponsored by Rangen Inc.</strong></td>
</tr>
<tr>
<td><strong>SESSION #7: Investigating Triploid Salmonids</strong></td>
<td><strong>CHAIR: Theresa Godin, Freshwater Fisheries Society of BC</strong></td>
</tr>
<tr>
<td>10:15 am – 10:35 am</td>
<td>Derek Ingram</td>
</tr>
<tr>
<td>10:35 am – 10:55 am</td>
<td>Christine Verhille</td>
</tr>
<tr>
<td>10:55 am – 11:15 am</td>
<td>Luke Allen</td>
</tr>
<tr>
<td>11:15 am – 11:35 am</td>
<td>Mark Scott</td>
</tr>
<tr>
<td>11:35 am – 12:00 am</td>
<td><strong>Final Raffle Draws, 2012 NWFCC Announcement and Closing Remarks</strong></td>
</tr>
</tbody>
</table>
Map of conference centre floor plan and location

720 Douglas Street (Trans-Canada Highway)
Thank-you to our NWFCC 2011 Exhibitors!

<table>
<thead>
<tr>
<th>Exhibitors</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>AKVA Group North America</td>
<td>Keith Richford, 1495 Baikie Road, PO Box 397, Campbell River, British Columbia, Canada V9W 5B6. Phone: (250)286-8802. Fax: (250)286-8805. Email: <a href="mailto:krichford@akvagroup.com">krichford@akvagroup.com</a>. Website: <a href="http://www.akvagroup.com">www.akvagroup.com</a></td>
</tr>
<tr>
<td>Canada Cryogenetics Services</td>
<td>Maureen Ritter, PO Box 13, Black Creek, British Columbia, Canada V9J 1K8. Phone (250)203-0333. Email: <a href="mailto:maureen.ritter@cryogenetics.ca">maureen.ritter@cryogenetics.ca</a>. Website: <a href="http://www.cryogenetics.no">www.cryogenetics.no</a></td>
</tr>
<tr>
<td>Christensen Networks</td>
<td>Joe Franson, 401 Lincoln Street, Everson, Washington 98247. Phone: (800)459-2147. Fax: (800)330-7980. E-mail: <a href="mailto:joe@cnwnetting.com">joe@cnwnetting.com</a>. Website: <a href="http://www.cnwnetting.com">www.cnwnetting.com</a></td>
</tr>
<tr>
<td>Dynamic Aqua-Supply Ltd.</td>
<td>Dean Tremblay, #112-8299 129th Street, Surrey, British Columbia, Canada V3W 0A6. Phone: (604)543-7504. Fax: (604)543-7604. Email: <a href="mailto:dean@dynamicaqua.com">dean@dynamicaqua.com</a>. Website: <a href="http://www.dynamicaqua.com">www.dynamicaqua.com</a></td>
</tr>
<tr>
<td>Emperor Aquatics Inc.</td>
<td>Scott Paparella, 2229 Sanatoga Station Road, Pottstown, Pennsylvania 19464. Phone: (610)970-0440. Ext 20. Fax: (610)970-0443. Email: <a href="mailto:scott@emperoraquatics.com">scott@emperoraquatics.com</a>. Website: <a href="http://www.emperoraquatics.com">www.emperoraquatics.com</a></td>
</tr>
<tr>
<td>EWOS Canada Ltd.</td>
<td>7721 132nd Street, Surrey, British Columbia, Canada V3W 4M8. Phone: (800)663-0476. Fax: (800)287-4422. Email: <a href="mailto:canada@ewos.com">canada@ewos.com</a>. Website: <a href="http://www.ewos.com">www.ewos.com</a></td>
</tr>
<tr>
<td>Hatchery International</td>
<td>Jeremy Thain, Hatchery International, 4623 William Head Rd, Victoria, British Columbia, Canada V9C 3Y7. Phone: (250)474-3982. Fax: (250)478-3979. Email: <a href="mailto:jeremy@capamara.com">jeremy@capamara.com</a>. Website: <a href="http://www.hatcheryinternational.com">www.hatcheryinternational.com</a></td>
</tr>
<tr>
<td>Hoskin Scientific Inc.</td>
<td>Grant Barr, 3735 Myrtle Street, Burnaby, British Columbia, Canada V5C 4E7. Phone: (604)296-5465. Fax: (604)872-0281. Email: <a href="mailto:gbarr@hoskin.ca">gbarr@hoskin.ca</a>. Website: <a href="http://www.hoskin.ca">www.hoskin.ca</a></td>
</tr>
<tr>
<td>Hydrolox</td>
<td>Eric Doern, Account Manager, 301 Plantation Road, Harahan, Louisiana 70123. Phone: (866)586-2825. Fax: (504)734-0063. Email: <a href="mailto:info@hydrolox.com">info@hydrolox.com</a>. Website: <a href="http://www.hydrolox.com">www.hydrolox.com</a></td>
</tr>
<tr>
<td>Jensorter LLC</td>
<td>Kurt Stelk, PO Box 217, Bend, Oregon, 97709. Phone: (541)389-3591. Fax: (541)389-0050. Email: <a href="mailto:kurt@jensorter.com">kurt@jensorter.com</a>. Website: <a href="http://www.jensorter.com">www.jensorter.com</a></td>
</tr>
<tr>
<td>Exhibitors continued</td>
<td>Contact Information</td>
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<tr>
<td><strong>Magic Valley Heli-Arc</strong></td>
<td>Linda Owens, 198 Freightway Street, PO Box 511, Twin Falls, Idaho 83303. Phone: (208)733-0503 Fax: (208)733-0544 Email: <a href="mailto:linda@aqualifeproducts.com">linda@aqualifeproducts.com</a> Website: <a href="http://www.aqualifeproducts.com">www.aqualifeproducts.com</a></td>
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<tr>
<td><strong>Marisource</strong></td>
<td>David Heutmaker, 7009 45th Street, Ct. East Fife, Washington 98424 Phone: (877)735-8910 ext 106 Fax: (253)922-0226 E-mail: <a href="mailto:davidh@marisource.com">davidh@marisource.com</a> Website: <a href="http://www.marisource.com">www.marisource.com</a></td>
</tr>
<tr>
<td><strong>Nelson &amp; Sons Inc.</strong></td>
<td>Chad Vanderlinden, 712 East 2400 North Tooele, Utah 84074 Phone: (800)521-9092 / (435)277-2100 Fax: (435)277-2101 E-mail: <a href="mailto:chad.vanderlinden@silvercup.com">chad.vanderlinden@silvercup.com</a> Website: <a href="http://www.silvercup.com">www.silvercup.com</a></td>
</tr>
<tr>
<td><strong>Norcan Electrical Systems Inc.</strong></td>
<td>Roy Hines, Feeding Systems Canada, 6296 Cherry Creek Road, Port Alberni, British Columbia, Canada V9Y 8S9. Phone: (250)723-7523 Fax: (250)723-7531 Email: <a href="mailto:roy@feeding-systems.ca">roy@feeding-systems.ca</a> Website: <a href="http://www.feeding-systems.ca">www.feeding-systems.ca</a></td>
</tr>
<tr>
<td><strong>Octaform</strong></td>
<td>Steve Bradbury (Territory Mng), Ian Scott (Business Development Mng), 520 - 885 Dunsmuir St. Vancouver, British Columbia, Canada V6C 1N5 Phone: (604)408-0558 / (888)786-0595 Email: <a href="mailto:info@octaform.com">info@octaform.com</a> Website: <a href="http://www.octaform.com">www.octaform.com</a></td>
</tr>
<tr>
<td><strong>PCI Gases</strong></td>
<td>Tom Elzey, 12201 Magnolia Avenue, Riverside, California 92503 Phone: (951)847-6169 (cell) Email: <a href="mailto:telzey@pcigases.com">telzey@pcigases.com</a> Website: <a href="http://www.pcigases.com">www.pcigases.com</a></td>
</tr>
<tr>
<td><strong>Pfizer Animal Health</strong></td>
<td>Elizabeth M. Crump, Aquaculture Biologics Research Pfizer Animal Health, 6761 Kirkpatrick Crescent, Saanichton, British Columbia, Canada V8M 1Z8. Phone: (250)652-4482 ext 222 Email: <a href="mailto:elizabeth.crump@pfizer.com">elizabeth.crump@pfizer.com</a> Website: <a href="http://www.pfizer.ca">www.pfizer.ca</a></td>
</tr>
<tr>
<td><strong>Point Four Systems</strong></td>
<td>Brian Hirsch, #103 - 16 Fawcett Road, Coquitlam, British Columbia, Canada V3K 6X9. Phone: (604)759-2114 Fax: (604)759-2115 Email: <a href="mailto:bhirsch@pointfour.com">bhirsch@pointfour.com</a> Website: <a href="http://www.pointfour.com">www.pointfour.com</a></td>
</tr>
<tr>
<td><strong>PR Aqua Supplies Ltd.</strong></td>
<td>Teresa Hanson, 1631 Harold Road, Nanaimo, British Columbia, Canada V9X 1T4. Phone: (250)714-0141 Fax: (250)714-0171 Email: <a href="mailto:info@praqua.com">info@praqua.com</a> Website: <a href="http://www.praqua.com">www.praqua.com</a></td>
</tr>
<tr>
<td><strong>Raincountry Refrigeration Inc.</strong></td>
<td>Mark Vondrachek, 1610 6th Street, Bellingham, Washington 98225 Phone: (360)671-9165 Fax: (360)676-8674 Email: <a href="mailto:raincountryrefrigeration@comcast.net">raincountryrefrigeration@comcast.net</a> Website: <a href="http://www.raincountryrefrigeration.com">www.raincountryrefrigeration.com</a></td>
</tr>
<tr>
<td><strong>Rangen Inc.</strong></td>
<td>Leon Klimes, 115 13th Avenue, PO Box 706, Buhl, Idaho 83316. Phone: (208)308-7406 Fax: (208)543-6090 Email: <a href="mailto:lklimes@rangen.com">lklimes@rangen.com</a> Website: <a href="http://www.rangen.com">www.rangen.com</a></td>
</tr>
<tr>
<td>Exhibitors continued</td>
<td>Contact Information</td>
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<tr>
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</tr>
<tr>
<td>RK2 Systems</td>
<td>Chris Krechter, 421 S Andreasen Drive # A, Escondido, California 92029-1955. Phone: (760)746-7400 Email: <a href="mailto:sales@rk2.com">sales@rk2.com</a> Website: <a href="http://www.rk2.com">www.rk2.com</a></td>
</tr>
<tr>
<td>VWR International Co.</td>
<td>Darlene Krueger, 2103 64th Avenue, Edmonton, Alberta T6P 1Z4 Phone: (778)238-2407 / (800)932-5000 Email: <a href="mailto:Darlene_Krueger@VWR.com">Darlene_Krueger@VWR.com</a></td>
</tr>
<tr>
<td>Water Management Technologies</td>
<td>Terry McCarthy, PO Box 66125, Baton Rouge, Louisiana 70896 Phone: (255)755-0026 Fax: (255)755-0995 Email: <a href="mailto:terry.mccarthy@w-m-t.com">terry.mccarthy@w-m-t.com</a> Website: <a href="http://www.w-m-t.com">www.w-m-t.com</a></td>
</tr>
<tr>
<td>Western Chemical Inc./Syndel</td>
<td>Jason Montgomery, 1269 Lattimore Road, Ferndale, Washington 98248 Phone: (360)384-5898 Fax: (360)384-0270 Email: <a href="mailto:info@wchemical.com">info@wchemical.com</a> Website: <a href="http://www.wchemical.com">www.wchemical.com</a></td>
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## Northwest Fish Culture Conference Hall of Fame

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<td>Roger Burrows</td>
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Recreational fishing generates significant social, environmental and economic benefits for the province of British Columbia. Anglers spend over $1 billion annually split more or less equally between salt water and freshwater fishing. Anglers spend their money on accommodation, transportation, supplies, fuel, guides and other goods and services that support thousands of small businesses and about 7,000+ jobs, mostly in rural areas.

BC resident participation in freshwater sport fishing has declined by approximately 30% over the past decade; but we have seen an increase in activity in the past two years. Participation by non-residents has remained relatively constant over time. Approximately 250,000 resident licenses, 70,000 non-resident licenses, plus classified waters permits and conservation stamps are sold each year. Total revenue from these 480,000 sales transactions is approximately $13 million which goes to the provincial government, Freshwater Fisheries Society of BC (FFSBC), and Habitat Conservation Trust Fund.

British Columbia recently moved to electronic licensing which gives us the ability to analyze purchasing trends and behaviors both spatially and temporally across the Province. In addition, electronic licenses minimize one of the barriers to fishing; anglers told the Provincial government that offering licenses for sale over the internet would make it easier for them to go fishing. Electronic licenses were first available as an initial “soft” launch starting in September 2007 to prepare for the next season start in April 2008. By 2010, the majority of freshwater fishing licence sales were electronic.

The e-Licensing system has many benefits: anglers have greater choice about how, where and when they buy their fishing licenses and the provincial Ministry of...
Forests, Lands and Natural Resource Operations and the FFSBC have access to better data about angler activity. This allows us to tailor our fish management plan and stocking programs to better match angler demand. The data will also be used to focus the FFSBC’s outreach and marketing programs. Our analysis of the past two complete years of data reveals exciting trends in angling in regards to demographics, seasonal behaviors, comparisons to other jurisdictions, and recruitment of new and lapsed anglers.
Quilcene National Fish Hatchery's centennial celebration event: planning, implementation and afterthoughts

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Education and outreach are essential components of conservation work. These efforts promote the understanding of and experiences with the outdoors and natural resources, fostering a public that is both informed and concerned. There are a great number of strategies that can be applied to this objective, including outreach events at hatchery facilities. With the centennial approaching, the Quilcene National Fish Hatchery recognized the opportunity to showcase their many and sustained contributions to conservation while promoting future advocates through an ambitious outreach event.

The Quilcene National Fish Hatchery invested one year of planning in order to prepare for an event of this scale. From consulting with other event organizers to developing unique activities and partnerships, this outreach endeavor was both a success and a learning experience. This centennial celebration was held on Saturday, August 20th from 10:00 am to 4:00 pm with 518 documented visitors thanks to the dedicated work of the hatchery staff, 34 partner organizations and 60 volunteers.

This presentation will focus upon what is essential to developing a successful large-scale public outreach event. Topics to be covered include; selection of the best time(s) to host the event, funding, permit requirements, advertising and promotion (including social media), logistical planning, essential facilities and equipment, staffing needs, soliciting volunteers, coordination with partner organizations, tips on displays and exhibits as well as suggestions for children’s activities. This will be a worthwhile presentation for those who are new to hatchery event planning as well as those looking for new ideas.
The use of catchable trout, lake infra-structure and innovative monitoring techniques to develop urban fisheries

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In the Province of British Columbia long-term trend data, as measured by freshwater and tidal licence sales, indicates a steady decline in resident angler participation over the past 10-15 years. On Vancouver Island, similar declines have been observed, partly due to reduced public access to lakes on privately managed forest land. In an effort to increase angling effort in Region 1, the Provincial Fisheries Branch developed the Vancouver Island Urban Small Lake Fishery Development/Improvement Program aimed at identifying areas on southern and east coast Vancouver Island where there is potential to create or enhance fishing opportunities on small lakes and/or ponds near urban centers. Regional Ministry of Forests, Lands, and Natural Resource Operations staff, working in consultation with local governments, community stewardship groups, fish and game clubs and private companies are identifying sites where access or amenities (i.e. boat launches, public fishing piers, fishing wharves, picnic facilities, etc) at existing urban lakes can be improved to encourage angler participation. Between 2009 and 2011, a total of 76 lakes were investigated with respect to historic angling effort, access and facilities. Potential for land securement at urban lakes with significant fisheries values are also being identified.

In an attempt to improve the fisheries on a number of urban lakes on Vancouver Island, catchable fish have been stocked and/or access was improved. Changes to fishing effort at these sites are being monitored using effort cameras and creel surveys to assess whether or not these types of improvements can help reverse the downward trend in fishing license sales.
Closing the loop

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The Idaho Department of Fish and Game sponsors or co-sponsors Trout in the Classroom (TIC) programs in 109 schools across the state. This state wide program reached 13,190 students last year. In the Magic Valley Region, about 19 schools and 1,380 students participate. The Hagerman State Fish Hatchery has been responsible for the TIC program at four schools and about 100 students each year for the past eleven years. In addition, other TIC programs from the region come to the hatchery for spring tours and fishing. Last year, all of the 1,380 students toured the hatchery and went fishing. Most of the TIC programs in Idaho involve taking the eggs to the classroom and giving a presentation about stewardship, caring for the eggs, and the life cycle of the fish, followed by a dissection class, then possibly a trip to a hatchery and/or fishing. Many students take their catch home, hoping someone in the family knows what to do with it, but possibly often times the student’s catch is discarded. Hagerman State Hatchery employees have addressed this problem the past two years. In addition to the three-phase program taught in prior years, all students were shown how to clean their catch, prepare and cook it, then given a taste of the finished product, thus educating young anglers about fish preparation and “closing the loop” on the TIC program.
Session #2: Alternative Species for Fish Culture

Nechako River white sturgeon: conservation fish culture as a tool to rebuild a threatened population aquaculture in BC

Cory Williamson, Operations Division, Freshwater Fisheries Society of BC, c/o Ministry of Forests Lands and Natural Resources Operations, Prince George BC. Tel: 250-614-9924. Email: cory.williamson@gov.bc.ca

The Nechako White sturgeon population has not reproduced successful in more than 40 years and is in serious decline due to ongoing reproductive (recruitment) failure. In 2006, Nechako white sturgeon were federally listed as “endangered” under the Species at Risk Act along with four other population in British Columbia. Since this time, the Nechako White Sturgeon Recovery Initiative has been working with it partners to avoid the loss of these fish.

To prevent the extirpation of these wild fish, conservation aquaculture has been proposed as, as a stop-gap to restore the population while the cause of recruitment failure is researched and habitat for spawning, incubation and early larval rearing is restored. In this case, the goal of conservation aquaculture is to transfer as much of the genetic variation remaining in this small population as possible to a new and demographically healthy founder population.

Following a detailed breeding plan developed through the experiences of other sturgeon recovery programs, a proposed Nechako Recovery facility will be built with the use energy efficient systems including the use of modern recirculation technologies. Unusual requirements, such as the use of river water for imprinting, substrate rearing of larvae for optimal growth and development, all set in cold climate will require an innovative design and approaches for this new facility.
Development of all-female sterile kokanee for recreational fisheries in British Columbia

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The province of BC is trying to reverse the downward trend in fishing license sales that has been occurring over the last fifteen years. Kokanee salmon are thought to be a good species to provide an alternative to brook trout and rainbow trout at times when families take more time for recreational activities. In an attempt to provide kokanee salmon fisheries while minimizing some of the potential impacts (high precocious male maturation rates, stunting in systems with spawning habitat and introgression into the wild), Freshwater Fisheries Society of BC (FFSBC) has been developing sterile (3n) and all-female sterile (AF3n) kokanee stocks.

For the past nine years, FFSBC has been producing sterile kokanee for stocking into a limited number of lakes for assessment purposes and to provide new fisheries. Performance data collected to age 5+ indicates that growth and survival of sterile kokanee is comparable to that of their reproductive counterparts unless lake environments are harsh. Further, the use of sterile kokanee increases the proportion of immature older age class fish in the population, potentially improving fishing quality: over 80% of fish older than age 3 that are available to anglers were sterile females. Sterile males still develop secondary sex characteristics and exhibit false spawning behavior by age 2. For that reason, the use of mono-sex female sterile kokanee (AF3n) could improve the fishery, reduce maturation mortality and further reduce the risk of stunting and introgression.

Progress has been made in the development of an all-female kokanee stock. 100% XX male kokanee brood is now being developed by immersion of eggs/alevins in baths containing a very low concentration of α-methyltestosterone. These XX males will be grown to maturity and crossed with females from Meadow Creek to produce all-female kokanee families. These eggs are then pressure shocked soon after fertilization to sterilize them.

Data showing potential effort response to new kokanee fisheries will also be presented. Preliminary effort investigations have demonstrated an unprecedented response to kokanee salmon by anglers in British Columbia. The kokanee salmon fishery appears to be providing both winter (ice) and summer fishing opportunities that are mainly harvest-oriented. Overall, sterile kokanee are an exciting new product that will help to reduce the downturn in license sales while limiting any negative impacts on wild stocks of fish in British Columbia.
Development of wolf eel aquaculture in BC

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Jeff Marliave, Vancouver Aquarium Marine Science Centre, Vancouver, BC

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Rob Saunders Island Scallops Ltd., Qualicum Beach, BC

Captive adult wolf eel (Anarrhichthys ocellatus) breeding pairs at the Vancouver Aquarium and the Centre for Aquaculture and Environmental Research have been successfully bred the last two years, using hormone implants. Approximately one to two weeks post-implantation, the wolf eels produced large cohesive egg masses. The egg masses were subsequently placed into venturi-style incubators for approximately two months, when the eggs began hatching. Egg development was monitored throughout the incubation period by removing samples from the egg mass on a weekly basis. Newly hatched wolf eel larvae were immediately fed an artificial marine fish diet and grown out to juveniles. Juvenile fish were used for two studies to determine optimal rearing density and diet. The first study compared growth rate and feed conversion for juveniles fed four different commercial diets. The second study examined growth and health of juvenile wolf eels reared at three different densities. As will be discussed, the results of these studies indicate that wolf eels exhibit excellent growth on commercial diets and can be reared at high densities without any adverse effects on growth and survival.

In summary, our research on wolf eels demonstrates that these fish possess the biological features that make them an ideal candidate for aquaculture. Specifically, they have high growth rates and feed conversion ratios, are tolerant of variations in water quality (i.e., low dissolved oxygen, salinity), they can be grown at very high densities, they readily accept artificial commercial diets, have high survival rates and appear to be relatively disease resistant. The next phase of our research will include culinary and market testing of wolf eels.
Conservation aquaculture development as a critical tool for recovery of burbot (*Lota lota maculosa*) in the Kootenai River

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Burbot are native to the Kootenai River of northern Idaho and British Columbia. Following a multitude of anthropogenic changes to the Kootenai system, current burbot populations in this system are considered functionally extirpated. The Kootenai Tribe of Idaho (KTOI) has developed a burbot conservation strategy aimed at recovery or re-establishment of this species and conservation aquaculture is considered a key critical component for this strategy to be successful. The challenge to this approach was that very little information on burbot culture was initially available and the life history pattern of this species presented many significant challenges to developing reliable aquaculture methods. However, through collaborative efforts between the KTOI, British Columbia Ministry of Environment, Idaho Department of Fish and Game, the US Fish and Wildlife Service, and the University of Idaho’s Aquaculture Research Institute (UI-ARI), we have established burbot aquaculture as a feasible approach to recovery. This program was initiative in 2003 with the capture and transport of adult broodstock from British Columbia to the UI-ARI. A series of empirical life-stage specific studies were undertaken and examined spawning, semen cryopreservation, egg incubation, larval and juvenile feeding, disease susceptibility, etc. Reliable culture techniques were established in 2006 and the life cycle of burbot under controlled conditions was closed in 2008 when F1 progeny from 2004 brood year successfully spawned in captivity, eggs were fertilized and F2 progeny began feeding on artificial diets. With culture techniques, disease susceptibility and pathogen screening tools developed, preparations were initiated by the Kootenai Valley Resource Initiative (KVRI) Burbot Conservation Subcommittee to begin experimental releases of cultured burbot in 2009. The success of this project’s initial developments has subsequently enabled F1 progeny from wild broodstock to be cultured and released experimentally into Canadian and US waters for the past 3 years to support conservation efforts.
Moberly Lake lake trout – A lake trout recovery program

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Moberly Lake is a large, deep lake located between the communities of Chetwynd and Hudson’s Hope in Peace Region of BC. Historically, lake trout in Moberly Lake have formed an important fishery for both First Nations and recreational anglers. However, catch rates of lake trout in Moberly Lake have declined significantly over the past 20-30 years. The collapse of the lake trout population in Moberly Lake has resulted in recruitment failure and a risk of population extirpation in less than 10 years. The recruitment failure is likely a result of depensatory interactions with other species following the shift in species community balance which has resulted from the over-harvesting of lake trout. The Freshwater Fisheries Society of BC (FFSBC) and the Ministry of Forests, Lands, and Natural Resource Operations formed a partnership in 2010 in hopes of rebuilding this vital fish stock. Eggs were collected from wild Moberly Lake lake trout in the fall of 2010, and will again be collected in the fall of 2012 and 2014. The resulting progeny are being reared by the Freshwater Fisheries Society of BC and will be stocked as yearlings in the spring of 2012, 2014, and 2016, respectively. This effort is intended to directly address the population bottleneck by re-establishing the species community balance and therefore natural recruitment of lake trout.
Rearing substrate improves larval white sturgeon growth, survival, and physiology

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Colin J Brauner, Department of Zoology, University of British Columbia

J Mark Shrimpton, Ecosystem Science and Management Program, University of Northern British Columbia

Larval white sturgeon (Acipenser transmontanus) were reared in the presence or absence of gravel substrate at either 13.5 or 17.5 ºC from 1 to 46 days post hatch (dph). At any given dph or thermal sum, larvae reared in gravel were significantly larger and survival was higher than those reared without substrate at both temperatures. Overall survival was lower at high temperature. Yolk utilization rate was greatest at 17.5 ºC and did not differ between rearing environments. Yolk utilization efficiency was significantly greater for larvae reared in gravel, and did not differ between temperatures. These results indicate that larval white sturgeon develop at a maximal rate, and growth is determined by allocation of yolk resources. In a second experiment, larvae were reared in the presence or absence of gravel substrate at 13.5 ºC and respirometry used to measure oxygen consumption. Larvae reared in gravel had significantly greater aerobic scope, and whole body glycogen was significantly greater in larvae reared in gravel at 8 dph, indicating that these larvae may have greater capacity available for growth and development during organogenesis. These findings suggest that larvae reared without substrate may divert more of their energy to non-growth related processes, such as exercise, which was observed but not quantified. Thus, larvae reared without substrate may be at a significant physiological disadvantage, leaving less energy for growth and development. These results underscore the importance of adequate rearing substrate, and may provide support for habitat restoration and alternative hatchery rearing methods.
Session #3: Fish Health and Disease

The effectiveness of aquaflor in controlling *renibacterium Salmoninarum*, the causative agent of bacterial kidney disease

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Two pivotal studies were conducted by the Eagle Fish Health Laboratory in 2010 to give insight on the effectiveness of Aquaflor medicated feed to control mortality caused by *Renibacterium salmoninarum*, the causative agent of BKD. Eggs from ELISA high optical density females were not culled and water hardened without iodophor. Once fry were feeding on a commercial diet, they were transported to the Eagle Fish Health Laboratory in Eagle, Idaho. These fish were held and fed a commercial diet until signs of BKD were noticed in moribund fish.

These fish were then seeded into experimental tanks and acclimated. Four tanks were fed Aquaflor medicated feed at 15 mg/kg for 10 days and four tanks were fed a commercial diet for a control. These groups were observed for 14 days post treatment. Statistical analysis demonstrated a significant decrease in mortality in the Aquaflor treated tanks.

A second pivotal study was also completed in 2010 at the Eagle Fish Health Laboratory comparing the efficacy of erythromycin medicated feed, Aquaflor medicated, and a non-medicated diet to control mortality in clinical infections of BKD. The eggs were collected from high risk females and water hardened without iodophor. Once fry were feeding on a commercial diet, they were transported to the Eagle Fish Health Laboratory in Eagle, Idaho. These fish were held and fed a commercial diet until signs of BKD were noticed in moribund fish.

These fish were then seeded into experimental tanks. The fish in three tanks were fed erythromycin medicated feed at 100 mg/kg for 28 days, the fish in three tanks were fed Aquaflor medicated feed at 15 mg/kg for 10 days, and the fish in the last three tanks received a control non-medicated diet. These fish were observed for 14 days post the last application of medicated feed. Statistical analysis demonstrated a significant decrease in mortality in the Aquaflor treated tanks and erythromycin treated tanks.
A potential vaccine to control bacterial coldwater disease

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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*. It can cause significant mortality in hatchery-reared Salmonids with estimates of $7-10$ million per year in the US trout industry alone. The University of Idaho has developed a live attenuated strain of *F. psychrophilum* and carried out successful laboratory vaccination and challenge studies that demonstrated efficacy. The attenuated vaccine strain (259-93B.17) was generated by passage on TYES plates containing increasing concentrations of the antibiotic rifampicin. It was demonstrated that the 259-93B.17 strain was completely attenuated and immunization of rainbow trout by intraperitoneal injection resulted in significant protection against challenge with the virulent parent *F. psychrophilum* strain at 8 and 15 weeks post-immunization. Fish exhibited elevated antibody titers and more importantly, immersion delivery of the 259-93B.17 strain stimulated protective immune responses in fish at 10 weeks post-immunization. It was unknown whether protection would be afforded against wild strains in a production environment; however, the vaccine was recently field tested and initial results have proven it to be safe and demonstrated protection following a natural CWD outbreak. Such trials must be repeated prior to licensing and commercialization, but it appears that this attenuated *F. psychrophilum* strain may serve as an easily delivered effective vaccine against CWD and RTFS.
Assessing probiotic use for the control of *Flavobacterium psychrophilum* in rainbow trout (*Oncorhynchus mykiss*)

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Probiotics have the potential to provide an alternative to antibiotic therapy for the control or prevention of bacterial infections. *Flavobacterium psychrophilum* is the causative agent of coldwater disease (CWD) and rainbow trout fry syndrome (RTFS) and impacts salmonid aquaculture worldwide. Currently no commercial vaccine is available for *F. psychrophilum*; however, new antibiotic treatments (Florfenicol) have been approved in some countries. This is promising, but there is continual concern when increasing reliance on antibiotics due to the development of potential long-term bacterial resistance. Our lab has tested eight candidate probiotic bacteria, previously isolated from the gastrointestinal tracts of rainbow trout for their ability to reduce mortality due to *F. psychrophilum* infection. These candidate probiotics were found to be non-pathogenic to rainbow trout, survive in the gastrointestinal tract and inhibit growth of *F. psychrophilum* in vitro. Candidate probiotics were grown, mixed into fish oil, and topcoated onto a commercial trout diet prior to feeding fish. Control and treatment groups were challenged with *F. psychrophilum* and mortality was monitored for 28 days. Two of these candidate probiotics (C6-6 and C6-8), both Enterobacter species, were shown to significantly reduce mortality (*p*<0.05) due to *F. psychrophilum* infection. Following on from experimental laboratory trials, field trials at aquaculture facilities have consistently resulted in reduced mortalities in treatment groups fed C6-6. Through safety and efficacy trials, including alterations in treatment duration and initiation, it is possible that application of these probiotics will provide an alternative strategy for the management of *F. psychrophilum* infections in aquaculture facilities affected by CWD. Additionally, the approach for selecting and screening probiotics has potential application for other problematic bacterial fish diseases.
Beating Infectious Hematopoietic Necrosis (IHN) at Dworshak National Fish Hatchery

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Nestled snugly below Dworshak Dam, the Dworshak National Fish Hatchery (Hatchery) is one of the largest conservation hatcheries in the Pacific Northwest. Annual production goals include 2.1 million steelhead, 1.4 million spring Chinook salmon, and 300,000 Coho salmon smolts. Throughout its 40 year history, the Hatchery has battled numerous Infectious Hematopoietic Necrosis (IHN) outbreaks. Many of these outbreaks have been attributed to a contaminated river water supply and a complex recirculating system. The Hatchery had particularly virulent IHN outbreaks in Brood Year 2009 steelhead that resulted in mortality rates of nearly 50%. Brood Year 2009 forced the Hatchery to take a hard look at all fish culture practices. The Hatchery staff met with partners and co-managers to come up with a plan for the future. This group, along with a new staff engineer, came up with creative solutions to reduce IHN outbreaks. As a result, Brood Year 2010 steelhead survival rates increased to 90% and the Hatchery experienced limited IHN outbreaks.

The Hatchery employed several techno and fish culture solutions to address IHN outbreaks including:

1. Adopting strict biosecurity measures in all aspects of culture
2. Securing a clean water source from Clearwater Fish Hatchery via a hot-tap, “open heart” surgery of the Hatchery water supply
3. Abandoning the recirculation system in favor of high volume/flow-through operation
4. Employing fish counting and pumping technology to reduce stress during fish movement on the facility
5. Experimenting with new rearing containers (mixed cells) to improve culture conditions

The Hatchery is currently working on plans to retrofit the aging rearing configurations into 30 foot fiberglass circular tanks. The 30 foot circular tanks will reduce water consumption so clean water supplies from the Clearwater Fish Hatchery can be utilized. This project, along with close coordination with co-managers and partners will ensure that Dworshak National Fish Hatchery will be a leader in conservation hatchery work into the future.
The effectiveness of AQUI-S®20E (10% Eugenol) and BENZOAK® (20% Benzocaine) as potential immediate-release fisheries sedatives

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The process to gain U.S. Food and Drug Administration (FDA) approval of drugs for use in aquaculture and fisheries is an arduous process that requires vast amounts of data to describe a drug’s effectiveness and prove it is safe to the environment, to human consumers, and to the animal in which its use is intended. Many involved in fish culture and fishery management are aware of and have strongly supported the development of new drugs for use in fish and the expanded availability of approved drugs.

In this presentation, the progress of effectiveness research on two immediate-release sedatives, AQUI-S®20E (10% eugenol) and BENZOAK® (20% benzocaine), will be summarized. Both products appear to be effective in sedating fish to a handleable stage in less than 2 minutes. Effectiveness studies have been completed on a variety of salmonid, coolwater fish and warmwater fish species.
Use of SLICE (0.2% emamectin benzoate) to reduce infestations of *Salmincola californiensis* in rainbow trout *Oncorhynchus mykiss*

Dan Carty, Niccole Wandelear*, Jim Bowker, Scott LaPatra, Jim Schaffer, and Wesley Swee
U. S. Fish and Wildlife Service, Aquatic Animal Drug Approval Partnership Program 4050 Bridger Canyon Road, Bozeman, Montana 59715. Tel: (406) 994-9913. Email: niccole_wandelear@fws.gov

SLICE® (0.2% emamectin benzoate) is an in-feed treatment developed specifically for the control of sea lice infestations in farmed salmon and trout. Control of sea lice on farmed fish is essential because lice feeding activity can cause mortalities and increase susceptibility of fish to a variety of other fish pathogens. When SLICE® is eaten by fish, emamectin benzoate (EB) is absorbed from the gut and distributed to several tissues. When parasitic crustaceans feed on the host fish, EB is taken into the tissues of the parasite, where it binds to ion channels of nerve cells and disrupts transmission of nerve impulses, which results in paralysis and death of the parasite. Currently, SLICE® is approved for the control of sea lice in salmonid species in the United Kingdom, Europe, Norway, Chile, and Canada. In the U.S., studies are being conducted to evaluate the effectiveness of SLICE® to reduce infestations of a variety of freshwater parasites in salmonid species in support of approval by the U. S. Food and Drug Administration (FDA). To that end, we conducted four studies to evaluate the effectiveness of SLICE® to reduce infestations of *Salmincola californiensis* in freshwater-reared rainbow trout *Oncorhynchus mykiss*.

In each study, we tested the null hypothesis (Ho): Mean abundance of *S. californiensis* among fish in test tanks treated with SLICE® at a dosage of 50 µg EB/kg of fish biomass/d for 7 d is equal ($P \geq 0.05$) to that in test tanks of fish not treated with SLICE®, or % reduction in mean abundance in treated tanks compared to control tanks is less than 90%. Entrance criteria included that at least 70% of the fish in the reference population had ≥ 1 parasite and mean abundance was > 2 parasites/fish. Twenty fish were randomly allocated into 6, 8 or 10 test tanks, depending upon study site. At the end of the 30 or 42-d post-treatment period, live adult female parasites were counted on live fish in all tanks. A significant difference in mean abundance was detected between treated and control tanks in all studies. However, a 90% reduction in mean abundance was only observed in the two studies with a 42-d post-treatment period. Overall, results indicate that SLICE® effectively reduces infestations of *S. californiensis* on rainbow trout. Results from these studies have been submitted to the FDA in support of a new animal drug approval for SLICE® for this claim.

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<th>Study</th>
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<th>Prevalence (%)</th>
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The status of fish drug approvals in the United States: what’s approved and what new approvals are coming down the pipe

Jim Bowker*. U.S. Fish and Wildlife Service. Aquatic Animal Drug Approval Partnership (AADAP) Program, 4050 Bridger Canyon Road, Bozeman, Montana, 59715. Tel: (406) 994-9910. Email: Jim_bowker@fws.gov

The difficulty to gain approval of drugs by the U. S. Food and Drug Administration (FDA) for use on fish is evidenced by the fact that there are currently only eight such drugs available for use in the United States. Six of these drugs were approved between 1964 and 1994, but only four are currently available (formalin, MS-222, oxytetracycline hydrochloride, and Romet®). Four products have been approved since 1994 (Aquaflor®, 35% Perox-Aid®, Chorulon®, and Terramycin® 200 for Fish), and these approvals are due, in large part, to the $30-million Federal-State Aquaculture Drug Approval Partnership Project, base funds from a few of the research entities involved in drug approval efforts, and other grants.

In spite of the fact that gaining FDA-approval of fish drugs for use in the United States is a lengthy, difficult, and expensive process, new approvals and new claims for currently approved drugs are coming down the pipe. For example, considerable research has shown that Aquaflor® is effective in controlling or reducing mortality in a variety of fish caused by systemic columnaris, streptococcal disease, or bacterial kidney disease. In addition, research has shown that Aquaflor® administered at 15 mg florfenicol/kg fish body weight/d for 10 d is safe to fish and doesn’t result in accumulation of residues that may cause human consumption concerns. Such results will undoubtedly be used to expand the label to allow new approved uses for this product and to allow it to be used at doses higher than what is currently allowed. Similar progress has been made to (1) expand the current approval of 35% Perox-Aid® to control (a) infestations of Gyrodactylus salmonis in freshwater salmonids and (b) mortality in freshwater fish caused by Saproligiasis, and to (2) gain new approvals for use of (a) SLICE® (0.5% emamectin benzoate) to reduce infestations of Salmincola californiensis in rainbow trout, and (b) AQUI-S®20E to sedate a variety of freshwater finfish to the handleable stage of anesthesia.

In this presentation, an overview will be presented on drugs currently approved for use on fish in the U. S. and what the drugs can be used for. More importantly, an update will be presented on the status of what new drugs might be approved relatively soon, when currently approved drug labels might be expanded to include new claims of effectiveness, and the game plan to gain approvals of new fish drugs in the future.
Renovation of the Ten Sleep Hatchery, Wyoming

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Bart Burningham, Ten Sleep Hatchery, HC 30 Box 2240, Ten Sleep, Wyoming 82442. Tel: (307) 366-2404.

The Wyoming Game and Fish Department operates ten salmonid fish culture facilities to manage Wyoming’s sport fisheries and cutthroat trout restoration programs. Ten Sleep Hatchery houses the Yellowstone cutthroat trout brood stock and is also a major incubator facility for the Department. Spores of Myxobolus cerebralis, the causative parasite of whirling disease, were confirmed in production lots during an annual fish health inspection in February 2008. Through funding by the Wyoming Legislature in 2009, the water supplies and hatchery facilities were renovated to remove further pathogen threats and update its operations. This presentation chronicles the renovation of the facility and the technology incorporated to protect this valuable fish culture station.
FFSBC Sustainable Energy Management Program - Our plan to achieve a 40% reduction in electrical energy consumption

Ray Billings*, VP Strategic Initiatives and Energy Manager, Freshwater Fisheries Society of BC, 101-80 Regatta Landing, Victoria, BC, V9A 7S2. Tel: (250) 414-4204. Email: ray.billings@gofishbc.com

The Freshwater Fisheries Society of BC (FFSBC) operates five trout hatcheries across British Columbia. The FFSBC is keenly interested in reducing operating costs wherever possible and electrical energy is the second most costly activity within hatchery operations. Electrical consumption differs between hatcheries due in part to the different age, design, location, climate conditions and fish production goals for each hatchery. On average, water pumping accounts for about 70% of electrical consumption with lighting being the next largest end use at 10%. HVAC, refrigeration, plug loads, compressors, fans and blowers consume the remaining electrical energy.

BC Hydro is the provincial organization responsible for electrical energy generation, transmission and distribution across most of British Columbia. This public utility must find ways to reduce electrical energy consumption as well as build new power generation facilities to meet rapidly growing demand in British Columbia. The FFSBC entered into an electrical energy reduction program with BC Hydro in 2009 and since that time BC Hydro has provided significant technical and financial support to FFSBC to help our organization achieve long lasting energy savings across all hatchery operations.

This presentation will highlight the key findings of the FFSBC Sustainable Energy Management Program including where electrical energy is being consumed, electrical intensity values measured as kilowatts hours consumed per kilogram of fish produced (KWh/kg), energy reduction opportunities, energy reduction goals, projects currently underway, projects planned for the near future, employee awareness and training programs and financial incentives provided by BC Hydro. One significant accomplishment arising from this program has been the development of a novel water re-use system utilizing airlift technology which will eventually lower the energy costs associated with pumping well water to fish by as much as 40% across hatchery operations. This water re-use system will be discussed and initial results presented.
Intensive hatchery production in a partial reuse recirculating aquaculture system at Wyoming Game and Fish Department’s Dubois Hatchery

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The Dubois Hatchery is one of ten state fish culture facilities belonging to the Wyoming Game and Fish Department. This facility is located along the continental divide on the east side of the Wind River Mountains in the northwest corner of the state. Back in 2006, construction was completed on a comprehensive hatchery remodel. This transformed an aging facility, operating on a flow through system, to a state of the art facility utilizing a partial reuse system. Today, using a limited and challenged water supply the facility is annually producing nearly 30,000 pounds and incubating over 5.2 million eggs. This presentation will evaluate the overall effectiveness of this partial reuse recirculating aquaculture system. In other words, is the facility accomplishing what it was built to do?
A freshwater recirculating culture system for experimental hatchery populations of steelhead

Christopher Tatara*, Jeff Atkins, Rob Endicott, and Barry Berejikian.*NOAA Fisheries, Northwest Fisheries Science Center, Manchester Research Station P.O. Box 130, Manchester, WA 98353. Tel: (360) 731-8917. Email: chris.p.tatara@noaa.gov

Limited availability of freshwater at the Manchester Research Station constrained our ability to culture sufficient numbers of juvenile steelhead needed to conduct hatchery reform research. We constructed an outdoor partially recirculating fish culture system that is supplied with 5 to 15 gpm of makeup water. The system provides 120 gpm of filtered, chilled, and UV sterilized water, and supplies twenty 1.85 meter diameter circular tanks at 6 gpm and two Heath tray incubators. The system is automated, connected to back-up generator power, and equipped with alarm systems that notify personnel by phone and/or email in the event of power failure, low water flow, and poor water quality. Water quality is monitored in real time using a Hydrolab multiprobe connected to a Netronix Thiamis intelligent control unit (control, data logging, global positioning, and telemetry) that allows data to be accessed and retrieved remotely from internet connected computers or smart phones. The recirculating culture system was tested over a five month period using a domesticated strain of rainbow trout, and a non-ESA listed strain of steelhead. Upon successful testing of the system we initiated culture of three experimental laboratory populations of ESA-listed steelhead from the upper Columbia River (Methow River, WA) to assess the benefits of rearing steelhead in hatcheries under a culture regime that produces smolts with a natural median age of smoltification (2 years).
Real-world applications of renewable energy technologies at hatcheries

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Many hatchery facilities possess significant natural renewable sources of energy that could potentially be harnessed to reduce the facility’s consumption of utility power. HDR is currently working on the design of renovation projects at two hatchery facilities that will incorporate renewable energy technologies to produce electricity for use at these facilities.

Quinsam Hatchery, operated by Canada’s Department of Fisheries and Oceans (DFO) near the north end of Vancouver Island, utilizes two sources for water supply. A diversion screen on the adjacent Quinsam River provides water that must be pumped to the facility, making electric power a significant element of the facility’s annual operating budget. However, the hatchery’s Cold Creek water supply feeds the hatchery by gravity pipeline from a diversion that is located on a hillside above the facility. The elevation of the Cold Creek diversion results in approximately 50 feet of excess head at the point of delivery to the facility. DFO has contracted with HDR to design a small hydroelectric turbine system that will put the excess Cold Creek head to work producing electricity to be used on site. The primary purpose of the project is to demonstrate how small hydro technology can be integrated into a hatchery water supply delivery system without significantly affecting the primary mission of providing reliable water supply to the facility.

The second facility is located in east-central Arizona, where solar energy is abundant. HDR is designing the renovation of a rearing station in Show Low, AZ operated by the Arizona Department of Game and Fish Department (AZGFD). Apache trout, the state fish of Arizona, have been reared from fingerling to catchable size by AZGFD at Silver Creek Hatchery since 1978, using lined earthen raceways that are gravity-fed from a spring water source. There is utility power at the entrance to the 840-acre site where the office and residences are located, but the spring and raceways are approximately one mile away at the opposite end of the property where there is no utility power. Planned renovations include circular rearing tanks to be installed in a new rearing building with a drum screen micro-strainer to improve waste handling. Power for the micro-strainer will be provided by a photovoltaic cell array that will be mounted on the roof of a new feed storage and headtank building in order to avoid the need to extend utility lines to the rearing building, and also as a demonstration of modern solar technology feasibility.
Relative breeding success of pacific salmon jack males and implications for broodstock management

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Steve Schroder2, Washington Department of Fish and Wildlife, 600 Capitol Way N., Olympia, WA 98501

Ewann Berntson NOAA Fisheries, Northwest Fisheries Science Center, Manchester Research Station P.O. Box 130, Manchester, WA 98353.

Sockeye salmon (*Oncorhynchus nerka*), coho salmon (*O. kisutch*) and Chinook salmon (*O. tshawytscha*) populations are usually comprised of typically low, but sometimes highly variable, proportions of ‘jack’ males that mature one year younger than the youngest females in a population. Jack males are substantially smaller than older males (‘adult’) and adopt breeding tactics (sneak spawning) that reflect their inability to compete for primary access to nesting females. Age at maturity is clearly and strongly influenced by environmental conditions; however, a genetic basis for variation in male age-at-maturity has also been fairly well established for Chinook salmon. The majority of salmon in the Pacific Northwestern United States are now produced in hatcheries. Recent high proportions of jacks returning to rivers in the Pacific Northwest have led to substantial debate regarding spawning practices that balance trade-offs among overall genetic diversity and adaptive genetic diversity related to age and size at maturity, and other utilitarian purposes (angling and harvest).

This presentation summarizes published and unpublished information on the breeding success of jack males relative to older, larger adult males (i.e., relative breeding success, RBS), and asks whether this type of information might be useful in providing a basis for hatchery broodstock management. We summarized the results of 18 different breeding groups of Chinook salmon from four separate studies where jacks comprised between 7% and 50% of the males within each breeding group. The RBS of jacks (number of offspring per jack male divided by number of offspring per adult male) averaged 0.50 (range = 0.14 to 1.09). The total proportion of offspring produced by jack males averaged 0.14 (range = 0.01 to 0.47), which reflected their low breeding success and generally lower frequency in the breeding populations. Data from coho and sockeye salmon, while more limited, suggest jack male RBS was quite similar to that observed for chinook salmon. In one study of chinook salmon conducted under experimental conditions, breeding success of the two alternative male phenotypes showed evidence of frequency-dependent selection, meaning that the breeding success of each life history type increased as its frequency in a breeding group decreased. If this relationship holds in natural populations (still to be tested) individual jack breeding success will likely be less in years where large numbers of jacks are present and greater in when their numbers are lower. A meta-analysis of the 18 breeding groups examined indicated a significant positive relationship between the proportion of jacks in a population and the total proportion of offspring produced.
from jacks; however the slope of this line was 0.64 (significantly less than 1.0), indicating support more broadly for frequency dependence. The slope of this relationship and the overall mean RBS of 0.5 may be useful in the development of broodstock management guidelines where the goal may be to mimic natural contributions of males of different ages and mating strategies. However, data from natural breeding success studies should be considered in the context of other selective forces (e.g., size-selective fisheries) and the goals of the hatchery program.

Hall of Fame Inductees 2:35 – 2:55 pm, Tim Yesaki
Afternoon Break and special session by Dr. John Halver of the University of Washington

Latest facts for fish and shrimp feed formulations (NRC Bulletin on nutrient requirements of fish and shrimp)

John Emil Halver*, School of Aquatic and Fishery Sciences, College of the Environment, University of Washington, Seattle, Washington, 98195 USA. Email: halver@u.washington.edu

Latest data on nutrient requirements of fish and shrimp were compiled by an expert group of international scientists to update the 1993 bulletin on Nutrient Requirements of Fish. This new National Academy of Sciences, National Research Council, USA bulletin includes summaries of latest research findings on nutrient requirements for Carbohydrates, Vitamins, Amino Acids & Proteins, Fats, and Minerals plus intermediary metabolism of each. Anti-nutritional factors present in some feedstuffs and their effects in physiology and growth are discussed. Also, chapters are written on the latest advances in feed technology and application in aquaculture systems for different sizes and species reared.

The bulletin includes special diets and techniques used in rearing larval species of marine fish and shrimp. General fish husbandry techniques and diets for seed stock are also reviewed.

A summary of significant new additions to knowledge of nutrient requirements and feed additives for fish and shrimp will be itemized that can be incorporated into feed formulation programming for specific size and species that are being reared in aquaculture.

Advancements in fish feed technology will be noted with respect to materials available and industrial processing for various fish and shrimp feed types.

The 2011 Bulletin concludes with a list of Research Needs for future research, tables of recommendations, and a massive list of data fact references.
The Grande Ronde Basin of northeast Oregon historically supported multiple large populations of spring chinook salmon *Oncorhynchus tshawytscha*. However, there was a steady decline from 1960 through the mid-1990s, when populations reached severely low levels, necessitating hatchery intervention. A captive broodstock program was designed to prevent extirpation of Chinook salmon and quickly increase the numbers of adults spawning in nature, without removing naturally spawning adults, by greatly improving the survival advantage that the captive broodstock salmon possess over naturally produced salmon. The Grande Ronde Basin Spring Chinook Salmon Captive Broodstock (CBS) Program was implemented in 1995 in three streams: Catherine Creek, Lostine River and Upper Grande Ronde River. This paper evaluates success of the F1 generation in meeting its goal of increasing natural production in each of the program streams. Egg-to-smolt survival was lower than a Conventional Hatchery Program and the smolt production goal was rarely achieved. Adult returns and smolt-to-adult return rate were higher than expected but so was the stray rate. Adult size at age was similar to natural salmon but age composition was younger than natural salmon. Run timing was similar to natural salmon but the spawning distribution was narrower and was focused near the acclimation sites. The CBS Program did contribute to increasing the numbers of adults spawning in nature in each of the program streams. However, there are issues that must be addressed for future captive broodstock programs, such as disease and slow growth. The ultimate measure of the success or failure of the CBS Program hinges on increases in natural production and escapement. Numbers of total adults returning to these streams have increased, so we have prevented extirpation of these populations, and we are seeing slight increases in natural production but not enough to produce self-sufficient populations.
Building a tanker truck to meet stocking program demands

Steve Arnold*, Hatchery Manager, Fraser Valley Trout Hatchery Freshwater Fisheries Society of BC, 34345 Vye Rd, Abbotsford, BC, Canada, V2S 7P6. Tel: (604) 504-4709. Email: steve.arnold@gofishbc.com

This presentation will cover the rational behind the new tanker truck used to more efficiently and cost effectively deliver Freshwater Fisheries Society of BC (FFSBC) Fishing in the City (FIC) urban lake stocking program. As well as the technical advantages of the new tanker truck over the smaller capacity trucks. The goal of the FIC program is to make recreational fishing accessible to urban dwellers targeting youth and their families, new immigrants to BC, lapsed and occasional anglers. One of the keys of the FIC program is to increase the number of fish stocked and frequency of stocking events of our catchable sized, Fraser Valley 3N strain of rainbow trout. The larger capacity of the new tanker truck gives us the capability of stocking the four urban fisheries in a single trip.

A brief history of planting eggs and a new perspective

Tod Jones*, Redd Zone, LLC, 390 Atlantic Ave. Astoria OR, 97103. Tel: (503) 791-9854. Email: tod.jones9@gmail.com

Out planting salmon eggs in stream reaches has been used in the past without adequate monitoring and evaluation to determine its effectiveness. Various methods, all of which were labor intensive were employed. Devices to contain the eggs proved to be equally difficult to implant also resulted in high mortalities. Use of this strategy has been limited until the development of the “Fish Egg Planting Device and Method” used aggressively in Alaska and now combined with thermal marking of pre-hatch gametes. These complimentary advances in fish culture have dramatically reduced the labor involved in and have allowed for tracking effectiveness of planting otolith marked eyed eggs.

Re-visiting and old idea may have application in jump-starting depressed wild runs or re-introduction efforts.
Quinsam River Hatchery has been enhancing Pinks for over 30 years. As the population has improved and larger escapements returned to the river to spawn, focus was turned to the river to understand and deal with limiting factors which affected in-stream survival.

For over 70 years, a series of bedrock cascades on the Quinsam River was identified as a barrier to upstream adult migration during periods of low flow. Climate change appears to be causing many more consistent years of low flows in the summer and early fall which limits the ability of Pink adults to migrate upstream. This seriously impacts spawning success and fry survival due to poor spawning conditions and high density. Reconnaissance surveys of upstream habitat and potential for fishways was done in 2004, and 2 fishways constructed in 2005.

Since 2005, an average of 200,000 Pink adults per year has migrated through the Cascade fishways, with fry outmigration doubling and quadrupling historical levels.

The success of this project has allowed the hatchery to reduce the numbers of fry production from the facility to accommodate the natural production.

The health of the Quinsam River Pink run is key to the Georgia Strait Pink CU (both even and odd years) – as most other systems on the east coast of Vancouver Island have poor returns. The combined Pink production from river and hatchery has also generated a very popular recreational fishery in the river and along the Campbell River waterfront.
Using an acoustic camera to monitor fish passage at the Leavenworth National Fish Hatchery

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Accurate and timely monitoring of fish passage around (or through) in-stream structures associated with hatchery operations can be logistically difficult and labor intensive. In many cases, these structures are critical to the operation of the hatchery (e.g. structures associated with water withdrawal), and effective management of non-target fish passage can constrain operations without reliable monitoring data. At the Leavenworth National Fish Hatchery (LNFH), operation of in-stream structures has the potential to hinder passage of listed fish in Icicle Creek. In 2011 the LNFH left its headgate dam in the fully open position for the entire year, offering the most unrestricted fish passage in over 70 years. A DIDSON acoustic sonar camera was used to monitor adult salmonid passage and provide data for adaptive management. The challenges of this monitoring system included; site selection, establishing adequate solar power, minimizing laborious review time, maintaining the equipment in extreme heat, and continuing operation during 20-fold fluctuations in discharge. With only a few days of down time, we were able to continuously monitor fish passage for over 120 days, with (at least) weekly counts of the target fish.
Nitinat Hatchery coho (*Oncorhynchus kisutch*) 2002-2004 brood year experiment: a comparison of semi-natural smolt enhancement techniques, to conventional production smolt enhancement methods and the wild spawning populations.

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The quality of coho (*Oncorhynchus kisutch*) smolts reared to represent those naturally produced in the wild (‘conservation’ or ‘semi-natural’ method) was compared to smolts reared by conventional production hatchery methods (‘conventional’ method). In order to reflect the features of more naturally reared conservation smolts, the ‘semi-natural’ smolts were: reared at lower densities; chilled to delay egg development; fed lower rations and released at a smaller size. By contrast, ‘conventional’ smolts were produced using a method that has been conventional at the Nitinat Hatchery for the last 20 years: creating an abundance of large smolts to ensure maximum adult production.

The smaller ‘semi-natural’ smolts returned as jacks at significantly lower numbers, having consumed in captivity half as much food as their conventionally raised counterparts. The ‘semi-natural’ group yielded increased numbers of adult returns compared to the ‘conventional’ group. Adults from the wild populations returned at significantly larger size than ‘semi-natural’ and ‘conventionally’ reared fish. We observed that fish reared at lower densities had less fin erosion and felt that this may have contributed to an overall improvement in fish health.

Results suggest that coho juveniles raised in a more natural environment, reflecting natural size produces the same number of returns and fewer jacks. Further research may enable us to maximize the quality of smolts, increase fish returns, reduce competition with wild smolts, while at the same time, providing an overall greater economic benefit to the hatchery.
Session #6: Optimizing Stocking Programs

Does size really matter? The optimum release size of rainbow trout fry for small BC lakes

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The key components of a successful stocking program involve determining the appropriate strain, size, density and time of release. Each of these factors is complex and varies depending on the physical characteristics of the lake, predators, weather etc. Many studies are currently underway to determine the optimum stocking density and past and current data has aided in strain selection; however, minimum size at stocking has yet to be fully determined. One of the barriers to survival among strains is juvenile overwinter mortality. If trout do not meet a threshold size prior to the onset of winter they starve to death even if they maximize lipid storage because small fish have higher weight-specific metabolic rates. Larger juveniles may also starve to death if winters are long and/or they do not maximize lipid storage. Allocating energy to lipid storage is a detriment to summer growth and survival in all environments but a benefit to over-winter survival only in stressful environments. In order to understand how stocking size affects survival, a replicated experiment in small lakes was conducted to assess performance of two wild stocks at three different sizes of fry in productive monoculture lakes to estimate the optimal stocking size.
Comparing natural and hatchery Imnaha River chinook salmon after 20+ years of supplementation: twin sons of different mothers

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Ewann A. Berntson, NOAA Fisheries, Northwest Fisheries Science Center, Manchester Research Station, 7305 East Beach Drive, Port Orchard, WA 98366.

Paul Moran, NOAA Fisheries, Northwest Fisheries Science Center, 2725 Montlake Blvd. East, Seattle, WA 98112.

The Imnaha River Chinook Supplementation Program was initiated in 1982 to augment declining northeast Oregon salmon numbers resulting from the construction and operation of the four Snake River dams. The Oregon Department of Fish and Wildlife initiated the program in hopes of producing a self-sustaining population of natural-spawning salmon. Initially, only native (natural) Imnaha River Chinook salmon were used as broodstock. Since the onset of hatchery returns, the program has been operated as an integrated hatchery program, in which both natural- and hatchery-origin Chinook are spawned together. All broodstock are collected at the Imnaha River weir and broodstock collection has been impacted by the limitations of weir installation and operation. Due to high spring flows, the weir is not usually installed until part of the run has passed the weir site. We estimate that a mean of only 43% of the run has been intercepted at the weir annually, and our broodstock has been taken from the later portion of the run in most years. There is a conservation component to this program, and one major objective is that hatchery-produced salmon maintain the life history and genetic characteristics of natural salmon. However, over time we have seen life history differences between natural- and hatchery-origin Chinook. Natural Chinook return to the river earlier, and spawn earlier and higher in the system than hatchery Chinook. Our inability to collect early-returning broodstock is most likely the cause of some of these differences. Age composition is also different; the majority of natural fish return at age 5 and most hatchery fish return at age 4. This difference in age composition results in natural fish being longer, heavier, producing larger and more eggs, and spawning earlier than their hatchery counterparts, even in a hatchery setting. We wondered if we would find genetic differences as well, since characteristics such as run and spawn timing have a genetic component. We collected genetic samples from natural and hatchery Imnaha River Chinook salmon used as broodstock in 2006 and 2008, and from natural and hatchery carcasses recovered on Imnaha River spawning grounds from these years. We explored a variety of approaches to examine the genetic relationships between hatchery and natural fish after 20+ years of supplementation. Preliminary results suggest that natural- and hatchery-origin Imnaha River Chinook have remained genetically similar, which is an encouraging result.
Captive broodstock program for threatened Nooksack River spring chinook

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Craig Olson, NW Indian Fisheries Commission, 6730 Martin Way E, Olympia, WA, 98516. Tel: (360) 528-4343. Email: colson@nwifc.org

In 2006, the Washington Department of Fish and Wildlife (WDFW), Lummi Tribe, Nooksack Tribe, and the Northwest Indian Fisheries Commission, in cooperation with NOAA Fisheries, established a cooperative 10 year captive broodstock program to aid in recovery of the South Fork Nooksack River spring chinook listed as threatened in 1999 under the Endangered Species Act.

Captive broodstocks are a form of artificial propagation in which fish are cultured in captivity for their entire life cycle. Increased survival in protective culture rapidly increases population size, accelerating recovery efforts by producing large numbers of offspring for return to the wild.

The South Fork Nooksack program employs a dual rearing strategy – half of the fish are reared from smolt to adult in freshwater and half are reared from smolt to adult in seawater. Wild parr (approximately 1000 per brood year), collected in the spring, are divided into the two rearing strategies and reared in captivity for 1 - 5 years, depending on rate of maturation. Mature adults are artificially spawned in the hatchery and offspring are released as zero age smolts.

A brief history of this program is provided with a main focus on the challenges of rearing captive chinook in fresh and seawater environments and the technologies involved.
Survival and migration behavior of hatchery steelhead trout reared at three different densities

Maureen Kavanagh*, U.S. Fish and Wildlife Service, Columbia River Fisheries Program Office, Vancouver, WA 98683. Tel: (360) 604-2520. Email: maureen.kavanagh@fws.gov

Doug Olson. U.S. Fish and Wildlife Service, Columbia River Fisheries Program Office, 1211 S.E. Cardinal Court Suite 100, Vancouver, WA 98683

Hatchery production goals in the Pacific Northwest have historically focused on fulfilling mitigation and harvest needs. Increasingly, concern for wild fish conservation has caused fisheries managers to incorporate management practices that minimize impacts of hatchery fish on wild populations. Releasing smolts at densities and lengths which optimize adult yields could reduce interactions between wild and non-migratory fish. We examined the effects of juvenile rearing density on growth, condition, and survival of winter steelhead for three brood years (2004-2006) at Eagle Creek National Fish Hatchery in Estacada, Oregon. Density groups (7500, 15,000, and 22,500 fish) were replicated three times and each brood year was reared for nine months before being released as yearling smolts. Mean length, condition and density were calculated at ponding and prior to volitional release. Coded wire tags, unique for each raceway group, were used to evaluate adult survival. The effects of rearing density on growth were compared for each brood year and for all years combined. Fish from each of the density groups were also radio-tagged to examine the effects of density on migration of winter steelhead.
Session #7: Investigating Triploid Salmonids

A new method to confirm triploidy rates in salmonids

Derek Ingram*, T. Godin, A. Flores, A. Clarke, Freshwater Fisheries Society of British Columbia, Biological and Program Support Section, Fraser Valley Trout Hatchery, 34345 Vye Road, Abbotsford, BC, V2S 7P6. Tel: (604) 855-2479. Email: derek.ingram@gofishbc.com

Currently, triploid fish are a major part of the Freshwater Fisheries Society of British Columbia (FFSBC) stocking program. Over 3 million triploid (3n, or sterile) rainbow trout (Oncorhynchus mykiss), eastern brook trout (Salvelinus fontinalis), and kokanee (Oncorhynchus nerka) are stocked into approximately 800 lakes and streams throughout BC. FFSBC produces sterile fish by applying hydrostatic pressure or heated water shortly after fertilization. Prior to stocking, a subset from each 3n group is sampled to verify the success of sterilization procedures.

Prior to 2010, FFSBC would ship live fish from all facilities to one hatchery in Abbotsford for blood sample collection and flow cytometry was used for ploidy confirmation. In order to improve the process, we developed an alternative method for testing ploidy using imaging software. Blood smears were taken and photographed through a microscope. These images were then analyzed using freely available software. We measured volume, shortest axis, surface area and longest axis of red blood cells from individual fish from known diploid control groups and from sterilized groups. Results from imaging software were analyzed using discriminate function analysis. Ploidy rates were compared among both Flow Cytometry and Imaging methods. The benefits of using imaging software include the reduction of risk associated with shipping live fish, elimination of staff exposure to toxic reagents, and more flexibility in the timeframe for sampling fish at developmentally appropriate sizes. While the new method has some initial cost associated with the set up of hardware and software, the total cost of running a group of samples is approximately 52% less than the Flow Cytometry method.

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The cardiovascular system of swimming and hypoxic triploid rainbow trout

Christine E. Verhille* and Tony P. Farrell. Department of Zoology, University of British Columbia, Biological Sciences Building, 4200-6270 University Boulevard, Vancouver, BC V6T 1Z4. Tel: (778) 846-5484. Email: verhille@interchange.ubc.ca

Survival and growth of triploid trout are inferior to their diploid conspecifics in lakes. The ability of trout to survive in summer lakes appears to be related to their endurance swimming capacity, which in turn is primarily limited by the capacity of the cardiorespiratory system. Despite a scarcity of information on the physiology of triploid salmonids, there is convincing evidence of impaired triploid cardiorespiratory capacity. In order to test the hypothesis that poor triploid lake performance is due to deficiencies to their cardiovascular system, we investigated the swimming endurance rank and cardiorespiratory status of diploid and triploid rainbow trout during critical swimming velocity and hypoxia exposure tests.

50 sibling diploid and triploid Fraser Valley Domestic rainbow trout were ranked for swimming endurance then surgically implanted with probes to monitor the circulatory system during critical swimming velocity and hypoxia exposure tests. The cardiac output (including heart rate and stroke volume), arterial and venous oxygen tensions and metabolic rate of diploid and triploid fish were compared throughout swimming and hypoxia tests. Results will be discussed in relation to the performance of diploid and triploid rainbow trout in BC lakes.
Roaring River Hatchery triploid trout program: the triploid process from egg take to egg shipments

Luke Allen*, Oregon Department of Fish and Wildlife, Roaring River Fish Hatchery, 42279 Fish Hatchery Dr. Scio OR 97374. Tel: (503) 394-2496. Email: luke.s.allen@state.or.us

Oregon Department of Fish and Wildlife utilizes the Roaring River Hatchery facility as the primary source for the states Rainbow triploid trout program. With the shift towards using triploid trout Roaring River is focused on the methodology of triploid production, and the improvement of the quality of eggs shipped to other ODFW facilities. Triploidy methodology was developed in concert with the Oregon Hatchery Research Center to achieve the highest induction rates with the lowest mortality. Egg loss at Roaring River was 25.3% for triploids along with induction rates being 99.6% compared to 12.8% loss for diploids in 2010.

This presentation will follow the egg from spawning through the triploid process, incubation, and preparation of shipment. The utilization of pressure technique for creating triploids, and utilization of a deep salt bath for removal of weak eyed eggs common to triploid programs will be discussed as a means for allowing the shipping of higher quality eggs with less resulting fry loss.

Hypoxia tolerance in four strains of diploid and triploid rainbow trout

Mark Scott*, Department of Zoology, University of British Columbia, #4200-6270 University Blvd., Vancouver, B.C V6T 1Z4. Email: mark_scott123456@hotmail.com

The goal of this project is to determine why triploid (3n) rainbow trout exhibit higher mortalities in the wild compared with their diploid (2n) counterparts. To accomplish this goal, we measured a number of physiological performance and environmental tolerance parameters in 2n and 3n varieties of wild and domesticated juvenile rainbow trout. Of the parameters we investigated only tolerance of low oxygen showed consistent significant differences between 2n and 3n trout. The differences we observed between 2n and 3n fish in their time to loss of equilibrium are repeatable across multiple strains and years. To explain the difference in hypoxia tolerance between 2n and 3n trout we are currently measuring the activities of key metabolic enzymes of aerobic and anaerobic energy production and the metabolites associated with them in muscle, liver, heart, and brain in normoxic and hypoxia exposed trout.
**Poster Abstracts**

1 - Construction of our newest fish stocking truck and tank

**Hal Boldt***, Oregon Department of Fish and Wildlife, Northwest Region Liberation Coordinator, 17330 SE Evelyn St. Clacklamas, OR, 97015. Tel: (971) 673-6009. Email: Hal.w.boldt@state.or.us

We recently added a new fish stocking truck to our fleet the new unit consists of a International chassis with a hydraulic lift bed and a 2,000 gallon split tank. I would like to share photos of the construction phases including the first load of trout successfully stocked from the new unit. I will be attending the entire conference and have no preference when the poster presentation will be.

2 - Rearing substrate improves larval white sturgeon growth and development

**Marcus Boucher**, Colin J Brauner, J Mark Shrimpton, Ecosystem Science and Management Program University of Northern British Columbia 3333 University Way, Prince George, BC, V2N 4Z9. Tel: (604) 855-4720 Email: marcus.boucher@gofishbc.com

See abstract under oral presentations
3 - Is using a purse seine a viable option for brood stock collection?

Carol Coleman*, WDFW, Natural Resources Building 1111 Washington St. SE Olympia, WA, 98501. Tel : (509) 476-3130 Email: csc@televar.com

A Purse Seine has been used for 2 seasons (2010 and 2011) to collect Summer Chinook Broodstock in the Upper Columbia River. The Purse Seine is a good option as a stop gap measure. The Purse Seine has been used for selective harvest and can help collect the locally adapted brood fish as they self select closer to the spawning grounds. It has a lower mortality rate then tangle net and beach seine. It is expensive and requires special equipment and a lot of personnel. The live broodstock collection has been tested by; the Colville Confederated Tribe in cooperation with Washington Dept. of Fish and Wildlife, Chelan Co. PUD and funded by Bonneville Power Admin

4 - The Oregon Hatchery Research Center (OHRC)

Ryan Couture*, Oregon Hatchery Research Center, 2418 East Fall Creek Rd, Alsea, OR, 97324, Tel: (541) 487-5510 ext.100 Email: Ryan.b.couture@state.or.us

The Oregon Hatchery Research Center provides a wide range of options for investigating the effects of spawning, incubation and rearing treatments on the growth, survival, reproductive success and other performance of hatchery and wild fish. The OHRC’s mission is to develop an understanding of the mechanisms that may create differences between hatchery and wild fish and devise ways to reduce and manage the differences so that hatcheries can be used responsibly in the conservation and use of Oregon’s native fish.

Top Priorities: 1 - Understand mechanisms that may create differences between hatchery and wild fish. 2 - Develop approaches to manage hatchery fish that conserve and protect native fish. 3 - Educate the public on the relationship between hatchery and wild fish, the connection between fish and watershed, estuarine and ocean systems, and the implications for fish management and stewardship.
5 - Fry ponding using a fish pump

David Ewart*, Watershed Enhancement Manager, Oceans, Habitat & Enhancement Branch
South Coast Area, Quinsam River Hatchery, 4217 Argonaut Road, Campbell River, BC, V9H 1P3. Tel: (250) 287-9564 ext 223. Email: David.Ewart@dfo-mpo.gc.ca

Poster will display photos of a technique being used at Quinsam River Hatchery to pond fry using a fish pump. This technique has proven very successful in moving fry from the incubation room to rearing containers. It has eliminated the back-breaking work of physically hauling fry using buckets and workers, and has improved the quality and conditions for the fry being transferred. The technique involves the use of the Heathro fish pump, a fry loading hopper, and various hoses and reducers.

6 - Does the mineralocorticoid receptor have a functional role in the fish gill?

Anne-Marie Flores*, J Mark Shrimpton, Ecosystem Science and Management Program, University of Northern British Columbia, 3333 University Way, Prince George, BC, V2N 4Z9. Tel: (250)596-7275. Email: anne-marie.flores@gofishbc.com

We examined whether a functional role exists for two different classes of cortisol receptors, the glucocorticoid receptor (GR) and the mineralocorticoid receptor (MR). In our first experiment, we transferred rainbow trout from fresh- to ionpoor or salt water. An increase in gill Na+,K+-ATPase (NKA) activity in salt water was associated with higher NKA a1b subunit mRNA. In contrast, there was little change in gill NKA activity following the transfer to ionpoor water, but a1a isoform mRNA was significantly elevated. GR and MR mRNA showed little change when fish were transferred to either treatment, but prolactin receptor (PrlR) and growth hormone 1 receptor (GH1R) mRNA showed significant changes. In our second experiment, we examined adult sockeye salmon migrating from the ocean to spawning grounds. Gill NKA activity declined consistently during migration; accompanied by significant increases in the a1a isoform. Generally, mRNA for MR & GR declined during migration to freshwater, but PrlR and GH1R increased – particularly after the fish were in freshwater. The findings suggest that cortisol may have a more limited role in freshwater ionoregulation than previously described.
7 - Development of sterile and all-female kokanee for recreational fisheries in BC

Theresa I Godin*, T Yesaki, K Tsumura, A Clarke, Freshwater Fisheries Society of BC, Research Evaluation and Development Section, 315-2202 Main Mall, UBC, Vancouver, BC, V6T 1Z4. Tel: (604) 222-6755. Email: theresa.godin@gofishbc.com

See abstract under oral presentations

8 - A hatchery incubation system designed to imprint kokanee to natal stream odors

Douglas Hatfield*, Hatchery Operations Manager, WDFW, Region 4 Office, 16018 Mill Creek Blvd, Mill Creek, WA, 98012-1541. Tel: (425) 775-1311 Ext. 109. Email: Douglas.Hatfield@dfw.wa.gov

In 2007, a petition was filed under the ESA to list Lake Sammamish kokanee

Representatives from King County, U.S. Fish and Wildlife Service, plus the Washington Department of Fish and Wildlife formed a work group in 2007 to recover Lake Sammamish kokanee. Lack of suitable spawning areas was identified as the principal limiting factor. Adult kokanee native to three Lake Sammamish streams have been collected and artificially spawned since 2009

The Challenge
• Fish from the three streams, Lewis, Ebright, and Laughing Jacobs Creeks are genetically distinct
• Dynamic flow regimes and a highly urbanized environment make stream-side incubation impossible
• A recovery challenge is how to imprint kokanee to natal stream waters when incubation takes place in a hatchery
9 - Characterizing the immune response to *Flavobacterium psychrophilum* and possible resistance/susceptibility conferring major histocompatibility alleles in *Oncorhynchus mykiss*

**Samantha Hodgins***, John Lumsden, Brian Dixon, Department of Biology, University of Waterloo, 200 University Avenue West, Waterloo, Ontario, N2L 3G1. Tel: (519) 888-4567 ext. 34461. Email: hodgins.samantha@gmail.com

The goal of this research was to develop a greater understanding of the immune response and survival of rainbow to Bacterial Coldwater Disease. Together this work will allow for further development of cold water disease prevention protocols and management tools to improve the aquaculture industry.

10 - Assessing the stock environment interaction in the growth and survival of age-0 rainbow trout

**Ellen Lea***, John Post, Eric A Parkinson, Department of Biological Science, University of Calgary, 2500 University Dr NW, Calgary, AB, T2N 1N4. Email: evlea@ucalgary.ca

The goals of this study were to (1) develop a better understanding of the main selective pressures facing rainbow trout in their first year, (2) assess the influence of genetics, environment, and the interaction between these two factors in determining first year survival and growth patterns, (3) determine how foraging activity and energy allocation influence first year performance of rainbow trout.
11 - Using matrix spawning to maintain genetic diversity among Cultus Lake sockeye

Catherine McClean*, FAO. Tel: (604) 820-7419. Email: Catherine.McClean@dfo-mpo.gc.ca

In May 2003 the Cultus Lake sockeye was officially designated as endangered by the Committee on the Status of Endangered Wildlife in Canada. Low numbers of returning adults and high pre-spawn mortality had already prompted a small group of Fisheries & Oceans Canada employees to take action prior to this official designation. A captive breeding program and a hatchery supplementation program using fry and smolts are just two of several measures being used to increase the population of Cultus Lake sockeye. Returning adult sockeye are collected and spawned using matrix spawning techniques with the aim of producing 500 genetically distinct groups of eggs. Matrix spawning at Cultus Lake may involve splitting an individual female’s eggs into anywhere from 2 – 10 equal lots of eggs each fertilized by a different male. This spawning technique has been successful at preserving the genetic diversity of the Cultus Lake sockeye run until it is able to sustain itself once again.

12 - Where is the catch? A closer look at the fishing surveys of British Columbia to reveal angler preference and motivation

Nina Mostegl*, Wolfgang Haider, Len Hunt, Ben Beardmore, School of Resource and Environmental Management, Simon Fraser University, 8888 University Drive, Burnaby, BC, V5S 1S6.

Every 5 years since 1985, the Canadian Wildlife Service and the Province of BC jointly undertake a survey on freshwater recreational fishing. The surveys also contain several questions about the Human Dimensions of Recreational Fishing, such as motivation, satisfaction and expenditures. So far little use has been made of this information at any time, and no longitudinal analysis has ever been conducted. Here we display some findings about the motivation for recreational fishing, and about satisfaction.
13 - Hatchery or Ecosystems Resource Center

Jeremy Mothus*, FAO, Chilliwack River Hatchery, 55205 Chilliwack Lake Road, Chilliwack, BC, V4Z 1A7. Tel: (604) 858-7227. Email: Jeremy.Mothus@dfo-mpo.gc.ca

The poster will show that the Chilliwack River Hatchery is not just a fish production facility, but a integral part of the watershed. Participants will see photos accompanied by text introducing them to the operations/duties performed by Chilliwack River Hatchery staff which contributes to watershed ecosystem management within the Chilliwack River Valley. After seeing all the different duties performed by Chilliwack River Hatchery the participants are able to make the decision if the facility is a "Hatchery" or an "Ecosystem Resource Center".

14 - Triploidy induction rates in rainbow trout using pressure shock treatment: the degree of success is dependent on adherence to protocol.

Richard Park*, Idaho Fish and Game, 71 Hayspur Lane, Bellevue, ID, 83313. Tel: (208) 788-2847. Email: Richard.Park@idfg.idaho.gov

Triploidy induction rates using the pressure shocking method are contingent on strict adherence to protocol. At Idaho Fish and Game’s rainbow trout broodstock hatchery, an average of nine million green eggs are pressure shocked each year for production hatcheries. Induction rates of 99.4 to 99.8 percent were achieved during production years 2005 to 2009. In 2010 and 2011, induction rates were 100 percent. The success of IDFG’s triploid production is solely due to maintaining the protocol which was developed based on the rate of fertilized egg cell division at the hatchery’s water temperature. To achieve 100 percent induction rate, we dispose any pressure shocked egg lots that have deviated from protocol.
15 - Physiological performance and environmental tolerance of four strains of 2n and 3n rainbow trout

Mark Scott*, Wallace Cheung, Rashpal Dhillon, Jeffrey Richards, Department of Zoology, University of British Columbia, 4200-6270 University Blvd, Vancouver, BC, V6T 1Z4. Email: mark_scott123456@hotmail.com

See abstract under oral presentations

16 - Predator netting for oversized rearing ponds

Daniel Straw*, Fish & Wildlife Manager, Clackamas Fish Hatchery, 24500 S. Entrance Rd, Estacada, OR, 97023. Tel: (503) 630-7210. Email: daniel.e.straw@state.or.us

Our goal behind the predator netting project at Clackamas Hatchery was to provide a rearing environment free of bird predation at a minimal equipment and construction cost. The poster will outline how the design and implementation was carried out solely by hatchery staff and volunteers. What we hope to share with others is that predator netting doesn't have to be complicated or expensive in order to be effective.

17 - High pH tolerance of four strains of diploid and triploid rainbow trout (Oncorhynchus mykiss)

William A. Thompson*, Jeffrey G. Richards, Department of Zoology, University of British Columbia, 4200-6270 University Blvd, Vancouver, BC, V6T 1Z4. Email: athompson@zoology.ubc.ca

Triploid rainbow trout commonly exhibit higher mortalities in the wild than their diploid counterparts. The cause of this differential mortality is unknown and the current investigation considers the role of increasing pH in lakes throughout British Columbia. The project focuses on three wild strains (Blackwater, Pennask, and Tzenzaicut) and a Fraser Valley hatchery produced strain. Diploid and triploid trout of each strain were held at pH 9.5 and sampled throughout a multi-day exposure. Preliminary data analysis suggests that the Fraser Valley strain has the greatest tolerance of pH 9.5 and that triploid trout may be more sensitive to high pH than diploid trout.
18 - Porteau Cove Chinook Program

**Jordan Uittenbogaard***, FOA, Tenderfoot Creek Hatchery, Box 477, Brackendale, BC, V0N 1H0. Tel: 604-898-3657. Email: Jordan.Uittenbogaard@dfo-mpo.gc.ca

The Howe Sound Chinook program is a unique program based out of Tenderfoot Creek Hatchery which supports various fisheries in British Columbia. The original brood stock for this program compromised of Chinook sub-stocks from the Squamish River. These stocks included the Squamish, Ashlu, Mamquam, and Cheakamus Rivers.

These white flesh Chinook are captured via seine nets at various locations through-out Howe Sound. The Chinook are then transferred from their salt water habitat to the hatchery groundwater ponds where they are held until maturity and then spawned. In recent years 700,000 to 1,500,000 juvenile Chinook are reared in fresh water and released into sea pens located at Porteau Cove Park on Howe Sound. Before the sea pen rearing, the juvenile Chinook are raised to approximately 3 grams and are vaccinated against Vibrio. Once the fry reach an average of 7.5 grams in size they are transferred to sea pens and reared to 9-15 grams. The juveniles react well to the low salinity levels in Howe Sound and thrive with the plankton blooms in the marine environment. Once the juveniles are released they migrate to the north Pacific and when they return as adults to Howe Sound, they stage for a period of time before dispersing to the Squamish River system.

19 - Bayesian influence diagram model for rainbow trout stocking optimization in British Columbia, Canada.

**Divya Varkey***, Paul Askey, Eric Parkinson, Adrian Clarke, Freshwater Fisheries Society of BC, 315-2202 Main Mall, Vancouver, BC, V6T 1Z4. Email: divya.varkey@gofishbc.com

An analysis toolkit to inform stocked lakes management is built using Influence Diagram model (IDM). The IDM works within a Bayesian decision analysis framework to combine both information and associated uncertainty from multiple sources: density and size of stocked fish, fisheries models of fish growth and survival, models of angler effort trade-off with fish size, lake productivity and release mortality. The model predicts the expected angler effort and expected catch or kill per angler day. The results are subsequently integrated with the cost of the stocking program and the revenue from angling effort to calculate the utility of different stocking management options. Managers will be able to use the “toolkit” to click through choices of fry or yearling stocking rates and check the impact various choices have on fishing effort. Overall, this is a significant step towards improving the small lake fishery management in British Columbia, Canada.
20 - Why do triploid rainbow trout die in lakes and what to do about it

Christine Verhille*, Department of Zoology, University of British Columbia, 4200-6270 University Blvd, Vancouver, BC, V6T 1Z4. Tel: (778) 846-5484. Email: verhille@interchange.ubc.ca

See abstract under oral presentations

21 - Angler characteristics in the Southern Interior of British Columbia

Hillary Ward*, Michael S Quinn, John R Post, Department of Biological Science, University of Calgary, 2500 University Dr NW, Calgary, AB, T2N 1N4. Tel: (604) 349-4324. Email: ward.hillary@gmail.com

Effective management of regional, recreational fisheries is predicated on understanding the expectations and use patterns of anglers. The objectives of our study were to (1) identify general characteristics of anglers in the study area, (2) determine motivations for fishing, (3) develop a typology of anglers for fisheries management purposes and (4) propose recommendations for the management of lakes in this area.

22 - Geoduck aquaculture and shell geochemistry: a case study of hypoxia

Geo Yongwen*, Makah Fisheries Management, P.O. Box 115, Neah Bay, WA 98357, USA &College of Fisheries, Huazhong Agricultural University, Wuhan, Hubei 430070, China. Email: gaoy@olypen.com

Geoduck clams, Panopea abrupta, are an economically important species in Puget Sound, Washington, with a long lifespan up to 160 years. The Makah Fisheries Management (MFM) started a test project on intertidal geoduck aquaculture in Neah Bay beaches in 2006, and collected samples from seawater, geoduck shell and flesh, and environmental parameters (e.g., temperature, salinity, pH, and dissolved oxygen) on a daily basis. Preliminary data showed that the monitoring results appear in agreement with stable isotopic and trace elemental analyses on geoduck shells from Hood Canal of Puget Sound. In particular, the $^{18}$O/$^{16}$O variations were consistent with seawater temperature changes in the geoduck beds whereas the Sr/Ca and Fe/Mn ratios were more related to water quality. In Hood Canal the $^{18}$O values of geoduck shells ranged from $-1.34$ to $+0.95\%$, while the $^{13}$C values ranged from $-2.19$ to $+0.35\%$. There were no apparent correlations between low dissolved oxygen (DO) and water temperature and salinity; however, comparisons between DO and $^{18}$O, $^{13}$C, and Sr/Ca and Fe/Mn ratios showed consistent changes over the past 16 years during which significant fish kills occurred in 2002-2003. Therefore, the shell geochemistry may provide valuable information for the long term ocean environmental studies as geoduck clams are long-lived and sedentary.
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