OREGON CHAPTER
AMERICAN FISHERIES SOCIETY

41st Annual Meeting

"MULTIDISCIPLINARY AND INNOVATIVE APPROACHES TO AQUATIC RESOURCE CONSERVATION"

February 16—18, 2005

CH2M Hill Alumni Center
LaSells Stewart Center
Oregon State University

Corvallis, Oregon

Oregon Chapter
American Fisheries Society
P.O. Box 722
Corvallis, OR 97339

www.orafs.org
LKBrenner@comcast.net

OREGON CHAPTER
AMERICAN FISHERIES SOCIETY

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Laura Tesler, Martyne Reesman, Tucker Jones, Chairs

Tom Friesen
Bruce Hansen
Joseph Tomelleri
Everyone who donated items & services

POSTER SESSION & SOCIAL

Jen Stone and Molly Webb Chairs

ARRANGEMENTS continued

PROGRAM EDITING & LAYOUT
Barry McPherson
Molly Webb
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SPONSORSHIPS & TRADE SHOW
Doug Olson

PRE-MEETING REGISTRATIONS & ON-SITE ASSISTANCE
Special thanks to the student volunteers

SPONSORS

The Oregon Chapter of the American Fisheries Society gratefully acknowledges the generosity of our sponsors. Sponsorship of our annual meeting underscores our common interests in constructively addressing natural resources issues and professional development. Thank you!

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PROGRAM PRINTING

Special thanks to the Bonneville Power Administration for printing the program and Peter Lofy for his assistance.

SPECIAL CONTRIBUTORS

Department of Fisheries and Wildlife, Oregon State University
Joseph Tomelleri, Cimmaron Trading Company
Stoneyburn Gallery

We also thank and recognize all the businesses and individuals that made a special Oregon Chapter AFS contribution or donated an item, service, or trip to our raffle and auction.

BEVERAGE SPONSORS

Full Sail Brewing Company, Hood River, Oregon
Mike Maytlewich
Jimmy Eisner, Hi-Tor Ranch

ACKNOWLEDGEMENTS

Special thanks go to all of the presenters of papers and posters and to those who coordinated and convened sessions. We are grateful for your time and special contribution to the Oregon Chapter AFS meeting.

To those whose names were not forwarded in time to be included in this program, or who saw a need and pitched in to help, we thank you!

Lastly, but not in the least, we acknowledge the countless hours of volunteer time and effort that go into making the Oregon Chapter meeting a success. Without the time, energy, and dedication of all the volunteers, we would not be able to plan and conduct a meeting of this size and caliber. Please consider getting involved in planning the 2006 Annual Meeting, or putting your energies into an officer or committee chair position. The Oregon Chapter AFS needs you! For more information contact Doug Olson, ORAFS President at doug_olson@r1.fws.org, or Loretta Brenner at LKBrenner@comcast.net, or visit our website at www.orafs.org

2005 Plenary Session Speakers

Note that instead of a multi-speaker plenary session at the beginning of the meeting, we are trying something new: you will hear one plenary speaker at the start of each day before you spread out into the concurrent technical sessions.

Dr. John Kitzhaber: "Creating a Society to Match our Scenery"

Our Wednesday plenary speaker is a powerful speaker and creative thinker dedicated to restoring and conserving watershed health. Dr. Kitzhaber is a former emergency physician, legislator and two-term Governor of Oregon (1995-2003). His legislative career, which began in 1979, was marked by active leadership in the areas of public education, community development, environmental stewardship and a wide variety of health care issues. Part of Dr. Kitzhaber's legacy as Governor is the innovative Oregon Plan for Salmon and Watersheds that fostered multidisciplinary management and monitoring efforts (Session 11 on Thursday afternoon reports on some results). Among other roles, Dr. Kitzhaber now serves as the Director for the *Center for Evidence Based Policy* at Oregon Health & Science University and as President of the *Kitzhaber Center*, a natural resource center housed at Lewis & Clark Law School.

John de Graaf: "Overworked Americans: The Impact on You, Family, Fish, and More"

On Thursday morning you'll want to hear John de Graaf, an author and independent television producer who produced the insightful TV specials "Affluenza" and "Running Out of Time" and co-wrote the book *Affluenza: The All-Consuming Epidemic*. As the National Coordinator for "Take Back Your Time Day" (October 24th of each year), he addresses the impacts of consumerism and time spent working to support the consumerism on our personal health and productivity, our families and relationships, our communities, and our environment. Many working in aquatic resource management and research find themselves overworked trying to stave off the effects of consumerism and lack of concern for the environment! An abstract of his paper is on page 45 of the *Abstracts of Papers* section in this program.

Nathan Mantua: "Global Warming Scenarios for the Northwest and Their Implications for Northwest Salmonids"

Friday morning you won't want to miss hearing from a renowned expert on global warming and its potential impacts on NW fishes. Nathan Mantua is an Assistant Professor of Atmospheric Sciences and Marine Affairs and a member of the Climate Impacts Group (CIG) at the University of Washington. The CIG has conducted applied interdisciplinary studies for 9 years, focusing on climate impacts on the water, forest, fishery, and coastal resources of Washington, Oregon, and Idaho and the entire Columbia River basin. Dr. Mantua has served on the US Global Oceans Ecosystems Dynamics (GLOBEC) Scientific Steering Committee, the National Research Council Committee on the Alaska Groundfish Fishery, and as Session chair for *Climate Variability and Change and Marine Fish Populations* at the Annual Beckman Frontiers of Science Symposium sponsored by the National Academy of Sciences. An abstract of his paper is on page 69 in the *Abstracts of Papers* section of this program.

Oregon Chapter American Fisheries Society 41st Annual Meeting
February 16-18, 2005
(Workshops begin February 15, 2005)
Corvallis, Oregon

PROGRAM AT A GLANCE (full program starts on page 13)

"Multidisciplinary and Innovative Approaches to Aquatic Resource Conservation"

PROGRAM SCHEDULE – TUESDAY, FEBRUARY 15, 2005	
Time Slot	
1:00–5:00pm *(break at 3:00pm)*	**Workshop A: "Experimental and Survey Design in Fisheries: A Statistics Workshop"** **Mary Buckman, Facilitator** CH2M Hill Alumni Center Ballroom 110A **Workshop B: "Age and Growth Assessment and Validation Techniques"** **Tom Rien, Facilitator** CH2M Hill Alumni Center Ballroom 110B
5:00-7:00pm	**Evening Social for Workshop Participants** CH2M Hill Alumni Center Foyer

PROGRAM SCHEDULE – WEDNESDAY, FEBRUARY 16, 2005	
Time Slot	
7:15-8:00am	**Coffee and Tea for Workshop Participants** CH2M Hill Alumni Center Foyer
8:00-11:30am *(break at 9:30am)*	**Workshop A continued: "Experimental and Survey Design in Fisheries: A Statistics Workshop"** CH2M Hill Alumni Center Ballroom 110A **Workshop B continued: "Age and Growth Assessment and Validation Techniques"** CH2M Hill Alumni Center Ballroom 110B
9:00-11:30am	**Free Workshop C: "AFS Certification: A How-To Guide"** Jen Stone and Carolina Franco (AFS), Facilitators CH2M Hill Alumni Center Trysting Tree Room 114A/B
10:00am-5:00pm	**Annual Meeting Registration, Welcome Coffee and Tea (9:30-11:00am)** CH2M Hill Alumni Center Foyer
12:30-6:30pm	**Poster Session Setup** CH2M Hill Alumni Center Ballroom
10:00am-11:00pm	**Presentation Preview and Practice Room** CH2M Hill Alumni Center (upstairs) - Stevenson Conference Room 201
11:15am-12:15pm	**"Box Lunch" Luncheon (must order before arrival)** CH2M Hill Alumni Center Foyer
12:00–1:00pm	**Plenary Session I:** **Dr. John Kitzhaber, Former Governor of Oregon** **"Creating a Society to Match our Scenery"** LaSells Stewart Center Austin Auditorium

PROGRAM AT-A-GLANCE CONTINUED

PROGRAM SCHEDULE – WEDNESDAY, FEBRUARY 16, 2005 continued					
Time Slot					
1:00-1:30pm	**Information Sharing Networks: New Ways to Professional Development and Chapter Activities** Don Ratliff & the Oregon Chapter Executive Committee LaSells Stewart Center Austin Auditorium				
1:30-1:40pm	**"Migration Time"—Spread Out and Navigate Your Way to Concurrent Sessions!**				
1:40pm – 5:30pm	**CONCURRENT SESSIONS** **(L = LaSells Stewart Center / C = CH2M Hill Alumni Center)**				
	(C) Alumni Center 115 A/B	**(L) Austin Auditorium**	**(L) C&E Auditorium**	**(C) Alumni Center 111A/B**	**(C) Alumni Center 114 A/B**
	Session 1 **Salmon 2100 Project: What Will It Take to Restore NW Salmon?** Conveners: Bob Lackey & Denise Lach	*Session 2* **Stream Habitat and Biological Condition Assessment** Convener: John Faustini *(includes student competitors)*	*Session 3* **Contributed Papers I: Watershed Programs and Fish/Habitat Relationships** Convener: Dave Ward	*Session 4* **Contributed Papers II: Cuttthroat Trout, Fish Disease and More** Conveners: Brad Smith & Bill Knox *(includes student competitors)*	*Session 5* **Contributed Papers III: Breadth, Depth and Innovation** Convener: Pete Lawson
3:20-3:40pm	**Refreshment Break (two locations)** LaSells Stewart Center & CH2M Hill Alumni Center Foyers				
6:00-7:00pm	**Student-Mentor Social—"Match the Hatch"** CH2M Hill Alumni Center Lounge. Library and Living Room				
7:00-11:00pm	**Chapter Poster Session, Trade Show & Social (included with registration)** CH2M Hill Alumni Center Ballroom				

PROGRAM AT-A-GLANCE CONTINUED

OREGON AFS PROGRAM SCHEDULE—THURSDAY, FEBRUARY 17, 2005

Time Slot					
6:45-7:45am	**Spawning Run (sign up at the registration desk on Wednesday)** CH2M Hill Alumni Center (meet outside the front door)				
7:15-8:00am	**Early Morning Coffee and Tea** LaSells Stewart Center Foyer *ONLY*				
7:15am-5:00pm	**Registration Desk, Sales, and Trade Show (opens at 9:00am)** CH2M Hill Alumni Center				
7:15am-11:00pm	**Presentation Preview and Practice Room** CH2M Hill Alumni Center (upstairs) - Stevenson Conference Room 201				
8:00-8:50am	**Plenary Session II:** **John de Graaf, Independent TV Producer:** **"Overworked Americans: The Impact on You, Family, Fish, and More"** LaSells Stewart Center's Austin Auditorium				
9:00–11:50am	**CONCURRENT SESSIONS** **(L = LaSells Stewart Center / C = CH2M Hill Alumni Center)**				
	(C) Alumni Center 114 A/B	**(L) Austin Auditorium**	**(C) Alumni Center 115 A/B**	**(L) C&E Auditorium**	**(C) Alumni Center 111 A/B**
	Session 6 **Avian Predation and Salmon Recovery: Scapegoat or Silver Bullet** Convener: Allen Evans *(includes student competitors)*	*Session* 7 **Contributed Papers IV: Habitat Restoration and More** Conveners: Steve Mazur & Blair Krohn *(includes student competitors)*	*Session* 8 **Introduced and Invasive Species** Convener: Charlie Corrarino	*Session* 9 **Contributed Papers V: Habitat Use, Distribution, Stress, and Systematics of Fishes** Conveners: Jeremiah Osborne-Gowey, Joseph Feldhaus, & Jens Lovtang *(includes student competitors)*	*Session* 10 **Nearshore Ecology and Management—Part I** Conveners: Hal Weeks & Selina Heppell *(includes student competitors)*
9:50–10:10am	**Refreshment Break (two locations)** LaSells Stewart Center & CH2M Hill Alumni Center Foyers				
12:00–1:20pm	**Business Lunch (included with registration)** **(Officer elections, resolutions, student award winners, and more!)** CH2M Hill Alumni Center Ballroom				

PROGRAM AT-A-GLANCE CONTINUED

OREGON AFS PROGRAM SCHEDULE—THURSDAY, FEBRUARY 17, 2005 continued

Time Slot				
1:30–5:20pm	**CONCURRENT SESSIONS** **(L = LaSells Stewart Center / C = CH2M Hill Alumni Center)**			
	(L) Austin Auditorium	**(L) C&E Auditorium**	**(C) Alumni Center 115 A/B**	**(C) Alumni Center 111 A/B**
	Session 11 **The Oregon Plan Coastal Coho Assessment** Convener: Bruce McIntosh	*Session 12* **Research and Management Issues in the Snake River Basin** Convener: Rich Carmichael	*Session 13* **Using Multiple Disciplines to Assess Restoration Opportunities in the Upper Klamath Basin** Conveners: Mary Hanson & Scott Snedaker	*Session 14* **Nearshore Ecology and Management—Part II** Conveners: Hal Weeks & Selina Heppell *(includes student competitors)*
3:20–3:40pm	**Refreshment Break (two locations)** LaSells Stewart Center & CH2M Hill Alumni Center Foyers			
5:30pm-11:00pm	Social Hour (5:30-6:30pm) — **CH2M Hill Alumni Center Ballroom** (all welcome) OSU Alumni Mixer (5:30-6:30pm) — **Alumni Center Lounge, Library & Living Room** (OSU Alums) Banquet (6:30-7:30pm) — **Ballroom** (included with FULL registration) Raffle and Silent and Oral Auction (7:30-9:00pm) — **Ballroom** (all welcome) Dance & Karaoke Party by NW Mobile DJ (9:00pm-11:00pm) — **Ballroom** (all welcome) After-Hours Mixer (9:00pm-11:00pm) — **Alumni Center Lounge, Library & Living Room** (all welcome)			

PROGRAM AT-A-GLANCE CONTINUED

PROGRAM SCHEDULE—FRIDAY, FEBRUARY 18, 2005

<table>
<tr><td>Time Slot</td><td colspan="4"></td></tr>
<tr><td>7:15-
8:00am</td><td colspan="4">Early Morning Coffee and Tea
LaSells Stewart Center ONLY</td></tr>
<tr><td>7:15am-
1:00pm</td><td colspan="4">Registration Desk, Sales, and Trade Show (opens at 9:00am)
CH2M Hill Alumni Center</td></tr>
<tr><td>7:15-
11:30am</td><td colspan="4">Presentation Preview and Practice Room
CH2M Hill Alumni Center (upstairs) - Stevenson Conference Room 201</td></tr>
<tr><td>8:00-
8:50am</td><td colspan="4">Plenary Session III:
Nathan Mantua, Climate Impacts Group, University of Washington
“Global Warming Scenarios for the Northwest and Their Implications for Northwest Salmonids”
LaSells Stewart Center Austin Auditorium</td></tr>
<tr><td rowspan="3">9:00am–
12:10pm</td><td colspan="4">CONCURRENT SESSIONS
(L = LaSells Stewart Center / C = CH2M Hill Alumni Center)</td></tr>
<tr><td>(L) Austin Auditorium</td><td>(L) C&E Auditorium</td><td>(C) Alumni Center 111A/B</td><td>(C) Alumni Center 115A/B</td></tr>
<tr><td>Session 15
Current Status of the Science and Management of Hatchery and Wild Fish in Oregon
Conveners:
Kirk Schroeder,
Dan Bottom &
Jeff Rodgers</td><td>Session 16
Futuring: Projecting Change in Use of Land and Water and Their Effects on Oregon Fishes
Convener:
Stan Gregory</td><td>Session 17
Building Tools and Resources to Increase Workforce Diversity: A Hands-On Work Session
Conveners:
Rebecca Goggans &
Judy Li</td><td>Session 18
Native Fishes: What Do We Know About the Species That Don't Make the Headlines
Convener: Steve Jacobs</td></tr>
<tr><td>9:50–
10:10am</td><td colspan="4">Refreshment Break (two locations)
LaSells Stewart Center & CH2M Hill Alumni Center Foyers</td></tr>
<tr><td>12:10pm</td><td colspan="4">Meeting Adjourns</td></tr>
<tr><td>1:30-
3:00pm</td><td colspan="4">Post-Meeting Tours of OSU Fish Research Facilities
(maps available at Registration Desk)
The Fish Performance and Genetics Laboratory
The John L. Fryer Salmon Disease Laboratory</td></tr>
</table>

Oregon Chapter American Fisheries Society 41st Annual Meeting
February 16-18, 2005

CH2M Hill Alumni Center, LaSells Stewart Center, Oregon State University, Corvallis

"MULTIDISCIPLINARY AND INNOVATIVE APPROACHES TO AQUATIC RESOURCE CONSERVATION"

2005 ANNUAL MEETING PROGRAM

Tuesday February 15

12Noon-5pm	Registration for Workshops Opens: **CH2M Hill Alumni Center - Foyer**
1:00–5:00pm	**Pre-meeting Workshops (break at 3pm)** Workshop A: "Experimental and Survey Design in Fisheries: A Statistics Workshop" Mary Buckman, Facilitator **CH2M Hill Alumni Center - Ballroom 110A** Workshop B: "Age and Growth Assessment and Validation Techniques" Tom Rien, Facilitator **CH2M Hill Alumni Center - Ballroom 110B**
5:00-7:00pm	Evening Social for Workshop Participants **CH2M Hill Alumni Center - Foyer**

Wednesday February 16

7:15-8:00am	Coffee and Tea for Workshop Participants **CH2M Hill Alumni Center - Foyer**
8:00-11:30am	Workshop A continued: "Experimental and Survey Design in Fisheries…" **CH2M Hill Alumni Center - Ballroom 110A** Workshop B continued: "Age and Growth Assessment…" **CH2M Hill Alumni Center - Ballroom 110B**
9:00-11:30am	Free Workshop C: "AFS Certification: A How-To Guide" Jen Stone and Carolina Franco (AFS), Facilitators **CH2M Hill Alumni Center - Trysting Tree Room 114A/B**
10:00am-5:00pm	Annual Meeting Registration / Welcome Coffee and Tea (9:30-11:00am) **CH2M Hill Alumni Center - Foyer**
12:30-6:30pm	Poster Session Setup **CH2M Hill Alumni Center Ballroom**
10:00am-11:00pm	Presentation Preview and Practice Room **CH2M Hill Alumni Center (upstairs) – Stevenson Conference Rm 201**
11:15am-12:15pm	Box Lunch Luncheon (must order before arrival) **CH2M Hill Alumni Center Foyer**

Wednesday continued February 16

Plenary Session I LaSells Stewart Center – Austin Auditorium

12:00-12:15 Opening Remarks & Welcome
Doug Olson, President, Oregon Chapter AFS
Barry McPherson, President-Elect & Program Chair, Oregon Chapter AFS

12:15-1:00 **Dr. John Kitzhaber,** *former Governor of Oregon and now president of* The Kitzhaber Center, *a natural resource center housed at Lewis & Clark Law School* - **"Creating a Society to Match our Scenery"**

1:00-1:30 **Information Sharing Networks:**
New Ways to Professional Development and Chapter Activities
Don Ratliff & the Oregon Chapter Executive Committee

1:30-1:40 **"Migration Time" – Spread Out and Navigate to Concurrent Sessions**

Session I CH2M Hill Alumni Center – 115 A/B

Salmon 2100 Project: What Will It Take to Restore NW Salmon?

Conveners: Bob Lackey (EPA) and Denise Lach (OSU)

1:40 Session Overview

1:50 The Salmon 2100 Project:
How to Sustain Significant, Sustainable Runs of Wild Salmon Through 2100
Bob Lackey (EPA) and Denise Lach (OSU)

2:10 Climate and Development in the 21st Century: Wild Salmon Caught in the Squeeze
James T. Martin (Berkley Fishing Tackle Company)

2:30 Thanksgiving 2101: A Salmon Story
Benjamin B. Stout (Retired; former university professor and administrator)

2:50 Caught in the Web: How to Sustain Wild Salmon Through 2100
David T. Hoopes (San Juan Conservation District)

3:10 Sustaining Wild Salmon Through 2100: Structural Barriers to Ecotopia
James L. Buchal (Murphy & Buchal LLP)

3:30 – 3:50 Refreshment Break – LaSells Stewart Center & CH2M Hill Alumni Center Foyers

3:50 Salmon 2100: A Strategy to Anchor and Expand the Remaining Wild Salmon Strongholds
Guido Rahr and Xanthippe Augerot (Wild Salmon Center)

4:10 Cost-Effective Solutions to Reversing the Failure of Wild Salmon Recovery
Larry L. Bailey and Michelle L. Boshard (Rural Resource Associates Ltd.)*

4:30 Saving Wild Salmon: Moving from Symbolic Politics to Effective Policy
Brent S. Steel (OSU)

4:50 Changes Necessary to Provide for Significant, Sustainable Wild Salmon Populations in North America South of Central British Columbia
John H. Michael Jr. (Fisheries Biologist, Olympia, WA)

5:10 Panel Discussion with All Speakers

6:00 – 7:00pm **Student-Mentor Social -"Match the Hatch"**
CH2M Hill Alumni Center – Lounge, Library and Living Room

7:00 – 11:00pm **Poster Session, Trade Show and Social – CH2M Hill Alumni Center Ballroom**

Session 2 LaSells Stewart Center – Austin Auditorium

Stream Habitat and Biological Condition Assessment

Convener: John Faustini (OSU)

1:40 Session Overview

1:50 Basin-Scale Controls on the Expression of Reach-Scale Channel Morphology, Debris Flow Runout, and the Spatial Distribution of Salmonids in Steep Mountain Streams
Christine L. May and William E. Dietrich (UC Berkeley)

2:10 Patterns in the Abundance and Distribution of Juvenile Coho in Oregon's Mid-Coast
Rebecca Flitcroft (OSU), Gordon Reeves (USFS) and Richard Schmitz (OSU)

2:30 A Landscape Classification Approach to Support the Design, Analysis, and Interpretation of Stream Habitat Assessment and Restoration Projects
Chris Jordan, Steve Rentmeester, Carol Volk, Mimi D'Iorio, and George Pess (NOAA Fisheries)

2:50 A Riverscape Perspective: Tier III Monitoring as a Planning Tool for Restoration
Guillermo Giannico, Scott Heppell, and Hiram Li (OSU), Chris Jordan (NOAA Fisheries), Michael Newsom (BOR), Phil Larsen (EPA), Nick Bouwes (Eco Logical Research) and Jim Ruzycki (ODFW)

3:10 Long-Term Water Temperature Variability in the John Day Basin: Spatial Analysis of Multi-Source Data
Carol J. Volk, Chris Jordan and Steve Rentmeester (NOAA Fisheries)

3:30 – 3:50 Refreshment Break – LaSells Stewart Center & CH2M Hill Alumni Center Foyers

3:50 Physiological Tools to Assess Thermal Stream Habitat Quality for Redband Trout (*Oncorhynchus mykiss*) in the South Fork John Day River
***J.W. Feldhaus (OSU)**, M.G. Mesa (USGS) and S.A Heppell, L.J. Madsen, and H.W. Li (OSU)*

4:10 Linking Fine- and Coarse-Scale Studies to Determine Spatial Distribution of Redband Trout (*Oncorhynchus mykiss gairdneri*) at the Watershed Scale
***Luis F. Madriñán**, Hiram W. Li, Guillermo Giannico, and Stanley Gregory (OSU) and Blake E. Feist (NOAA Fisheries)*

4:30 Macroinvertebrate Assemblage Patterns in the North Fork John Day River During Sediment Inputs
W.J. Gerth and J.L. Li (OSU)

4:50 Assessing Stream Habitat Quality in Two Interior Columbia Basin Watersheds with an Emphasis on Excess Fine Sediments
John M. Faustini and Alan Herlihy (OSU) and Philip R. Kaufmann, David P. Larsen, and Peter Leinenbach (EPA)

5:10 In Search of the Holy Grail: Evolution of an Integrated Aquatic Monitoring Program on Private Timberlands
Lowell V. Diller, Matthew R. House, and Brian D. Michaels (Green Diamond Resource Company)

6:00 – 7:00pm **Student Mentor Social -"Match the Hatch"**
CH2M Hill Alumni Center – Lounge, Library and Living Room

Wednesday continued February 16

7:00 – 11:00pm Poster Session, Trade Show and Social – CH2M Hill Alumni Center Ballroom

Session 3 LaSells Stewart Center – C & E Auditorium

Contributed Papers I: Watershed Programs and Fish/Habitat Relationships

Convener: Dave Ward (ODFW)

1:40 Session Overview

1:50 Habitat Improvement Locally to Benefit At-Risk Species Regionally—Oregon's Landowner Incentive Program
Nancy L. Breuner, Bruce Campbell and Miriam Hulst (ODFW)

2:10 Salmon Habitat Conservation and Restoration Using Utility Customer Renewable Energy Funds
Leslie B. Bach, Catherine Macdonald and Christopher S. Robbins (The Nature Conservancy)

2:30 Siuslaw River Basin Restoration Partnership Wins Theiss International Riverprize Award: What Does It Mean for Restoration and Where Do We Go from Here?
Paul Burns (USFS), Johnny Sundstrom (Siuslaw Institute) and Todd Miller (Siuslaw Watershed Council)

2:50 Enforcing Removal-Fill Laws and Protection of Wetlands and Waters of the State
Craig Ball (Oregon State Police)

3:10 Growth, Survival and Movement of Juvenile Salmonids as Indicators of Habitat Quality
J. L. Ebersole, P.J. Wigington Jr., J.P. Baker, M.A. Cairns, M.R. Church, J.E. Compton, S.G. Leibowitz, and D. White (EPA), B. Hansen (USFS) and B. Miller (ODFW)

3:30 – 3:50 Refreshment Break – LaSells Stewart Center & CH2M Hill Alumni Center Foyers

3:50 Longitudinal Patterns of Stream Fishes, Aquatic Habitat and Water Temperature in the Lower Crooked River, Oregon
C.E. Torgersen and R.E. Gresswell (USGS), D.S. Bateman (OSU) and D.P. Hockman-Wert (USGS)

4:10 A Comparison of Salmonid Abundance and Habitat Availability Within Two Managed Tributaries in Del Norte County, California
C.F. Howard (Mill Creek Fisheries Monitoring Program)

4:30 Connecting Bull Trout Habitat and Populations—What Is Gained?
Steve Cramer and Keith Underwood (SP Cramer and Associates, Inc.)

4:50 Reach-Specific Survival of Spring Chinook Salmon Smolts in the Grande Ronde River
F. R. Monzyk (ODFW)

5:10 Overwinter Survival Estimates of Juvenile Coho: A Cautionary Tail
Matthew R. House, Lowell V. Diller and Glen Wightman (Green Diamond Resource Company)

6:00 – 7:00pm Student Mentor Social -"Match the Hatch"
CH2M Hill Alumni Center – Lounge, Library and Living Room

7:00 – 11:00pm Poster Session, Trade Show and Social – CH2M Hill Alumni Center Ballroom

Session 4 CH2M Hill Alumni Center – 111 A/B

Contributed Papers II: Cuttthroat Trout, Fish Disease, and More

Convener: Brad Smith and Bill Knox (ODFW)

1:40 Session Overview

1:50 Seasonal Persistence of Coastal Cutthroat Trout Distributions in a Headwater Stream
M. S. Novick *(OSU) and R. E. Gresswell (USGS)*

2:10 Topography and Distribution Patterns of Lahontan Cutthroat Trout (*Oncorhynchus clarki henshawi)* in a Stream Habitat Mosaic
George Boxall*, Guillermo Giannico, and Hiram Li (OSU), Matthew Varner (BLM)*

2:30 Responses of an Endangered Cutthroat Trout to an Exotic Invading Charr
J.D. Osborne-Gowey *and G. Boxall (OSU), A. Jenne (Nevada Dept. of Wildlife), S. Heppell, H. Li and C. Pereira (OSU) and M. Varner (BLM)*

2:50 Coastal Cutthroat Trout Life History Strategies in Abernathy Creek and Chinook River, Washington, Two Tributaries of the Columbia River
Jeffrey Johnson (USFWS), Joe Zydlewski (U. of Maine) and Jeff Hogle, John Brunzell,, and Michael Hudson (USFWS)

3:10 Cutthroat Trout Conservation: Are Conservation Agreements/Strategies Effective?
J. Michael Hudson (USFWS)

3:30 – 3:50 Refreshment Break – LaSells Stewart Center & CH2M Hill Alumni Center Foyers

3:50 Controlling the Spread of *Myxobolus cerebralis* in Clear Creek, a Tributary of the Clackamas River
Jerri Bartholomew, Stephen Atkinson, Harriet Lorz, Donald Stevens, and Sascha Hallett (OSU) and Antonio Amandi (ODFW)

4:10 Replacement of Sentinel Fish Exposures with a Real-Time PCR Assay to Detect the Parasite *Ceratomyxa shasta* in the Klamath River
Sascha L. Hallett and Jerri L. Bartholomew (OSU)

4:30 Larval Transport Versus Larval Retention of River and Lake Spawning Suckers in Upper Klamath Lake, Oregon
Susan Reithel*, Mark Terwilliger, David Simon and Douglas Markle (ODFW)*

4:50 Using Social Foraging Theory to Examine the Effects of Resource Availability on Juvenile Salmonids in the Interior Columbia River Basin
Karl M. Polivka and Joshua Y. Kill (USFS)

5:10 Growth Dynamics of Smallmouth Bass in Lake Billy Chinook, Oregon
T. M. Shrader (ODFW) and M. Weldon (Confederated Tribes of Warm Springs)

6:00 – 7:00pm Student Mentor Social -"Match the Hatch"
CH2M Hill Alumni Center – Lounge, Library and Living Room

7:00 – 11:00pm Poster Session, Trade Show and Social – CH2M Hill Alumni Center Ballroom

Wednesday continued February 16

Session 5 CH2M Hill Alumni Center – 114 A/B

Contributed Papers III: Breadth, Depth and Innovation

Convener: Pete Lawson (NOAA Fisheries)

1:40 Session Overview

1:50 Ghost Nets in the Columbia River: How Scary Are They?
Kevin M. Kappenman and Blaine Parker (Columbia River Inter-Tribal Fish Commission)

2:10 Fall Chinook Turn-Arounds During Lower Columbia River Dam Passage Attempts (1998-2003): Where Did They Occur and How Far Did Fish Retreat?
Kinsey E. Frick and, Brian J. Burke (NOAA Fisheries) and Christopher A. Peery (U. of Idaho)

2:30 Genetic Population Structure of Central Oregon Coast Coho Salmon (*Oncorhynchus kisutch*)
Michael J. Ford, David Teel, Donald M. Van Doornik, David Kuligowski, and Peter W. Lawson (NOAA Fisheries)

2:50 Estimating the Size of Historical Coastal Oregon Salmon Runs
Chad C. Meengs (OSU) and Robert T. Lackey (EPA)

3:10 Peer Review: Science's Gatekeeper. Is This a Good Thing?
C. Dewberry (Gutenberg College)

3:30 – 3:50 Refreshment Break

3:50 Timing the Salmon
Bernie Taylor (The B. Taylor Group LLC)

4:10 Evidence of Xenoestrogens in Fishes from Rocky Mountain National Park, Colorado
A. R. Schwindt and C. B. Schreck (OSU), D. H. Landers (EPA) and L. Ackerman, S. Simonich, J. Ramsay, and M. L. Kent (OSU)

4:30 An Outmigrant Trapping Effort: An Industrial Revolution
Darold B. Perry and Matthew R. House (Green Diamond Resource Company)

4:50 Tracking Bull Trout with Stream-Width Half-Duplex Passive Interrogation
J. Vincent Tranquilli, Mark G. Wade and Chad K. Helms (ODFW)

5:10 Evaluation of Outplanting Hatchery-Origin Adult Spring Chinook Salmon (*Oncorynchus tshawytscha*) to Supplement an Endemic Population in Shitike Creek, Oregon
G.W. FitzGerald and Bob Spateholts (Confederated Tribes of the Warm Springs) and Douglas E. Olson, Rod O. Engle, Thomas A. Hoffman, David M. Hand, Donald E. Campton, William R. Arden, Jason Baumsteiger and Mike Paiya (USFWS)

6:00 – 7:00pm Student Mentor Social -"Match the Hatch"
CH2M Hill Alumni Center – Lounge, Library and Living Room

7:00 – 11:00pm Poster Session, Trade Show and Social – CH2M Hill Alumni Center Ballroom

Thursday February 17

6:45-7:45am Spawning Run (sign up at the registration desk on Wednesday)
CH2M Hill Alumni Center (meet outside the front door)

7:15-8:00am Early Morning Coffee and Tea
LaSells Stewart Center *ONLY*

7:15am-5:00pm Registration Desk & Sales / Trade Show (opens at 9:00am)
CH2M Hill Alumni Center - Foyer

7:15am-11:00pm Presentation Preview and Practice Room
CH2M Hill Alumni Center (upstairs) - Stevenson Conference Room 201

Plenary Session II LaSells Stewart Center – Austin Auditorium

8:00 – 8:50 **John de Graaf**, *independent TV producer, author and "Take Back Your Time" National Coordinator* – **"Overworked Americans: The Impact on You, Family, Fish, and More"**

Session 6 CH2M Hill Alumni Center – 114 A/B

Avian Predation and Salmon Recovery: Scapegoat or Silver Bullet

Convener: Allen Evans (Real Time Research, Inc.)

9:00 Session Overview

9:10 Avian Predation on Juvenile Salmonids in the Columbia River Basin: An Overview
Daniel D. Roby (OSU), Ken Collis (Real Time Research, Inc.), Donald E. Lyons (OSU), Allen Evans (Real Time Research, Inc.), Karen N. Fischer, Anne Mary Myers, Christopher Couch, and Jessica Y. Adkins (OSU), and Mike Hawbecker (Real Time Research, Inc.)

9:30 Adaptive Management of Predator-Prey Linkages: Piscivorous Birds and Endangered Salmon in the Columbia River
Francis K. Wiese, Julia K. Parrish, and Christopher W. Thompson (UW)

9:50 – 10:10 Refreshment Break - LaSells Stewart Center & CH2M Hill Alumni Center Foyers

10:10 The Monitoring and Evaluation of Avian Predation on Juvenile Salmonids on the Yakima River, Washington, Annual Report 2003
Ann E. Stephenson (Yakama Nation Fisheries)

10:30 Avian Predation on Juvenile Salmonids in the Mid-Columbia River: Assessing the Magnitude of Impacts
Allen Evans and Ken Collis (Real Time Research, Inc.), Daniel D. Roby and Donald E. Lyons (OSU), Mike Hawbecker (Real Time Research, Inc.), Garrett Dorsey, Christopher Couch, S. Kim Nelson, Jessica Y. Adkins, and Anne Mary Myers (OSU)

Thursday continued February 17

Session 6 continued CH2M Hill Alumni Center – 114 A/B

10:50 Avian Predation in the Columbia River Estuary: World's Largest Caspian Tern and Double-Crested Cormorant Colonies
Donald E. Lyons *and Daniel D. Roby (OSU), Ken Collis (Real Time Research, Inc.), Karen N. Fischer and Anne Mary Myers (OSU), Allen Evans (Real Time Research, Inc.), Christopher Couch and Jessica Y. Adkins (OSU) and Mike Hawbecker (Real Time Research, Inc.)*

11:10 Losses of Radio-Tagged Smolts to Avian Predators in the Columbia River Estuary: What We Know and How to Better Understand What We Don't Know
B. J. Clemens, M. D. Karnowski, and C. B. Schreck (OSU)

11:30 Use of PIT Tags to Evaluate Predation by Colonial Waterbirds on Juvenile Salmonids
Brad A. Ryan, G.M. Matthews and B.P. Sandford (NOAA Fisheries)

12-1:20pm **Thursday Lunch & Business Meeting (included with all registrations) – CH2M Hill Alumni Center Ballroom**

Session 7 LaSells Stewart Center – Austin Auditorium

Contributed Papers IV: Habitat Restoration and More

Conveners: Steve Mazur and Blair Krohn (ODFW)

9:00 Session Overview

9:10 Comparison of 1-D and 2-D Hydraulic Models in a Boulder-Strewn River
David G. Callery and Tim S. Hardin (Hardin-Davis, Inc.)

9:30 Sand Seals in Coho Salmon Redds: Do They Improve Egg Survival?
Carolyn B. Meyer (U of Wyoming), Michael D. Sparkman (CDFG) and Bernard A. Klatte (USACE)*

9:50 – 10:10 Refreshment Break - LaSells Stewart Center & CH2M Hill Alumni Center Foyers

10:10 Large-Wood Restoration in Oregon Streams: Biological Integrity or Photo Op?
Michele Koehler (ABR, Inc.) and Ralph Garono (Earth Design Consultants, Inc.)

10:30 Effectiveness of Common Habitat Restoration Techniques at Increasing Fish Abundance in the Pacific Northwest, U.S.A.
Phil Roni, Todd Bennett, Martin Liermann, Sarah Morley, and George Pess (NOAA Fisheries)

10:50 Riparian Reserve Monitoring of Post-Fire Logging in the Siskiyou National Forest
Richard K. Nawa and Lisa Shelton (Siskiyou Regional Education Project)

11:10 The Effects of Forest Harvest and Flow-Duration on Insect Emergence from Headwater Streams in the Oregon Coast Range
Janel Banks*, Alan Herlihy, and Judith Li (OSU)*

11:30 What's for Dinner? Seasonal Differences in Riparian Consumer Diet and Insect Communities in an Oregon Coast Range Watershed Food Web
Amanda Robillard *and Judith Li (OSU)*

12-1:20pm **Thursday Lunch & Business Meeting (included with all registrations) – CH2M Hill Alumni Center Ballroom**

Session 8 CH2M Hill Alumni Center – 115 A/B

Introduced and Invasive Species

Convener: Charlie Corrarino (ODFW)

9:00 Session Overview

9:10 Aquatic Invasive Species 101 – The Big (and Scary) Picture
Paul Heimowitz (USFWS)

9:30 Response to Aquatic Invasive Species
Mark Sytsma (PSU)

9:50 – 10:10 Refreshment Break - LaSells Stewart Center & CH2M Hill Alumni Center Foyers

10:10 Non-Native Species in Oregon Estuaries
Sylvia Behrens Yamada (OSU)

10:30 An Assessment of the Impacts of Introduced Fishes on the Oregon Coast Coho ESU
Michael E. Gray (ODFW)

10:50 Impacts of Invasive Species on Riparian Restoration Projects
Sam S. Chan (OSU)

11:10 Hazard Analysis and Critical Control Point (HACCP) Planning; a Protocol for Preventing the Spread of New Zealand Mudsnails (*Potamopyrgus antipodarum*) by Hatcheries and Field Researchers
Robyn Draheim (PSU), David Huff (DEQ), Kristina A. Fausti (USFS) and Paul Heimowitz (USFWS)

11:30 Preparing for Lewis and Clark: Efforts Throughout the West to Prevent Zebra Mussels from Hitching a Ride Across the Continent with Lewis and Clark Visitors
Bill Zook (Consulting Contractor) and Stephen Phillips (PSMFC)

12-1:20pm Thursday Lunch & Business Meeting (included with all registrations) – CH2M Hill Alumni Center Ballroom

Session 9 LaSells Stewart Center – C & E Auditorium

Contributed Papers V: Habitat Use, Distribution, Stress, and Systematics of Fishes

Conveners: Jeremiah Osborne-Gowey, Joseph Feldhaus and Jens Lovtang (OSU)

9:00 Session Overview

9:10 Strategies for Survival: Habitat Use and Distribution of Juvenile Chinook Salmon in the Metolius River Basin, Oregon
Jens C. Lovtang *and Hiram W. Li (OSU)*

9:30 Estimating Abundance and Spatial Distribution of Fall Migrating *Oncorhynchus mykiss* in the South Fork of the John Day River
Ian A. Tattam *(OSU), James R. Ruzycki, Wayne H. Wilson and Troy D. Goby (ODFW), Hiram W. Li and Guillermo R. Giannico (OSU)*

9:50 – 10:10 Refreshment Break - LaSells Stewart Center & CH2M Hill Alumni Center Foyers

10:10 A Microarray-Based Analysis of the Stress Response in *Oncorhyncus mykiss*
Tracey S. Momoda*, Lena Gerwick, Chris Bayne and Carl B. Schreck (OSU)*

Thursday continued February 17

Session 9 continued LaSells Stewart Center – C & E Auditorium

10:30 Whole-body Cortisol as an Indicator of Crowding Stress in Adult Zebrafish (*Danio rerio*)
J.M. Ramsay *and G.W. Feist (OSU), Z. Varga, M. Westerfield and J.L. Matthews (UO), M.L. Kent and C.B. Schreck (OSU)*

10:50 Spawning, Larval Drift, and Early Mortality of Pacific Lamprey (*Lampetra tridentata*) in the South Fork Coquille River
Abel Brumo *(OSU), Leo Grandmontagne (Wild Fish for Oregon), Steve Namitz (USFS) and Douglas Markle (OSU)*

11:10 Systematic Study of Smallscale Sucker (*Catostomus rimiculus*) in Oregon
J. Kettratad *and D. F. Markle (OSU)*

11:30 Invasive Species Stream Assessments in the Umatilla, Walla Walla, John Day, and Grand Ronde River Systems
Patrick Luke *(OSU), Gary James, Jayne Brimbox and Jeanette Howard (Confederated Tribes of the Umatilla Indian Reservation), and Blaine Parker (Columbia River Inter-Tribal Fish Commission)*

12-1:20pm Thursday Lunch & Business Meeting (included with all registrations) – CH2M Hill Alumni Center Ballroom

Session 10 CH2M Hill Alumni Center – 111 A/B

Nearshore Ecology and Management – Part I

Conveners: Hal Weeks (ODFW) and Selina Heppell (OSU)

9:00 Session Overview

9:10 Using Stable Isotopes to Delineate Shelf and Offshore Pelagic Communities Off California and Oregon
T.W. Miller *(OSU), R.D. Brodeur and K.L. Bosley (NOAA Fisheries)*

9:30 Differing Anti-Predator Strategies of Three Juvenile North Pacific Flatfish Species
Jena L. Lemke *(OSU) and Clifford H. Ryer (NOAA Fisheries)*

9:50 – 10:10 Refreshment Break - LaSells Stewart Center & CH2M Hill Alumni Center Foyers

10:10 Age, Growth, and Maturity of the Longnose Skate (*Raja rhina*) for the U.S. West Coast: Preliminary Results
Josie Thompson *(OSU), Wade Smith (Pacific Shark Research Center), Michael Schirripa, and Scott Heppell (OSU)*

10:30 Do Big Old Fat Females Spawn First? Assessment of the Reproductive Cycle of Black Rockfish (*Sebastes melanops*) from the Central Oregon Coast
Brooke Martin *and Selina Heppell (OSU)*

10:50 Defining Micro-Habitat for Juvenile Black Rockfish (*Sebastes melanops*): the Role of Abiotic and Biotic Structure
Marion Mann *(OSU)*

11:10 Determinants of Refuge Utilization by Post-Settlement Lingcod (*Ophiodon elongatus*)
***Megan Petrie** (OSU)*

11:30 Habitat Utilization of an Oregon Estuary by Lingcod (*Ophiodon elongatus*)
***T. W. Schwager** and S. A. Heppell (OSU)*

12-1:20pm **Thursday Lunch & Business Meeting (included with all registrations) – CH2M Hill Alumni Center Ballroom**

Session 11 LaSells Stewart Center – Austin Auditorium

The Oregon Plan Coastal Coho Assessment

Convener: Bruce McIntosh

1:30 Session Overview

1:40 Development and Application of Biological Criteria to Assess the Viability of the Oregon Coast Coho ESU
Mark Chilcote, Tom Nickelson, Kelly Moore, and Ed Bowles (ODFW), Jay Nicholas (OWEB), and Bruce McIntosh (ODFW)*

2:00 Conservation Efforts to Address Harvest Management as a Factor for Decline for the Oregon Coast Coho ESU
Curt Melcher (ODFW)

2:20 Conservation Efforts to Address Hatchery Management as a Factor for Decline for the Oregon Coast Coho ESU
Mark Lewis (ODFW)

2:40 The Status and Trend of Instream Habitat and Riparian Conditions in the Oregon Coast Coho ESU
Jeff Rodgers (ODFW)

3:00 Water Quality of the Oregon Coast Coho ESU
Michael Mulvey, Aaron Borisenko and Rick Hafele (DEQ)

3:20 – 3:40 Refreshment Break - LaSells Stewart Center & CH2M Hill Alumni Center Foyers

3:40 A Spatial Evaluation of Habitat Access Conditions and Oregon Plan Fish Passage Improvement Projects in the Oregon Coast Coho ESU
Liz Dent and Andrew Herstrom (ODF) and Erin Gilbert (ODFW)

4:00 Conservation Efforts to Address Wetlands and Estuaries as a Factor for Decline for the Oregon Coast Coho ESU
Eric Metz and Julie Wirth (DSL)

4:20 Conservation and Restoration Efforts to Address Factors for Decline for the Oregon Coast Coho ESU: *Story-Boarding* the Coho ESU Assessment
Jay Nicholas (OWEB)

4:40 Panel Discussion with All Speakers

5:15 Wrap Up
Bruce McIntosh (ODFW)

Thursday continued February 17

5:30-11:00pm **Social, Banquet, Awards, Raffle, Auction, Music & Mixing**

Social Hour (5:30-6:30pm) — CH2M Hill Alumni Center Ballroom (all welcome)

OSU Alumni Mixer (5:30-6:30pm) —
CH2M Hill Alumni Center Lounge, Library & Living Room (OSU Alums)

Banquet (6:30-7:30pm) — Ballroom (included with FULL registration)

Raffle and Silent and Oral Auction (7:30-9:00pm) — Ballroom (all welcome)

Dance & Karaoke Party by NW Mobile DJ (9:00pm-11:00pm) —
Ballroom (all welcome)

After-Hours Mixer (9:00pm-11:00pm) —
CH2M Hill Alumni Center Lounge, Library & Living Room (all welcome)

Session 12 LaSells Stewart Center – C & E Auditorium

Research and Management Issues in the Snake River Basin

Convener: Rich Carmichael (ODFW)

1:30 Session Overview

1:40 Current and Historical Steelhead Population Structure in the Snake River: Diversity, Data, and Designations
Michelle McClure (NOAA Fisheries) and the Interior Columbia Technical Recovery Team (11 others)

2:00 Effects of Juvenile Migration and Ocean/Climate Conditions on Smolt-to-Adult Return Rates and Recruitment for Snake River Chinook Salmon
Howard Schaller (USFWS) and Charlie Petrosky (IDFG)

2:20 The Effects of Mainstem Flow and Water Velocity on Spring Chinook Salmon and Steelhead Populations from the Snake River
M.J. Filardo and J.A. McCann (Fish Passage Center)

2:40 NOAA Fisheries' Hydro Actions Being Applied to Manage Listed Snake River Salmon
Paul Wagner (NOAA Fisheries)

3:00 Life History Study of Spring Chinook Salmon in the Grande Ronde River Subbasin
Brian Jonasson, Fred Monzyk, Alyssa Reischauer, and Erick Van Dyke (ODFW)

3:20 – 3:40 Refreshment Break - LaSells Stewart Center & CH2M Hill Alumni Center Foyers

3:40 Alternative Life History Strategies of *Oncorhynchus mykiss* in Northeast Oregon: Evidence from Otolith Elements
James Ruzycki and Michael Flesher (ODFW), Timothy Whitesel (USFWS) and Richard Carmichael (ODFW)

4:00 Chinook Salmon and Steelhead Behavior at Dams as Determined by PIT Tags and Radio Tags
Brian J. Burke and Sandra L. Downing (NOAA Fisheries), Theodore J. Bohn (UW) and Michael A. Jepson (UI)

4:20 Snake River Sockeye Salmon Captive Broodstock Program
C. Willard, D. Baker, and P. Kline (IDFG), and T. Flagg (NOAA Fisheries)

4:50 Research and Management Issues Relevant to Snake River Fall Chinook Salmon
William P. Connor (USFWS)

5:30-11:00pm **Social, Banquet, Awards, Raffle, Auction, Music & Mixing**

Social Hour (5:30-6:30pm) — CH2M Hill Alumni Center Ballroom (all welcome)

OSU Alumni Mixer (5:30-6:30pm) —
CH2M Hill Alumni Center Lounge, Library & Living Room (OSU Alums)

Banquet (6:30-7:30pm) — Ballroom (included with FULL registration)

Raffle and Silent and Oral Auction (7:30-9:00pm) — Ballroom (all welcome)

Dance & Karaoke Party by NW Mobile DJ (9:00pm-11:00pm) —
Ballroom (all welcome)

After-Hours Mixer (9:00pm-11:00pm) —
CH2M Hill Alumni Center Lounge, Library & Living Room (all welcome)

Session 13 CH2M Hill Alumni Center – 115 A/B

Using Multiple Disciplines to Assess Restoration Opportunities in the Upper Klamath Basin

Conveners: Mary Hanson (ODFW) and Scott Snedaker (BLM)

1:30 Session Overview

1:40 The Klamath Water Crisis
Bob Hunter (WaterWatch)

2:00 Reconstruction of the Distributions of Anadromous Fish Upstream from Iron Gate Dam on the Klamath River – An Approach Based Upon Multiple Lines of Evidence
John Hamilton and G.L. Curtis (USFWS), S.M. Snedaker (BLM), and D.K. White (NOAA Fisheries)

2:20 Ecology of the Salmonid Parasite *Ceratomyxa shasta* in the Klamath River
R.W. Stocking (OSU), R.A. Holt (ODFW), S.J. Foott (USFWS), M. Hiner (Yurok Tribal Fisheries Program), and J.L. Bartholomew (OSU)

2:40 Life History of Redband Trout in the Klamath River, Oregon
William R. Tinniswood and Roger C. Smith (ODFW)

3:00 Seasonal Water Quality and Fish Assemblage of Keno Impoundment and Implications for Native Fish Restoration
Richard M. Piaskowski (BOR) and David C. Simon (OSU)

3:20 – 3:40 Refreshment Break - LaSells Stewart Center & CH2M Hill Alumni Center Foyers

3:40 Understanding Relationships Between Habitat and Early Life Stages of Lost River and Shortnose Suckers in a Restored Riverine Wetland
John D. Crandall (The Nature Conservancy)

4:00 Nutrient Trends and Land Use in the Sevenmile Creek Tributary of Upper Klamath Lake: Opportunities for Management and Restoration
J. Kann (Aquatic Ecosystem Sciences LLC) and D. Ciotti (OSU)

4:20 Fish Passage Recovery Activities in the Upper Klamath Basin
Chuck Korson (BOR)

Session 13 continued CH2M Hill Alumni Center – 115 A/B

4:40 The Use of the Ecosystem Diagnosis and Treatment (EDT) Model in Fish Habitat Restoration in the Klamath Basin
Ian B. Chane (PacifiCorp), Kevin Malone (Mobrand Biometrics) and Linda Prendergast (PacifiCorp)

5:00 Structuring Klamath River Fish Passage Decisions
Gretchen R. Oosterhout (Decision Matrix, Inc.)

5:30-11:00pm **Social, Banquet, Awards, Raffle, Auction, Music & Mixing**

Social Hour (5:30-6:30pm) — CH2M Hill Alumni Center Ballroom (all welcome)

OSU Alumni Mixer (5:30-6:30pm) —
CH2M Hill Alumni Center Lounge, Library & Living Room (OSU Alums)

Banquet (6:30-7:30pm) — Ballroom (included with FULL registration)

Raffle and Silent and Oral Auction (7:30-9:00pm) — Ballroom (all welcome)

Dance & Karaoke Party by NW Mobile DJ (9:00-11:00pm) —
Ballroom (all welcome)

After-Hours Mixer (9:00-11:00pm) —
CH2M Hill Alumni Center Lounge, Library & Living Room (all welcome)

Session 14 CH2M Hill Alumni Center – 111 A/B

Nearshore Ecology and Management – Part II

Conveners: Hal Weeks (ODFW) and Selina Heppell (OSU)

1:30 Session Overview

1:40 Modeling Juvenile Salmonid Migration Patterns for the Columbia River Estuary
Nathan Truelove *and Carl Schreck (OSU) and Antonio Baptista (Center for Coastal and Land-Margin Research)*

2:00 A Telemetry Study of Downstream Coho Smolt Movement in the Yaquina River and Estuary
James H. Power (EPA) and Steven Johnson and Derek Wilson (ODFW)

2:20 Tidal Effects on Smolt Behavior in the Columbia River Estuary and the Relationship to Avian Predation; Can This be Managed?
M. D. Karnowski, B. J. Clemens and C. B. Schreck (OSU)

2:40 From Genotyping Salmon to Ageing Flatfish: What Pinniped Scat Can Reveal About Marine Ichthyofauna
Susan D. Riemer, Bryan E. Wright, and Robin F. Brown (ODFW)

3:00 Life Under Pressure: A Look at Swimbladders and Barotrauma Using Pressurized Aquaria
Polly S. Rankin, Steven J. Parker, and Robert W. Hannah (ODFW)

3:20 – 3:40 Refreshment Break - LaSells Stewart Center & CH2M Hill Alumni Center Foyers

3:40 Use of a Video-Equipped Recompression Cage to Observe Barotrauma Recovery in Rockfish
Keith Matteson and Robert W. Hannah (ODFW)

4:00 Fish Density and Diversity on a Nearshore Rocky Reef Complex
Hal Weeks, Arlene Merems, Bill Miller, and Dave Fox (ODFW)

4:20 Dungeness Crab Harvest by Native People in Netarts Bay, Oregon
Robert J. Losey (University of Alberta), Sylvia Behrens Yamada (OSU), and Leah Largaespada (USFS)*

4:40 Developing Oregon's *Nearshore Marine Resource Management Strategy*: A Proactive Approach to Marine Resource Management
Cristen Don and Maggie Sommer (ODFW)

5:00 A Cost-Benefit Analysis of Marine Reserves and Stock Enhancement for Recovering Rockfish Populations
Selina Heppell, Scott Heppell, and Mark Hixon (OSU)

5:30-11:00pm **Social, Banquet, Awards, Raffle, Auction, Music & Mixing**
Social Hour (5:30-6:30pm) — CH2M Hill Alumni Center Ballroom (all welcome)
OSU Alumni Mixer (5:30-6:30pm) —
Alumni Center Lounge. Library & Living Room (OSU Alums)
Banquet (6:30-7:30pm) — Ballroom (included with full registration)
Raffle, and Silent and Oral Auction (7:30-9:00pm) — Ballroom (all welcome)
Dance & Karaoke Party by NW Mobile DJ (9:00-11:00pm) — Ballroom (all welcome)
After-Hours Mixer (9:00-11:00pm) —
Alumni Center Lounge. Library & Living Room (all welcome)

Friday February 18

7:15-8:00am Early Morning Coffee and Tea
LaSells Stewart Center *ONLY*

7:15am-1:00pm Registration Desk & Sales / Trade Show (opens at 9:00am)
CH2M Hill Alumni Center - Foyer

7:15-11:30am Presentation Preview and Practice Room
CH2M Hill Alumni Center (upstairs) - Stevenson Conference Room 201

Plenary Session III LaSells Stewart Center – Austin Auditorium

8:00 – 8:50 **Nathan Mantua,** *Climate Impacts Group, University of Washington* – **"Global Warming Scenarios for the Northwest and Their Implications for Northwest Salmonids"**

Session 15 LaSells Stewart Center – Austin Auditorium

Current Status of the Science and Management of Hatchery and Wild Fish in Oregon

Conveners: Kirk Schroeder (ODFW), Dan Bottom (NOAA Fisheries) and Jeff Rodgers (ODFW)

9:00 Session Overview

9:10 The Opportunities and Challenges of Implementing ODFW's Native Fish Conservation and Fish Hatchery Management Policies
Kevin Goodson (ODFW)

9:30 Domestication in Steelhead: Caught in the Act
Reg Reisenbichler and Steve Rubin (USFWS)

9:50 – 10:10 Refreshment Break - LaSells Stewart Center & CH2M Hill Alumni Center Foyers

10:10 Parentage of Steelhead Progeny (*Oncorhynchus mykiss*) in Little Sheep Creek, Snake River Basin: The Search Continues
Ewann A. Berntson (NOAA Fisheries), Richard W. Carmichael and Jim Ruzycki (ODFW) and Paul Moran (NOAA Fisheries)

10:30 A Stochastic Model Investigation of the Potential Benefits of a Conservation Hatchery Program for Supplementing Oregon Coast Coho (*Oncorhynchus kisutch*)
Gretchen R. Oosterhout (Decision Matrix), Charles W. Huntington (Clearwater BioStudies), Thomas E. Nickelson (ODFW) and Peter W. Lawson (NOAA Fisheries)*

10:50 Hatcheries and the Conservation of Lower Columbia River Coho Salmon
Mark Chilcote (ODFW)

11:10 Diversity of *Oncorhynchus clarki clarki* Across the Landscape and its Implications for Hatchery Programs
Thomas Williams (NOAA Fisheries)

11:30 The Oregon Plan: Ask Not What You Can Do For Hatcheries But What Hatcheries Can Do For You
Carl Schreck (OSU)

11:50 Panel Discussion with All Speakers

12:10pm Meeting Adjourns

1:30-3:00pm Post-Meeting Tours of OSU Fish Research Facilities

(maps available at Registration Desk)
The Fish Performance and Genetics Laboratory
The John L. Fryer Salmon Disease Laboratory

Session 16 LaSells Stewart Center – C & E Auditorium

Futuring: Projecting Change in Use of Land and Water and Their Effects on Oregon Fishes

Convener: Stan Gregory (OSU)

9:00 Session Overview

9:10 Analysis of Future Scenarios to Evaluate Trajectories of Ecosystem Change in the Willamette Basin
Stan Gregory (OSU)

9:30 Modeling Landscape Change in the Willamette Basin – A Biocomplexity Approach
John Bolte (OSU)

9:50 – 10:10 Refreshment Break - LaSells Stewart Center & CH2M Hill Alumni Center Foyers

10:10 Developing Web Sites to Help Citizens and Policy Makers Make Better Decisions About Land and Water Use
Tim Fiez (OSU)

10:30 Simulating Future Private Landowner Behavior in the Coastal Forests of Oregon
K. Norman Johnson (OSU), Pete Bettinger (Univ. of Georgia) and Tad Larsen (OSU)

10:50 What the Numbers Tell Us About Salmon Recovery in a Changing World: Bob Lackey, You are Wrong!
Ray Beamesderfer (S.P. Cramer and Associates)

11:10 Conservation Incentives for Private Agricultural Land and Their Potential Benefits for Oregon Fishes
Kathryn Boyer (USDA)

11:30 The Confluence of Science, Policy, and Action in the Willamette River Basin
Rick Bastasch (Willamette Conservation Network)

11:50 Working With People to Envision Future Scenarios
Dave Hulse (UO)

12:10pm Meeting Adjourns

1:30-3:00pm Post-meeting Tours of OSU Fish Research Facilities

(maps available at Registration Desk)
The Fish Performance and Genetics Laboratory
The John L. Fryer Salmon Disease Laboratory

Session 17 CH2M Hill Alumni Center – 111 A/B

Building Tools and Resources to Increase Workforce Diversity: A Hands-On Work Session

Conveners: Rebecca Goggans and Judy Li (OSU)

9:00 Session Overview

9:05 Demographics and Oregon: Past, Present, and Future (45 minute talk)
Richard Bjelland (Oregon Housing and Community Services)

Session 17 continued CH2M Hill Alumni Center – 111 A/B

9:50 – 10:10 Refreshment Break - LaSells Stewart Center & CH2M Hill Alumni Center Foyers

10:10 Changing Customer Base Challenges Natural Resource Managers
Bill Otani (USFS)

10:20 Panel Discussion on What Worked/What Didn't: Personal Perspectives
Cedric Cooney (ODFW), Monty Gregg (USFS), and Sue Knapp (ODFW)

10:30 Small Group Concurrent Work Sessions:
Opening the First Door
Accommodating Cultural Differences
Work Unit Groups
Retention

11:30 Wrap up / Debrief

12:10pm Meeting Adjourns

1:30-3:00pm Post-Meeting Tours of OSU Fish Research Facilities
(maps available at Registration Desk)
The Fish Performance and Genetics Laboratory
The John L. Fryer Salmon Disease Laboratory

Session 18 CH2M Hill Alumni Center – 115 A/B

Native Fishes: What Do We Know About the Species That Don't Make the Headlines

Convener: Steve Jacobs (ODFW)

9:00 Session Overview

9:10 Improved Status of Oregon Chub in the Willamette River Drainage
Paul D. Scheerer (ODFW)

9:30 Pacific Lamprey Larval Distribution and Adult Escapement in the Lower Deschutes River
J. C. Graham (Confederated Tribes of the Warm Springs Reservation of Oregon)

9:50 – 10:10 Refreshment Break - LaSells Stewart Center & CH2M Hill Alumni Center Foyers

10:10 Integrating Sampling Methods to Characterize Bull Trout Spawning in the South Fork McKenzie River
Mark G. Wade, J. Vincent Tranquilli, and Chad K. Helms (ODFW)

10:30 The Inland Lampreys: Diversity in the Klamath and Goose Basins
Stewart Reid (Western Fishes), D. Goodman (HSU), M. Docker (University of Windsor), D. Markle and C. Lorion (OSU)

10:50 Distribution and Behavior of Radio-Tagged Adult Lost River and Shortnose Suckers in Response to Water Quality Conditions in Upper Klamath Lake, Oregon
B. D. Swigle and B.J. Adams (USGS)

11:10 Seasonal Variability of Westslope Cutthroat Trout Movement Patterns and Habitat Use in Headwater Tributaries of the John Day River
S.J. Starcevich (ODFW), R.E. Gresswell (USGS), and A.R. Hemmingsen (ODFW)

11:30 Oregon's Great Basin Endemics – An Update on the Status of Four Federally Listed Fish from Southeast Oregon
C.A. Allen, R.G.White and A.J. Mauer (USFWS) and A.V. Munhall (BLM)

11:50 Water Temperatures Used by Migratory Bull Trout from the Lostine River
Philip J. Howell and Jason B. Dunham (USFS), Paul Sankovich (USFWS) and Gwynne Chandler (USFS)

12:10 Meeting Adjourns

1:30-3:00pm Post-Meeting Tours of OSU Fish Research Facilities

(maps available at Registration Desk)
The Fish Performance and Genetics Laboratory
The John L. Fryer Salmon Disease Laboratory

ABSTRACTS OF PAPERS

In alphabetical order by primary author's last name

Presenters for Best Student Paper competition are listed in bold type

* Indicates presenter when multiple authors are listed

Oregon's Great Basin Endemics—An Update on the Status of Four Federally Listed Fish from Southeast Oregon

C.A. Allen[1]*, R.G.White[1], A.J. Mauer[2], and A.V. Munhall[3]
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In the 1980s, threats to fish fauna in the Great Basin portion of Southeast Oregon resulted in federal listings for Borax Lake chub (*Gila boraxobius*), Warner sucker (*Catostomus warnerensis*), Foskett speckled dace (*Rhinichthys osculus ssp.*); and Hutton tui chub (*Gila bicolor ssp.*). The chubs and dace are endemic to three different isolated springs and their associated channels and wetlands, and the sucker is endemic to the streams and lakes of the Warner Basin. Accomplishments towards the conservation and recovery of these fish have come primarily through a change in land ownership to public or conservation ownership, and through better management of public lands. Some limited progress has been made working with private landowners and irrigators, especially in passage and screening improvements. Despite some successes in meeting recovery goals and obtaining baseline data, monitoring of these populations in recent years has been irregular and insufficient to determine status and trends. This presentation will provide a brief overview of available information on each of these fish, an update on the extent to which recovery goals have been met since finalization of recovery plans, and ideas for accomplishing greater conservation.

Salmon Habitat Conservation and Restoration Using Utility Customer Renewable Energy Funds

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The Nature Conservancy recently formed a partnership with two Oregon utilities, Portland General Electric and Pacific Power, to protect and restore native anadromous fish species and educate the community on the benefits of healthy streams. The program will use funds provided by utility customers participating in the habitat renewable energy option. Projects supported by the Salmon Habitat Fund include in-stream and riparian restoration, watershed assessments and analysis, land acquisitions and easements, monitoring, and public outreach and education. The Salmon Habitat Fund is supporting ongoing and new projects that The Nature Conservancy has identified to protect and restore native anadromous fish species. In addition, the Conservancy is re-granting a portion of the funds to Watershed Councils, Soil and Water Conservation Districts and other Non-Governmental Organizations to complete similar projects. The Conservancy mapped several spatial datasets to identify priority watersheds where the use of the Salmon Habitat Fund would most likely complement or contribute to existing salmon conservation efforts. These data sets included Oregon Trout Healthy Stocks Assessment, American Fisheries Society Aquatic Diversity Areas, Oregon Plan Salmon Core Areas, and FEMAT Key Watersheds, as well as sites identified as conservation/restoration priorities in regional assessments such the Northwest Power and Conservation Council subbasin plans, and The Nature Conservancy's ecoregional assessments. The prioritization methodology and priority watersheds were peer reviewed by experts who suggested additions or deletions based on professional judgment. To date, the Salmon Habitat Fund has supported a variety of anadromous fish habitat conservation and restoration projects across Oregon.

Cost-Effective Solutions to Reversing the Failure of Wild Salmon Recovery

Larry L. Bailey[1] and Michelle L. Boshard[1]*
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The current management model for salmon recovery is deeply flawed structurally, logistically, and politically. The failures in salmon recovery are not because we lack policies, plans, technical knowledge, or ability. The question is not "can we manage to restore the salmon", but "can we manage ourselves so that salmon can be restored". From southern British Columbia south to California, the model that we have followed is one of central planning and "top-down" implementation of technical and bureaucratic approaches. It is mostly driven by political, economic, or urban interests and implemented through expensive consultant contracts or by appallingly inefficient government agencies. Those who own the lands and live in the tributary watersheds in which much of the critical salmon habitat physically exists have the most influence on the quality of the habitat. They also have the most to gain or lose economically and culturally when the typical centrally planned salmon recovery efforts systematically exclude them from what can charitably be called a superficially inclusive bureaucratic process. The present day reality is that salmon recovery, as now practiced across the region, is a sideshow to everyday human life and is more about allocating funds, political placation, or bureaucratic control and ego-stroking than recovering salmon. In short, the current approach does not (and will not) work, and, worse, it provides a veneer of illusion to the public for the utter waste of billions of dollars of taxpayer and ratepayer funds.

Enforcing Removal-Fill Laws and Protection of Wetlands and Waters of the State

Trooper Craig Ball
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The Fish and Wildlife Division of the Oregon State Police is responsible for enforcing the laws and regulations that protect the fish and wildlife and natural resources of Oregon. There are thirteen officers around the state who are specially trained to recognize and enforce violations of removal-fill laws in wetlands and waters of the state. Often times compliance from violators of these laws is accomplished through site visits and cease and desist orders issued by the Department of State Lands. On occasion more severe law enforcement action must be taken. I will discuss actual cases in my presentation.

The Effects of Forest Harvest and Flow-Duration on Insect Emergence from Headwater Streams in the Oregon Coast Range

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This study compared the community assemblages of aquatic insects emerging from 20 headwater streams in the Oregon Coast Range. Study streams represented differences in flow duration (perennial or seasonally intermittent) and riparian condition (not logged for at least 35 years and logged). Whether headwater streams are perennial or seasonally intermittent depends on location in the watershed, annual climatic cycles, and modifications of hydrological patterns by human activities. Of the 10 streams in logged catchments, three streams were intermittent and seven were perennial. The remaining 10 sites included four intermittent and six perennial streams in forested catchments. For each of two sampling periods (August-September, October-November 2003), emergence traps were set for 4 weeks and samples were collected every 2 weeks. NMS Ordination analyses indicate that aquatic insect community assemblages differ by season and by riparian condition. Regardless of flow-duration or season, more aquatic insects emerged from streams in logged catchments. Ephemeroptera, Plecoptera, Trichoptera, and aquatic Diptera emerged at rates that varied by logging condition and season. More Ephemeroptera and Trichoptera emerged during the summer sampling. More Plecoptera emerged from logged sites in the fall

sampling. More aquatic Diptera emerged from logged sites in both summer and fall collections. Stream flow-duration does not appear to strongly influence community assemblages.

Controlling the Spread of *Myxobolus cerebralis* in Clear Creek, a Tributary of the Clackamas River

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The detection, in 2001, of *Myxobolus cerebralis* from a private facility on Clear Creek and from a single fish above this hatchery represents the first site of establishment of *M. cerebralis* in Oregon outside of the enzootic tributaries of the Snake River. Because of the potential for effects on native salmonids, this detection resulted in a decision to require removal of all fish from the hatchery and elimination of the hatchery outflow. To determine if *M. cerebralis* is more widely distributed in Clear Creek, six sentinel exposures were conducted between March 2003 and September 2004 at 10 locations. The inability to detect infection above the hatchery at any time following its closure indicates that the parasite has not become widely established in Clear Creek and that the hatchery may provide the source of infection for fish downstream. Surveys to determine the prevalence of *T. tubifex,* the alternate host for the parasite, demonstrated a very low prevalence of this oligochaete outside the hatchery pond and no infected worms were ever found, indicating that the hatchery was the likely point source of *M. cerebralis* on Clear Creek. Data from surveys of wild fish in the river also support the premise that *M. cerebralis* has been introduced only recently in this river and that eliminating a known point source of infected worms and fish could reduce parasite numbers below the level needed to maintain the infectious cycle.

The Confluence of Science, Policy, and Action in the Willamette River Basin

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There is an increasing expectation among researchers and policy-makers that scientific information be used to shape policies and direct actions, especially for environmental protection. However, there are great challenges inherent in acting on that expectation that bring into question: the capacity for scientists to communicate with policy-makers, the understanding of science by policy-makers and their motivations to cite science, and the role of the public in refereeing the interchange between the two. The Willamette River Basin is a laboratory for the use of science in decision-making. The Basin has recently been subject to some of the most sophisticated ecological studies in the nation and has new communication mechanisms established to deliver scientific information on the environment to the public and decision-makers. This presentation explores how the Willamette Conservation Network, the Pacific Northwest Ecosystem Research Consortium, and others are attempting to build a logic path between new science and on-the-ground actions in the Willamette Basin.

What the Numbers Tell Us About Salmon Recovery in a Changing World: Bob Lackey, You are Wrong!

Ray Beamesderfer
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Expected future changes in climate and human population of the Pacific Northwest have led to some cynical assessments of dim prospects for salmon recovery. We have all heard the litany: economic realities, population growth, increasing demands, and social ambivalence at best mean that billions of dollars of investment will produce only marginal results and at worst mean that efforts will fail entirely. During the last two years, we completed a series of quantitative analyses of human impacts, salmon status, and recovery prospects as part of a recovery planning effort by the Washington Lower Columbia River Salmon Recovery Board. These analyses indicate that salmon recovery is realistic and even likely in spite of projected future trends in future and climate. Synergistic benefits of reductions in human impacts compounded across the salmon life cycle make significant improvements feasible with relatively modest efforts to address each threat. Small scale incremental improvements add up to significant benefits over long periods of time. Over the last 10-20 years, new scientific insights into the causes of declines and an increased commitment to wild salmon protection and recovery have led to implementation of a variety of beneficial measures that have already began to reverse declining trajectories. Recovery will clearly require significant investments by multiple stakeholders and wise choices on where to focus efforts. However, premature predictions of imminent failure are likely to turn into a self-fulfilling prophecy that erodes efforts to sustain effective recovery strategies.

Parentage of Steelhead Progeny (*Oncorhynchus mykiss*) in Little Sheep Creek, Snake River Basin: The Search Continues

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Ecological and genetic interactions between hatchery and wild fish in the natural river system are often poorly understood. Hatchery supplementation programs are designed to increase natural production; however, it can be difficult to monitor and evaluate the success of these projects. This study is using DNA-typing to document specific matings among hatchery and natural steelhead, and includes results for the first 4 years of a 10-year study (two steelhead generations). We genotyped adult steelhead of both hatchery and natural origin (marked and unmarked fish) returning to the weir on Little Sheep Creek. Juvenile and adult progeny were also genotyped and through exclusion of incompatible matings we estimated the parentage of sampled progeny. Previously, we reported that a significant proportion of the progeny could not be matched to two adult steelhead parents. We hypothesized that returning steelhead adults may be spawning with resident rainbow trout, or that our samples included juvenile rainbow trout. We sampled the adult rainbow trout population for three consecutive years to determine if these resident fish might be the "missing" parents. Our most recent analyses have documented rainbow trout matings as well as interbreeding between anadromous and resident fish. However, quantitative evaluation of these observations is limited by a very large number of resident *O. mykiss* and the relatively small number that we have actually sampled. Recent evidence from multiple sources suggests that, at least in some populations, life history traits of anadromy vs. residence may be significantly more plastic than previously assumed.

Demographics and Oregon: Past, Present, and Future

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Oregon is changing with regards to racial and ethnicity composition, age and sex composition, and household composition. This presentation not only identifies the changes that are taking place, but also examines the reasons why these changes are occurring and some of the impacts of these changes.

Modeling Landscape Change in the Willamette Basin—A Biocomplexity Approach

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Increasingly, models (and modelers) are being asked to address the interactions between human influences, ecological processes, and landscape dynamics that impact many diverse aspects of managing complex coupled human and natural systems. New tools in the areas of spatial data management and analysis, multicriteria decision-making, individual-based modeling, and complexity science have all begun to impact how we approach modeling these systems. Questions related to system vulnerability and resilience, adaptation, feedback processing, cycling, nonlinearities and other complex behaviors are being addressed using models employing new representational approaches to analysis. An emerging application area is alternative futures analyses, the study of how complex coupled human/natural systems dynamically respond to varying management strategies and driving forces. This methodology is increasingly being used to inform decision makers about the implications of policy alternatives related to land and water management, expressed in terms related to human valuations of the landscape. Trajectories of change become important indicators of system sustainability, and models that can provide insight into factors controlling these trajectories are rapidly becoming essential tools for planning. The complexity inherent in these systems challenges the modeling community to provide tools that capture sufficiently the richness of human and ecosystem processes and interactions in ways that are computationally tractable and understandable. We examine one such tool, Evoland, and actor-based modeling framework being applied use to conduct alternative futures analyses in the area surrounding the confluence of the McKenzie and Willamette Rivers.

Topography and Distribution Patterns of Lahontan Cutthroat Trout (*Oncorhynchus clarki henshawi)* in a Stream Habitat Mosaic

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The distribution of Lahontan cutthroat trout (LCT) (*Oncorhynchus clarki henshawi)* is currently reduced to a patchwork of small isolated populations, the result of habitat degradation and interactions with non-native salmonids. Understanding which factors are responsible for the isolation and decline of these populations may be critical to the recovery of the species. Our study was conducted on three low order streams located in the sagebrush dessert of southeastern Oregon and northern Nevada. Streams consisted of both headwater and valley

segments, with fish in all three streams potentially being challenged by sections with low discharge and high temperatures during the summer and anchor ice during the winter. Contiguous whole stream surveys were used to look at fish distribution and stream habitat during summer of 2003 and spring and fall of 2004. After preliminary analysis using spatial statistics, topography appeared to be a strong factor in determining salmonid distribution within all three catchments. Specifically, salmonid densities were highest in areas immediately upstream of the transitional zone between less confined and more confined valley segments. Hyporheic flows may be greatest in such areas thus providing refugia from warm water and low discharge in the summer and anchor ice in the winter. The information on LCT small stream distribution patterns derived from this study will help managers ensure land use activities are compatible with this species needs.

Conservation Incentives for Private Agricultural Land and Their Potential Benefits for Oregon Fishes

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The USDA offers a portfolio of conservation programs to manage and improve natural resources on their lands. Depending on the program, the results of conservation actions can potentially benefit aquatic habitats into the future. This portfolio now includes a far-reaching and well-funded opportunity for managers of working lands to be compensated for conservation stewardship and enhancement actions they have implemented or plan to implement. The Conservation Stewardship Program (CSP) is a voluntary program that provides financial and technical assistance to promote the conservation and improvement of soil, water, air, energy, plant and animal life, and other conservation purposes on Tribal and private working lands, watershed-by-watershed. In 2005, Oregon NRCS will offer CSP payments to all eligible landowners in 10 watersheds. Using this approach, within the next eight years, every farmer and rancher will have an opportunity to participate in the program. Landowners in watersheds not yet chosen for funding can anticipate the benefits and begin making natural resource improvements immediately. A tiered approach is used to determine the amount of compensation to a landowner; those who specifically employ practices to benefit aquatic habitat and species are entitled to the maximum amount of compensation for the longest period of time. This paper will explore how scientists and fish habitat managers might influence conservation on working lands, and which watersheds are chosen in future sign-up years to ultimately contribute to improving habitats for Oregon native fishes.

Habitat Improvement Locally to Benefit At-Risk Species Regionally—Oregon's Landowner Incentive Program

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Approximately 45% of Oregon's lands are privately owned. Restoring and maintaining habitat within these lands is essential to the conservation of Oregon's fish and wildlife. The Landowner Incentive Program (LIP) provides grants for management of habitats to benefit at-risk species on private property. During 2003-2004, the first 2 years of LIP in Oregon, nearly 4,000 acres of terrestrial habitat and 90 linear miles of in-stream and riparian habitat have been restored, enhanced or protected. Additionally, fish passage has been restored to over 75 miles of stream. This paper describes the LIP and summarizes these aquatic habitat accomplishments.

Spawning, Larval Drift, and Early Mortality of Pacific Lamprey (*Lampetra tridentata*) in the South Fork Coquille River

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Following a 2003 petition for ESA listing of Pacific lamprey, there has been an increased effort to understand their biology and status. A critical aspect of status assessment is identification of factors influencing survival and reproduction. Survival of egg and larval stages is particularly important because their mortality rates are naturally high and variable, thus shaping adult recruitment. Timing of spawning and larval movement may have important consequences for year-class success. We assessed spawning activity and larval lamprey (ammocoete) emergence over diel and seasonal cycles and examined relationships between spawning activity, age-0 ammocoete production, and environmental variables. In 2004, Pacific lamprey in the South Fork Coquille River spawned between early April and early June at water temperatures from 12 to 18 ºC. Numbers of spawning adults and redd counts were strongly, positively correlated, but both survey methods present difficulties and have no straightforward way to quantify errors. Newly hatched ammocoetes were caught in nighttime drift samples from early May through mid-July, peaking between May 17 and June 21. 99.8% of all ammocoete size classes were caught during hours of darkness. Compared to adult surveys, nighttime drift samples provide consistent, quantifiable data, as well as information on multiple age-classes and other species. In rivers where adult surveys are impractical, drift nets could be used to verify presence and timing of spawning.

Sustaining Wild Salmon Through 2100: Structural Barriers to Ecotopia

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Ever-growing centralization in natural resource and other decision-making is giving rise to problems akin to those produced by analogous unstable monocultures in biology. Efforts to recover salmon in western North America have followed a similar pattern. Centralized funding of biological research has crippled scientific understanding of complex ecosystems, replacing cost-effective scientific management with politically-correct management of astounding ineffectiveness and waste. The rise of an irrational ideology within and without the emerging monoculture is making economic development and the active management of natural resources politically incorrect. Studied indifference to all-important predator effects, including commercial salmon harvest, a fetish for treating trivial variations in freshwater habitat as having overwhelming importance, and demonization of hatchery fish are the hallmarks of this destructive ideology. Long term viability of wild salmon depends upon a healthy economy and political/scientific freedom, both threatened by the monoculture and the rising ideology. Programs for ever more stringent and centralized control of natural resources, coupled with the loss of private property rights, are doomed by their nature to bring about the very economic and political stressors that have destroyed ecosystems throughout the world, from Biblical times to modern Eastern bloc nations.

Chinook Salmon and Steelhead Behavior at Dams as Determined by PIT Tags and Radio Tags

Brian J. Burke[1]*, Sandra L. Downing[1], Theodore J. Bohn[2], and Michael A. Jepson[3]
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[3]University of Idaho, Idaho Cooperative Fish and Wildlife Research Unit

During 2002 and 2003, we double tagged over 3,200 adult Chinook salmon and steelhead with both a radio tag and a PIT tag as they migrated upstream past Bonneville Dam. We used two behavioral measures of fish performance, dam passage and fallback, to compare radiotelemetry and PIT-tag systems at each of four dams: Bonneville, McNary, Ice Harbor, and Lower Granite Dams. We developed an interpretive PIT-tag model for measuring dam passage and fallback events and used 2002 data from double-tagged fish to help define the critical parameters for the model. We then applied the model to double-tagged fish in 2003. The PIT-tag model was accurate at determining dam passage events. However, no PIT-tag interrogation system was able to directly detect a fallback event. We therefore concluded reascension rate was the best available surrogate for fallback rate. Comparisons between PIT-tag data and radiotelemetry data were less consistent for fallback than for passage events, partially due to low fallback sample sizes relative to passage events. In hopes of finding a possible conversion factor between the two measures of fallback, we analyzed radiotelemetry data from 1998 through 2002. There were no consistent trends between fallback and reascension rates among years or among dams. Finally, we applied the PIT-tag interpretive model to a broader group of non-radio-tagged fish to simulate the type of data analysis one could expect in years without radiotelemetry. We used spring, summer, and fall Chinook populations from 2003. Passage and reascension rates were similar to those estimated from radiotelemetry data sets, though some differences exist.

Siuslaw River Basin Restoration Partnership Wins Theiss International Riverprize Award: What Does It Mean for Restoration and Where Do We Go from Here?

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The Partnership boasts a strong collaborative framework, community support, a base of scientific knowledge, a focused restoration strategy and a committed educational component. It has received multiple awards over the last 4 years (2000 USFS Caring For the Land, 2003 USFS Chief's Stewardship, 2003 Coastal America Spirit, 2004 Theiss International Riverprize). The Siuslaw Restoration strategy is innovative in that high priority restoration areas, agreed upon by the Watershed Council technical team (Federal, State and local agencies, industrial timber companies and private landowners), are approached as whole watershed restoration efforts by a variety of groups regardless of ownership. In 2002 and 2003, restoration projects in the Siuslaw River Basin generated between $2.5 and $3.7 million each year for the local economy. Four highlighted projects provide examples of work being done throughout the basin. Each project differs in its longevity, design, and composition of partnerships, but taken together, they supply a model of holistic collaboration necessary to build a sustainable river basin. The four projects are: Knowles Creek Restoration; Deadwood Enhancement Project; Karnowsky Creek Restoration Project; Siuslaw Stewardship Program. The future of the partnership is bright. A commitment of the Theiss International Riverprize is to mentor a less advanced area/country that is struggling with similar watershed problems. Hopefully this partnership will provide information that may give them the chance to maintain their watersheds with greater function and not commit the same mistakes we have made.

Comparison of 1-D and 2-D Hydraulic Models in a Boulder-Strewn River

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In the Pit River (California), a boulder-strewn riffle was measured with PHABSIM and River2D at 185 to 1903 cfs. Both models were calibrated, and the results compared from 100 to 800 cfs. Weighted usable area (WUA) for rainbow trout (*Oncorhynchus mykiss*) and hardhead (*Mylopharodon conocephalus*) were tabulated. Also, WUA for binary depth-velocity criteria were compared, as well as habitat diversity indices. Rainbow trout adult WUA was higher for 2-D vs. 1-D, and reached a peak at lower flow. Juvenile WUA was also higher for 2-D. Hardhead adult WUA was higher for 2-D, especially at lower discharges. Juvenile WUA was higher for 1-D vs. 2-D. The 1-D model predicted more area with low (<0.5 ft/sec) and high (>2.5 ft/sec) velocity. The 2-D model predicted more area with moderate (1.0 -2.5) velocity. Habitat diversity was higher with the 1-D model for most flows. The River2D model has rarely been applied in boulder-strewn streams. In this study, we obtained model convergence, and accurately reproduced measured water surface elevations. The 2-D model appeared to smooth the observed velocity distribution. Maximum and minimum velocities were reduced, and moderate velocities increased, compared to measured values. The biggest difference between the two models was in the combination of moderate-depth/moderate velocity, where the 2D model predicted about twice as much habitat as 1-D for some discharges. Because this hydraulic combination had a high suitability score for juvenile and adult trout, the 2-D model probably overestimated WUA for adult and juvenile RBT at moderate discharges.

Impacts of Invasive Species on Riparian Restoration Projects

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Riparian ecosystems generally have higher plant and animal diversity and productivity due to the interactions aquatic and terrestrial systems, and complex physical habitats. In western Oregon, it is not uncommon to find more than 40% of the species in rivers and streams or vegetative cover in riparian areas to be non-native and often invasive. Invasive species modify natural ecological functions, displace native species, disrupt the food web and alter species composition and the habitat they provide. Invasive species can modify successional trajectories. Restoration of riparian areas based on defined historic conditions may no longer be valid. Invasives may in some cases naturalize in an area and perform some of the functions of natives. Restoration objectives based on desired functions rather than historic conditions may be the most appropriate path in riparian areas altered by invasive species. Watershed councils and their members account are major forces behind riparian restoration projects. Many of these riparian projects focus on controlling invasive species to facilitate the establishment or reestablishing of desirable species and proper functioning conditions. Oftentimes, a species specific (e.g. Japanese knotweed) “top down” or “headwaters first” approach is used to control invasive plants in riparian areas. Future riparian restoration programs are likely to include an integrated approach to invasive species management that include the rapid restoration or capture of these sites by native communities. Watershed councils are currently better equipped to address invasive riparian plants than aquatic nuisance species that principally reside in the water. This suggests a need to build the capacity of watershed councils to address both aquatic and riparian invasive species.

The Use of the Ecosystem Diagnosis and Treatment (EDT) Model in Fish Habitat Restoration in the Klamath Basin

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PacifiCorp's Klamath Hydroelectric Project, located on the Klamath River in Oregon and California, is currently undergoing Federal relicensing. As part of the relicensing studies, PacifiCorp and interested stakeholders are using the Ecosystem Diagnosis and Treatment (EDT) model to assess anadromous salmonid habitat in areas of the Klamath Basin. The EDT model, developed by Mobrand Biometrics, uses habitat attributes and literature based performance values to assess capacity and productivity for a focal salmonid species. The model can incorporate data from site specific surveys, data extrapolation, and other modeling outputs. The models' components lend themselves to habitat restoration by providing reach, or site specific reports that identify the attributes that reduce current or potential capacity and productivity of the focal species. The scenario builder component of the model then allows a user to input attribute ratings that would reflect restoration efforts to determine the potential benefits of the action. Once populated with completed data sets the model provides a long-term modeling tool for prioritizing habitat restoration activities.

Hatcheries and the Conservation of Lower Columbia River Coho Salmon

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For coho salmon hatchery programs, egg to smolt survival rates are typically 10 to 20 times greater than observed for coho rearing in the natural environment. This fact has led to the idea that critically depressed wild populations could be stabilized and even "rescued" by bringing a portion of the returning wild fish into a hatchery production program and subsequently releasing their offspring back into the natural environment. Such a program has been attempted for coho in the Clackamas River basin. In 1997, 1998, and 1999 wild coho were removed from the Clackamas River for broodstock to initiate a hatchery-based program to help rebuild the wild population. Hatchery reared offspring from these broodstock, released as smolts into the Clackamas River, survived poorly. Smolt to adult survival rates for these hatchery fish were approximately 1/15 of those observed for naturally produced smolts emigrating to the ocean in the same years. In addition, an earlier hatchery program based on wild Clackamas coho broodstock collected in 1985, 1986, and 1987 yielded somewhat similar results with smolt to adult survival rates averaging 1/5 of those observed for wild smolts in the same years. These results demonstrated that the expected freshwater survival advantages due to rearing in the hatchery environment were nearly cancelled by the subsequently much lower post-release survival rates. Possible reasons for the poor post-release performance of the hatchery-raised offspring of wild fish were explored including: size of broodstock (number spawned), collection date of broodstock, timing of smolt releases, and smolt condition.

Development and Application of Biological Criteria to Assess the Viability of the Oregon Coastal Coho ESU

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We assessed the status of the Coastal Coho Evolutionarily Significant Unit (ESU) relative to viability criteria developed as part of the Coastal Coho Project. The analysis was based on the ESU, strata, and population structure as determined by the NOAA Fisheries Technical Recovery Team: one ESU, five strata, and 19 independent populations. Population viability criteria were developed for productivity at low spawner density,

probability of long-term persistence, spatial distribution, and diversity. Specific criteria for strata and ESU viability were developed based on a roll-up of population criteria. The current status of the Coastal Coho ESU was determined relative to population, strata and ESU viability criteria based on the biological attributes described above. All five strata had to pass a conservation risk threshold for the ESU to be classified as not at risk of becoming endangered in the foreseeable future. We found that all five strata passed the population criteria. Across the ESU, 12 populations pass all criteria, five fail (do not pass one or more population criteria), and the status of two populations (Floras and Sixes) is unknown. Based on the conservation criteria developed for this ESU, the results of this evaluation lead to the conclusion that the Oregon coast coho ESU is not at risk and may not warrant listing as a threatened species under the ESA.

Losses of Radio-Tagged Smolts to Avian Predators in the Columbia River Estuary: What We Know and How to Better Understand What We Don't Know

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Losses of smolts to avian predators in the Columbia River estuary is gaining increased attention, particularly as these birds may influence smolt-to-adult returns. The objectives of our research have been to assess migration patterns of outmigrants and estimate survival and losses of barged and run-of-river smolts to avian predators in the Columbia River estuary. To achieve these objectives, we implanted radio tags in steelhead (*Oncorhynchus mykiss*) and Chinook (*O. tshawytscha*) salmon collected upstream, and recorded detection histories via receiver arrays and actively tracking individual fish. Several hypotheses exist regarding what renders a smolt vulnerable to depredation by birds, including environmental and biological (endogenous) factors. Based on data from radio-tracked smolts, it appears that environmental variables such as tidal stage, light levels, and migration path increase exposure to avian predators on East Sand Island via certain migration trajectories and increased residence time. One hypothesis for smolt losses is that these environmental factors improve foraging efficiency of avian predators on smolts. However, we do not yet fully understand the endogenous reasons why smolts choose specific migration behaviors with respect to the horizontal (Washington or Oregon sides of the estuary) or vertical (migration depth) planes, which could influence vulnerability to depredation by avian predators. In order to understand endogenous influences, we make the case for assessing physiology and health status of smolts. Evidence suggests that stressed and diseased fish exhibit migration behaviors that may be deleterious, but as of yet have not been linked conclusively to losses of smolts to avian predators.

Research and Management Issues Relevant to Snake River Fall Chinook Salmon

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Historically, juvenile Snake River fall Chinook salmon entered saltwater at age-0 and spent their first winter in the ocean (i.e., an ocean-type life history). During the 1950s—1960s, dams in the middle Snake River eliminated the core area of historical production. Snake River fall Chinook salmon were listed under the Endangered Species Act in 1992. Management activities for recovery include flow stabilization during spawning, summer flow augmentation, juvenile fish bypass systems at dams, transportation, summer spill, and the release of age-0 and age-1 hatchery smolts into contemporary production areas. Researchers estimated that flow stabilization provided adequate spawning habitat to reach recovery goals. In contrast to conventional belief, researchers found that returning adults had exhibited two alternative life histories as juveniles, namely ocean-type and reservoir-type. Reservoir-type life juveniles winter reservoirs, sometimes pass dams in the winter, and enter saltwater at age-1. The existence of the reservoir-type life history does not support the dewatering of juvenile fish bypass systems in the winter, violates assumptions of studies designed to evaluate summer flow augmentation, transportation, and summer spill, but supports culturing both age-0 and age-1 smolts at hatcheries.

Connecting Bull Trout Habitat and Populations—What Is Gained?

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Recent studies of bull trout throughout the West provide new data on the population dynamics and relationships of resident, fluvial and adfluvial life history types in basins where multiple forms are present. A common strategy proposed by fish managers for increasing population viability of bull trout is to connect bull trout in headwater streams to downstream habitat and neighboring populations. It has been expected that connecting populations through mitigative measures (e.g. adult passage at dams) will increase the population range and genetic exchange among populations, thereby increasing viability. We used data from bull trout sampling at weirs in the Yakima and Walla Walla basins as a foundation for modeling population dynamics of bull trout, and simulated the future population growth contributed by each life history type. We show that environmental factors play a key role in determining whether bull trout are likely to benefit from reconnecting habitats above and below dams.

Understanding Relationships Between Habitat and Early Life Stages of Lost River and Shortnose Suckers in a Restored Riverine Wetland

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To assist with the recovery of shortnose and Lost River suckers in the Klamath Basin, The Nature Conservancy initiated the Riverbend restoration project in the fall of 2000. The goal of this project was to restore 11 hectares of potential larval and juvenile rearing habitat adjacent to the lower Williamson River to determine if this type of restoration could be successful at providing habitat, increasing survivorship and, ultimately, improving recruitment of these species. A monitoring program was established to determine the responses of physical habitat and fish communities to the restoration. Larval and juvenile suckers have been observed in Riverbend in all four years of monitoring. After entering, larval suckers remain in the restored area for extended periods of time. Riverbend larvae are larger, more developmentally advanced and have more food in their guts than larvae in the Williamson. Vegetation has responded favorably with robust recruitment of Salix, Scirpus, and other wetland species. Water quality has been adequate with seasonal levels at or above tolerance levels for the sucker species, although areas of poor water quality exist. Overall, monitoring indicates that restoration of this type may be providing critical rearing habitat for these species. Data and observations from Riverbend are being incorporated into future restoration alternatives for the Williamson River Delta.

Overworked Americans: The Impact on You, Family, Fish, and More (Plenary Session II)

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"We want more…faster!!" That might just be the mantra for America these days, but it's a philosophy with serious consequences for our health, our families and communities and the environment on which we depend. Biologists and others know that, as Edward Abbey put it, "growth for the sake of growth is the ideology of the cancer cell." Yet we measure our strength as a society on the rate by which our GDP continues to rise. Unless fish generate profits they are wasted as far as GDP measures things. The decimation of fish populations is the tip of the iceberg—if the rest of the world suddenly adopted our material "standard of living" we'd need four more planets. We simply must challenge the rush to grow—the push for "development" that will cost many fish their habitats. We need to speak about what all of us are losing in the current rush—time to live. To consume more, we work more—Americans now put in 350 hours more a year on the job than western Europeans. It's hurting our health—as stress and obesity mount—and the time we need for family, friends, community and environmental stewardship. The longer we work the less likely we are to recycle, the more likely we are to use throwaways and

so on. It's time to begin trading productivity for time instead of stuff. The "Take Back Your Time" campaign is a strategic initiative to bring quality of life back into our political debate.

A Spatial Evaluation of Habitat Access Conditions and Oregon Plan Fish Passage Improvement Projects in the Oregon Coast Coho ESU

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One of the goals of the Oregon Plan for Salmon and Watersheds (Oregon Plan) is to improve access to habitat. State measures and guidelines describe methods to install and upgrade stream crossings to accommodate all life history stages of native fish. We summarize and evaluate the current and expected rates of implementation, what is known about effectiveness of Oregon Plan, and the extent to which fish passage barriers remain a factor for decline for coho salmon. We estimate that 43% of crossings pass fish, 20% limit fish passage, and 37% remain unknown in terms of their ability to pass fish. We estimate that OP projects improved access by 6% to High Intrinsic Potential (IP) coho streams and 10% on Low IP coho streams. Throughout the ESU, 11% of Low IP streams and 10% of High IP streams are estimated to still have limited access. While 10-11% is a relatively low number, the access status of 28-31% of coho stream miles was estimated as unknown at the time of this analysis. Oregon has a strong regulatory program that requires passage of juvenile fish at all stream crossings. In addition, there has been a significant commitment through volunteer activities to improve access throughout the ESU. If restoration continues at the levels estimated by this analysis, it is feasible that fish passage could be eliminated as a factor for decline of coho within the next 7-10 years.

Peer Review: Science's Gatekeeper. Is This a Good Thing?

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From legislators to industry people, to environmentalists, almost everyone assumes that peer reviewed science ought to be the sole basis for recovering Pacific Northwest salmonids. They agree virtually unanimously that all actions to recover depleted salmon runs should be based on peer review science. Scientists appear to concur with this assessment. Peer review has never been defended nor is it defensible. My analysis focuses on 2 questions: 1) what is the purpose of peer review? and 2) where does the authority of science rest? Peer review represents a move that destroys the foundation of modern science. Using the Copernican revolution as a paradigm case, this paper will show that peer review was one of the major weapons used by the Catholic Church against the Copernicans. With regards to salmon recovery, a focus on peer review science results in: 1) many of the wrong people making critical decisions about salmon recovery; 2) much critical information for making an informed decision kept out of the decision-making process; and 3) the basis for decisions being made by key individuals is wrong.

In Search of the Holy Grail: Evolution of an Integrated Aquatic Monitoring Program on Private Timberlands

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Green Diamond (formerly Simpson) Resource Company has been developing an aquatic monitoring program for its coastal northern California timberlands for over 10 years. Initially, the expectation was that we could develop a program with few or even a single methodology that would accurately record trends in water quality and instream

habitat conditions for a variety of aquatic species. The first monitoring work was based on the premise that instream habitat conditions would provide an accurate reflection of trends in watershed conditions. Initially, we utilized randomly selected 300-foot fixed stream reaches, but this approach was abandoned after two years because these relatively short fixed reaches were not capturing the dynamic nature of streams. The methodology was modified to focus on longer (2000-3000 feet) depositional reaches in upper watersheds, and the number of variables recorded in each reach has been reduced to include only those that could be measured with repeatability and minimal subjectivity, and statistically analyzed. Over time, it also became apparent that single or small suites of monitoring protocols were not likely to satisfy our overall monitoring objectives for aquatic resources. We made a paradigm shift in which the goal was to develop an integrated monitoring approach that focused on identifying a suite of aquatic response variables that had the greatest potential to be impacted by timber management, were of critical importance to an aquatic resource and were conducive to monitoring (i.e. minimal subjectivity in measurement, amenable to statistical analysis and minimal time lag between disturbance and measured impact).

Developing Oregon's *Nearshore Marine Resource Management Strategy*: A Proactive Approach to Marine Resource Management

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Oregon's nearshore environment, defined as the area from the intertidal zone offshore to an approximate depth of 30 fathoms, is a productive and diverse environment which plays an important economic and ecological role. Nearshore species and habitats currently face new and increasing fishing and non-fishing human pressures, but managers lack much of the scientific and socioeconomic information/knowledge needed to determine their effects and to make the most appropriate management decisions. In order to more effectively and efficiently manage marine resource issues in Oregon, the Oregon Department of Fish & Wildlife is currently working to develop a strategic vision and comprehensive management strategy (Nearshore Strategy) for Oregon's nearshore resources. The Nearshore Strategy will address unmet harvested and non-harvested fish, wildlife, and habitat needs in Oregon's nearshore environment, emphasizing species with the greatest conservation needs. The strategy will: identify key issues and where they occur, identify where scientific and socioeconomic data gaps currently exist, and establish a framework for implementing sound resource management actions. This paper delves into the process undertaken to formulate the Nearshore Strategy, emphasizing collaborative partnerships and uses of scientific and socioeconomic information. We also demonstrate how the Nearshore Strategy is helping move Oregon's management of marine resources towards a more holistic, ecosystem-based management approach.

Hazard Analysis and Critical Control Point (HACCP) Planning; a Protocol for Preventing the Spread of New Zealand Mudsnails (*Potamopyrgus antipodarum*), by Hatcheries and Field Researchers.

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The invasive New Zealand mudsnail, *Potamopyrgus antipodarum*, has become well established in the rivers of eight western states and is rapidly expanding its range. The western populations of *P. antipodarum* consist of small (<5mm), live-bearing, parthenogenic snails found in densities ranging from 10,000 to 40,000 per square meter but often exceed 300,000 per square meter. As the threat of *P. antipodarum* continues to grow simple control measures are needed to stop the spread. Dispersal of *P. antipodarum* is thought to be unintentionally facilitated by anglers, recreational water users and field research personnel transporting snails in contaminated gear. *Potamopyrgus antipodarum* may also be spread by the stocking operations of infested hatcheries. HACCP (Hazard Analysis and Critical Control Point) planning, originally designed to remove contamination in food

production, has been adapted as a pathway management planning tool to remove contaminating species and prevent unintentional introductions. The recent contamination of at least one Pacific Region national fish hatchery by *P. antipodarum* has spurred efforts to generate HACCP plans at all relevant USFWS hatcheries. Teams of field research personnel also require practical control methods to limit the spread of *P. antipodarum*. A series of HACCP protocols were devised and tested by field crews working for the Oregon Department of Environmental Quality and the US Forest Service during the summer 2004 sampling season.

Growth, Survival and Movement of Juvenile Salmonids as Indicators of Habitat Quality

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Fish-habitat relationships often have relied on measures of fish abundance as indices of habitat quality. Indices based on abundance measures may be misleading, however, due to high turnover rates in suboptimal habitats, seasonality of habitat use, or lagged responses to habitat conditions. We are investigating habitat-specific demographics and movement characteristics of PIT-tagged juvenile salmonids in the West Fork Smith River, a 6800 ha watershed in coastal Oregon, to evaluate the relationship of habitat conditions to growth, survival and movement. Pre-winter size and condition of juvenile coho salmon (*Oncorhynchus kisutch*) varied by watershed location, and were correlated with summer water temperature and infestation by a parasitic *Neascus*-type trematode. Fall body size of juvenile coho was a good predictor of smolt size and overwinter survival, but smolt size was influenced also by overwintering location. This was due to strong spatial patterns in winter growth rates associated with residency and movement into a small tributary that had highest densities of adult coho salmon spawners in early winter. Compensatory winter growth and improved survival of juvenile coho using tributary habitats underscores the importance of maintaining connectivity between seasonal habitats that provide a diversity of sheltering and foraging opportunities, particularly where mainstem habitats have been simplified by human activities.

Avian Predation on Juvenile Salmonids in the Mid-Columbia River: Assessing the Magnitude of Impacts

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Piscivorous waterbirds annually consume millions of juvenile salmonids in the Columbia River Basin, losses that may hinder salmon recovery. The second largest colony of Caspian terns (*Sterna caspia*) in the Columbia River Basin resides on Crescent Island, a dredge-spoil island in McNary Pool. Tern numbers on Crescent Island have remained stable for the last eight years, consisting of 400-650 breeding pairs. Unlike terns nesting in the Columbia River estuary, the diet of Crescent Island terns is predominately salmonids with total consumption estimated at approximately 700,000 smolts in 2001. Despite the small number of terns nesting on Crescent Island relative to the estuary, predation rates on some salmonid stocks have been surprisingly high, especially during low flow years. For example, Crescent Island terns consumed a minimum of 21% of the in-river migrating Snake River steelhead smolts in 2004 (based on PIT-tagged steelhead interrogated at Lower Monumental Dam and subsequently recovered on the Crescent Island colony). In-river Snake River steelhead smolts were more vulnerable to tern predation than their counterparts from the Upper Columbia (4%; based on PIT-tagged steelhead interrogated at Rock Island Dam and subsequently recovered on Crescent Island colony). The relatively high predation rate on in-river Snake River migrants was, however, offset by the transportation of most juvenile salmonids around McNary

Pool, which was not the case for Upper Columbia River stocks. There were other nesting colonies of piscivorous waterbirds in McNary Pool (i.e., gulls, cormorants, pelicans) during this study, but their predation rates on juvenile salmonids were comparatively minor.

Assessing Stream Habitat Quality in Two Interior Columbia Basin Watersheds with an Emphasis on Excess Fine Sediments

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Recent concern over threatened or endangered salmonid populations in the Interior Columbia River Basin (ICRB) has prompted substantial research, monitoring and restoration efforts by various federal, state, and tribal agencies. We outline a broad-scale assessment approach for physical habitat and present preliminary results for two watersheds within the ICRB, the John Day/Deschutes basin (JDD) in Oregon (n=72 sites) and the Wenatchee basin in Washington (n=32). Sites were sampled during 2000-2002 as part of the EMAP Western Pilot Study conducted by the U.S. EPA and cooperating state agencies. We focus on measures of streambed substrate condition, particularly indicators of excess fine sediment deposition that may represent a response to anthropogenic activities, and on how these measures relate to ecosystem health. We found a significant negative relationship between two indicators of excess fine sediments and an index of biotic integrity (IBI) based on aquatic invertebrates in both the JDD ($p<0.001$, $r^2 = 0.30$ to 0.32) and Wenatchee ($p<0.001$, $r^2 = 0.46$ to 0.53) basins. In both basins, sites with the highest values of excess fine sediments had low IBI scores, although several sites in the JDD basin with low IBI scores had low to moderate values of both indicators of excess fine sediments. These results suggest that excess fine sediments adversely impact stream habitat and benthic invertebrate communities at some locations within both watersheds, but that factors other than sediment may be impairing aquatic invertebrate communities at other locations, at least within the JDD basin.

Physiological Tools to Assess Thermal Stream Habitat Quality for Redband Trout (*Oncorhynchus mykiss*) in the South Fork John Day River

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The physiological condition of redband trout (*Oncorhynchus mykiss*) during summer in the South Fork John Day River, Oregon may indicate the thermal habitat quality for juvenile *O. mykiss* in this river. The overall goal of this project is to determine if juvenile *O. mykiss* habitat can be categorized based on summer maximum daily water temperatures. To help achieve this goal, the physiological response of juvenile *O. mykiss* to summer water temperatures will be measured by lipid levels and potential induction of heat shock proteins (specifically Hsp70). Heat shock proteins are a family of highly conserved cellular proteins that protect cellular function when cells are challenged by a physiological insult. It has been suggested that temperatures sufficient to induce heat shock proteins predict distribution patterns and limits for optimal growth and long-term survival of stream salmonids. Lipid levels reflect acquired energy reserves and elevated water temperatures during the summer might deplete

these reserves and contribute to winter mortality. We will discuss the utility of using heat shock proteins and lipid levels to measure thermal habitat quality and show how this research complements a diverse set of studies being conducted in the South Fork John Day River.

Developing Web Sites to Help Citizens and Policy Makers Make Better Decisions About Land and Water Use

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The World Wide Web's ability to provide information anytime and essentially anywhere makes it the natural choice to provide information and decision tools concerning natural resource issues. The Oregon State University Library hosts two web sites designed to help citizens and policymakers make land and water use decisions. The Willamette Explorer site (http://WillametteExplorer.info) focuses on the Willamette River Basin while the Oregon North Coast Explorer focuses on Oregon's north coast. The development and user testing of these sites has shown that three areas are important for their success: content, context, and access. First, there must be a strong collection of content. Users of the Willamette Explorer can access publications, geospatial data, photos and videos, people and expertise, and web links. While this portal function is essential, our user testing found that we needed to provide context to the site and the information within it. Therefore we developed web-based stories to answer the "why should I care?" or "what do these data mean?" type of questions. Early after the launch of the Willamette Explorer, our feature story about the past, present, and future of the Willamette River Basin was the most popular destination on the site. Finally, users must have easy access to the information within the site. To provide access to geospatial data, our sites provides simple geographic information system capability for viewing and working with geospatial data. By combining content, context, and access, these sites help explain the possible impact of future changes in land and water use.

The Effects of Mainstem Flow and Water Velocity on Spring Chinook Salmon and Steelhead Populations from the Snake River

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Flow objectives to aid the seaward migration of juvenile salmonids in the Columbia Basin by decreasing the time spent migrating through the hydrosystem were included in the 1992, 1993-1998, 1995 and 2000 National Oceanic and Atmospheric Association (NOAA) Fisheries' Federal Columbia River Power System (FCRPS) Biological Opinions (Biop). Increases in hydroelectric system flow are considered to be beneficial to migrating salmonids for several reasons. Historically, most juvenile salmonids migrated when environmental conditions (flow, water temperature and turbidity) were more favorable for survival. The primary objective of this study was to investigate the relation between flow and other variables as they affect juvenile survival, using data collected with PIT tag technology over the range of variation in flow observed since the implementation of the NOAA Fisheries' Biological Opinions. All data collected and analyzed to-date shows flow (water velocity) as the important factor affecting the overall survival of juvenile migrants transiting the hydroelectric power system. Flow affects the migration timing and ocean entry of juvenile salmonids. All information collected thus far suggests that relaxing flow requirements may increase the risk of recovery to these Endangered Species Act listed populations.

Evaluation of Outplanting Hatchery-Origin Adult Spring Chinook Salmon (*Oncorynchus tshawytscha*) to Supplement an Endemic Population in Shitike Creek, Oregon

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Shitike Creek, on the Warm Springs Reservation of Oregon, has an endemic population of spring Chinook salmon. Despite habitat improvement in the watershed via passage barrier removal in 1983 and protection of riparian areas, natural populations did not increase to the levels which the habitat is predicted to support. In 2000, the Warm Springs Reservation and the U.S. Fish and Wildlife Service initiated an outplanting evaluation project using surplus hatchery-origin spring Chinook salmon returning to the Warm Springs National Fish Hatchery to supplement Shitike Creek. From 2000 to 2004, 83 to 224 hatchery-origin Chinook salmon were outplanted each year in 5 release locations throughout the drainage. Subsamples of the outplanted fish were radio tagged. Males generally moved further distances following release than females. Mating occurred in outplant/outplant, outplant/wild and wild/wild combinations. Redd locations of radio tagged and non-tagged salmon were found in previously undocumented habitat. Starting in 2002, genetic samples were obtained from outplanted and returning wild adults and outmigrating juveniles to establish pedigree. Over the past 5 years, we have documented an increase in redd production, juvenile densities, outmigrating juveniles and returning 4 year old adults compared to pre-supplementation.

Patterns in the Abundance and Distribution of Juvenile Coho in Oregon's Mid-Coast

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Life history diversity over broad geographic regions characterizes Pacific Northwest salmonid populations. The life history of coho salmon (*Oncorhynchus kisutch*), is a complex example of adaptation that is a response to a diverse array of habitats. We explore stream networks as a framework for understanding juvenile coho distribution at a landscape scale. Streams are not simple linear landscape features. The dendritic shape of many western Oregon streams may result in upstream or downstream movement of organisms or abiotic materials that is complicated by tributary junctions, as well as the fragmentary effect of natural or anthropogenic disturbances. Precision in estimating juvenile coho distribution is improved by considering the shape, orientation, fragmentation and juxtaposition of habitats and fish within the dendritic stream network. Preliminary analysis of the abundance of juvenile fish indicated a relationship between areas that provide for successful adult spawning, and juvenile rearing through both summer and winter. Additionally, locations of complex rearing habitats and high juvenile abundance within the stream network appeared to be related. This implies that stream habitat restoration or protection needs to consider the spatial orientation of necessary complex habitats. Ultimately, it is not enough to simply count pools, riffles and glides. Rather, the proximity of these habitats to each other to allow for accessibility to resources by juvenile coho must be considered.

Genetic Population Structure of Central Oregon Coast Coho Salmon (*Oncorhynchus kisutch*)

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We surveyed microsatellite variation from 22 spawning populations of coho salmon (*Oncorhynchus kisutch*) from the Oregon Coast to help identify populations for conservation planning. All of our samples were temporally replicated, with most samples obtained in 2000 and 2001. We had three goals: 1) to confirm the status of populations identified on the basis of spawning location and life history; 2) to estimate effective population sizes and migration rates in order to determine demographic independence at different spatial scales; and 3) to determine if releases of Washington hatchery coho salmon in the 1980's into Oregon Coast streams resulted in measurable introgression into nearby wild Oregon Coast coho populations. For the last question, our study included a hatchery broodstock sample from 1985, after the Puget Sound introduction, and a 1975 sample taken from the same area prior to the introduction. Our results generally supported previously hypothesized population structure. Most importantly, we found unique lake-rearing groups identified on the basis of a common life-history type were genetically related. Estimates of immigrant fraction using several different methods also generally supported previously identified populations. Estimates of effective population size were highly correlated with estimates of spawning abundance. The 1985 hatchery sample was genetically similar to contemporary Washington samples, and the contemporary Oregon Coast samples were similar to the 1975 Oregon Coast sample, suggesting that introductions of Washington coho salmon did not result in large-scale introgression into Oregon populations.

Fall Chinook Turn-Arounds During Lower Columbia River Dam Passage Attempts (1998-2003): Where Did They Occur and How Far Did Fish Retreat?

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Nearly 5000 adult fall Chinook salmon were radio tagged between 1998 and 2003 in an effort to examine the effects of the Columbia Basin hydropower system on passage, timing, and behavior of migrating fish. For these analyses, we looked specifically at turn-arounds during dam passage and time spent in various fishway segments at dams on the mainstem Columbia River. Overall project passage time and its allotment among each of five segments of the fishway (tailrace, entrances, collection channels, transition pools, and ladders) were calculated. Salmon spent the majority of their time in the tailrace and at the base of the dams, yet they tended to do so both before and after making an attempt to pass the dam. Thus, turn-arounds in multiple segments of the fishway contributed to the total time spent at a dam. Turn-around analyses examined the temporal and spatial distribution of events, the retreat distance within the project, and the time to return to a segment after failing to pass that segment. The most common places for a fish to turn around during dam passage attempts were in the collection channel and transition pool segments. Retreat distances and fishway segment success rates varied greatly among projects and study years. However, at all but John Day Dam, most fish only entered each segment a few times on median, indicating a disproportionate contribution to the total turn-arounds by just a few fish. In the majority of turn-arounds, fish returned to the failed segment within two hours of the failure.

Macroinvertebrate Assemblage Patterns in the North Fork John Day River During Sediment Inputs

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The North Fork John Day River upstream of Dale, Oregon, is designated as a federal Wild and Scenic River and about 25% of its watershed is set aside as Wilderness. Nonetheless, historic alluvial gold mining and recent sediment inputs have impacted this river. Recent sediment delivery began as a result of floodplain mine-tailing leveling from 1993-1997. As these disturbances from human activities ended, post-fire erosion and tributary channel scour events contributed more sediment. Sediment inputs occurred at multiple points along the river, and these points changed from year to year. We studied macroinvertebrates, fine sediment accumulation and other environmental factors that could influence macroinvertebrate assemblages during 1997 and 1998 along a 16km, 5th order river section. Most environmental measurements were consistent between years and showed local variation, but few longitudinal trends. However, fine sediment deposition was greater in 1998, than in 1997; and in the one year when detailed measurements were taken (1998), fine sediment accumulation increased from upstream to downstream. During the study period, invertebrate assemblages varied with local habitat, but also showed longitudinal and year-to-year compositional changes. Proportional abundances of sediment tolerant taxa, especially oligochaete worms, increased from 1997 to 1998, and from upstream to downstream, indicating a response to fine sediment accumulation. Macroinvertebrate response appeared to reflect cumulative impacts and/or increasing input of sediment over the course of this study.

A Riverscape Perspective: Tier III Monitoring as a Planning Tool for Restoration

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Remotely sensed imagery can be efficient at sampling across large spatial scales, and patterns at these scales can indicate habitat conditions and limiting factors critical for stream restoration processes. However, these patterns are correlative and need ground truthing. Ground truthing is used to determine cause-and-effect, which is Tier III stream monitoring. Hypotheses concerning patterns are tested at different levels of biological organization that correspond to different spatial scales. Once causal mechanisms are identified the status of other basins may be determined by capturing the same kinds of remote images (Tier I monitoring), because ambiguous results and spurious correlations would have been previously identified. Likewise, monitoring trends from a monitoring program can be done very efficiently. With the advent of remote sensing, it may be advantageous to conduct Tier III monitoring first, rather than last as suggested by its number (i.e., Tier I vs. III). This approach is being tested in the John Day Basin with the hypothesis that *Oncorhynchus mykiss* smolt production is greater in colder rather than warmer stream reaches. We use longitudinal temperature patterns to identify habitat patches of different quality and classify them into categories of physiological tolerance. PIT-tagged fishes are geo-referenced with respect to location and are subsequently tracked over time. Several metrics are used to predict smolt production; spatial distribution of individuals in response to habitat characteristics, physiological influences on growth and survival, and PIT-tag detections at various locations (including Columbia River dams) of fish raised at different temperatures (detection rates = 10% pilot test).

Building Tools and Resources to Increase Workforce Diversity: A Hands-On Work Session

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As Oregon demographics have become more ethnically diverse and expectations of women in resource careers change, resource agencies have struggled to recruit and retain a workforce representative of these cultural shifts. It is time to evaluate our progress and renew our energies. In this workshop participants will develop strategies that combine past experiences, resource needs and future predictions of population growth. Attendees with varying responsibilities and experience in this arena, from young employees to agency supervisors, are encouraged to participate. In the first part of the workshop, speakers will identify current demographic trends, review innovative programs regionally and nationally, and discuss personal experiences of professional hiring and development. We will ask "What worked? What didn't? What can we do?" The second half of the workshop will be a working session for brainstorming and creating new, possibly agency specific, programs and initiatives to address challenges of the changing populace.

The Opportunities and Challenges of Implementing ODFW's Native Fish Conservation and Fish Hatchery Management Policies

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Implementation of the Native Fish Conservation and Fish Hatchery Management Policies provides a significant opportunity for the State of Oregon to develop all-encompassing Conservation and Hatchery Program Management Plans for native fish species. The policies prioritize the conservation of naturally produced native fish species as Oregon Department of Fish and Wildlife's (ODFW's) principle obligation, while also fostering the ecological, economic and cultural benefits of each species to the citizens of Oregon. There are significant challenges to implementing both policies. Conservation Plans for each Species Management Unit (SMU) will provide the guidance for all fish management and hatchery program management actions. It will be a considerable challenge for ODFW to quickly produce a large number of Conservation Plans utilizing existing staff. ODFW has produced a Native Fish Status Report to help prioritize planning efforts. The quantity and quality of the data used in the development of the report, as well as the criteria used to assess SMU health, provided their own set of challenges. Both policies call for the responsible use of hatcheries and hatchery-produced fish to minimize the influence they have on naturally produced fish species. The ability to quantify the influence of hatchery fish is currently limited, which will inhibit the ability to determine their responsible use. It will also be difficult to define the current and desired biological attributes of some SMUs as called for in the Native Fish Conservation Policy. The challenges of implementing both of these policies will be resolved as Conservation and Hatchery Program Management Plans are developed.

Pacific Lamprey Larval Distribution and Adult Escapement in the Lower Deschutes River

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In 2004 larval lamprey distribution and habitat surveys were conducted in perennial tributaries to the lower Deschutes River. An ABP-2 larval lamprey backpack electrofisher was used to determine lamprey presence. At each sampling site water quality and habitat parameters were collected including conductivity, water depth, and velocity. Larval lampreys were present in four of the fifteen streams surveyed but distribution was limited to the lowest reaches of each streams. Larval lampreys were also present throughout the mainstem lower Deschutes

River. Although sample sizes were small relationships were found with larval lamprey presence and wood and depositional area. During the summer of 2003, a mark-recapture feasibility study was conducted to determine if it was possible to estimate adult Pacific lamprey escapement at Sherar's Falls, located at Rkm 71 in the Deschutes River. A systematic approach was used to collect adult Pacific lamprey in the fish ladder at Sherar's Falls. A total of 199 adult Pacific lampreys were collected using a long-handled dip net and fitted with Floy tags, fin clipped, and released downstream 2 Rkm. Thirty-five lampreys were recaptured in the fish ladder and during a tribal harvest creel. During 2004, 174 lampreys were tagged and 39 were recaptured. A tribal harvest creel was conducted in 2003 and 2004 to estimate the number of adult Pacific lampreys collected by Confederated Tribes of Warm Springs tribal members for subsistence use. Adult Pacific lamprey escapement and exploitation rates will be estimated for the lower Deschutes River.

An Assessment of the Impacts of Introduced Fishes on the Oregon Coast Coho ESU

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The Oregon Plan for Salmon and Watersheds was initiated in 1997 to effect restoration of watershed conditions, water quality, and listed fish populations. Six years into implementation, it was deemed appropriate to assess the effectiveness of Oregon Plan measures in relationship to the recovery and sustainability of the Oregon Coast Coho ESU. Within the Coho Assessment is an evaluation and ranking of the physical, biological, and management factors potentially limiting coho recovery, including the impacts of introduced fishes on Oregon Coast coho. Potential limiting factors were evaluated on three scales: the ESU scale, the Oregon Plan Monitoring Area scale, and the coho population scale. Coastal fish biologists provided lists of introduced species and descriptions of known or potential impacts to coho salmon. Management data, research results, and professional observation were utilized in this assessment. The impacts of introduced fishes appear localized, with risks greater at the coho population scale. On the Monitoring Area scale, coho overlap with introduced fishes and potential impacts are greater on the southern end of the Oregon Coast, where coho populations have been healthier and more stable than northern populations. Exposure to introduced fishes and potential risks are not widespread on the ESU scale. It is suggested that limiting factors be considered collectively, rather than independently, when evaluating risk to the sustainability of listed coho salmon.

Analysis of Future Scenarios to Evaluate Trajectories of Ecosystem Change in the Willamette Basin

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The state of Oregon and the federal government have analyzed risks of extinction of salmon and are currently assessing the effectiveness the Oregon Plan for Salmon and Watersheds. These critical analyses are essential given the profound changes that are likely in human populations and land use over the next century. Unfortunately, most of these assessments have been based on static landscapes with the landscape of the year 2000 unchanging over the next 100 years. Analysis of trajectories of past and future ecosystem change will be illustrated for the Willamette basin. We documented trajectories of change in watershed land cover, channel structure, and riparian plant communities for all 2nd-4th-order tributaries and the 270-km mainstem of the Willamette River. We also mapped current human systems (population density, buildings and roads, public lands, land values, land use) as measures of social opportunities and constraints. We also measured the consequences in future alternatives as described by stakeholders in the Willamette River basin. Scenarios of change from 2000 to 2050 were developed for current policies and practices, development alternatives, and conservation alternatives. Current policies and practices resulted in continued but decreased rates of decline in fish and wildlife communities, but plausible conservation practices resulted in the reversal of such declines. These quantitative evaluations of

historical changes and future trajectories of ecological properties of the Willamette River basin are essential for natural resource decisions in the face of rapid population growth in the next few decades.

Replacement of Sentinel Fish Exposures with a Real-Time PCR Assay to Detect the Parasite *Ceratomyxa shasta* in the Klamath River

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Ceratomyxa shasta is a virulent myxozoan parasite of salmonid fish endemic in the Pacific Northwest of North America. Its distribution in the Klamath River has been documented using sentinel fish exposures. However, these studies are laborious, use live fish and do not provide data on parasite abundance. Thus, a real-time (or quantitative) polymerase chain reaction (QPCR) assay was developed to detect the parasite in environmental water samples. The assay targeted a 71bp amplicon of the 18S rDNA gene. The assay was sensitive enough to detect 1/1000th of a myxospore, indicating that each spore has greater than 1000 copies of the target. The assay was also specific and did not fluoresce for related parasites, including *Parvicapsula minibicornis*, *Myxobolus cerebralis*, *M. insidiosus* or *Henneguya salmonicola*. Our QPCR methodology was utilized as part of a collaborative project to investigate the temporal and spatial distribution of *C. shasta* in the Klamath River, Oregon/California. The parasite was detected throughout the river and several sites of high infectivity were identified where parasite abundance was in excess of 10 spores/L. Two of five tributaries tested contributed parasites to the mainstem river, although levels in the Trinity River were very low. The QPCR data corroborated results of previous and concurrent sentinel fish exposures. QPCR proved to be a feasible method to detect and quantify parasite levels in environmental water samples and supersedes previous methods.

Reconstruction of the Distributions of Anadromous Fish Upstream from Iron Gate Dam on the Klamath River—An Approach Based Upon Multiple Lines of Evidence

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Without knowledge of the historical distribution of anadromous fish, the hydropower relicensing process and ongoing restoration efforts have an imprecise basis to guide management decisions for the Klamath River. This uncertainty is also a region-wide problem for coho salmon recovery. This document reconstructs the distribution of anadromous fish in the Klamath River above Iron Gate Dam. Evidence based upon photos, historical documents, fisheries reports, and logical reasoning clearly show that Chinook salmon historically migrated upstream into the Klamath Upper Basin. Steelhead trout occupied habitat as far upstream as Keno Dam and the distribution of either anadromous redband or steelhead extended above Upper Klamath Lake. Coho salmon and anadromous lamprey likely were distributed upstream at least to the vicinity of Spencer Creek. A population of anadromous sockeye salmon may have occurred historically above Iron Gate Dam. Green sturgeon, chum salmon, pink salmon, coastal cutthroat trout, and eulachon were restricted to the Klamath River well below Iron Gate Dam. This synthesis resolves much of the uncertainty regarding which species were present above Iron Gate Dam and the extent of their upstream distribution, key information necessary to guide relicensing efforts and anadromous fish restoration.

Aquatic Invasive Species 101—The Big (and Scary) Picture

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From Asian clams to zebra mussels, aquatic invasive species (AIS) pose a major threat to Pacific Northwest ecosystems and economies. They are a major contributor to native species extinctions and collectively cost the United States billions of dollars each year. Some invaders, like the Atlantic cordgrass *Spartina* plaguing Willapa Bay mudflats, represent decades of existing impacts in the Northwest. Others, like silver carp currently causing havoc in the Missouri River, represent the many potential problems looming on our horizon. AIS arrive via "inadvertent" pathways like ballast water and hull fouling as well as via intentional introductions (legal and not). Whether a nonnative species becomes invasive or a "nuisance" is both a matter of science and social perspective. Away from predators, disease, and other limits from their native range, AIS populations can explode and dominate their new habitats. In many cases, we possess scant information about the distribution of nonnative species in Northwest waters as well as negative impacts from those species. Although invasive species often share common traits like high fecundity, predicting invasiveness is still a challenging proposition. However, past experience makes it clear that once AIS become established in aquatic ecosystems and begin to cause problems, eliminating those invasions is extremely unlikely. Preventing unwanted introductions, along with the capacity to quickly detect and control incipient invasions, offer the best chance for avoiding future harm from AIS.

A Cost-Benefit Analysis of Marine Reserves and Stock Enhancement for Recovering Rockfish Populations

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The depletion of fish stocks worldwide has led to increasingly restrictive and complex management measures and development of new tools for ensuring sustainability. A marine reserve is a passive conservation tool for enhancing natural production, while stock enhancement is an active tool in which the offspring from wild fish are reared in artificial conditions for subsequent release. The costs, benefits and efficacy of reserves and enhancement need to be assessed quantitatively. Ensuring an old-growth age structure is an inherent principle of marine reserves, and field studies show shifts in the age and size structure of fishes inside (and sometimes outside) of reserves. Using two rockfishes as examples, we compared the number of larvae that would have to be reared and released from a hatchery in order to equal the increased reproductive contribution of females in a marine reserve over time. Our simple model suggests that for rapidly growing black rockfish (*Sebastes melanops)*, hatchery efficiency or capacity would need to increase by 8-10 fold over a 40 year period to equal the productivity increase of a reserve. In contrast, an enhancement program for slow growing but highly fecund yelloweye rockfish (*Sebastes ruberrimus*) would need to increase annual production by 20-30 fold to equal a reserve over the same time period. Estimating the cost of a reserve, in terms of annual lost revenue to a fishery, is difficult due to shifting fishery effort. Nevertheless, our preliminary cost:productivity estimates indicate that reserves are less expensive and more beneficial than enhancement for most rockfishes.

Caught in the Web: How to Sustain Wild Salmon Through 2100

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The recovery of wild salmon in western North America will be determined by the relative balance struck between altruism, greed, and indifference manifested by our rapidly growing human population. The only realistic way I can envision sustainable runs in 2100 is by shifting human consciousness toward a life-style more supportive of Pacific salmon through an educational program that incorporates environmental values, actions, and consequences throughout the entire K-12 educational spectrum. I am calling for a pervasive shift in educational outlook. Essential to this change is the development of environmentally oriented curricula in all areas of study such as mathematics, social studies, humanities, and science. A number of schools throughout the region already incorporate varying levels of environmental studies in existing curricula, but most do not. When considering the format found to be most successful, teachers queried emphasized the value of getting outside the classroom and providing a relevant, holistic learning experience. While past efforts to restore salmon have emphasized practical options for maintaining biologically sustainable populations of wild salmon, they have been spectacularly unsuccessful. My policy prescription extends far beyond recovering salmon populations, as it must to be successful. The ultimate goal for environmental education (that will allow us to maintain significant, sustainable runs of wild salmon) is to ensure that our descendants, the generations still unborn, have a world no worse than ours and, hopefully, better.

Overwinter Survival Estimates of Juvenile Coho: A Cautionary Tail

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Over-winter survival of juvenile coho is commonly believed to be a limiting factor in many California coastal streams. Historical logging practices and “stream cleaning” projects have resulted in simplified stream habitats that may provide less than optimal winter rearing habitat. Summer versus smolt population estimates are often used to calculate estimates of over-winter survival. However, there are potential problems estimating smolt populations such as timing in which the traps are installed and the amount of time they are operational that are not reflected in the confidence intervals for the smolt estimate. In addition, over-winter survival estimates are based on the assumption of no immigration or emigration within a given tributary such that the ratio of the out-migrant population relative to the summer population will be considered a minimum estimate of over-winter survival. Based on data from three streams in the Little River watershed (a Northern California coastal tributary in Humboldt County) these assumptions are not likely to be met, and the degree to which the assumptions are violated depends on such factors as population density, winter flows and the amount of suitable winter rearing habitat.

A Comparison of Salmonid Abundance and Habitat Availability Within Two Managed Tributaries in Del Norte County, California

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Anthropogenic disturbance resulting from natural resource extraction is a major component of the Pacific Northwest landscape. In 1994, with the potential federal listing of the coho salmon, a long term monitoring program (adult escapement surveys, summer juvenile abundance estimates and smolt trapping) was initiated to determine the diversity, abundance and stability of anadromous salmonids within West Branch and East Fork Mill

Creek. These two watercourses converge to form Mill Creek, tributary to the main stem Smith River, Del Norte County, California. Mill Creek drains approximately 24,000 acres, of which sub basins West Branch and East Fork drain approximately 9,000 and 11,000 acres, respectively, with a long history of intensive timber management activities. Ten years of population data collected from these two tributaries were used to compare abundance and assemblage of anadromous salmonids within each tributary with several coarse-scale habitat parameters. Stream habitat variables included large wood, stream embeddedness and percent canopy cover. Historical logging records where collected to determine timing of entry and relative rate of harvest within each sub-basin. Abundance of coho salmon, chinook salmon, steelhead and coastal cutthroat trout was generally higher in the West Branch relative to the East Fork Mill Creek over ten years. These findings will be presented and their interaction over time as potential contributing factors in observed differences in overall species abundance.

Water Temperatures Used by Migratory Bull Trout from the Lostine River

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Bull trout are noted for their affinity to cold water, and elevated water temperatures are believed to limit their distribution. In 2003 the EPA issued guidance to the states and tribes for water temperature standards to protect bull trout and other species. The ODEQ subsequently revised the state water temperature standards. However, most of the studies and data collected to date relate to water temperatures used by juvenile bull trout and resident adults typically found in cooler headwater reaches. To describe water temperatures used by migratory bull trout, we captured adults and attached archival tags to record temperatures experienced by the fish and radio tags so their locations could be monitored and the fish recaptured. We also placed thermographs throughout their migratory route to measure ambient water temperatures. The study was designed to address these questions: 1) What temperatures do fish use across an annual cycle? 2) How does thermal habitat use by fish compare to ambient temperatures? 3) Do the fish use thermal refugia? 4) How do the temperatures observed compare with state water quality standards? 5) Are there linkages between fish movements and temperature? 6) How do temperatures measured at different temporal intervals compare?

Cutthroat Trout Conservation: Are Conservation Agreements/Strategies Effective?

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Conservation agreements and strategies have been developed and implemented in Utah for a variety of sensitive species over the past decade, including Bonneville cutthroat trout (*Oncorhynchus clarki utah*) and Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*). Since 1997, a statewide conservation agreement and strategy has existed for each of these sub-species of inland cutthroat trout. By 2000, a rangewide conservation agreement and strategy had been developed and implemented for both subspecies. The conservation agreement identifies all stakeholders and their authority toward cutthroat trout conservation. Furthermore, it outlines the coordination and implementation of decision making processes that include all parties. The conservation strategy identifies the goals of cutthroat trout conservation and the actions that will be implemented to achieve quantifiable objectives. Over the past eight years, the cooperative implementation of these strategies toward inland cutthroat trout conservation has resulted in the enhancement of habitat and population status for these subspecies throughout their ranges. The coastal cutthroat trout (*Oncorhynchus clarki clarki*) is considered a sensitive species throughout much of its range.

The development of a conservation agreement and strategy may provide an effective mechanism toward managing for conservation of another subspecies of cutthroat trout.

Working With People to Envision Future Scenarios

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Spatially explicit landscape analyses are a central activity in research on the relationships between people and changes in natural systems. Using geographical information systems and related tools, the Pacific Northwest Ecosystem Research Consortium depicted Historical (pre-EuroAmerican settlement, ca. 1850), current (ca. 1990) and three alternative future (ca. 2050) landscapes for western Oregon's Willamette River Basin. We worked for 30 months with lay and professional citizen groups to create, map and refine a set of value-based assumptions about future policy in three scenarios concerning land and water use. The Plan Trend 2050 scenario represents the expected future landscape in 2050 if current policies are implemented as written and recent trends continue. Development 2050 reflects a loosening of current policies, to allow freer rein to market forces across all components of the landscape, but still within the range of what citizen stakeholders considered plausible. Conservation 2050 places greater emphasis on ecosystem protection and restoration, still reflecting a plausible balance among ecological, social, and economic considerations as defined by the stakeholders. For the Conservation scenario, natural resource managers and scientists provided estimates for the area of key habitats required to sustain, in perpetuity, the array of dependent species. Spatially explicit analyses identified locations biophysically suited to meet the area targets. These locations, titled the Conservation and Restoration Opportunity Areas, were mapped and then reviewed by a series of groups regarding the political plausibility of conserving or restoring them to the indicated vegetation types.

The Klamath Water Crisis

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The fundamental problem in the Klamath Basin is that too much water has been promised to too many interests. The earliest promises were made to the basin's Tribes. Upper Klamath Lake once teamed with prodigious numbers of Lost River and shortnose suckers that were an integral part of the culture and economy of the Klamath Tribes. The Klamath River was once the third most productive salmon fishery in the West. These fish were the cornerstone of the culture and economy of the Yurok, Karuk and Hoopa Valley Tribes. Klamath salmon were also the foundation of the coastal fishing economy from Coos Bay, Oregon to Fort Bragg, California. Later, the Bureau of Reclamation initiated the Klamath Project and promised homesteaders irrigated land. Over the years the Project grew to over 200,000 irrigated acres, while Oregon and California promised water to irrigate another 200,000 acres. The landscape of the upper basin was transformed. Eighty percent of the basin's wetlands were drained. So much water was diverted from the natural system and the agricultural return flows were so polluted that fish and wildlife populations dramatically declined, creating a crisis for the interests that relied on them. The basin will remain in crisis until demand for water is brought back into balance with what is ecologically sustainable. Demand can be reduced in a fair manner through a voluntary program to acquire water rights in the basin from willing sellers, and by phasing out leases for commercial farming on the basin's national wildlife refuges.

Coastal Cutthroat Trout Life History Strategies in Abernathy Creek and Chinook River, Washington, Two Tributaries of the Columbia River

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Coastal cutthroat trout (*Oncorhynchus clarki clarki)*) express a broad range of life history strategies, often within the same watershed. In this study, we investigate life history strategies of two wild coastal cutthroat trout populations in the lower Columbia River. Chinook River (rkm 6) is a low gradient system that historically witnessed high tidal influences and today is subjected to more moderate tidal intrusions. Abernathy Creek (rkm 76) is a higher gradient system subjected to little tidal influence. For this study, cutthroat trout were PIT tagged in fall 2001, 2002 and 2003 by electrofishing upstream of stationary PIT tag antenna arrays. These arrays interrogate the entire stream width at one point continuously without obstructing the path of the fish. Based on data from antenna detections and electrofishing recaptures, we compare life history parameters exhibited by these two populations of cutthroat trout.

Simulating Future Private Landowner Behavior in the Coastal Forests of Oregon

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Policy makers in Oregon have developed numerous policies since the early 1990's to deal with contentious biodiversity issues. Questions remain, however, about how well these policies achieve their goals and how efficiently they achieve them. To answer these questions, a group of PNW and OSU scientists created a multi-disciplinary effort called the Coastal Landscape Analysis and Modeling Study (CLAMS) to simulate the future implications of these policies for forest condition, socio-economic conditions, and biodiversity in Oregon's Coast Range. In this work we pay special attention to private landowners since they control about 60% of the forest within the region, including key salmonid habitat, and are the major source of recent disturbance through development and timber harvest. These owners retain considerable freedom in management of their forests, presenting a challenge to anyone simulating future conditions. Using a combination of economic theory, history, and surveys, we project likely behavior and forest conditions on private lands over the next 100 years, including the amount and spatial distribution of clearcutting under a particular set of policy assumptions. These results then feed into a variety of terrestrial and aquatic models to assess the implications of these potential actions and conditions for biodiversity. Our effort is intended to ease simulation of the aggregate implications of current and alternative policies for coastal forests.

Life History Study of Spring Chinook Salmon in the Grande Ronde River Subbasin

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We have been investigating the critical habitat, abundance, migration patterns, survival, and alternate life history strategies exhibited by spring Chinook salmon from distinct populations in the Grande Ronde River subbasin since the mid 1990s. This study provides a means for long term monitoring of juvenile salmonid production in the Grande Ronde River subbasin that is essential for assessing the success of restoration and enhancement efforts including hatchery supplementation and habitat improvement. We estimated abundance of spring Chinook salmon migrants using rotary screw traps and estimated survival from different periods to Lower Granite Dam using PIT tags. We have documented two general life history patterns of juvenile spring Chinook salmon in all populations

studied in the subbasin: (1) juveniles migrate downstream out of spawning and summer rearing areas in the fall, overwinter in larger river habitats, and begin their seaward migration in the spring, and (2) juveniles remain in spawning and summer rearing areas through the winter and begin their seaward migration in the spring. We have used the abundance and survival estimates of the juvenile migrants, estimates of returning adults from redd counts, and estimates of fecundity to estimate egg to smolt survival and smolt to adult survival for the study populations of spring Chinook salmon in the Grande Ronde River subbasin. Egg to smolt survival has ranged from 3% to 10%, and smolt to adult survival has ranged from 0.5% to 5% for the study populations before supplementation with hatchery fish.

A Landscape Classification Approach to Support the Design, Analysis, and Interpretation of Stream Habitat Assessment and Restoration Projects

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This project seeks to classify the watersheds of the Pacific Northwest (Oregon, Idaho and Washington) based on their potential to support anadromous salmonids both as a function of underlying geomorphic and physiographic characteristics as well as anthropogenic impacts due to land-use practices and activities. Given existing broad-scale descriptions of the Northwest, for example GIS data-layers for landscape characteristics and human impacts, we score 6th field Hydrologic Unit Codes (HUC) by reducing the data to a pair of condition vectors for each watershed with respect to its immutable biophysical setting and human impacts. This process takes complex continuous data, including multiple data layers that contain significant spatial correlation, and generates a single score for each 6th field HUC. The watersheds are then rolled up into regions with similar conditions. This step revolves around the quantitative process by which classified watersheds are grouped into clusters of "like" condition independently for immutable characteristics and for human impact scores. In this presentation we will discuss our approach to classifying and clustering watersheds, and how the results can be used in the analysis of monitoring and restoration data, as well as in the design of monitoring and restoration projects.

Nutrient Trends and Land Use in the Sevenmile Creek Tributary of Upper Klamath Lake: Opportunities for Management and Restoration

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Poor water quality associated with high nutrients and algal blooms is linked to the decline of endangered Lost River and shortnose suckers in Upper Klamath Lake (UKL). As part of an effort to provide increased quantity and quality of water to UKL, the Klamath Basin Rangeland Trust measured longitudinal nutrient concentration as well as the export of nutrients from flood irrigated cattle pasture in the Sevenmile Creek tributary of UKL. The longitudinal study showed a significant increase in both nitrogen and phosphorus from upstream to downstream stations, with the most dramatic increase occurring downstream of a major irrigation return flow. Increased nitrogen and phosphorus concentration coinciding with a significant rain event of 1 inch in a 24-hour period indicated the potential for storm events to contribute significantly to nutrient export. Measurements taken at headwater and tailwater locations on a 2-acre study plot during five irrigation events in the summer of 2003 showed that average seasonal concentrations of dissolved organic carbon (DOC), total dissolved N (TDN), total dissolved P (TDP), and orthophosphate (OP) were 2.8, 6.3, 2.8 and 3.2 times greater, respectively, at tailwater stations than headwater stations. Tailwater nutrient concentration showed a strong time-dependent pattern, with concentrations of OP, TDP and TDN greatest during the rising limb of the runoff hydrograph. Taken together, the data from these studies indicates that various cattle management and irrigation strategies have the potential to decrease downstream nutrient export to UKL.

Tidal Effects on Smolt Behavior in the Columbia River Estuary and the Relationship to Avian Predation; Can This be Managed?

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One aspect of our research in the Columbia River estuary has been to determine the importance of avian predation to salmonids at the population-level, but we have also assessed factors that may influence it. Some of those factors include migration patterns and rates of smolts within the estuary. To examine large-scale migration patterns, we surgically implanted acoustic tags in steelhead (*Oncorhynchus mykiss*) and Chinook salmon (*O. tshawytscha*), then monitored them with arrays of receiver-buoy systems. To answer questions on downstream rates, we implanted smolts with radio transmitters and actively tracked them by boat. We hypothesize that increased residence time within the estuary may exacerbate levels of avian predation. Both migration patterns and tidal effects on downstream rates could be major factors in increasing residence time. The downstream rate was influenced mainly by the tidal cycle, tidal strength, diurnal effects, and species. The location in the estuary where a fish is influenced by the tide may also be very important, for example, more mortality may occur if fish were to hold during an incoming tide next to the avian predator colony. The ultimate goal of our study is to recommend adaptive management techniques to maximize survival of transported (barged) smolts. One way to accomplish this is to release transported fish in the estuary; the time of release on a given day would depend on modeled fish movements and holding patterns in the estuary so that bird predation could be minimized (i.e. fish hold near the bird colonies at night).

Ghost Nets in the Columbia River: How Scary Are They?

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Lost gillnets commonly known as “ghost nets” constitute a threat to salmonids as well as resident fishes, particularly white sturgeon (*Acipenser transmontanus*) in the Columbia River. We designed a study with three goals: to determine the presence and extent of lost gillnets and the threat they pose to aquatic species, to test the efficacy of locating lost nets using side scan sonar (SSS), and to develop methods and test the feasibility of recovering lost gill nets using fishing vessels. To test the efficacy of using SSS to mark lost nets we searched Bonneville Reservoir with SSS and a fish finder to image suspected lost net targets. A global positioning system was used to run transects and mark suspected targets. We performed recovery operations in areas of suspected lost nets and in known commercial fishing areas. We used a 73 foot trawling vessel and non-tribal crew and a more maneuverable 26 foot fishing vessel and tribal crew to drag for and recover lost nets. A total of 23 days were spent performing dragging and recovery operations. A total of 33 nets were recovered containing 121 carcasses of white sturgeon and 5 live white sturgeon. Our efforts showed that a number of lost nets were present in the river and that net recovery operations can be successful but the Columbia River presents special challenges to dragging and recovery operations. Our test of SSS revealed that though we were successful locating nets, its effectiveness for our applications was limited.

Systematic Study of Smallscale Sucker (*Catostomus rimiculus*) in Oregon

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Smallscale suckers (*Catostomus rimiculus*) are found in two river systems in Oregon: Rogue River and Klamath River. Recent Klamath suckers study suggested differences in morphological feature between two localities. Morphological data and cytochrome b sequence were used in this study. Both data sets suggested two distinct groups. *C. rimiculus* in the Rogue tended to have more vertebrae anterior to the pelvic fin than those found in the Klamath system. Based on cytochrome b sequence, *C. rimiculus* in the Klamath system were more closely related to other species of suckers in the Klamath system than to its own species in the Rogue River. Hybridization among four sucker species (*Catostomus snyderi*, *C. rimiculus*, *Chasmistes brevirostris* and *Deltistes luxatus*) was the possible cause of this pattern.

Large-Wood Restoration in Oregon Streams: Biological Integrity or Photo Op?

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The benefits of large woody debris (LWD) to the biota of Pacific Northwest streams have long been established. However, historical and current land use patterns have decreased the amount of LWD in freshwater ecosystems and downstream movement to estuaries. Stream restoration activities that increase instream structure by placement of LWD are increasingly common, yet the biological significance of these projects is seldom recognized. We explored current state and federal databases, case studies and recent literature to investigate the disparity between the social and financial costs of LWD placement projects and the occurrence, costs and benefits of biological monitoring. Our conclusion is that the general public perception is that LWD enhancement projects are beneficial to fisheries although the financial cost of these projects is often high. Biological monitoring is rarely conducted due to the lack of established monitoring protocols and funding. The biological benefits and restoration science of these projects must be recognized if the streams and estuaries of the Pacific Northwest are to achieve biological integrity comparable to reference conditions.

Fish Passage Recovery Activities in the Upper Klamath Basin

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The Bureau of Reclamation has undertaken or has been involved with several important fish passage projects to benefit native fish assemblages, particularly endangered shortnose and Lost River suckers in the Upper Klamath basin. The new A-Canal fish screen and pump bypass system was completed in 2003, has eliminated the high rate of sucker entrainment, and returns fish to Upper Klamath Lake as designed. Reclamation is currently constructing a state-of-the art fish ladder on Link River Dam, which controls outflow from Upper Klamath Lake, to restore connectivity for suckers and native redband trout, a State sensitive species. Reclamation and Bureau of Indian Affairs are working with local stakeholders to potentially remove Chiloquin Dam on the Sprague River to improve fish passage and take an important step to help recover endangered sucker populations. The Klamath Fish Passage Technical Committee is also investigating other opportunities for screening Klamath Project diversion sites which pose the greatest entrainment risks for native fish species.

The Salmon 2100 Project: How to Sustain Significant, Sustainable Runs of Wild Salmon Through 2100

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The primary goal of the Salmon 2100 Project is to identify practical options that have a high probability of maintaining biologically significant, sustainable populations of wild salmon through this century. Many experts have concluded that wild salmon recovery efforts in western North America (especially California, Oregon, Washington, Idaho, and southern British Columbia), as earnest, expensive, and socially disruptive as they currently are, do not appear likely to sustain biologically significant populations of wild salmon through this century. Long-term sustainability, although apparently broadly supported in the abstract, remains elusive in reality. Rather than supporting or advocating any particular policy or class of policies, the overarching theme of the Salmon 2100 Project is to help policy makers and the public evaluate a suite of possible policy options by providing a number of independent, policy-neutral analyses and proposed policy prescriptions. To accomplish its goal, the Project enlisted two dozen senior scientists, resource managers, and policy analysts. The policy prescriptions offered by Project participants are universally candid, sometimes uncomfortably radical, and occasionally sobering. Most Project participants conclude that major, sometimes wholesale modification of core societal values and preferences will have to occur if significant, sustainable populations of wild salmon are to be present in the region by 2100.

Differing Anti-Predator Strategies of Three Juvenile North Pacific Flatfish Species

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Pleuronectid flatfish are generally thought to utilize a standard set of anti-predator behaviors to reduce encounters with potential predators, including burial, maintaining a low profile on the bottom, cryptic coloration, and reduced activity. However, a series of laboratory experiments demonstrate significantly different predation rates on juvenile (Age-0) English sole (*Parophrys vetulus*), northern rock sole (*Lepidopsetta polyxystra*), and Pacific halibut (*Hippoglossus stenolepis*) by Age-1 Pacific halibut predators, suggesting differing anti-predator strategies and/or capabilities. Specifically, differences between the three species include their cryptic ability to match sediments as well as their activity levels associated with perceived predation risk. English sole, with the highest predation rates, have a reduced cryptic ability as well as generally higher activity levels in the presence of predators when compared to the other two species. In additional experiments where the cryptic ability to match sediments was manipulated, conspicuous individuals were subject to significantly higher rates of predation demonstrating that one's cryptic ability to match sediments has a strong influence on survival. As an estuarine dependent species, English sole are generally exposed to lower densities of predators than species that tend to recruit to open coastal areas such as northern rock sole and Pacific halibut. As such, estuarine areas with reduced predation risk may allow juveniles to relax their anti-predator behaviors in comparison to those under increased predation risk.

Conservation Efforts to Address Hatchery Management as a Factor for Decline for the Oregon Coast Coho ESU

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The Oregon Plan for Salmon and Watersheds (OPSW) identified hatchery coho programs as one of the main factors for decline of Oregon Coast wild coho. The OPSW prescribed six measures for hatchery coho programs, to reduce risks and aid recovery of wild coho populations. We reviewed implementation of those measures in the Oregon Coast coho ESU, and compared metrics of hatchery risks in pre- and post-OPSW periods. Although implementation of the OPSW hatchery measures is not yet complete, results to date suggest a significant change in the management of hatchery programs, and a substantial reduction in risks to wild coho populations. In the post-OPSW period various policies and plans have been developed which establish explicit and quantifiable goals and guidelines for hatchery programs in the Oregon Coast coho ESU. The number of hatchery coho smolts released has been reduced from over 25 million to less than 1 million, well below the goal of 2.2 million. The goal of 10% or less hatchery fish in natural spawning populations has been met for the ESU as a whole, and for 14 of the 16 individual wild coho populations for which we have population specific data. While there are still areas of concern, these and other results should substantially reduce the potential for adverse impacts to wild coho. Therefore, we conclude that the hatchery coho programs in this ESU are likely no longer a significant limit to the sustainability of the Oregon Coast coho ESU.

Dungeness Crab Harvest by Native People in Netarts Bay, Oregon

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Coastal people worldwide harvested and consumed a wide variety of shellfish. While most archaeological analyses focus on bivalves such as clams and mussels, crab remnants are often ignored. We examined the use of Dungeness crabs (*Cancer magister*) by native people living at Netarts Sandspit village from 1300 to ~1750 AD on Netarts Bay on the northern Oregon Coast. Ethnographic and ethnohistoric records suggest that crabs were both individually hunted as well as gathered, often en masse. We employed allometric scaling of Dungeness claws (propal finger) recovered from household middens to estimate crab body size and age. These data indicate that while a wide age range of crabs were collected, most harvesting efforts focused on juvenile and young adults. This suggests that most Dungeness crabs at this site were gathered in shallow subtidal areas where cockles (*Clinocardium nuttallii*) were also being regularly taken. As such, Dungeness crabs were part of a foraging strategy that involved the efficient mass harvest of small prey using minimal technology such as rakes, nets or traps. (A complete version of the study appears in the *Journal of Archaeological Science* 31: 1603-1612)

Strategies for Survival: Habitat Use and Distribution of Juvenile Chinook Salmon in the Metolius River Basin, Oregon

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Successful growth and survival of juvenile salmon during the freshwater phase of their life history depends on a balance between three main factors: energy intake, energy utilization, and avoidance of predators. However, the metabolic demands of temperature, the availability of food, and the presence or absence of predators all factor into the strategies that must be adopted to maximize growth and minimize risks of mortality. Juvenile salmon that are rearing in conditions that are below or above optima in terms of energy inputs or costs require more energy to maintain metabolic equilibrium, and must either 1) forage more (increase input) or 2) reduce activity levels (reduce costs). The selection of habitat types and diurnal activity patterns reflect the implementation of these life history strategies. Therefore, the potential for growth and survival is dictated by the ecological setting of the stream in which the juvenile salmon are rearing. In this study, we examined the size, condition, and seasonal habitat use and distribution of juvenile spring Chinook salmon in relation to habitat availability, water temperature, food availability (invertebrate drift), and the fish communities in six unique study reaches in the mainstem and tributaries of Metolius River, a tributary of the Deschutes River in Central Oregon. We released hatchery-origin Chinook fry into five locations around the Metolius Basin in the winters of 2002 and 2003, and conducted seasonal day and night snorkel surveys to quantify abundance and distribution.

Invasive Species Stream Assessments in the Umatilla, Walla Walla, John Day, and Grand Ronde River Systems

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The goal of my project is to provide the results from my investigations for the presence and absence of the exotic New Zealand mudsnail, *Potamopygus antipodarum*, a herbivore-detrivore that is rapidly spreading throughout waters in the western United States. To date, there is very little research on the impacts of the mudsnail, its effects with macroinvertebrates, or its potential as a secondary host for vertebrate parasites, and diseases. This snail preys on mayflies, caddisflies, and other invertebrates, and has been documented to out compete native species for the same food resources. New Zealand mudsnail reproduction occurs through development of unfertilized eggs. It's a livebearer whose physiology and life history are conducive for an invasive lifestyle, and degradations of whole stream systems. Suspected vectors responsible for its spread include: recreational use, fish hatcheries, ill-prepared water resource managers- scientists, and aquatic birds. This project was implemented on the Umatilla Indian Reservations ceded lands in northeastern Oregon summer of 2004. Project efforts were focused on each system in correlation with the vector theory. We evaluated 24 transect sites, and at each site a Serber sampler was used to evaluate physical substrate and composition of invertebrates in the four main systems in the Wallowa-Whitman, Umatilla, and Malheur National forests. Out of 24 surveyed sites, we found zero hydrobiids, which means mudsnails are not present at this time. With some effort, fishery managers/fishers can avoid the invasion of *Potamopygus antidarum* into new ecosystems, by cleaning and disinfecting their aquatic equipment, prevention is priority.

Avian Predation in the Columbia River Estuary: World's Largest Caspian Tern and Double-Crested Cormorant Colonies

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In 2004 we continued field studies designed to assess the impact on smolt (*Oncorhynchus* spp.) survival of predation by large colonies of Caspian terns (*Sterna caspia*) and double-crested cormorants (*Phalacrocorax auritus*) in the Columbia River estuary. Management to reduce the magnitude of Caspian tern predation on smolts resulted in relocation of the world's largest colony of the species from Rice Island (river mile 21) to East Sand Island (river mile 5) 3 years ago. Preliminary results indicate that the 9,500 pairs of Caspian terns nesting on East Sand Island in 2004 averaged about 17% salmonids in the diet, compared to ca. 75% salmonids in the diet of terns that formerly nested on Rice Island. The relocation of the tern colony from Rice Island to East Sand Island has been associated with a major decline in losses of salmonid smolts to Caspian tern predation in the Columbia River estuary; in 2004, losses were approximately 3.5 million smolts, one fourth of peak losses 5 years ago (ca. 13.8 million smolts). Although numbers of Caspian terns nesting in the Columbia River estuary have remained stable over the last 7 years, the numbers of double-crested cormorants nesting on East Sand Island have more than doubled during the same period to ca. 14,000 pairs. Although juvenile salmonids represented only ca. 5% of the diet of cormorants nesting on East Sand Island in 2004, estimated smolt consumption by the cormorant colony is now comparable to that of the East Sand Island tern colony.

Linking Fine- and Coarse-Scale Studies to Determine Spatial Distribution of Redband Trout (*Oncorhynchus mykiss gairdneri*) at the Watershed Scale

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The principal land use activities affecting redband trout (*Oncorhynchus mykiss gairdneri*) in the John Day River are cattle grazing, channelization, and water diversion. These activities are principally expressed at the reach scale. Most ecological knowledge, however, is derived from studies done at finer spatial scales, and their results are rarely applied to watershed management decisions. Linking fine and coarse scale studies requires using different approaches because while habitat units are controlled by local factors such as flow, hydraulic conditions, large woody debris, and human-made structures, reaches are defined by differences in mass movement inputs, bounding landform, bank material, and riparian vegetation. We use existing land use-land cover maps, LANDSAT images and in situ observations to map human and natural impacts over large scales. PIT tags, radio tags and visual estimates were used to characterize the distribution of juvenile *O. mykiss* at the habitat unit scale in the South Fork John Day River (SFJD). Unit specific information was combined using geomorphologic features and longitudinal temperature profiles from the forward-looking infrared (FLIR), to define reaches. To measure human impacts over space, we conducted a buffer analysis to identify areas surrounding geographic features, and we calculated water withdrawal in the upper portion of the SFJD using LANDSAT images. These methods will help merge information at different scales and increase our understanding of the distribution patterns of *O. mykiss* at the watershed scale.

Defining Micro-Habitat for Juvenile Black Rockfish (*Sebastes melanops*): The Role of Abiotic and Biotic Structure

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In the marine environment, management delineates fish stocks and associated habitats primarily by large-scale, geographic and oceanographic information. However, habitat is more appropriately defined at the scale of the fish, as the environmental requirements necessary for survival, growth and reproduction (i.e. fitness). Habitat for any organism includes biotic and abiotic factors working at multiple scales and affecting individual and population survival. Fishing activities adversely impact sediment types, biodiversity and benthic communities, particularly macrofaunal assemblages. Yet, preference by adult and juvenile rockfish to associate with biotic habitat, including many species and genera of invertebrates has been observed in the natural environment. Confounding physical factors such as temperature, salinity, and currents may be responsible for such observations, depicting co-inhabitation rather than true preference behavior. This may be particularly important for young of the year (YOY) rockfish, which undertake decisions regarding settlement, habitat choice, and migration. Thus a series of controlled experiments were undertaken to identify juvenile rockfish behavior as it relates to habitat choice and biotic interactions. Strong social relationships were identified that potentially influence density dependence within particular micro-habitats. Moreover, there appeared to be a difference in the proportion of fish associating with different substrate types at varying light levels. Significantly more fish were detected in a specific habitat type during daylight conditions, with a reversal in this relationship during twilight and at night. Individual preferences for biotic habitat components were also identified and significant differences found.

Global Warming Scenarios for the Northwest and Their Implications for Northwest Salmonids (Plenary Session III)

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How might global warming impact NW salmonids? Answering this question requires developing biophysical models linking climate to salmonids, developing future climate scenarios, and linking the scenarios to the biophysical models. The latest round of IPCC future climate scenarios show a regional PNW warming of ~2 to 3 ºC by the 2040s. The same set of model simulations suggest a few percent decrease to as much as a 20% increase in annual average precipitation by the 2040s. Hydrologic changes in these models are highly temperature sensitive, especially in "transitional" watersheds that today develop an annual winter/spring snowpack at high elevations while warmer/lower parts of the basin experience rainfall runoff. Generally speaking, hydroclimatic change scenarios for the PNW include increases in wintertime runoff, reduced mountain snowpack in spring, earlier snowmelt and earlier peak runoff, and reductions in summer streamflow. Observed climate variations from the 20th century show that warmer than average coastal ocean conditions have tended to favor poor marine productivity for many stocks of PNW salmon, and all IPCC climate scenarios point to warmer ocean temperatures in the future. Possible increases in the intensity of upwelling winds and possible changes in the behavior of El Niño remain key areas of uncertainty for better understanding the marine part of global warming impacts on salmonids. For those aspects of future climate and climate impacts on salmonids that can now be simulated with some confidence, the regional expression of global warming is likely to add significant stress to many populations of NW salmonids.

Do Big Old Fat Females Spawn First? Assessment of the Reproductive Cycle of Black Rockfish (*Sebastes melanops*) from the Central Oregon Coast

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The annual reproductive cycle of some live-bearing rockfishes (Genus *Sebastes*) has been generally described through histological analysis. However, the annual endocrine cycle has not been fully documented for most species, and only recently have researchers investigated potential size- or age-specific variability in the frequency and timing of mating and parturition. We are using biochemical assays to compare estradiol, progesterone, testosterone and vitellogenin levels in black rockfish sampled throughout the year. Initial results indicate size-specific differences in vitellogenin production, timing of parturition and atresia (egg and larvae resorption). Our newly developed vitellogenin assay should be applicable to other rockfish species, providing a rapid assessment tool to compare reproductive cycles and response to environmental variance.

Climate and Development in the 21st Century: Wild Salmon Caught in the Squeeze

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Across western North America, from southern British Columbia southward, projections for population growth and the associated development in low elevation watersheds will probably force salmon populations into severe depletion or localized extinction, regardless of harvest management or hatchery strategies. The anticipated consequences of climate change in the region will push salmon populations in low elevation streams towards extinction due to elevated water temperatures, increased flood frequency, and reduced cold water supplies from snow pack. Many salmon populations will be caught in deteriorating aquatic habitats squeezed by the twin stressors of continuing human development of the region and the adverse effects of climate change. Our only alternative to sustain significant, sustainable runs of wild salmon is to manage low elevation streams as migration corridors for adult and juvenile salmonids with spawning and rearing in higher elevation, federally protected watersheds. This policy alternative will not be an easy sell with many of the entrenched interests in the salmon recovery world. The important and necessary role of incentives and disincentives for local government to support such a watershed based land-use planning approach will be discussed. In order for many headwater streams to support significant, sustainable runs of wild salmon, they will have to be successfully passed around high-head hydro dams. New approaches to achieve fish passage will be explored.

Use of a Video-Equipped Recompression Cage to Observe Barotrauma Recovery in Rockfish

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Current management regulations require recreational fishers to discard yelloweye (*Sebastes rubberimus*) and canary rockfish (*Sebastes pinniger*). These rockfish often remain on the surface after release, displaying acute barotrauma symptoms. Experience from Oregon Department of Fish & Wildlife rockfish tagging has shown that the use of a recompression device (e.g. a recompression cage or inverted hook) to rapidly return the fish to depth may improve recovery and survival of these fish. To investigate changes in barotrauma symptoms during recompression and behavior upon release, we constructed a cage with a door that can be opened remotely, and installed a video camera with low light capability. We captured rockfish using recreational fishing gear at depths of 108-220 feet (33-68m). We evaluated each fish for the severity of barotrauma symptoms, placed the fish into the recompression cage, and lowered it rapidly to 70-90 feet (21-27m), at which time we opened the cage. We observed each fish under recompression, noting changes in visible symptoms and behavior, such as protruding

"gut-in-mouth," bulging eyes, orientation, and buoyancy control. In general, visible barotrauma symptoms decreased markedly as the fish descended. Most fish remained quietly along a corner or side of the cage during descent. Upon opening the door of the cage, the majority of fish became active, displayed good orientation, and swam vigorously downward. These observations suggest that rockfish that are quickly recompressed appear to exhibit normal behavior. Further research will investigate longer-term survival.

Basin-Scale Controls on the Expression of Reach-Scale Channel Morphology, Debris Flow Runout, and the Spatial Distribution of Salmonids in Steep Mountain Streams

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Steepness and concavity indices derived from the relationship between drainage area and channel slope provide a process-based characterization of river profiles. We propose that these geomorphic indices provide a useful context for classifying basins that express different reach morphologies, fish habitat capacity, and responses to episodic disturbance. Strongly concave profiles that develop in steep terrain indicate that almost all of the relief in the drainage network occurs in small headwater streams. In these basins a large proportion of the alluvial network has low-gradient morphologies, such as pool-riffle sequences, which provide favorable rearing for many salmonid species. Complex metapopulation structures can develop because fish distribution expands into tributaries, allowing for a spatial spreading of risk. The severity of pulse disturbances is also reduced because debris flows typically form discrete deposits where steep tributaries abruptly encounter low-gradient mainstem channels. In contrast, less concave profiles signify that the spatial extent of steep reaches (such as step-pool and cascade sequences) is more extensive. Metapopulation development in these basins is diminished because most tributaries are too steep to provide habitat, confining fish to mainstem channels. Furthermore, the change in slope at tributary junctions is less pronounced and debris flows rarely form discrete deposits. Instead, these mass flows continue to travel down steep mainstem channels and alter aquatic and riparian habitats for long distances. The combined influence of a limited spatial distribution and the increased severity of debris flows may result in more extreme fluctuations in population abundance because they are less resilient to pulse disturbances.

Current and Historical Steelhead Population Structure in the Snake River: Diversity, Data, and Designations

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The Interior Columbia Technical Recovery Team has designated demographically independent populations within the Snake River Steelhead Evolutionarily Significant Unit (ESU). For areas currently occupied, we used a combination of genetic, geographic, phenotypic, demographic and habitat information to designate population boundaries. We also predicted population boundaries in areas historically occupied, but currently inaccessible using distances and ecological similarity between likely spawning areas. Patterns of genetic and habitat or ecoregional variation suggest that there is a intermediate level of organization, which we term "Major Population Groupings," between populations and the ESU level. We also suggest that A- and B- run steelhead in this ESU are not monophyletic. We designated 24 extant populations in five Major Population Groups within this ESU, as well as a similar number of likely populations that are currently extirpated. These populations are the units for future recovery planning efforts.

Estimating the Size of Historical Coastal Oregon Salmon Runs

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Increasing the abundance of salmon in Oregon's rivers and streams is a high priority public policy objective. The goals of all salmon recovery efforts are based on assumptions, often unstated, about the size of the runs prior to significant habitat alteration, coupled with an estimate of the amount and quality of freshwater and estuarine habitat currently available. Current run sizes in coastal Oregon may approximate the recovery potential of the existing salmon habitat. Conversely, recovery potential may be higher even given the available freshwater and estuarine habitat. We estimated the historical aggregate salmon run size in rivers along the Oregon coast excluding the Columbia River using two methods: (1) converting estimated aboriginal population levels into numbers of salmon; and (2) extrapolating cannery pack into numbers of salmon. Annual aboriginal harvest of all salmon species is estimated to have been approximately 10 million pounds/year or 1.75-5.36 million salmon, a harvest level similar to that occurring during the height of commercial fishing on Oregon's coastal rivers in the late 1800s and early 1900s. Extrapolating cannery pack data, the estimated size of the late 1800s aggregate runs of Coho salmon (*Oncorhynchus kisutch*) was 1.5-2.5 million. The estimated size of aggregate runs of Chinook salmon (*Oncorhynchus tshawytscha*) runs was 290,000-517,000. Compared to our estimates of mid-1800s Coho salmon levels, early 2000 runs (during favorable ocean conditions), are 11-19% of the historical level. During poor ocean conditions (1990s), current Coho salmon runs are 3-6% of the historical size.

Conservation Efforts to Address Harvest Management as a Factor for Decline for the Oregon Coast Coho ESU

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High harvest rates were a significant factor in the decline of OCN coho. Prior to the 1990s, ocean harvest rates on OCN coho averaged 61% and approached 90% in some years. During the same period, freshwater harvest rates averaged 10% and approached 20% in some years. A harvest management strategy incorporating fixed escapement goals combined with a lack of accurate escapement estimates lead to these unsustainable harvest rates. As the OCN stock continued to decline in the mid 1990s, and in conjunction with development of the Oregon Plan, the State of Oregon began advocating for the use of a harvest management matrix that did not rely upon preseason abundance forecasts or fixed escapement goals. Instead, the matrix relied upon the abundance of parent spawners and an index of marine survival to determine the maximum allowable exploitation rate. This approach was included in the *Oregon Plan for Salmon and Watersheds* and ODFW successfully sponsored an amendment to the Pacific Fishery Management Council's Salmon Fishery Management Plan. Since the implementation of the *Oregon Plan for Salmon and Watersheds* and the adoption of the corresponding harvest management matrix, harvest rates in mixed stock ocean fisheries have been dramatically reduced, averaging only 9% and 1% in ocean and freshwater fisheries, respectively.

Conservation Efforts to Address Wetlands and Estuaries as a Factor for Decline for the Oregon Coast Coho ESU

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DSL contracted with the Oregon Natural Heritage Information Center (ORNHIC 2004) to prepare the first estimation of freshwater losses for the coast. The resultant analysis showed estimated total acres of wetland in the ESU converted to other uses, from 1850-2000, was 43,672 acres. The 43,672 acres include: 1) freshwater wetland-34,276; 2) lacustrine (lake associated) wetlands-13 acres; 3) salt marsh-9,383; and 4) subtidal habitat-0. DSL recently reported to the Oregon Progress Board wetland gains and/or losses that could be attributed just to the removal-fill regulatory program statewide. Oregon Benchmark 77 measures the gain/or loss of wetland acreage per year. For the four years spanning FY 01 through FY 04, there was a gain of 330 acres of freshwater wetland, and a net gain of 10 acres of estuarine wetland. On balance, taking into account DSL regulatory data and OWEB restoration project data, the trend in the ESU appears to be consistent with statewide goals of no net loss in freshwater wetland area, and a net gain in estuarine wetland. Note that these data do not provide ecological information on the functions of the wetlands lost vs. functions of the wetland accepted as mitigation, restored from uplands to wetlands, or converted from one wetland type to another. Converting one wetland type to anther does not result in a net gain of total wetland area. The data do not provide information about the significance of any of these wetland changes for coho. More detailed studies would be required to address these types of questions.

Sand Seals in Coho Salmon Redds: Do They Improve Egg Survival?

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We investigated if sand seals form in the upper egg pocket of salmonid redds and improve egg survival in a sediment-impacted coastal stream in northern California. Sand seals can potentially reduce infiltration of detrimental finer sand and silt into the lower egg pocket. We predicted sand seals would form when the redds were exposed to stream flows high enough to entrain coarse sand and form seals. Sediment analysis in the upper and lower egg pocket of coho salmon *Oncorhynchus kisutch* artificial redds indicated protective sand seals formed in redds when discharge was approximately $\geq$2 times the flow that entrains the median particle size of the streambed. When the coarse sand in the upper egg pocket was incorporated into a 2-stage model that predicted survival to hatching and emergence, it greatly improved the predictions in years with higher flows in both natural and artificial redds. However, the sand seals provided little protection when suspended sediment flux was high from logging or road construction. The model used for these predictions was built using data from artificial redds and applied to natural redds during six years of different flow regimes. Predictor variables in the model included cumulative flow above the entrainment flow, peak discharge, coarse sand in the upper egg pocket, fine sediment in riffle gravel, coarse sand in the upper and entire egg pocket, suspended sediment flux, and presence of predaceous worms. The model explained 67% of the variance in egg survival to emergence in coho salmon natural redds.

Changes Necessary to Provide for Significant, Sustainable Wild Salmon Populations in North America South of Central British Columbia

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The retention and restoration of anadromous salmonid populations to levels that will support the ecosystems in which they live will require substantial changes in current public policies. At the top of the list of necessary changes is the way in which water and fisheries are managed in the region. These two examples are areas of required change over which fisheries management agencies exercise some degree of control. The availability of high quality freshwater is arguably the single most limiting factor affecting the environment for salmon from central British Columbia southward. As a start, I recommend the elimination of marine discharge of freshwater and open channel diversions, and the corresponding reuse of diverted waters. Although painful for a traditional political consistency that supports fish and wildlife agencies, fisheries management will need to shift from permitting "search fishing" based on harvest of immature fish in mixed stock situations to "targeted fishing" directed at mature salmon from stocks with harvestable numbers while at the same time avoiding harvest of weaker stocks. These changes in water and fisheries management, while perhaps traumatic to some interest groups, must be accompanied by other changes in land use, agriculture, aquaculture, forestry, mining, and power generation in order to accomplish the goal of maintaining significant, sustainable runs of wild salmon through 2100.

Using Stable Isotopes to Delineate Shelf and Offshore Pelagic Communities Off California and Oregon

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Regional differences in seasonal upwelling occur between Northern California and British Columbia. Whether these hydrographic features contribute to offshore advection and changes in the food web between near-shore and offshore systems is not well understood. Between May and September, the coastline is characterized as having a highly productive near-shore coastal band (1-20 km offshore) with relatively low productivity water offshore (>20 km offshore). Differences between the two environments are also associated with species-specific assemblages of zooplankton and fish. These systems therefore represent rather distinct habitats for some species that may overlap through cross-shelf transport generated by hydrographic events such as upwelling. From the 2002 GLOBEC (Global Ocean Ecosystem Dynamics) project we analyzed carbon and nitrogen stable isotopes of zooplankton and nekton (fish and market squid) to examine whether organisms from the two habitats contained distinct isotopic signatures. Collections were made to examine the relationship of upwelling to isotopic signature, which may imply differences in trophic structure (using $d^{15}N$) and source production ($d^{13}C$). We collected zooplankton and nekton from shelf ($\leq$200m depth contour) and offshore (>200m) waters to delineate cross-shelf zonation. We observed a consistent pattern of higher $d^{13}C$ within species collected near-shore relative to offshore, with highest values occurring south of Cape Blanco. Cross-shelf and north-south gradients in $d^{13}C$ followed a direct relationship with regional upwelling intensity. In terms of $d^{15}N$, organisms north of Cape Blanco were more enriched, implying differences in trophic structure between the two regions.

A Microarray-Based Analysis of the Stress Response in *Oncorhyncus mykiss*

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An oligonucleotide microarray specific for rainbow trout, (*Oncorhynchus mykiss*) is being developed to study the stress response. The microarray is a relatively new tool in functional genomics that allows researchers to study the expression of many genes in the rainbow trout at one time. Applications of such research are aimed at developing assays for new biomarkers of interest. Our research is focused on applying this tool to understanding how the gene expression in the liver of the rainbow trout is affected by handling stressors. We have conducted two experiments, one involving transportation, the other handling and crowding. In both cases there appears to be differential gene expression.

Reach-Specific Survival of Spring Chinook Salmon Smolts in the Grande Ronde River

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Numerous studies have been conducted investigating reach specific survival of spring Chinook salmon smolts through the Snake/Columbia river hydrosystem. However, little is known about survival of smolts prior to their entrance into the hydrosystem. We investigated reach specific survival of hatchery and wild smolts as they migrated over 300 rkm from tributary streams of the Grande Ronde River to Lower Granite Dam on the Snake River. Through PIT-tagging and recapturing smolts at trap sites located in the Grande Ronde River and tributaries, we assessed survival through designated reaches of the migration corridor over a five-year period using SURPH software. Mortality was greatest for both wild and hatchery Chinook salmon in a river reach where the gradient was the lowest. Fish size had an effect on survival with larger fish surviving at a significantly greater rate. For hatchery fish, length significantly affected survival of smolts during the first part of the migration but had no effect after fish migrated through a low gradient river reach. The relationship between fish length and survival was not as evident with wild fish. Survival from the lower Grande Ronde River to Lower Granite Dam was compared between Catherine Creek and Lostine River hatchery stocks. Hatchery fish from Catherine Creek tributary consistently had greater survival rates through this reach.

Water Quality of the Oregon Coast Coho ESU

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Since 1998 the Oregon Department of Fish and Wildlife (ODFW) and the Oregon Department of Environmental Quality (DEQ) have implemented a coordinated stream monitoring program to factors related to the decline of Coho salmon in the Oregon Coast Coho Evolutionarily Significant Unit (OCCESU) as part of the Oregon Plan for Salmon and Watersheds. DEQ's portion of this monitoring has two primary components: large river ambient monitoring sites and a network of randomly selected and reference smaller wadeable streams. Large rivers were monitored for chemical water quality six times per year. Most wadeable streams were monitored one time for chemical water quality, continuous water temperature, and habitat condition, and vertebrate and macroinvertebrate assemblages. In the OCCESU 42% of the large rivers had excellent to good water quality and 58% had fair to poor water quality. For a ten year period no large rivers sites had declining water quality and 39% showed improving water quality trends. Water Quality from the randomly selected streams indicate that 53% of the

wadeable stream miles exceed the temperature standard, 51% exceed the total solids benchmark, 42% exceed the phosphorus benchmark, and 41% exceed the fine sediment benchmark. The vertebrate and macroinvertebrate assemblages integrate water quality and habitat factors. 38% and 46% of the wadeable stream miles did not meet benchmarks for vertebrate and macroinvertebrate assemblages. In general, North Coast Monitoring Area streams have the best water quality while Umpqua Monitoring Area streams have the worst water quality.

Riparian Reserve Monitoring of Post-Fire Logging in the Siskiyou National Forest

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The 2002 Biscuit Fire burned much of the Kalmiopsis Wilderness and adjacent lands managed by the Siskiyou National Forest. The Forest Service decided in July 2004 to log dead trees on 18,900 acres. The 1994 Northwest Forest Plan provides for 150 ft minimum no cut buffers on non fish bearing perennial and intermittent streams. Subsequent to logging of the 125 acre Horse Timber Sale, we identified 7,990 ft of perennial and intermittent stream channel within or adjacent to logging units. Approximately 5,890 ft (74%) of stream channel were fully protected with required buffer widths, 650 ft (8%) were partially logged, and 1,450 ft (18%) were clearcut logged. In October 2003, the Forest Service proposed logging portions of riparian reserves in the Biscuit Fire area while protecting 50 ft on each side of intermittent streams. A month later the agency issued an internal memo directing field marking of 100 ft no-cut buffers on intermittent streams. In July 2004, the Forest Service specified in contracts that logging companies would be responsible for field identification and protection of snags 174 ft on each side of stream channels. A lawsuit eventually compelled the agency to have Forest Service professionals identify stream channels and post no cut riparian buffer signs. Riparian buffers were posted in the Horse Timber Sale only days before logging began in October 2004. Legally required protection of trees adjacent to stream channels needs to be accomplished by trained professionals at the same time that timber sale boundaries are delineated.

Conservation and Restoration Efforts to Address Factors for Decline for the Oregon Coast Coho ESU: *Story-Boarding* the Coho ESU Assessment

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The Oregon Plan for Salmon and watersheds was implemented in 1997 with an initial focus on the Oregon Coast and specifically on the Coastal Coho ESU. Seven years of programmatic implementation, monitoring, and restoration had occurred when a decision was made to assess the biological status of the ESU, the habitat, management programs, and conservation efforts that support the species, and the restoration effort intended to improve the status of the species. The assessment has been complex and daunting to execute. Communicating the findings of the assessment has also posed unique challenges based on the broad ranging nature of the Oregon Plan efforts and the analyses conducted. Key outcomes of the assessment at the ESU scale are displayed using a Story-board approach to communicate complex, information-rich data related to: (1) ESU viability analysis, (2) coho population trends, (3) restoration, (4) analysis of factors potentially limiting to coho production, and (5) changes in the perceived risk associated with limiting factors between 1997 and 2005.

Seasonal Persistence of Coastal Cutthroat Trout Distributions in a Headwater Stream

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Previous research in South Fork Hinkle Creek suggested that coastal cutthroat trout exhibit an aggregated spatial pattern across multiple scales. To evaluate the persistence of the observed spatial patterns and identify factors that affect those patterns, half-duplex passive integrated transponders (PIT-tags) were implanted in 268 coastal cutthroat trout ($\geq$ 100 mm, about age 1-plus fish) throughout the watershed. Twenty-three habitat patches of high or low relative fish abundance were delineated and monitored over a 13-month period. Seasonal habitat surveys quantified channel characteristics in each patch. Immigration and emigration were monitored using stationary and portable PIT-tag antennas along 2 km of stream, including main stem and tributary habitats. Concomitant sampling throughout the watershed enabled detection of PIT-tagged fish beyond the 2 km study section. Results revealed that fish of downstream origin immigrated more frequently into the study area, and moved longer distances, than fish originating in the upper watershed. Patch fidelity was variable, but in general, patches that originally supported a high abundance of cutthroat trout experienced less immigration, and abundance was relatively consistent through time. Fish movements were strongly correlated with discharge, occurring at moderate seasonal flows or between storm events. Individual fish exhibited habitual patterns of diel movement and habitat use within seasons. Identification of the spatial extent of functional habitat and the behavioral processes associated with changes in relative fish abundance may assist managers challenged with monitoring fish population dynamics, setting angling rules, and regulating forest harvest activities in headwater ecosystems.

Structuring Klamath River Fish Passage Decisions

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We developed a decision structure for decision-makers and stakeholders to use to conduct systematic analyses of fish passage alternatives for PacifiCorp's dams in the Klamath River. Agencies, tribes, conservation groups, and others involved in the process believed a formal decision structure would be useful because they have struggled to systematically integrate the enormous quantity of information generated by the process in order to make informed decisions. The purpose of this effort was to clarify objectives, define alternatives, document thinking, and facilitate decision-makers' efforts to meet their agency obligations to evaluate strategies for balancing resources and developing license conditions. We developed the overall structure in collaboration with an ecological and a socio-economic working group. The objectives were grouped into Aquatic, Terrestrial, and Cultural Integrity components. The alternatives were defined by the Klamath Collaborative effort. The relative robustness of alternatives, given multiple uncertainties, was investigated via multiple scenarios, using dominance and sensitivity analysis methods. Alternatives that included one or more PacifiCorp projects ranked highest under all baseline assumptions. Alternatives most similar to the status quo ranked lowest. Alternatives had net positive ratings with good water quality and no peaking, regardless of whether fish passage succeeded. These analyses suggest that the more the system is operated like a healthy river, the more net benefits it will provide (averaged across ecological and cultural objectives). This conclusion held regardless of whether anadromous fish were assumed to migrate above Iron Gate Dam, though the total benefits were more substantial with fish passage.

A Stochastic Model Investigation of the Potential Benefits of a Conservation Hatchery Program for Supplementing Oregon Coast Coho (*Oncorhynchus kisutch*)

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This study developed a stochastic life-cycle model to simulate idealized supplementation strategies in order to investigate the question: Under what circumstances could hatchery fish stocking contribute to the recovery of Oregon Coast coho? Supplementation strategies modeled were short-duration, tightly controlled, and low intensity in order to minimize genetic and ecological risks. Although optimistic assumptions were emphasized over pessimistic ones, no set of assumptions was found that indicated clear long-term benefits from the supplementation program, and all scenarios indicated short-term risks while the program was in effect. The simulations suggest that stocking of habitat that is poorly seeded or lacks fish may yield minor short-term increases in adult coho abundance while posing ecological and genetic risks. Temporary gains in salmon abundance suggested by the model disappeared shortly after the supplementation programs ended. Of all the management actions modeled, habitat restoration offered by far the largest and only permanent gains in coho abundance while posing no genetic or ecological risk to the fish. The modeled benefits of habitat restoration were significant regardless of assumptions made about the fitness of hatchery fish and their offspring.

Responses of an Endangered Cutthroat Trout to an Exotic Invading Charr

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Recent studies suggest that competition from Eastern brook trout (EBT; *Salvelinus fontinalis*) may have a negative effect on Lahontan cutthroat trout (LCT; *Oncorhynchus clarki henshawi*). Results from these studies, however, are equivocal and have failed to elucidate the responsible mechanisms. The primary objectives of this study were 1) to determine if Lahontan cutthroat and Eastern brook trout compete for resources in streams in which they co-occur, and 2) to determine the mechanisms responsible for the competition. The field study was designed to examine how LCT and EBT interact in a colonization situation typical of many LCT reintroductions, and to provide insight into how LCT respond, under natural conditions, to EBT under various *habitat* conditions. The laboratory component was designed to force competitive interactions and measure the responses of LCT under varying *habitat* and *environmental* conditions. The laboratory component should also help elucidate the mechanisms responsible for the competitive interactions between LCT and EBT. Results from the field manipulation revealed that EBT recolonize further and faster than LCT and that about 25% of the individuals of both species stayed in the relocation pool. When in sympatry, LCT lost five times as much weight as EBT during the three week trial (2.5g to 0.5g, respectively). Lahontan cutthroat trout almost always had empty stomachs whereas EBT usually had at least some food present in their stomachs. These results suggest that EBT are the dominant competitor.

Changing Customer Base Challenges Natural Resource Managers

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Natural resource managers are facing a new set of clients and customers. This changing clientele brings a shift in social attitudes about and connections to natural resources. The challenge to resource managers in the next two decades will be to incorporate these customers and their philosophies into natural management strategies. Increasing workforce diversity will be key to responding to the changing clientele. A new slate of tools is required to attract and retain a diverse workforce.

An Outmigrant Trapping Effort: An Industrial Revolution

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In Northern California, some of the most productive coho streams are not well suited for monitoring with conventional fisheries sampling techniques. There have been a large number of coho adults observed during winter spawning surveys in Ryan Creek (a small tributary of Humboldt Bay, California) However, tannic water conditions combined with the soft sedimentary geology of the Wildcat Formation have impeded effective direct observation methods and made electrofishing problematic. Highly erodible fine grained sand and silt substrate hindered construction of a fixed weir for a pipe trap. Mark and recapture methods such as minnow trapping and seining proved ineffective to develop accurate population estimates. Additionally, the low stream gradient (<0.3%) and resulting low stream velocities were not sufficient to turn a standard rotary screw trap. A pilot project was initiated during the spring of 2004 where a 1.5-m rotary screw trap was mechanized with a DC motor and chain to operate the trap 24 hours a day during the smolt migration season. Utilizing a combination of standard mark-recapture methods and PIT tagging, population estimates of coho and steelhead smolts in Ryan Creek were generated. The mechanized rotary screw trap methodology has substantial promise for use in many previously unsurveyed systems where traditional sampling methods are ineffective.

Determinants of Refuge Utilization by Post-Settlement Lingcod (*Ophiodon elongatus*)

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Fish habitat is an important dictator of aquatic ecology, encompassing many important environmental factors that influence fish behavior. Many fish use structural components of habitat to mediate the risk of conspicuousness. Laboratory experiments and a field study were performed in order to investigate the factors involved with how juvenile lingcod use structured habitat. Body size, nutritional state, and light level are three determinants of the extent to which juvenile lingcod use refugia. In the lab, older, larger individuals exhibited a higher propensity for structure than did smaller juvenile fish. Increasing hunger levels caused test fish to emerge more readily from refugia than those who were satiated. Diurnal patterns of light level change were mimicked in the lab and also had an effect on refuge use. Interactions between each of these factors were also tested under experimental conditions. An acoustic tagging study helped corroborate results found in the lab, primarily regarding the preference of juvenile lingcod for structured versus unstructured habitat.

Seasonal Water Quality and Fish Assemblage of Keno Impoundment and Implications for Native Fish Restoration

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Water quality conditions in Keno Impoundment, a 20-mile long reservoir along the Klamath River beginning 1-mile below Upper Klamath Lake (UKL), have been monitored by the Bureau of Reclamation continuously since 2001 using multi-probe instrumentation. Fish species composition and relative abundance have been surveyed by Oregon State University from 2002 to 2004 using a combination of nets and traps. Extremely poor water quality during summer in Keno Impoundment, believed to be largely driven by nutrient loading from UKL, appears to have a strong influence on fish composition and distribution, and the fish community in Keno Impoundment is dominated by non-native species. Because of its location in Upper Klamath Basin, conditions in Keno Impoundment limit recovery efforts for endangered Lost River and shortnose suckers, and could severely limit recovery efforts of anadromous salmonids if re-introduced to the Upper Klamath Basin.

Using Social Foraging Theory to Examine the Effects of Resource Availability on Juvenile Salmonids in the Interior Columbia River Basin

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Social foraging theory examines the response to resources by individuals foraging in groups of either homogeneous or mixed species composition. The interactions between individuals and their resources can reveal important information about the quality of that habitat in terms of productivity, competition, and the costs of foraging. We observed the behavior of individuals in groups of foraging salmonids native to streams in the Interior Columbia River Basin (ICRB) including chinook (*Oncorhynchus tshawytcha)*, coho (*O. kisutch*) and steelhead trout (*O. mykiss*). We examined group size, foraging rate, aggressive interactions between individuals, patch residence time, and the availability of drifting macroinvertebrates during each set of behavioral observations to determine how each of these parameters varied with stream productivity. Chinook foraged in larger groups throughout the study system with a mean group size per individual that was at least twice that of any other species. Coho in this region are derived from a hatchery-reared parental generation used to replace an extirpated wild stock. Although these were second generation, wild-spawned juveniles, they reduced the foraging rate of young-of-the-year steelhead and wild juvenile chinook by 30%. These interactions, combined with stream productivity can yield important insights into the sustainable carrying capacity for streams in the ICRB and the effects of supplementation programs.

A Telemetry Study of Downstream Coho Smolt Movement in the Yaquina River and Estuary

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Coded acoustic transmitters were surgically implanted in coho salmon smolts that had initiated downstream movement in the Yaquina watershed. Passive acoustic receivers, capable of identifying individual fish, were deployed along the migration route. Eighteen smolts were detected by the receivers, and revealed the following movement patterns: 1) Smolts remained in the freshwater stream, below the trap site, for an average of nine days before entering the main stem of the Yaquina. Once downstream movement started the fish moved rapidly during

daylight and nighttime, and usually entered the tidal portion of the river within 24 hours. Overall fish spent 70% of the known time at large within the freshwater stream. 2) However, after entering the Yaquina River smolts spent the greatest amount of time at large (17%) in the most seaward stretch of the estuary, where the Yaquina enters the ocean. Smolts moved extensively both up- and downstream while in the Yaquina, and on multiple occasions smolts approached to within a few hundred meters of open ocean before moving back upstream again. There is evidence that fish moved passively with tidal currents, but there were also instances of fish holding position near receivers for over 24 hours. 3) Nine of the fish were last detected at receivers closest to the ocean, and presumably entered the ocean. The other nine were last detected at receivers further up the estuary, and since these final detections were well within the transmitter's expected battery life it is uncertain whether these fish reached the ocean.

Salmon 2100: A Strategy to Anchor and Expand the Remaining Wild Salmon Strongholds

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Society must adopt a bold salmon protection and restoration policy if significant, sustainable runs of wild salmon are to exist from British Columbia southward in 2100 and beyond. We propose such a strategy. If adopted, our strategy would sustain and increase the diversity and productivity of wild runs of salmon and steelhead in selected river basins in this region. We propose the identification and creation of a suite of whole river basins and subbasins as "sanctuaries" for wild salmon. The proposed network would extend from California around the Pacific Rim to Korea and include the most robust and species-rich remaining salmon ecosystems within each salmon ecoregion. Each sanctuary would contain sufficient protected habitat to ensure the health of local wild salmon populations. Critical land and water resources would be managed primarily for optimal wild salmon reproduction. Fish harvest and hatchery programs, if permitted at all in the sanctuary, would emphasize wild salmon conservation. Society must change the current ESA-driven pattern of focusing salmon restoration resources on the populations that have the lowest probability of recovering because this approach is unlikely to succeed in creating or maintaining "significant, sustainable runs of wild salmon" by 2100 in this region. Worse, it diverts resources and bureaucratic energy from strategies that will work. The sanctuary strategy we propose has a high likelihood of being successful. A better balance must be struck between investments in restoring the most threatened populations and the protection and expansion of existing salmon strongholds.

Whole-Body Cortisol as an Indicator of Crowding Stress in Adult Zebrafish (*Danio rerio*)

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Zebrafish are widely used as a vertebrate model for developmental biology, disease, toxicology and genomics. Despite the wide use of zebrafish in research, little is known about the optimal rearing conditions for this species. The objective of this study was to determine whether whole-body cortisol levels could be used to assess crowding stress in adult zebrafish. Zebrafish held at a density of 44 fish per liter for 3 hours (acute stress) and 5 days (chronic stress) had significantly elevated whole-body cortisol levels compared to zebrafish held at a much lower density (0.25 fish per liter). A similar experiment was conducted at the NIH Zebrafish International Resource

Center, a stock maintenance and distribution facility. The subsequent experiment yielded comparable results with apparent effects of tank size and feeding on zebrafish cortisol levels. In general, chronic elevations in cortisol are maladaptive with the potential to impair reproduction, growth and disease resistance. Whole-body cortisol levels appear to be a good indicator of rearing density stress in zebrafish. Determination of how rearing stressors affect zebrafish fitness will provide useful information to optimize husbandry, health and reproduction as well as improve the consistency and reproducibility of *in vivo* studies that use this popular vertebrate model.

Life Under Pressure: A Look at Swimbladders and Barotrauma Using Pressurized Aquaria

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Fish with physoclistous swimbladders forced to ascend in the water column are prone to injury from gas expansion. Pressure-related injury, or barotrauma, can be fatal to fish and presents significant challenges to researchers, fishers and fishery managers working with live fish or bycatch of non-retainable species. To mitigate barotrauma symptoms in black rockfish *Sebastes melanops* brought to the surface for tagging, Oregon Department of Fish and Wildlife fishers recompress fish by immediately submersing them to a predetermined depth. To investigate barotrauma and potential mortality of tagged black rockfish, we constructed three flow-through 450-L pressurized aquaria (one control tank and two experimental tanks) to evaluate trauma in fish brought to the surface and then recompressed. We experimentally established the rates of swimbladder inflation and deflation and then investigated fish mortality, swim bladder injury and swim bladder healing. For black rockfish (29 – 48 cm) acclimated to neutral buoyancy at a depth of 30 m, the results established a swimbladder inflation period of 7 d and a deflation period of 45 h. A 90-s ascent for fish acclimated to 30 m was found to rupture the swimbladders of all healthy adult rockfish. Mortality was 5 % (3 of 60 fish) after 30 days for fish acclimated to depth (30 m for 7 d), depressurized to simulate ascent to the surface, held at the surface for 2 min and then repressurized to the original depth. The swimbladders in 83% of surviving test fish were significantly healed and held gas after 30 d.

The Inland Lampreys: Diversity in the Klamath and Goose Basins

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The Klamath Basin, straddling the Oregon-California border, exhibits the highest diversity of lampreys in the world. At least four taxa occur in the upper Klamath Basin and at least one additional species, anadromous Pacific Lamprey, also occurs in the Klamath River. The potential presence and distribution of Western River and Brook lampreys in the Klamath River are currently uncertain. In the Goose Lake and Upper Pit River drainage, there are two sympatric taxa, the non-trophic Pit Brook Lamprey and the Goose Lake Lamprey, a predatory taxon of unresolved systematic status. Our understanding of the biology of these inland lampreys is limited. However, ongoing studies seek to clarify the systematics, genetics, and distribution of the various taxa in order to lay the groundwork for future study and stewardship of this unique fauna.

Domestication in Steelhead: Caught in the Act

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Genetic theory and data suggest that sea ranching of anadromous salmonids (*Oncorhynchus* spp. and *Salmo* spp.) results in domestication (increased fitness in the hatchery program) accompanied by a loss of fitness for natural production. We tested for genetic differences in growth, survival, and downstream migration of hatchery and wild steelhead (*O. mykiss*) reared together in a hatchery. We found little or no difference in survival during hatchery rearing but substantial differences in growth and subsequent downstream migration. Intense natural selection after release from the hatchery favored fish that had performed well (e.g., grew fast) in the hatchery. This selection in the natural environment genetically changes (domesticates) the population because at least some of the performance traits are heritable. Domestication should improve the economic efficiency for producing adult hatchery fish but compromise conservation of wild populations when hatchery fish interbreed with wild.

Larval Transport Versus Larval Retention of River and Lake Spawning Suckers in Upper Klamath Lake, Oregon

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Both endangered suckers (Lost River sucker, *Deltistes luxatus* and shortnose sucker, *Chasmistes brevirostris*) in Upper Klamath Lake (UKL) have in-lake spring spawners and riverine spawners with little evidence of intermixing between groups. In-lake spring spawners are dwindling in numbers and several groups have gone extinct. They begin spawning in late February/early March on the eastern shore of UKL. A month later the riverine groups migrate up the Williamson and Sprague rivers. Riverine-spawned larvae drift down river and enter UKL. Larvae from both groups rear in UKL, but in-lake spawned larvae develop at colder temperatures, are present from swim-up, and are geographically closer to the southern outflow at Link River Dam. During the larval period, suckers drift at night and may be subject to current transport out of the lake. Currents in UKL are wind driven and a recent model suggests that early spring currents predominately rotate in a clockwise pattern, potentially transporting larvae directly towards Link River Dam. Transport out of UKL would likely have a negative impact on recruitment. Transported individuals face poorer water quality and the need, if maturity is reached, to navigate a fish ladder designed for trout to return to UKL. In this research, we are using otolith-based growth models and larval sampling to evaluate whether in-lake spawners suffer a greater loss of larvae through transport out of UKL while riverine spawners have better retention in the primary habitat. This work may provide insight into the continued poor recruitment of in-lake spawning groups.

From Genotyping Salmon to Ageing Flatfish: What Pinniped Scat Can Reveal About Marine Ichthyofauna

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The Oregon Department of Fish and Wildlife (ODFW) Marine Mammal Program has been researching the diet of pinnipeds in Oregon for many years through the analysis of scat (fecal) samples. This method is a reliable tool for describing the diet of pinnipeds. Since these animals are coast wide piscivorous predators their food habits can give insight into the seasonal abundance, yearly variation and type of fishes found in coastal waters and estuaries. This study includes analysis of Pacific harbor seal (*Phoca vitulina*) scats collected from 1997 – 2002 at the Alsea River in Waldport, Oregon. Structures recovered from scat included otoliths and skeletal elements of teleost fish,

teeth and gills from jawless fishes, teeth and vertebrae from Elasmobranches and cephalopod beaks and statoliths. Elements recovered were identified using comparative specimens collected from the Northeast Pacific. A total of 3,301 harbor seal scat samples were collected during the study period. Thirty-nine species of fish and cephalopods were identified. Seal tagging data and individual scat samples indicate a preference for animals to concentrate feeding in certain locations (upriver or near-shore). DNA analysis was completed on salmonid bones from fall samples for species and individual identification. Dover sole otoliths were aged and provided information on size and age class of fish consumed. These results have given us a more complete picture of seal foraging, prey selection and presence and abundance of local fishes. We feel this information can be applied to other disciplines and shows that pinnipeds can be effective samplers of marine ichthyofauna.

What's for Dinner? Seasonal Differences in Riparian Consumer Diet and Insect Communities in an Oregon Coast Range Watershed Food Web

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In riparian areas, terrestrial and aquatic habitats overlap creating zones where they interact as an aquatic-terrestrial interface. This coupling allows energy to move between systems and generates intertwining food webs. Thus, vertebrate riparian consumers, such as fish or birds, potentially have alternative prey derived from sources external to their respective habitats. The purpose of our study was to explore this reciprocal exchange in an alder dominated riparian forest of the Oregon Coast Range. Diet samples were collected from birds and fish in the summer and fall of 2003 along with a suite of insect samples at Honey Grove Creek and two of its small tributaries. In a comparison of emerging aquatic insects and flying terrestrial insects during June and again in September, we detected seasonal differences in terrestrial and aquatic insects available to riparian consumers. Despite this availability of externally derived prey, fish depended more on resources derived from within their respective habitats during summer. Cutthroat trout (*Oncorhynchus clarki*) and coho salmon (*Oncorhynchus kisutch*) ate more juvenile aquatic than adult aquatic or terrestrial insects. During fall, the same pattern was exhibited by Coho but Cutthroat trout appeared to consume a slightly greater number of terrestrial insects. The preliminary analysis of bird diet samples from commonly encountered species such as, Swainson's thrush, Song Sparrow, and Pacific-slope Flycatcher, showed more terrestrial derived prey in their diets than aquatic during the summer sampling season.

Avian Predation on Juvenile Salmonids in the Columbia River Basin: An Overview

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Research during the late 1990s to measure the magnitude of avian predation on juvenile salmonids (*Oncorhynchus* spp.) in the lower Columbia River and estuary indicated that annual smolt losses (15 – 20 million) likely exceeded those attributed to predation by northern pikeminnow (*Ptychocheilus oregonensis*). Although most concern by fisheries managers over avian predation was focused on gulls (*Larus* spp.) foraging near dams, the vast majority of smolt losses to avian predators were caused by Caspian terns (*Sterna caspia*) and double-crested cormorants (*Phalacrocorax auritus*) nesting at large colonies in the estuary. Although estimated numbers of smolts consumed by birds based on bioenergetics models do not equate to stock-specific predation rates, recoveries of smolt PIT tags on piscivorous waterbird colonies indicated that smolt predation rates were also highest for bird colonies in the estuary. The one exception to this general rule is a relatively small colony of Caspian terns near the confluence of the Snake and Columbia rivers that in some years has depredated in-river migrants of Snake River stocks at a similar rate as the large colonies in the estuary. Although the last 20 years have seen dramatic increases in the numbers of some avian predators in the lower and mid-Columbia Basin, these increases have been largely local,

especially for the two primary avian predators: Caspian terns and double-crested cormorants. Restoration, enhancement, or establishment of tern and cormorant colony sites away from the Columbia River would likely benefit Columbia Basin salmonids without negatively affecting protected populations of piscivorous waterbirds.

The Status and Trend of Instream Habitat and Riparian Conditions in the Oregon Coast Coho ESU

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Data from ODFW random habitat surveys from 1998-2003 were analyzed for the status and trend of 10 instream habitat variables and 4 riparian variables. Habitat conditions were described at the scale of the Oregon Coast ESU and for each of four monitoring areas within the ESU. Sites were also post-stratified, and analyzed, by land management categories. The range of values for each habitat variable was extensive, influenced by geomorphic setting, and natural and anthropogenic history of each stream. As a result, the variability relative to the mean and median value minimized our ability to detect differences between monitoring areas, land management classes, or trend. Amounts of fine sediment were high and amounts of large wood in the stream channel and conifers in the riparian were low relative to minimally human disturbed sites across the ESU. The Umpqua monitoring area has the lowest habitat quality, scoring low in 9 out of the 10 habitat variables considered important to coho salmon. Habitat conditions, for the most part, did not change significantly from 1998 to 2003.

Effectiveness of Common Habitat Restoration Techniques at Increasing Fish Abundance in the Pacific Northwest, U.S.A.

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Habitat enhancement and restoration techniques are used in streams throughout the world in an effort to increase and conserve fish stocks. However, few of these techniques have been thoroughly evaluated. Since 1996, we have been systematically evaluating various habitat restoration techniques in the Pacific Northwest United States. Here we summarize the results of almost a decade of our research evaluating anadromous fish response to habitat improvement techniques including: large woody debris (LWD) and boulder weir placement, reconnection off-channel habitats, and constructed side-channels. In 30 small streams, higher levels of coho salmon (*Oncorhynchus kisutch*), steelhead (*O. mykiss*), cutthroat trout (*O. clarki*), and larval lamprey (*Lampetra spp.*) were found in reaches treated with LWD though the level of response varied by season and species. Higher levels of coho salmon were also found in streams treated with boulder weirs in 12 southwest Oregon streams. An increase in juvenile and adult salmon abundance and species richness was found in habitats associated with constructed logjams in two large western Washington rivers. We analyzed existing smolt-trapping data from over 30 off-channel habitat enhancement projects and found that constructed groundwater channels were particularly productive for juvenile coho salmon. We then examined groundwater channels intensively and found that constructed channels supported higher densities of coho salmon during the winter, but fish diversity was higher in naturally-occurring channels. Our results suggest that common habitat improvement techniques increase the abundance of salmonids as well as species richness, but results vary by species habitat preferences, season, and magnitude of habitat improvement.

Alternative Life-History Strategies of *Oncorhynchus mykiss* in Northeast Oregon: Evidence from Otolith Elements

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In 1997, the anadromous form of *Oncorhynchus mykiss* in the Snake River basin was protected as a threatened species under the federal ESA. However, *O. mykiss* exhibit a variety of life-history strategies ranging from very localized residency to anadromy that can involve migrations of hundreds of kilometers. In Northeast Oregon, both resident and anadromous forms coexist. Reproductive isolation of the anadromous form is unclear but isolation affects both ESA listing status and regional management. Our objective was to evaluate the relationship between these life history forms in Northeast Oregon. Using elemental analysis of otoliths collected from various life stages, we demonstrate that both resident and anadromous females produced progeny that expressed both life history strategies. Most (79-87%), of the sampled age 0 fish had anadromous mothers. Resident mothers produced 7-33% of the smolts and 9-33% of the anadromous adults sampled. Fifty-four to seventy-seven percent of resident adults had anadromous mothers. The range in the results represents the various basins we sampled. While the majority of *O. mykiss* produced in these basins appear to originate from anadromous mothers, we clearly demonstrate a plasticity of phenotypes with each life-history form producing both resident and anadromous adults. Our evidence suggests that resident *O. mykiss* significantly contribute to steelhead 'populations' in the basins we studied and that federal and state agencies should consider both life-history forms in population identification, viability assessment, and management decisions.

Use of PIT Tags to Evaluate Predation by Colonial Waterbirds on Juvenile Salmonids

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Juvenile salmonids (*Oncorhynchus* spp.) tagged with passive integrated transponders (PIT) have been released into the Columbia River Basin since 1987 to answer a variety research questions. When piscivorous birds prey upon tagged fish, the tag is often regurgitated intact with the bone pellet, and the tags are often subsequently deposited in localized areas, such as nesting colonies. Sufficient tags may be present to provide estimates of predation, prey vulnerability, and effects of migration on prey susceptibility. Since 1998, we have detected over 400,000 juvenile salmonid PIT tags on colonial waterbird nests in the Columbia River Basin. Data from these detections have shown juvenile steelhead (*O. mykiss*) to be more vulnerable to avian predation than other juvenile salmonids, both in the Columbia River estuary and 500 km upstream in the McNary Dam reservoir. Rear-type did not affect the vulnerability of steelhead to avian predation either in the Columbia River estuary or McNary Dam reservoir. Conversely, hatchery chinook salmon (*O. tshawytscha*) were more vulnerable than their wild cohorts while migrating through the estuary but not while migrating through the McNary Dam reservoir. In addition, juvenile salmonids transported and released downstream from Bonneville Dam were generally less susceptible to avian predation in the estuary than their in-river-migrating cohorts.

Effects of Juvenile Migration and Ocean/Climate Conditions on Smolt-to-Adult Return Rates and Recruitment for Snake River Chinook Salmon

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Snake River salmon and steelhead *Oncorhynchus* spp. have substantially declined since the completion of the Columbia River hydrosystem. Currently, the species are listed under the Endangered Species Act. These species evolved in systems without dams and were dependent on the river current to aid in their migration to the ocean. We evaluated the impact of flow, spill, ocean and estuary conditions common to Snake River populations and populations in the mid Columbia over life stages that include survival through the hydrosystem and survival following this migration. (Mid Columbia populations migrate past fewer dams). Through previous large scale assessment processes, analytical approaches were used to identify management options for halting the decline of these populations. The benefits these actions are predicted to have on salmon recovery hinge on whether the source of mortality that takes place in the estuary and early ocean is related to earlier hydrosystem experience during downstream migration (delayed mortality). Despite recent improvements in climate/ocean conditions, the overall mortality of Snake River stocks remains much higher than John Day stocks (Mid Columbia) for these brood years. Our analyses indicate that the delayed mortality for Snake River spring/summer chinook populations remained high in recent brood years.

Improved Status of Oregon Chub in the Willamette River Drainage

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Status and trends of abundance of populations of Oregon chub, a small floodplain minnow endemic to the Willamette Valley of western Oregon, were investigated by estimating fish abundance and from extensive fish surveys of nearly 700 off-channel habitats from 1991 through 2004. Recent discovery of previously unknown populations of Oregon chub, some occurring in subbasins where they were presumed extinct, combined with successful reintroductions into suitable habitats have resulted in the improved status of this species. In 1991, eight populations of Oregon chub were known to exist. In 2004, we identified 32 populations of Oregon chub in the Willamette River basin. Ten of these populations, including the two most abundant populations, were introduced populations. Oregon chub status is approaching the recovery plan goal for downlisting the species to threatened. Nonnative fishes, which were found to be widespread in off-channel habitats preferred by Oregon chub, are the largest threat to full recovery and delisting of this species.

The Oregon Plan: Ask Not What You Can Do For Hatcheries But What Hatcheries Can Do For You

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This paper reviews comments by Oregon's Independent Multidisciplinary Science Team (IMST) regarding the use and management of hatcheries in the context of meeting objectives of the Oregon Plan for Salmon and Watersheds. Basically the IMST recommends a landscape approach to the consideration of operation and evaluation of hatcheries. Goals and objectives of hatchery programs need to be considered in the larger context, evaluating consequences to stocks watersheds beyond the immediate watershed where they are located. Effectiveness monitoring for hatchery performance and effect both local and at the landscape level is critical. I also review findings of a workshop directed at establishing research questions and objectives and facility design

for the Hatchery Research Center being developed at Fall Creek in the Alsea watershed. This facility is to serve state-wide research needs concerning development of wise hatchery strategies practices aimed at diverse objectives ranging from conservation to production. The facility should (1) accommodate a broad range of experiments including whole life cycle capability, (2) conduct experiments not being able to be done elsewhere, and (3) include learning opportunities for graduate and undergraduate students as well as extended education. Importantly, the concept for the facility is to include the whole Alsea watershed, with off-site fish collection and monitoring capacity.

Habitat Utilization of an Oregon Estuary by Lingcod (*Ophiodon elongatus*)

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Estuaries are considered Essential Fish Habitat (EFH) for all life-stages of lingcod (*Ophiodon elongatus*). However, the relative value of these areas for the persistence of coastwide populations is unknown. I used two methods to determine the spatial and temporal movement patterns of sub-adult lingcod found within Yaquina Bay, Oregon. First, I tagged lingcod with acoustic pingers and tracked individuals over several months. Between 2 October 2003 and the present, twelve fish were tagged in the marine-dominant region of the estuary. Lingcod caught and released within range of a stationary receiver took frequent, short forays out of range but never permanently left. None showed movement "upstream" into the estuary. Second, I surveyed three sites within the bay on a monthly basis using SCUBA to document any seasonal changes of lingcod densities (July 2004 to the present). As of late November, there is no apparent trend in these results. I conclude that sub-adult lingcod in Yaquina Bay are resident and exhibit high site fidelity. Therefore, interaction with lingcod in the nearshore must be extremely limited or occur on a much longer time scale. Further conclusions drawn from this study will contribute to an assessment of the critical habitat requirements for Oregon coast lingcod.

Evidence of Xenoestrogens in Fishes from Rocky Mountain National Park, Colorado

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Airborne contaminants have been detected in alpine aquatic ecosytems and fish in Canada and Europe. However, little information exists for similar occurrence in the U.S. despite the preferential deposition of some airborne contaminants to high-elevation ecosystems. Therefore a multidisciplinary study was initiated to determine levels and potential effects of contaminants in western U.S. national parks. Sampling sites range from southern California to arctic Alaska, from 427 m to more than 3,020 m, and represent as near-pristine conditions as potentially found in the world. In the summer of 2003, salmonid fishes from lakes in Sequoia, Rocky Mountain, and Olympic National Parks were captured and assessed for endocrine disruption, physiological impairment, and, in some lakes, contaminant loads. Additionally, general health, histological changes, age, and sex steroids were also determined. Fish age ranged from one to 10 years. All fish appeared healthy based on macroscopic examination. Microgram per milliliter concentrations of plasma vitellogenin, a biomarker for xenoestrogen exposure, were detected in 30-50% of male and immature female fishes captured at Rocky Mountain National Park, one of these fish appeared to be hermaphroditic, and estrogen-like anthropogenic compounds were found in concentrations ranging from 10's to 1000's ng/g lipid in these fishes. Physiological impairment was assessed by quantifying melano-macrophage

aggregates and indicates that fish from Sequoia National Park may also be impacted by contaminants. Fishes were also sampled in the summer of 2004 from lakes in three Alaskan National Parks and will be discussed if data are available.

Growth Dynamics of Smallmouth Bass in Lake Billy Chinook, Oregon

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During May-October, 2001, we analyzed the growth patterns and diet overlap of different ages of smallmouth bass in Lake Billy Chinook, Oregon to identify periods within the growing season when temperature or competition for food might limit growth. Bass of various ages were sampled during three 6-wk periods with a boat-mounted electroshocker from nearshore sites in two separate habitat types. Age 0 bass consumed smaller prey items, while older and larger fish were able to consume an increasingly wider size range of prey, predominantly crayfish. Bass consumed fewer crayfish through the study. Age 1 smallmouth bass consumed only age 0 crayfish, while older bass were not as limited. Diets of age 3 and age 4 smallmouth bass were similar with crayfish constituting at least 70% of the diets by volume, although amphipods and other invertebrates were important prey items to individual fish. During all periods of the study, realized consumption, defined as actual consumption divided by theoretical metabolic maximum consumption and indexed by the P-value generated from bioenergetic modeling, was generally higher for smaller fish than for larger bass. Consumption rates for juvenile and adult bass dropped dramatically in the fall demonstrating potential food limitation during this period. Our study suggests that during the fall, high densities of age 0 bass may affect the availability of alternative prey (chironomids and amphipods) and consequently, the growth of older age classes of smallmouth bass.

Seasonal Variability of Westslope Cutthroat Trout Movement Patterns and Habitat Use in Headwater Tributaries of the John Day River

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We used radiotelemetry to monitor the seasonal movement and habitat use of westslope cutthroat trout (*Oncorhynchus clarki lewisi*) in two headwater tributaries of the mainstem John Day River from August 2000 to December 2001. Our objectives were to assess how fish movement patterns and habitat associations differ among seasons (summer, winter, and spring) and how the spatiotemporal distribution of habitats may influence fish movement. Movement and habitat use data were gathered by weekly, stream-side tracking of 61 cutthroat trout (>200mm FL) tagged with surgically implanted radio transmitters. Fish movement distance and stream habitat variables were recorded each time a fish was tracked to a new location. To estimate seasonal habitat availability, habitat inventories of the two streams were done in August-October 2000, February 2001, and May-June 2001. Our preliminary results show distinct seasonal movement patterns, with fish moving relatively longer distances and more frequently in spring. They also show that studying habitat use at multiple spatial scales (pocket/subunit, channel unit, and reach) was useful in determining the seasonal habitat needs of these cutthroat trout.

Saving Wild Salmon: Moving from Symbolic Politics to Effective Policy

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In democratic societies legitimacy is based upon the results of elections whereby the actions taken by politicians and policy makers alike have to be justified continually by the politically active public. As part of this process, policy makers have a duty to inform citizens about their policy preferences and decisions. However, many social scientists have argued that this process is far from being realized in the United States and have warned about the development of "symbolic politics," where policy makers consciously or subconsciously produce a make-believe political world for the electorate using political symbols and rituals. The end result of symbolic politics is a situation where policy makers may appear that they are solving a problem, yet in fact little if any effective action is taking place. One can make a strong case that the politics of wild salmon in the western North America fits a symbolic politics perspective. While polls show majorities of citizens express concern for the status of wild salmon, they also show that the public has very little understanding and much misinformation concerning the decline of these runs. While I am doubtful that any effective political response is attainable in our current political environment, I will propose a path of action that citizens and wild salmon proponents could take to stop the symbolic saving of wild runs and move us toward a more effective policy that incorporates many of the ecological policy reforms advocated by other participants in the Salmon 2100 Project.

The Monitoring and Evaluation of Avian Predation on Juvenile Salmonids in the Yakima River, Washington, Annual Report 2003

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Avian predation contributes to the loss of migrating juvenile salmonids in the Yakima River Basin, constraining natural and artificial production. In 1997, the Yakima/Klickitat Fisheries Project (YKFP) assessed the feasibility of developing an index to avian predation of juvenile salmonids. The initial research confirmed that gulls and Common Mergansers were the primary avian predators impacting migrating smolts (Phinney et al., 1998). From 1999 to 2002, the Cooperative Fish and Wildlife Research Unit (WACFWRU) continued monitoring the impacts to juvenile salmonids along river reaches and at areas of high predator/prey concentrations, hotspots. The YKFP, Yakama Nation Fisheries, began monitoring avian predation in 2002, and continued monitoring in 2003 and 2004, at hotspots and along river reaches. Consumption by gulls at hotspots was based on direct observations of foraging success and modeled abundance. Consumption by all piscivorous birds on river reaches was estimated using published dietary requirements and modeled abundance. 2003 saw a shift in predator species at one of the hotspots from gulls to American White Pelicans. Gulls remained the primary predatory at the other hotspot. American White Pelicans were the major consumer on the lower Yakima River and Common Mergansers remained the primary consumer on the upper river. Estimated consumption by gulls at both hotspots in the spring was 141,349 fish. Consumption by Common Mergansers accounted for 82% of the consumption of birds on fish on the upper Yakima River.

Ecology of the Salmonid Parasite *Ceratomyxa shasta* in the Klamath River

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Ceratomyxa shasta has been implicated as a significant source of mortality in salmonids in the Lower Klamath River. A study on the prevalence of *C. shasta* infections and the distribution of the parasite's invertebrate host, *Manayunkia speciosa,* was conducted with the objective of determining parasite distribution in relation to both the salmonid and the invertebrate host. To determine parasite spatial and temporal distribution, sentinel fish were held for 4 d at 13 locations between Beaver Creek and Keno Reservoir in April, June, July, September and early November 2003. In June 2004, sentinel fish were exposed for 4 d at 18 locations between Upper Klamath Lake to the mouth of the Klamath River including key tributaries and sites used in 2003. *Ceratomyxa shasta*-related mortality in 2003 occurred only in fish held at 3 locations, all in the free-flowing reaches of the river. In both 2003 and 2004, all sites below Iron Gate Dam showed 100% infection prevalence with 100% *C. shasta*-related mortality. In 2004, results of exposures at index sites were similar to 2003. Using molecular techniques, infection was detected in all groups, except in the tributaries and in Keno Reservoir. To identify polychaete populations and habitat requirements, benthic samples were collected above and below all sentinel sites with corresponding physicochemical measurements. Fine sand/silts and attached epiphytes such as early-stage cladophora spp., within slow flowing mesohabitats provided specific microhabitats for the worm. Polychaete presence appears to be limited by flow velocity, substrate type, and organic-matter deposition.

Thanksgiving 2101—A Salmon Story

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The evidence is strong that salmon in western North America should be managed as salmon, period; the wild/hatchery dichotomy only detracts from wise management of the resource. After reviewing the evidence for this statement, I will propose policy changes that would result in maintenance of significant, sustainable runs of salmon through and beyond 2100. These changes involve the incorporation of the principles of modern plant and animal husbandry that would result in increased production efficiencies, particularly the expanded use of modern genetics in hatchery and stream production systems; expanded study of the influence of the Pacific Ocean on salmon abundance, reallocating funds presently being used in unproductive ways in terrestrial systems, and modifying where practical those oceanic factors that influence salmon abundance; modification of applicable laws to reduce predation losses to the protected species; modification of harvest systems; and enhanced stream cleanliness, particularly in the increasingly dense urban centers. The situation expected in 2100 is a happy one if my policy prescriptions are adopted.

Distribution and Behavior of Radio-Tagged Adult Lost River and Shortnose Suckers in Response to Water Quality Conditions in Upper Klamath Lake, Oregon

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Upper Klamath Lake, Oregon is the largest remaining habitat of endangered Lost River suckers and shortnose suckers. Periodic fish kills caused by extreme water quality conditions during summer months represents a substantial barrier to recovery of these species. To better understand the summer distribution and behaviors related to water quality conditions, radiotelemetry located suckers between June and September of 2002–2004. Distribution differed by species and over time. Mean water depth for all years was 2.9 m at Lost River sucker locations and 2.7 m at shortnose sucker locations. Mean weekly water depths at sucker locations were generally greater than mean weekly available depths within the study area. No behavioral responses to poor water quality conditions were observed in 2002. In 2003 and 2004, however, both species avoided areas with low dissolved oxygen concentrations by moving into Pelican Bay, an area with higher dissolved oxygen and lower temperatures than most of UKL. Mean dissolved oxygen concentrations for all years were 7.66 mg/L at Lost River sucker locations and 7.71 mg/L at shortnose sucker locations. In 2002 and 2004, small proportions (< 4.2%) of both species were located in areas where dissolved oxygen was < 4.0 mg/L. In contrast, during 2003 more than 11.9% of both species were found in areas where dissolved oxygen was < 4.0 mg/L. Sucker distribution in UKL was influenced by a number of factors including low dissolved oxygen avoidance, the use of Pelican Bay, and depths use versus depth availability within the study area.

Response to Aquatic Invasive Species

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Increased awareness of the economic and ecological threat of aquatic invasive species has stimulated response at multiple scales. International and national efforts have been implemented to address shipping related pathways of introduction. President Clinton signed an Executive Order and Congress enacted legislation that directs federal agencies to coordinate and establish programs for AIS prevention and management. Regional coordination occurs through the Western Aquatic Nuisance Species Task Force, established by the National Aquatic Invasive Species Act in 1996, the Pacific Ballast Water Group, and others. In Oregon, responsibility for aquatic invasive species management is dispersed. The Center for Lakes and Reservoirs was established by the legislature in 1999 to address and coordinate lake management in Oregon. Programs at the CLR have broadened to include marine and estuarine invasive species. The CLR produced and is currently implementing, in collaboration with other agencies, an Aquatic Nuisance Species Management Plan, which includes prevention, detection, education, and management elements. Major foci of work include ballast water and shipping related research and policy, aquatic weed management and policy, and education and outreach projects. Recently, the CLR entered into a joint program with the Smithsonian Environmental Research Center to establish the Aquatic Bioinvasion Research and Policy Institute to enhance and broaden participation and geographic scope of aquatic invasive species activities in the region. The legislature established the Oregon Invasive Species Council in 2001 to focus on prevention of new invasions, primarily through raising awareness in Oregon. The Council is developing a public awareness campaign strategy to be implemented following fundraising.

Estimating Abundance and Spatial Distribution of Fall Migrating *Oncorhynchus mykiss* in the South Fork of the John Day River

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Downstream dispersal of *Oncorhynchus mykiss* during fall is a common phenomenon in the interior Columbia River basin. We characterized the extent and distribution of *O. mykiss* fall migrants in the South Fork of the John Day River. A total of 3,101 *O. mykiss* were tagged with Passive Integrated Transponder (PIT) tags in summer rearing habitat from 10 to 35 kilometers upstream of the South Fork screw trap (Rkm 10). A stationary PIT tag antenna 79 meters upstream of the South Fork trap was used to estimate the efficiency of the trap at capturing PIT-tagged fall migrants. We used this alternate method of trap calibration in addition to the standard method of marking fish captured in the trap and releasing the marked fish 1.4 kilometers upstream of the trap. Using both methods allowed us to evaluate the standard trap efficiency test. We radiotagged *O. mykiss* captured at the screw trap on a weekly basis from October through December to determine their migratory patterns and spatial distribution downstream of the South Fork screw trap. Fall migrating *O. mykiss* dispersed 10 to 35 kilometers downstream to the South Fork trap. Radiotagged *O. mykiss* migrated into the Mainstem John Day River as far as 32 kilometers from the South Fork trap. Unbiased abundance estimates of fall emigrant *O. mykiss*, and knowledge of their migratory patterns will help determine the importance of this life history strategy and identify downstream areas that are important for winter rearing.

Timing the Salmon

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The timing of the migrations and spawning for salmon have long been considered to be primarily influenced by the photoperiod with the variations between years a result of differing water temperatures and flows. This presentation seeks to demonstrate that salmon, and some other animals, are entrained to the length of night, most significantly by the phases of the moon, via physio-chemical processes, and that the differences in timing of migrations, spawning and other events from one year to the next can be predicted and explained by this influence. Indigenous peoples have been aware of this phenomenon and possess stories and calendars designed to reinforce methodologies that enable to them to most efficiently harvest salmon.

Age, Growth, and Maturity of the Longnose Skate (*Raja rhina*) for the U.S. West Coast: Preliminary Results

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The goal of this research is to more accurately determine age, growth and maturity parameters for the longnose skate, *Raja rhina*. In the last forty years, two known skate species (the common skate, *Raja batis*, and the barndoor skate, *Raja laevis*) have nearly disappeared from regions where they were once abundant, most likely as a result of fishing practices (Brander, 1981; Casey and Myers, 1988). Given that skates in general have k-selected life history traits (Holts, 1988; Holden,1974), it seems plausible that skate stocks could become severely depleted on the West Coast, especially as traditional stocks are becoming less abundant, and fishers are compelled to fish for more non-traditional species, like skates. In order to help prevent this from occurring, basic life history data should be collected for these species before they become overfished. The longnose skate, is one of the most commonly landed skate species on the West Coast (Roedel and Ripley, 1950). Currently, only a small amount of information exists on the biology of *R. rhina*, and skate species in general. Age structures (vertebral centra), and length and maturity data were collected from 320 longnose skates during the summer of 2003 along the U.S. West Coast shelf and slope. For age validation purposes, ~25 longnose skates were collected each month (for one year) from commercial catches made off of Oregon. This presentation will include preliminary analyses of the age and maturity data for individuals collected during the summer of 2003.

Life History of Redband Trout in the Klamath River, Oregon

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The Oregon Department of Fish and Wildlife, Klamath Watershed District and Corvallis Research lab began investigations of redband trout in the Oregon section of the Klamath River in 2003 and continuing through 2005. Life history investigations included the use of radio telemetry, scale analyses, length frequencies, relative weight analyses, and spawning timing. Adult redband trout radio tagged in the peaking reach (RM 214.5- 218.8) showed no inclination to migrate to or above the J.C. Boyle fish ladder during spring or fall. Downstream migration of adult redband trout in the peaking reach was most common. Radio tagged redband trout in the bypass reach displayed upstream migration to the JC Boyle Fish ladder in the fall. Radio tagged redband trout were unsuccessful traversing the fish ladder. Two redband trout tagged in the bypass reach displayed downstream migration to a spawning area in the spring. Relative weight analyses showed a highly significant difference between Keno reach compared to the bypass reach and peaking reach and bypass reach compared to peaking reach. Scale analyses displayed differences in juvenile growth and life history between the Keno Reach and peaking reach. Larger redband trout were captured in the Keno reach than in the hydro power affected reaches. From redd observations spawning timing in the Bypass reach occurred from February- early July. Redband trout tagged in the peaking reach moved to spawning grounds from April-June suggesting spawning during this time.

Longitudinal Patterns of Stream Fishes, Aquatic Habitat and Water Temperature in the Lower Crooked River, Oregon

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The Lower Crooked River is a groundwater-fed stream in which over 90 percent of the streamflow is derived from groundwater inputs (15° C), creating a unique, highly heterogeneous thermal environment in which to study stream fishes. To protect and enhance the outstandingly remarkable values that are the basis for the wild and scenic designation of this section of river, the Bureau of Land Management has identified the need to evaluate fish presence and use of aquatic habitat in the 11-km section of river between Opal Springs and Highway 97. In July and August 2004, we conducted an extensive survey of aquatic habitat and stream fishes in the entire 11-km river section using snorkeling gear. Electrofishing and angling surveys in six 400-1000-m sites provided additional information on the size and relative abundance of fish species present. Cyprinids (dace, chiselmouth, and northern pikeminnow) comprised approximately 60-70% of the stream fish assemblage. Redband trout were common (20%) and were present throughout the river but were found in greatest relative abundance in the lower half of the study section. Local correspondence of spatial patterns of water temperature with the distribution of redband trout indicated that this species may be responding to thermal patterns at small (1-2 km) as well as large spatial scales (5-10 km). Of particular interest was the inverse relationship between redband trout abundance and size (length). The largest trout were found in warmer reaches upstream of the relatively cool groundwater inputs downstream of which juvenile salmonids were most abundant (>3000 individuals/km).

Tracking Bull Trout with Stream-Width Half-Duplex Passive Interrogation

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Passive integrated transponders or PIT tags can be used to monitor individual fish movements. Using the Texas Instruments Radio Frequency Identification (TI-RFid) system based on a 23 mm long, half-duplex, PIT tag, we were able to deploy a network of inexpensive, stream-width antennas and track individual fish with little disruption to flow or fish behavior. We will share our experiences using the TI-RFid system to track movements of individual bull trout in the South Fork McKenzie River above Cougar Dam and provide examples of systems designed to meet site-specific criteria.

Modeling Juvenile Salmonid Migration Patterns for the Columbia River Estuary

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We attempt to understand of the role of hydrology in determining fish migration patterns within the Columbia River Estuary and plume by integrating recent advances in biotelemetry and environmental observation and forecasting systems (EOFS). The underlying methodology includes analysis of the spatial and temporal movements of juvenile outmigrant salmonids with hydrological data from CORIE model (http://www.ccalmr.ogi.edu/CORIE). The CORIE model, an EOFS for the Columbia River and nearshore environment, integrates a real-time sensor network, data management system and advanced 3 dimensional numerical models. Numerical simulations of key physical variables (water levels, velocities, salinity and temperature) were generated for the precise time and location that individual juvenile salmonids implanted with either radio or acoustic transmitters were present in the Columbia River Estuary. Within the estuary we show that

the hydrological regime dominates the movement patterns of outmigrant salmonids. Residence time for outmigrants in the estuary appears to be largely a function of tides and estuarine residence time variability. Preliminary analysis over a two-year period suggests that data from the CORIE model corresponds well with salmonid migratory behavior and that the model may be a useful tool for evaluating the impact of different hydrological regimes on fish movement.

Long-Term Water Temperature Variability in the John Day Basin: Spatial Analysis of Multi-Source Data

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Surface water temperature regimes are affected by landscape-level conditions and play a critical role in determining the distribution and abundance of biological communities. In eastern Oregon, water temperatures often exceed biological thresholds and state water quality standards due to climatic variability and land use. To determine spatial patterns in water temperature, we compiled continuous air and surface water data from over 200 sites within the John Day Basin measured by multiple agencies over the past 20 years. Data was summarized at multiple temporal scales (e.g., daily and monthly) and is currently being compiled into a spatially-referenced database. Analyses will include the investigation of spatial and temporal patterns in temperature regime as well as comparisons across contrasting land use, geology, stream order, and gradient types. We will also investigate the usefulness and difficulties associated with the collection, storage, and maintenance of long-term data sets. The compilation and analyses of these existing data sets will aid and align multi-agency monitoring efforts within the John Day basin.

Integrating Sampling Methods to Characterize Bull Trout Spawning in the South Fork McKenzie River

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Roaring River, a tributary to the South Fork McKenzie River, is the only known spawning area for the bull trout population isolated above Cougar Dam. Since 1999, the Oregon Department of Fish and Wildlife has used a Vaki Riverwatcher electronic fish counter to estimate the abundance of bull trout entering Roaring River during the spawning period. The count is only an index of abundance because it includes fish other than bull trout and fish moving upstream through the counter more than one time. We added a PIT tag interrogator and a video recorder to the counting station in 2003, and a screw trap in 2004. The PIT tag interrogator recorded occurrences of individual PIT-tagged bull trout at the Vaki counter. We used the video recordings to visually identify the species of untagged fish. We captured bull trout with the screw trap to measure their length and accurately determine their sex. Combining data collected using these methods with the Vaki Riverwatcher counts allows us to more accurately and fully characterize bull trout spawning in Roaring River. We will present our findings on the number, sex, size, growth, timing and iteroparity of bull trout spawning in Roaring River and compare these data with redd counts.

NOAA Fisheries' Hydro Actions Being Applied to Manage Listed Snake River Salmon

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Major modifications have been made at federally owned Snake River mainstem dams to improve the passage survival of both juvenile and adult salmonids. The major emphasis in the past decade has been to improve juvenile passage survival. The steps taken to improve juvenile survival include flow management, spill at the dams, installation of state-of-the-art fish screening and bypass systems, barge transport, and surface bypass. A brief description of each of these management measures will be presented. Survival estimates of juveniles with the current management measures in place have shown marked improvement.

Fish Density and Diversity on a Nearshore Rocky Reef Complex

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Nearshore rocky reefs are important habitat for a suite of commercially and recreationally important finfish species. Estimating the abundance of fishes in these reef habitats is difficult because trawl surveys are ineffective in areas of high relief, and potentially damaging to emergent epifauna. Consequently, many species occupying rocky habitat lack adequate quantitative assessments. The ODFW Marine Resource Program has conducted visual transect surveys using a remotely operated vehicle on the Cape Perpetua Reef complex (south of Yachats OR) since 2000. This reef complex is comprised of numerous rocky outcroppings ranging in area from 8 m^2 to 30000 m^2. This paper will synthesize four years of data on fish density and community structure, and will discuss the potential for visual transects to be a useful assessment and monitoring methodology.

Adaptive Management of Predator-Prey Linkages: Piscivorous Birds and Endangered Salmon in the Columbia River

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Caspian Terns and Double-crested Cormorants have been documented as significant mortality sources to out-migrating salmon smolts in the Columbia River estuary. Whether avian predators negatively impact smolt populations in the mid-Columbia River is currently unknown. We present a quantitative evaluation of the effects of avian predators on out-migrating salmon in the mid-Columbia (Chelan Co.), central Washington, based on diet studies, bioenergetics, and behavioral observations. Although lethal and non-lethal bird control is concentrated at dams, our data indicate that 82 - 97 % of the predation occurs elsewhere on the river. We estimate that birds in Chelan County currently consume between 45,000 - 70,000 salmon smolts between April – August, less than 1% of those present above Rock Island dam. Adult Common Mergansers and Ring-billed Gulls are mostly responsible for this predation, although there are significant species-specific differences. Finally, some avian predators may be beneficial to salmonids during certain periods, as gulls and mergansers also consume large numbers of northern pikeminnow, a major predator of juvenile salmonids. We present an adaptive management model that includes running the bioenergetics model backwards and integrates policy set salmon mortality limits. This temporally and spatially explicit approach is more ecologically sound, and ensures the protection of endangered salmon, while not unnecessarily impacting their predators.

Snake River Sockeye Salmon Captive Broodstock Program

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Snake River sockeye salmon *Oncorhynchus nerka* were listed as endangered in 1991. Prior to listing, a captive broodstock program was initiated to prevent species extinction and to begin rebuilding the population. Between 1991 and 2004 the captive broodstock program has produced approximately 2,750,000 eyed-eggs through hatchery spawning for annual broodstock development and reintroduction to the habitat. Spawning protocols are primarily designed to minimize the risk of inbreeding and minimize the loss of heterozygosity. Reintroduction plans for captive broodstock progeny have followed a "spread-the-risk" philosophy. Since 1993, more than 570,000 eyed-eggs, 1,070,000 presmolts, 159,000 smolts, and 1,400 prespawn adults have been reintroduced into program lakes and creeks. From this production, 342 anadromous sockeye salmon have returned to the Sawtooth Valley of Idaho. Monitoring and evaluation efforts have focused on maximizing the use of limited hatchery rearing space and identifying and prioritizing the most successful reintroduction strategies. Comparisons of presmolt overwinter survival and out-migration success from nursery lakes have shown that (1) presmolts released directly to Redfish Lake in October emigrated more successfully than presmolts reared in Redfish Lake net pens prior to release, and (2) presmolts released directly to Alturas and Pettit lakes in October emigrated more successfully than presmolts released directly to lakes in July. Parentage exclusion analysis using nuclear DNA microsatellite markers was initiated in 2002 to associate unmarked smolts produced from prespawn adult release strategies and eyed-egg reintroductions. Using captive broodstock techniques, the program has successfully prevented the extinction of Snake River sockeye salmon.

Diversity of *Oncorhynchus clarki clarki* Across the Landscape and its Implications for Hatchery Programs

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Pacific salmon and trout (*Oncorhynchus* spp.) have evolved and adapted to a landscape that is a shifting mosaic of abiotic and biotic conditions. Population structure within a species reflects the complex interactions of many evolutionary and environmental processes. The diversity we observe within and among populations is a result of natural selection under various environmental conditions that is constrained by their genes. The capacity for a population or set of populations to respond to future changes in environmental conditions will depend on both the genetic and environmental legacy from which it has to draw. Examining this diversity in coastal cutthroat trout provides a useful backdrop for consideration when conservation efforts include hatchery options. Coastal cutthroat trout exhibit significant genetic differences among populations across large and small spatial scales, significant differences in meristic characteristics among populations at various spatial scales, and a broad range of life-history patterns. The implications that such broad ranges of diversity have on developing conservation hatchery programs will be discussed.

Non-Native Species in Oregon Estuaries

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As global travel and trade intensify, non-native species are arriving in our estuaries at an ever-increasing rate. Once these species are established, they are here to stay. More than 100 non-natives, representing all taxa, life history traits and ecological roles reside in Oregon estuaries (http://science.orst.edu/~yamadas/). Oysters from the Atlantic coast and Japan brought with them over 20 undesirable hitchhikers. Ships with fouled hulls, rock ballast and ballast tanks and the transport of marine products brought many more. The rate of invasions is greater than our ability to document the arrival and to understand the role of these exotics in our estuaries. Not only do alien species displace natives through predation and competition, they also alter habitat structure and energy flow through ecosystems. For example, the European green crab, *Carcinus maenas* preys on small native clams, worms and juvenile flatfish and competes for food with native crabs, fishes and migratory seabirds. The Japanese eelgrass, *Zostera japonica* consolidates mudflats by trapping sediment in its roots. Furthermore, this species adds detritus to the food web and provide habitat and food for other species, including other exotics. Some lessons learned from the arrival, spread and growth of the European green crab can be applied to predict the invasion process of other non-native species. Right now, we need to educate the general public and members of the aquaculture and shipping industries to prevent further introductions and to fund biologists to document the arrival, spread, and impact of invaders in our estuaries.

Preparing for Lewis and Clark: Efforts Throughout the West to Prevent Zebra Mussels from Hitching a Ride Across the Continent with Lewis and Clark Visitors

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The Lewis and Clark Bicentennial celebration (2004-2006) increases the risk of an inadvertent zebra mussel introduction into Western North America. Tens of thousands of visitors of all ilks are expected to visit some portion of the Lewis and Clark trail between St. Louis to Astoria during this period. Many of them, coming from states where zebra mussels are known to occur, are bringing their boats with the intention of reenacting a portion of the trip by water. Water resource managers throughout the west have banded together to develop and implement specific public outreach and education efforts in an attempt to prevent this from happening. These “exclusion” strategies for the Missouri and Columbia River basins will be discussed during this presentation. For those unfamiliar with zebra mussels, a brief overview of their life history and reasons for concern will also be presented and samples will be available for viewing.

ABSTRACTS OF POSTERS

In alphabetical order by primary author's last name

Presenters for Best Student Poster competition are listed in bold type

*Indicates presenter when multiple authors are listed

Risk Assessment of Whirling Disease Introduction to Alaska and the Willamette River, OR

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Myxobolus cerebralis, the cause of salmonid whirling disease is widespread in many regions of the US, and its distribution continues to expand. Effects of the parasite on eastern populations of wild trout populations appear to be negligible. Yet, in some areas of the western US, particularly Montana and Colorado, severe declines in wild populations of rainbow trout and Yellowstone cutthroat trout have occurred. Management concerns surrounding these population declines have led to research that has increased understanding of the ecology and lifecycle of the parasite and its intermediate hosts. The development of risk assessment models will help managers identify means to prevent the introduction of whirling disease into non-endemic areas and to reduce its effects in areas where the parasite already exists. This study examines the risk of introduction and establishment of the parasite into two uniquely different anadromous systems: Alaska and the Willamette River, OR. The parasite is not known to occur in Alaska and routes of introduction are suspected to be limited. Also limited is information regarding the potential for parasite establishment if it were introduced. In contrast, there are numerous potential introduction routes throughout the Columbia River Basin (straying and migration of anadromous fish from endemic areas, angler activity, transfers of infected fish between private ponds) though environmental conditions and the absence of tubificid hosts may limit the parasite's establishment in certain tributaries. Here we will present the development of the first steps in a risk assessment for these two systems: a release and an exposure assessment.

Modeling the Response of Fish Assemblages in Stream Networks to Habitat Change

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Many models exist that simulate how fish populations, particularly salmonids, respond to habitat change. Less attention has been paid to projecting changes in the entire fish assemblage, even though species interactions can be an important factor determining the success of individual populations. A major challenge is incorporating sufficient biological detail to capture key processes controlling assemblage responses while maintaining realistic requirements for model parameterization. We developed a model that simulates a set of mobile fish species occupying a stream network. It predicts the relative abundance of each species per network segment and time step (year) as a function of environmental attributes of the network. Model parameters are (a) the habitat requirements of each species, in the form of a habitat suitability index; (b) a species' interaction matrix, expressing the degree to which the occurrence of each species affects the occurrence of all other species; and (c) indices of relative movement ability and growth potential. The model is still in the prototype stages. Using a set of archetypical species, we evaluated whether the model reasonably mimics fish assemblage responses to habitat patterns and changes over time. Model experiments included quantifying the sensitivity of predicted assemblage patterns to assumptions about the relative importance of habitat constraints versus species' interactions, and to different patterns and frequency of habitat disturbance. We will summarize results from these initial model experiments. A primary objective of this presentation is to elicit feedback from fishery scientists on the structure of the assemblage model.

Using Passive Integrated Transponder Tags to Evaluate Fish Trout Distribution at a Watershed Scale

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In an attempt to evaluate recently applied forest practice regulations in Oregon, U.S.A., we use low-frequency 23-mm passive integrated transponder (PIT) tags to collect growth, movement, distribution and abundance data for adult (>1 year) coastal cutthroat (*Oncorhynchus clarki clarki*) and steelhead trout (*Oncorhynchus mykiss*) at multiple spatial and temporal scales within two watersheds. Each summer, beginning in 2001, the watersheds were surveyed with spatially continuous single-pass electrofishing. Starting in 2002, PIT tags were surgically implanted in all captured trout $\geq$100 mm (fork length). A series of fixed-site PIT tag readers with gate-antennas spanning the stream channel were installed to provide temporally continuous fish movement data at the stream segment scale. Portable backpack PIT tag readers are currently being used to collect spatially continuous data on the seasonal distribution of PIT-tagged trout. Because trout abundance data were collected continuously (i.e., all habitat units are sampled, and the sampling extent includes the entire fish-bearing portion of the watershed), we have the ability to detect patterns in fish abundance over a range of spatial and temporal scales. The combination of fixed antenna sites and portable readers provides a method for detecting (1) life-history patterns, (2) local changes in abundance in relation to movement and survival, (3) timing of movements of both potamodromous and anadromous trout, (4) the correlation of trout movement patterns with potential explanatory variables such as discharge, water temperature, bedload movement, and turbidity, and (5) the temporal persistence of both low- and high-density aggregations of trout.

Effects of Temperature and Desiccation on *Ceratomyxa shasta* Actinospore Production and Release from the Polychaete Host *Manayunkia speciosa*

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Ceratomyxa shasta, the cause of Ceratomyxosis, has a life cycle requiring both a salmonid and polychaete host. Thus far, little is known about the effects of environmental variables on parasite replication in the polychaete. To test the effects of temperature, both algae and sediment containing *M. speciosa* was collected from the Klamath River where *C. shasta* is endemic, and maintained in the laboratory at four temperatures ranging between 5º C and 25º C. In addition, tolerance to desiccation was tested by drying the material for 24 hours, then rehydrating and maintaining it at 12º C. Prior to treatment, polychaete density was determined for the population. To measure rates of parasite release, 1 L water samples were collected from each of the treatments twice weekly and suspended material was collected on filters for assay by quantitative PCR. At termination of the experiment, final polychaete density was determined and QPCR was used to establish the percent of infected worms.

The Application of Probabilistic Data: The Coho ESU Case

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The Watershed Assessment section of DEQ applied a probability based study design to look at Factors for Decline effecting coho stocks on the Oregon Coast. Probabilistic study designs provide a cost effective, statistically valid method for evaluating conditions over large areas. Evaluations can be scaled to sub-regions, land use or other physical attributes of interest. This provides useful information on the status of conditions at the scale or attribute of interest. Over time, probabilistic study designs can be used to monitor the effectiveness in land use management changes.

Fish Habitats in Seasonally Flooded Agricultural Lands

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In the Pacific Northwest, floodplains and seasonal waterways in low gradient agricultural fields may provide winter habitat to several species of native fish during high flow periods. In the winters of 2001-02 and 2002-03, the composition of fish communities and the spatial and temporal distributions of their species were examined in four sub-basins of the Upper Willamette River in western Oregon. Grass seed production is the predominant land use in these sub-basins and all our sampling locations were in seasonal creeks ran through agricultural fields. Fish were sampled from November to May using minnow traps and electrofishing. Standard fish habitat variables were recorded, as well as riparian vegetation features, water quality and discharge. Samples of both terrestrial and aquatic invertebrates were collected. Ten native species of fish (including four salmonids) were present in these habitats and were differentially distributed in response to drainage features. Although few to no fish were found in drainages directly feeding into the river's main-stem, fish numbers decreased as distance from the main-stem increased. During this study, fish abundance or community composition were not associated with riparian vegetation or water quality.

The Rural Science Education Program: Cooperative Learning Between Rural K-12 Schools and Oregon State University Scientists

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The Rural Science Education Program is a partnership between Oregon State University researchers and educators and science teachers, for enhancing science education in rural classrooms. The university places graduates and undergraduate Fellows in the classroom for developing and implementing inquiry-based science education. Preliminary analysis of 'before' and 'after' quizzes used for program evaluation indicate an improvement in science content test scores of K-12 students. In addition to teaching inquiry-based lessons, the program encourages OSU students to focus curriculum on their areas of expertise. Students at Cascades elementary school in Lebanon, Oregon have been learning about salmon biology through a partnership with the Oregon Department of Fish and Wildlife Salmon-Trout Enhancement Program. Salmon were raised in the classroom and released in the South Santiam River late December 2004.

Evaluating a Non-lethal Method for Measuring Lipid Content in a Salmonid

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The ability to non-lethally and rapidly measure lipids in live fish would provide researches with a valuable tool for monitoring fish condition and health. The Distell© Model 992 Fish Fatmeter is a commercially available hand held instrument that externally measures the lipid content of fish. In a replicated experiment with three feeding levels, we tested the effectiveness, reliability, and usefulness of the Fatmeter against an industry standard for quantifying whole body lipid content (Sohxlet proximate analysis) in juvenile rainbow trout (*Oncorhynchus mykiss*). Linear regression of the Fatmeter values against proximate analysis values show a poor correlation. For all feeding rations, the average lipid values obtained with the Fatmeter were lower than the lipid values obtained with proximate analysis. Our experience with the Fatmeter raises serious concerns about the practical use of the Fatmeter in field conditions. When evaluating fish condition, researchers should exercise caution if the Distell Fatmeter is used to quantify lipid levels in juvenile salmonids.

Myxozoan Match-Making: Linking Myxosporeans and Actinosporeans from Oregon

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An excellent opportunity for expanding our knowledge of myxozoan parasites was provided by sampling efforts to survey and manage the prevalence of known myxozoan fish pathogens in Oregon, chiefly *Myxobolus cerebralis* and *Ceratomyxa shasta*. Most myxozoans are believed to have a two-host lifecycle developing as a myxosporean in fish and an actinosporean in annelid worms. Over 18 months, both wild and sentinel fish as well as samples of stream substrates containing oligochaete and polychaete worms were examined from 6 rivers in Oregon: Willamette (mainstem, tributary & hatchery), Clackamas (Clear Creek mainstem & hatchery), Mackenzie (mainstem, tributaries & hatchery), Klamath (mainstem & tributaries), and Deschutes (mainstem, tributaries & hatcheries). A wide range of myxozoans were identified. From fish, *Chloromyxum* and *Myxobolus* were the most speciose myxosporean genera with at least 3 & 7 species respectively. Other myxosporean genera included *Sphaerospora*, *Myxobilatus*, *Henneguya*, *Parvicapsula*, *Zschokkella* and *Myxidium*. A wide range of actinosporean collective groups were recorded from oligochaete and polychaete worms, including Triactinomyxon (13 types), Raabeia (3), Echinactinomyxon (6), Aurantiactinomyxon (3), Siedleckiella (2), Tetractinomyxon (2) and Antonactinomyxon (1). At least 2 new oligochaete species were found to be parasitised by myxozoans: *Nais pseudobtusa* and *Spirosperma nikolski*. Sequencing and comparison of 18S rDNA from the fish myxosporean and worm actinosporean stages is currently underway to determine relationships among these organisms, including if any are alternate lifecycle stages. Matching up these alternate stages will enhance our understanding of the Myxozoa, as lifecycles are known for only about 2% of species.

National Clusters of Lotic Fish and Macroinvertebrate Assemblages in the United States and Their Relationship to Existing Spatial Classification Schemes

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Conducting biological assessments at a national scale requires a classification scheme to report results, define reference conditions, and interpret data. Analyzing stream biological assemblage data across the conterminous 48 United States is difficult due to the lack of synoptic assemblage data. In the last 10 years, however, the number and scope of bioassessments has increased dramatically. We compiled a national-scale database of lotic fish and macroinvertebrate assemblages containing over 6,000 sample sites from available national and state agency data. Cluster analysis (Bray-Curtis distance) and indicator species analysis were used to cluster the data, identify clusters, and describe them. We developed 12 national clusters of fish assemblage groups that were well-described by indicator fish species and predicted using both discriminant function analysis and classification tree analysis. We also examined the relationship of existing spatial classification schemes to fish assemblage similarity. Existing schemes did not capture the majority of the within-group similarity expressed in biologically derived clusters. Schemes based on ecoregion, physiography, hydrologic units, and geopolitical boundaries had very similar mean within-group fish assemblage similarities.

Update on Age Validation Studies using White Sturgeon Pectoral Fin Spine Sections Marked with Oxytetracycline

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Accurate growth information is vital to managing white sturgeon *Acipenser transmontanus* populations. Inaccurate growth information can lead to over harvest or lost fishing opportunities. Growth rates are most often determined by counting annuli formed in pectoral fin spines. Initial attempts to validate this ageing technique used 220 samples from fish at large 0-3 years and found that results were neither accurate nor precise (Rien and Beamesderfer 1994). An additional 620 samples ranging 0-9 years at large have since been collected. This poster updates previous work incorporating new samples interpreted by different readers using the same techniques.

A Biopsy Procedure for Determining Total Hg Concentration in Fish Relative to Regional Stream Condition Assessment

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Although Hg contamination of fish is a widespread phenomenon, its regional evaluation is hindered by the reluctance of permitting agencies to grant collection permits, problems in securing adequate freezer space, and time to process whole large fish or filets. We evaluated Hg concentrations in 210 filet biopsies from 65 sites in 12 western states relative to whole-body Hg concentration in the same fish. We found a highly significant relationship ($r^2 = 0.96$) between biopsy and whole-fish Hg concentrations for 13 piscivorous and nonpiscivorous fish species. We concluded that relative to conventional fish-tissue sampling and analysis procedures, Hg biopsies

are nonlethal, less cumbersome, more likely to be permitted by fisheries agencies, and precise and accurate means for determining filet and whole-fish Hg concentrations.

The Difference Between Growth Determined by Length-at-age and Measured from Tagged Individuals: Does VonBertalanffy's Function Function?

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White sturgeon *Acipenser transmontanus* research in the Columbia River has provided continuous refinements to population dynamics parameters of managed populations of white sturgeon. One such refinement has been an ever-expanding appreciation of growth variability in these fish. Estimation of harvest quotas are complicated by estimations of growth, i.e. fish growing into and out of the legal size-slot limit over time. Past methods for modeling population changes have relied upon length-at-age estimates. Such estimates for white sturgeon are inherently biased due to difficulties in accurately aging these fish. However, lacking individual growth information, a length-at-age approach is one of the only available methods for describing fish growth. Since 1990, methodologies for conducting population abundance estimates in Zone 6 reservoirs have included marking substantial numbers of white sturgeon with unique marks, which have provided an opportunity for direct calculation of growth over long periods of time. In two of the three reservoirs this data is available for, average growth has been substantially slower than estimated by length-at-age methods. In all three reservoirs, the change in growth rate as fish age is substantially different than the pattern assumed by length-at-age methods. We present a new description of white sturgeon growth rate patterns indicating a period of very slow growth, followed by a period of exponential increase to a maximum rate, then a linearly declining rate theoretically approaching zero at maximum size. We also discuss the methods used to derive suitable equations to best describe these observed patterns for use in managing populations.

Timing and Stages of Metamorphosis in Pacific Lamprey, (*Lampetra tridentata*)

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Lampreys are ancient fishes with a diversity of life histories. Lamprey experience a true metamorphosis that has been well described for certain species. However, relatively little information exists describing metamorphosis in lamprey found in the northwestern U.S. Metamorphosis of Pacific lamprey (*Lampetra tridentata*) was examined within laboratory conditions. The objectives of the study were to assess survival and growth, document the process of metamorphosis, and begin describing the characteristics of lamprey that undergo metamorphosis. In June 2004, 144 ammocoetes ranging from 91 to 164mm (total length), and 1.8 to 8g were collected from Cedar Creek, WA. Ammocoetes were randomly assigned to three different feeding regimes and held at Abernathy Fish Technology Center in Longview, WA for 140 days. Periodically, length and weight of the fish were measured and survival was assessed. Criteria developed for sea lamprey (*Petromyzon marinus*) were used to identify ammocoetes that might be likely to initiate metamorphosis. Twenty-five of these lamprey were photographed periodically to document external morphological changes. Survival was 0%, 94%, and 100% in the high, medium and no food (control) groups, respectively. Of the lamprey from the medium food group, 21% initiated metamorphosis and within the no food group, 8% initiated metamorphosis. Metamorphosis began in early July and was generally complete by mid-November. Of lampreys initiating metamorphosis, the smallest length was 106mm and the smallest condition factor was 1.52. When compared to metamorphosis in other lamprey species, the stages in Pacific lamprey appear similar but the conditions for initiation may be different.

Long-Term Channel Monitoring on Industrial Forestlands: the First Decade

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Green Diamond Resource Company in northern California has implemented a long-term aquatic monitoring program. Since its inception in 1993, one of the primary elements of this program has been the monitoring of changes in stream channel characteristics resulting from hillslope activities. The successful implementation of this channel monitoring approach requires, the following critical attributes: 1) variables being measured represent processes being monitored; 2) monitoring focuses on processes rather than "average conditions" or "desired future conditions"; 3) time lag between an action and a change in the variable being measured is minimized; 4) field techniques involve a minimum of subjectivity and key variables are quantitative and repeatable over time and between field crews and 5) data is amenable to the development of rigorous statistical tests to detect changes. There were two channel monitoring reaches established in Hunter Creek, a tributary to the Klamath River, California, which provided an opportunity to examine the potential lag effects. Storm events in the winter of 1998 activated slope failures in the headwaters of Hunter Creek and approximately 1.2 meters of aggradation were measured in the upper reach (2.3 km downstream from the slide) when it was re-measured in the following summer. In contrast, approximately 0.5 meters of aggradation was recorded in the lower reach (5.3 km downstream of the slide) in the same monitoring period. In the years since the storm event, the upper reach has re-adjusted more quickly, while the lower reach is still showing effects from the sediment delivered by the 1998 storm.

Benthic Macroinvertebrate Sampling in the South Fork and Mainstem McKenzie Rivers in Relation to the Temperature Control Project at Cougar Dam

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Drawdown of Cougar Reservoir for the construction of a temperature control tower at Cougar Dam (RM 4.5) on the South Fork McKenzie River occurred from April 1-May 26, 2002 and resulted in unexpected levels of turbidity downstream. In August 2002 we sampled the South Fork above and below Cougar Reservoir and the mainstem McKenzie Rivers to determine whether severe immediate impacts occurred to benthic invertebrate communities following the elevated turbidity levels. A portion of the samples we collected were compared to baseline data collected by the Forest Service during October 2000 and 2001. In both October 2000 and 2001, and in the August 2002 and 2003 samples, a decline in the total bioassessment score of about 10% occurred between the site directly above the reservoir and the site directly below. In riffle habitat, seasonal trends in cold water biota abundance and richness appeared to be more pronounced than impacts resulting from increased turbidity (Wisseman 2002). Comparisons between the turbid and non-turbid margin samples below the dam did not indicate substantial impact to benthic invertebrate communities due to increased siltation. The 2003 scores were nearly identical to those in 2002, with the 2004 sample set yet to be assessed. Sampling will continue past the completion and implementation of the temperature control project to track alterations in the benthic invertebrate communities below the dam resulting from the return to historic temperature regimes.

Implementing HDX PIT-tag Technology in Headwater Stream Networks

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Fisheries biologists have a variety of biotelemetry options available for studying the behavior of individual organisms or populations. Most of these technologies (i.e., acoustic or radio telemetry) rely on internal transmitter batteries to provide power for signal generation and transmission. The overall size and weight of active transmitters may be unsuitable for marking small organisms (i.e., fish < 150 mm), transmitter cost may be prohibitive for marking a sufficient number of animals (i.e., $100 > per tag), or battery life may be insufficient for long-term research projects. Passive integrated transponders (PIT-tags) contain no internal batteries, only attempt to transmit when in close proximity to receiving antennas, are suitable for marking small individuals, and are relatively inexpensive. We used half-duplex PIT-tag technology over a three-year period to study the behavior, habitat usage, and movements of juvenile steelhead and coastal cutthroat trout in a headwater stream network. We provide background information regarding the use and implementation of a relatively new technology suitable for tracking many individual organisms over multiple spatio-temporal scales.

Factors Influencing Benthic Food Availability and Diet of Over-wintering Juvenile Coho Salmon *Oncorhynchus kisutch* in a Coastal Watershed in Oregon

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Studies linking the spatial distribution of a species to the quality, quantity, and dynamic nature of their food resources are needed. This study will investigate the over-wintering food resource requirements and habits of juvenile coho salmon *Oncorhynchus kisutch* in a coastal basin in Oregon. Diet and benthic samples will be collected monthly. Stomach contents of captured fish will be analyzed and compared with biomass and abundance indices of available food. Individual fish, marked as part of a larger project by the EPA, will be used to track movement and growth. Temporal patterns of potential food sources to juvenile coho examined will include: i.) eggs from spawning adult salmonids, ii.) biomass of benthic invertebrates, iii.) emerging fry, and iv.) invertebrates made available through increased stream-flow. Greater growth or condition is expected for juvenile coho coincident within reaches of higher spawning density. Diet samples are anticipated to corroborate the importance of salmon eggs and fry as an important source of food to juvenile coho. Preferential movement is anticipated by juvenile coho into areas with high available food resources such as spawning areas and areas with high overall prey availability. Lastly, flow events are expected to increase the availability of prey to coho by flushing terrestrial invertebrates from the surrounding canopy, dislodging benthic invertebrates from substrates, and increasing foraging area. The results of this research will inform natural resource management in the Pacific Northwest and elsewhere, through improved understanding of the underlying mechanisms driving food dynamics, movement, and habitat requirements for over-wintering juvenile salmon.

Cool Hideaways: Use of Summer Temperature Refuges by Juvenile Coho Salmon in the West Fork Smith River

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More than 400 juvenile coho salmon regularly pack themselves into an area no bigger than a kitchen table near Crane Creek on the West Fork Smith River on hot summer afternoons. Around the watershed, other groups of coho and trout use other cold refuges and small cold spots to avoid main channel water temperatures that can reach as high as 25^{o} C. What are the benefits to fish using coldwater refuges and how far do fish travel to use them? In 2003 we mapped cold refuges and performed snorkel surveys and fish counts at several sites. In 2004 we chose four main refuges as study sites. We installed temperature loggers in each refuge and in the nearby main channel. We measured (length, weight) and PIT-tagged juvenile coho salmon at each site in early July and recaptured and measured fish in September. We tracked fish movement throughout the summer using a portable PIT-tag reader and snorkel surveyed to count fish numbers in the refuges and nearby pools at various water temperatures and to observe fish behavior. The number of coho in refuges increased with main-channel temperature. Coho and other fish congregated in multiple smaller pockets of cold water not detected during the initial refuge mapping. Even so, the total area of coldwater refugia was too small to accommodate the majority of juvenile coho at any given time. Preliminary results will be presented on the influence of refuge use on coho growth and development.

Cost-effectiveness of Riparian Planting Treatments in Southern Oregon: Getting the Biggest Bush for the Buck

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Tree planting is a common restoration technique used to accelerate ecological processes in riparian areas and improve aquatic habitats. Riparian planting projects, however, often lack monitoring to assess their effectiveness. This study evaluated a riparian planting project in South Fork Little Butte Creek, a major salmon-producing tributary to the upper Rogue River, Oregon. Over 5000 native trees and shrubs were planted along 1.5 stream miles in winter 2002 to help recover riparian areas previously damaged by a large flood. In summer 2004, surveyors assessed almost 3000 plants and found survival of all 6 species varied greatly among 13 planting sites from 1 to 97% (total = 69%, mean = 55%, s = 28%). When sites were combined, Pacific willows had the highest (90%) and red alders the lowest (15%) survival rates, while Douglas-fir and incense-cedar survival exceeded 60%. Cost-benefit analyses showed willow cuttings were the most ($4.20 / surviving plant) and red alders the least ($43.50 / surviving plant) cost-effective planting treatment. Survival rates of three species (black cottonwood, incense-cedar, Pacific willow) were strongly correlated (r^2 > - 0.8) to their planting order suggesting plants staged near the study area were stressed by cold weather, which increased mortality. Although large trees probably have greater roles in influencing riparian processes, this study indicates willow cuttings were the most cost-effective planting treatment and provide an affordable riparian restoration strategy. In this region, however, conifers should be planted in combination with willows to provide for future shade, large wood recruitment, and channel complexity.

Tracking Voluntary Restoration Efforts in the Oregon Coastal Coho ESU

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Each year Oregonians participate in projects designed to restore fish habitat and water quality conditions. These voluntary actions by private citizens and landowners, working in partnership with federal, state, and local groups, are a fundamental component of the Oregon Plan for Salmon and Watersheds. Voluntary restoration efforts have been documented in the Oregon Watershed Restoration Inventory database (OWRI) since 1995. The OWRI provides a measure of progress for the Oregon Plan for the implementation of voluntary restoration activities. The OWRI provides an opportunity to gain an understanding of what past investments in restoration are providing in terms of ecological recovery. Restoration data compiled for the Oregon Coastal Coho ESU will soon be featured in the Oregon Plan Coastal Coho Assessment.

Status of Chinook Salmon in the John Day River Subbasin

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The John Day River subbasin supports one of the last remaining intact, wild populations of spring Chinook salmon (*Oncorhynchus tshawytscha*) in the Columbia River Basin. Index spawner surveys for spring Chinook were initiated in 1959 and provide important population trend data. In 1998, we began to develop a monitoring program that included more survey sites to census this population. The goal was to quantify redd distribution and abundance, spawner escapement and age structure, hatchery stray rates, and make comparisons to historical trend data. Yearly spawning ground surveys were conducted during September in the Mainstem, Middle Fork, North Fork, and Granite Creek System, and other non-index sites in the John Day River. Surveys encompassed 86-205 rkm of suspected spawning habitat in addition to the 88 rkm of index sites. Subbasin index counts increased significantly since 1959 (54 redds) and have stabilized since 2000 (>1,000 redds). Census counts have been fairly constant since 2000, with 1,656 redds observed in 2004 and an estimated escapement of 4,968 adults. Hatchery stray rates have apparently tripled during 2004. Of 1,130 carcasses sampled, 41 (3.6%) were adipose clipped (hatchery) fish. Census counts more accurately reflect spawner abundance and distribution as Chinook continue to expand into previously unoccupied areas. The John Day spring Chinook are an important index population for directing management practices on salmon stocks in the Columbia Basin.

Restoration of Habitat Complexity and Salmon Nutrient Inputs: Influence on Coho Growth and Marine-derived Nutrient Incorporation in Oregon Coastal Streams

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An important consequence of salmon decline in the Pacific Northwest is the reduction in the supply of marine-derived nutrients (MDN) to juvenile fish, invertebrates and other stream and terrestrial organisms. Recent work suggests that the declining supply of marine-derived nutrients to freshwater systems could limit juvenile salmonid

production. For this reason, the State of Oregon initiated a carcass placement program in 1997 and since then more than 158,700 hatchery salmon carcasses have been distributed along 2,880 stream miles in western Oregon. The goal of this program is to stimulate salmon production through increased food availability. In addition, physical habitat restoration can increase salmon carcass retention and thus the potential for MDN incorporation into stream organisms. Our study examines juvenile coho growth and stable isotope ratios in response to salmon carcass and wood placement in coastal Oregon streams. We present preliminary data on our study design and pre-treatment physical habitat and isotope ratios of fish and aquatic invertebrates. We hypothesize that planting salmon carcasses in stream reaches with improved physical habitat will produce the greatest growth and incorporation of MDN by juvenile coho. Our goal is to better inform stream management concerning the most effective placement of the limited resource of salmon carcass nutrients.

The Pacific Northwest Native Freshwater Mussel Workgroup

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The status of the seven species of freshwater mussels native to the Pacific Northwest has received very little attention, despite the fact that freshwater mussels are considered the most endangered group of animals in North America. The Pacific Northwest Native Freshwater Mussel Workgroup was founded in 2003 with the goal of ensuring that freshwater mussel research, management, and educational activities are coordinated, prioritized and consistent with identified information needs. The Workgroup adopted nine objectives to achieve this goal: 1. Hold an annual freshwater mussel conference in the Northwest to review the state of mussel research and management, 2. Maintain a list of mussel research needs to provide guidance for species conservation, 3. Protect quality mussel habitat, 4. Maintain a website that provides information about freshwater mussels and about the Workgroup, 5. Maintain a Northwest database of mussel distribution, 6. Support classes on mussels to aid resource managers and researchers, 7. Publicize mussel issues to raise public awareness of mussel needs, 8. Provide speakers for requested presentations to organized groups on mussels, and 9. Produce mussel educational material to raise public awareness of mussels. The Workgroup meets four times annually. Recent accomplishments are the establishment of a website (http://columbiariver.fws.gov/musselwg.htm), the second Mussel Symposium, and the development of a mussel field guide. The guide will be available in 2005. Additionally, the Workgroup is planning the third annual Mussel Symposium for June 2005. The Workgroup intends to raise the awareness of the status of mussels and assure that the knowledge-base continues to build.

OSU and ODFW Cooperate in the Development of a Hatchery Research Center in the Alsea Basin

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The Hatchery Research Center (HRC) is a cooperative project between the Oregon Department of Fish and Wildlife and Oregon State University Department of Fisheries and Wildlife. The mission of the HRC is to understand the mechanisms that may create differences between hatchery and wild salmon and steelhead, develop approaches to best manage any differences in order to meet fishery and conservation objectives, and to help Oregonians understand the role and performance of hatcheries in responsibly using and protecting Oregon's native fish. Presently under construction at the site of the old Fall Creek Hatchery in the Alsea Basin, the HRC will feature four semi-natural stream channels where discharge and habitat variables can be controlled and replicated. The HRC will also have four "traditional" raceways, a tank farm, wet lab, conference and meeting facilities and rooms for overnight stays. The HRC will undertake to inform the public as to the role fish culture and fish

research have in the management of Oregon's fishery resources. The senior scientist at the HRC will be a tenure-track position with OSU and jointly funded by OSU and ODFW. This person will work with an advisory committee comprised of stake-holders and scientists. Construction will be completed by July 1, 2005.

Genetic Identification of Chinook Salmon in the Upper Willamette River

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Native upper Willamette River spring-run Chinook salmon (*Oncorhynchus tshawytscha*) are genetically distinct from other Columbia Basin populations and are recognized under the U.S. Endangered Species Act (ESA) as an Evolutionarily Significant Unit (ESU). Fall-run Chinook salmon are also native to the Willamette River. Due to low summer and autumn flows, Willamette Falls historically restricted fall-run fish to the lower river. However, as a result of fish ladders constructed at the falls beginning in the late 19th century and extensive hatchery introductions of fall-run stocks primarily in the mid 20th century, adult Chinook salmon now pass above Willamette Falls in the late summer and autumn as well as in the spring. Although time of return provides a straightforward basis for identifying the stock type of migrating adults, the stock classification of juveniles is less certain. In the present study, we examine the feasibility of using genetic (microsatellite DNA) markers to identify the stock origin of individual Chinook salmon in the upper Willamette River basin. Genetic data from populations in the upper Willamette River are compared to data for populations in the lower Columbia River, the source of most fall-run stock transfers into the upper Willamette. The upper Willamette River genetic data are then used to assign individuals of unknown origin to spring-run (native) or fall-run (introduced) population groups. Analyses of juveniles collected at several beach seine sites indicate that both spring- and fall-run lineage fish rear in the Upper Willamette River in both early and late summer.

Should I Stay or Should I Go? Evidence of Life History Plasticity of *Oncorhynchus mykiss* from Controlled Breeding Experiments

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Oncorhynchus mykiss exhibit a complex of life-history strategies ranging from residency in small streams to anadromy involving migrations of hundreds of kilometers. Both forms coexist in northeast Oregon but it's unclear if these forms are reproductively isolated and function independently. The objective of this study was to evaluate the ability of the resident life-history form to produce anadromous fish. We conducted various crosses in the hatchery between anadromous and resident forms from the Grande Ronde River basin to determine morphological variation and migratory propensity of progeny. Offspring were reared in a hatchery, PIT tagged, released, and then monitored for detection at downstream dams. Progeny from resident matings had symmetrical length distributions compared to anadromous matings that were negatively skewed. Generally, progeny from resident matings had greater condition factors than those from anadromous matings. Offspring from anadromous parents had the highest propensity to migrate (45.8%), resident progeny had the lowest (3.8%), while crosses were intermediate. Resident parents produced the most precocious progeny (17.6%), while all other matings were significantly lower. A disproportionately small proportion of precocious progeny (2 of 1,236) migrated. Larger progeny (>170 mm)

were detected migrating at significantly higher proportions ($P < 0.001$), however, there was no significant difference in condition factors between progeny that were detected at downstream dams ($P = 0.1$) and those that went undetected. Phenotypic plasticity in life-history strategies was clearly expressed among *O. mykiss* progeny from resident and anadromous matings. However, life-history strategy also appeared to have a heritable component.

Spatial Distribution of Widow Rockfish Bycatch in the Shoreside Pacific Hake Fishery in Relation to the Rockfish Conservation Area

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Widow rockfish *Sebastes entomelas*, an overfished species, is routinely captured as bycatch in the Pacific hake *Merluccius productus* fishery, the largest fishery on the West Coast. A significant portion of the widow bycatch occurs within the Rockfish Conservation Area (RCA), which was established in 2002 and bans trawling between 150 and 400 meters, except for the Pacific hake midwater fishery. The optimum yield for Pacific hake will likely be reduced in 2005 to reduce widow rockfish bycatch. Using logbook tow data and landed catch weights from the Oregon shoreside directed fishery (1999-2003), the spatial distribution of widow rockfish and Pacific hake in relation to the RCA was examined. Results showed that 70 percent of the widow bycatch occurred within the RCA. These same tows captured 47 percent of the hake. The average catch rate of hake harvested within the RCA was 19 metric tons per hour (mt/hr) towed, compared with 23 mt/hr outside the RCA. If midwater trawling was not allowed in the RCA and the catch rates for widow rockfish and hake outside the RCA were applied to the entire catch, there would be an overall 43 percent reduction in widow rockfish bycatch. This savings in widow rockfish mortality could be used by managers to maintain a high hake yield and minimize widow rockfish bycatch.

Implementation of the Environmental Monitoring and Assessment Program (EMAP) Sampling Design to Evaluate Summer Steelhead *Oncorhynchus mykiss* Spawners in the John Day River, OR

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Although the John Day River subbasin supports one of the last remaining intact, wild populations of summer steelhead *Oncorhynchus mykiss* in the Columbia River Basin, limited information is available for steelhead life history, escapement, and productivity measures in the basin. In 2004, we implemented the EMAP sampling design and standard survey protocols to quantify steelhead redd abundance, spawner escapement, and hatchery steelhead stray rates. We surveyed 48 spatially-balanced, random spawning sites that encompassed 94.8 km of an estimated 4,112 km (2%) of steelhead spawning and rearing habitat within the basin. Surveyors observed 66 redds, 50 live fish, and sampled five carcasses during these surveys. Our basin estimates for steelhead redds (2,862 redds) and adult spawners (6,010 spawners) are significantly lower than those estimated from non-random index surveys (7,921 redds; 16,633 spawners) conducted concurrently with our monitoring. These differences result from the high percentage of EMAP sites located on small, high gradient streams in the upper distribution of steelhead spawning habitat and likely bias of index survey sites towards more densely used spawning habitat. Hatchery steelhead comprised a high percentage of both live (38%) and dead (60%) fish where the presence or absence of an adipose clip could be determined. Although based on only 34 live fish observations primarily on one stream (Service Creek, rkm 245), our findings suggest a significantly higher hatchery steelhead stray rate in the basin than

has been previously reported (4 - 8% stray rate). Implementation of the EMAP sampling design in 2004 was an important first step in determining the status and health of summer steelhead in the John Day subbasin.

Feeding Behaviors of Redside Shiner (*Richardsonius balteatus*) in a Recirculating Stream Aquarium

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Ephemeral streams in the Willamette Valley floodplains are important winter refugia for aquatic species. Interest in terrestrial organisms as food from agricultural fields is becoming more important to understanding the ecological status of these habitats. Our experiment studied the feeding behavior of redside shiners (*Richardsonius balteus*) in a recirculating stream aquarium at the Pacific Northwest Research Station at Oregon State University. The recirculating stream was divided into 9 replicate chambers for our experiment. In May 2004, fish were collected from a representative ephemeral tributary of the Mary's River in the Willamette Valley and held for 18-19 days prior to use in the laboratory stream. In the feeding experiment thirty-three individual shiners were given three prey species (adult caddisflies *Limnephilus* sp., *Tubifex* sp., and *Daphnia magna*). Fish were fed at 0900 and 1600 each day under a light regime of 10h light/14h dark and 12-14^{0}C. The freshly killed *Limnephilus* were introduced on the surface, *D. magna* in the mid-water column, and *Tubifex* on the stream bottom. These prey were provided first singly for 2 days, then simultaneously for 2 days, to test for preference of prey and the water level at which fish fed. We conducted 3 paired trials (a total of 12 days). Shiners did not feed at the surface nor did they eat adult *Limnephilius* sp. frequently. These results suggest the importance of aquatically derived prey for redside shiners in winter floodplain habitats.