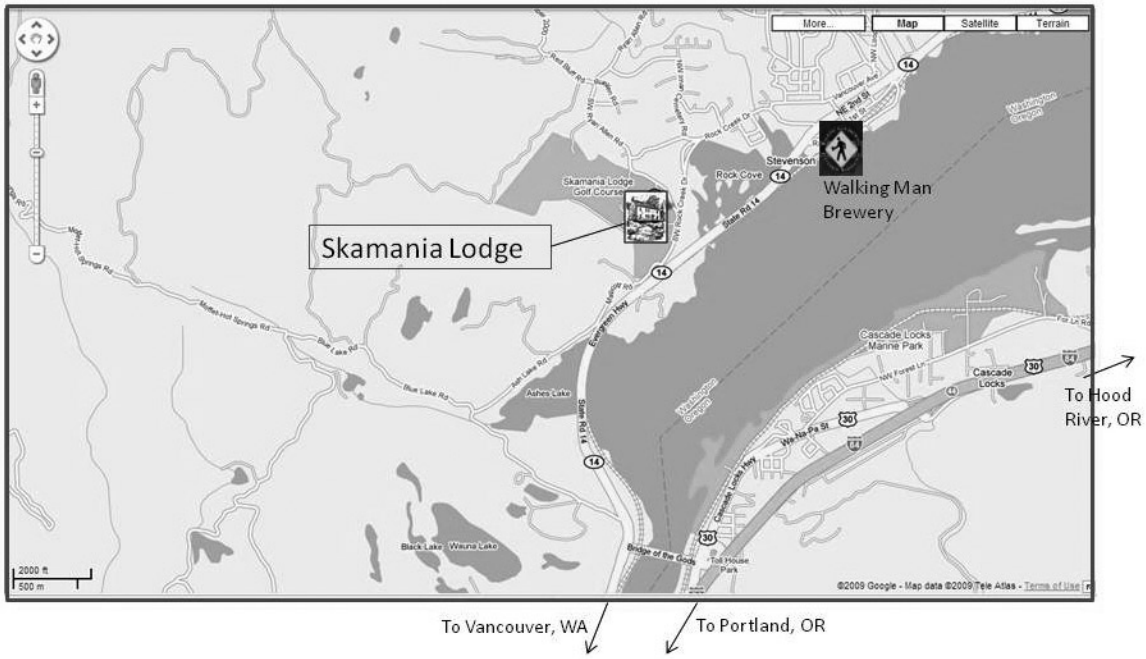
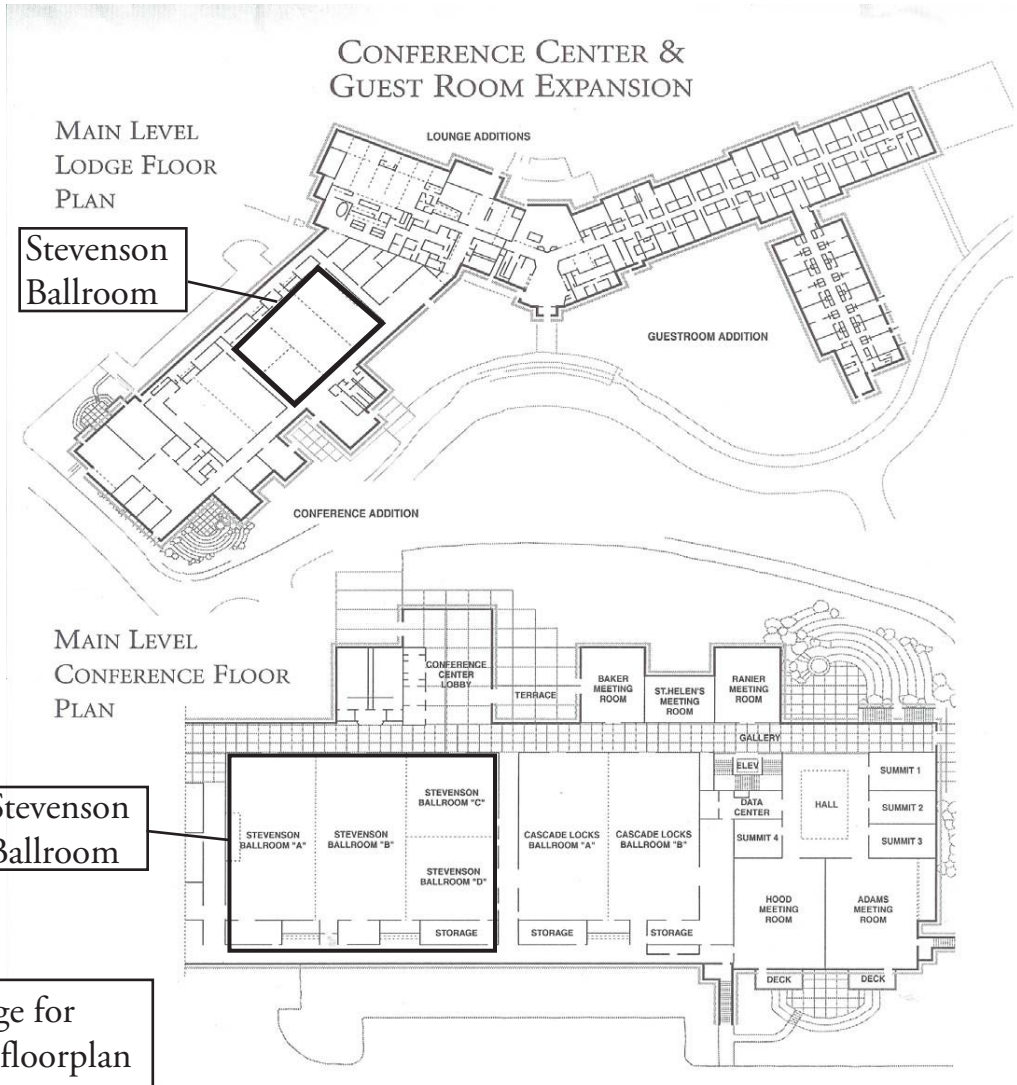
The Society for Northwestern Vertebrate Biology
The Washington Chapter of the Wildlife Society
2009 Joint Annual Meeting
Temporal Issues in Ecological Science: Implications for Research, Management, and Conservation in the Pacific Northwest

February 18 – 21, 2009
Skamania Lodge, Stevenson, WA

Skamania Lodge and Vicinity





See last page for additional floorplan

The 2009 Joint Annual Meeting of The Society for Northwestern Vertebrate Biology & Washington Chapter of The Wildlife Society

"Temporal Issues in Ecological Science: Implications for Research, Management, and Conservation in the Pacific Northwest"

Welcome to the 2009 Joint Annual Meeting of the Society for Northwestern Vertebrate Biology and Washington Chapter of The Wildlife Society. SNVB and WA TWS have partnered as annual meeting co-hosts many times, and as a result have developed highly functional teams of hosts and organizers. It is no small feat orchestrating such an event and we appreciate you for acknowledging their work with your attendance. We thank you for your participation and thank the meeting organizers for planning such a timely and worthwhile event. We are privileged to offer you a forum to foster information exchange, meet future collaborators, and develop long-lasting professional associates and friendships.

The meeting theme, **"Temporal Issues in Ecological Science: Implications for Research, Management, and Conservation in the Pacific Northwest"**, which was chosen well before the collapse of the global economy, is especially timely. "Temporal issues" of funding, administrations, and our own individual life stages speak to the many facets of research, management, and conservation, by which decisions are made that have fleeting or lasting effects. When you look at the program, you will see an all-star cast beginning with three symposia addressing different aspects of time and place: Long-term Ecological Research, Amphibians and Forest Management, and Invasive Species. Opening the regular meeting plenary session, you will hear three dynamic speakers, Chuck Fowler, Pieter Johnson, and Fred Swanson, who will discuss temporal issues in ecological science related to systemic management, humanities, and environmental change. At the close of the first day, we will learn lessons 100 years in the making as Steve Beissinger speaks candidly about the findings he and others from the Museum of Vertebrate Zoology at the University of California-Berkeley unveiled as they retraced the steps of pioneer Joseph Grinnell in the deserts of California. After a series of important and diverse presentations highlighting your work, not to mention great food in between, we close the meeting with a special plenary session. This special session features the work of five long-standing members and major contributors to SNVB and WA TWS, Harriet Allen, Keith Aubry, R. Bruce Bury, Dede Olson, and Hart Welsh, who will speak to conservation challenges and management strategies for wide-ranging and low-mobility species in present and future.

Tara Chestnut, President
Society for Northwestern Vertebrate Biology

A. J. Kroll, President
Washington Chapter of The Wildlife Society

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We also wish to thank the individuals, businesses, and organizations who provided special contributions or donated items for our raffle and auction.

Lessons and Insights on Long-term Ecological Research in the Pacific Northwest (Stevenson Ballroom A; 9:00 am - 12:10 pm)

Quantifying spatial and temporal variation in population and ecosystem responses is a fundamental enterprise in ecology. In particular, long-term datasets are required to develop reliable understanding about population responses to environmental and anthropomorphic stressors, such as fire and regulated harvests. However, given the difficulty in maintaining consistent monitoring of populations or sites over time, relatively few long-term datasets (> 5 years) exist. The symposium will feature results from both terrestrial and aquatic studies conducted in the Pacific Northwest. Participants will present results from a variety of different ecological settings and across a range of disturbance gradients (e.g., relatively undisturbed to intensively managed). The primary objectives of the symposium are to discuss general conclusions from long-term studies and to determine whether short-term studies can be implemented to test patterns identified in long-term studies. The symposium will include researchers from federal, state, and private organizations.

Invasive Species Research and Management in the Columbia River Basin: Estuary to Headwaters (Stevenson Ballroom C/D; 9:00 am - 5:10 pm)

Invasive species affect natural ecosystems, agriculture, water delivery and flood protection systems, human health and the economy. In this one-day symposium, we will present the state of aquatic invasive species management and research in the Columbia River Basin from the estuary to the headwaters. Case studies of current research in aquatic environments will be presented as well as assessments of invasion risk for those species not yet established. Topics include policy and land management, impoundments, and wetland restoration. Species specific presentations will discuss the origins, ecological impacts and management strategies of a suite of plant and animal species including Purple Loosestrife, Spartina, Hydrilla, Phragmites, Zebra and Quaaga Mussels, New Zealand Mudsnail, Bullfrogs, Nutria, and a number of fish species. Land managers actively engaged in on-the-ground restoration will share their experiences, discussing what has (and has not) worked for them with regard to management and policy. Participants will leave the symposium with a better understanding of invasive species management and tools to aid them in decision-making.

The program will include a keynote address from Dr. Pieter Johnson, University of Colorado -Boulder Department of Ecology and Evolutionary Biology, discussing the interactions among invasions and habitat alteration, particularly freshwater impoundments. Ed Jahn, producer of *The Silent Invasion*: an Oregon Field Guide Special, will present the closing address. *The Silent Invasion* documentary on invasive species in Oregon received a DuPont-Columbia University Award (Silver Baton), one of the most prestigious national honors in the field of broadcast journalism. A special showing of *The Silent Invasion* will follow the close of the symposium.

Stream-associated Amphibians and West-side Forest Management in the Pacific Northwest (Stevenson Ballroom B; 9:00 am - 5:00 pm)

Symposium supported by the Western Wildlife Task Group, National Council for Air and Stream Improvement, Inc. (NCASI)

The relationship between forest management and stream-associated amphibians (SAA; *Ascaphus truei*, *Dicamptodon* spp., *Plethodon* spp., and *Rhyacotriton* spp.) in the Pacific Northwest is an important concern for researchers and managers. Forest harvesting can affect abiotic and biotic portions of SAA habitat. However, variation in the spatial and temporal intensity and duration of these impacts is less well understood, and may explain the gradient of occurrence and abundance seen across a range of stand age and ecological conditions. In addition, current forest management prescriptions and conservation measures for amphibians are not well supported by research results. Consequently, a more robust understanding of current habitat conditions in managed and unmanaged forests, relative influences of forest practices, and the use of appropriate study designs and statistical methods to evaluate hypotheses is needed. In addition, a workshop centered on the presentation and discussion of data will facilitate identification of critical research and management questions.

Goal of the Symposium:

To encourage researchers to share both published and unpublished data collected on public and industrial forest landscapes. Priority will be placed on the open discussion of data and results; strength of statistical methodologies used to make inferences; scope of inference from different data-sets; and development of important research questions.

Participants:

Researchers and managers from state, federal, and private land management organizations.

Symposium schedules may be found on p. 12 and 13

Long-term Ecological Research Symposium abstracts begin on p. 21

Amphibians and Forest Management Symposium abstracts begin on p. 24

Invasive Species Symposium abstracts begin on p. 28

Special Events

Amphibians and Forest Management Poster Session and no-host bar

Wednesday 18 Feb.
5:30 - 7:30 pm

Stevenson Ballroom B

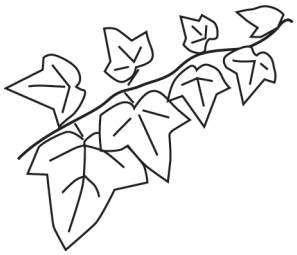
Wednesday 18 Feb. after the Invasives Symposium (5:30 pm)

Special screening of Oregon Field Guide's **The Silent Invasion**

Stevenson Ballroom C/D

The Silent Invasion is a DuPont-Columbia Award-winning documentary on invasive species in Oregon.

No-host bar available next door at the poster session (see above).



Photography Contest

Thursday 19 Feb.

The contest includes fish and wildlife in the following photographic categories: ***Portrait***, ***Telling a Story***, ***Abstract Art***, ***Capturing an Unusual Moment***. Prizes will be awarded for the best photo in each category, as well as best in show. Photos will be displayed for viewing during socials and poster session. The winning photos will be announced at the banquet. All awards are by peoples' choice, so be sure to vote!

Silent Auction and Raffle

Thursday 19 Feb.

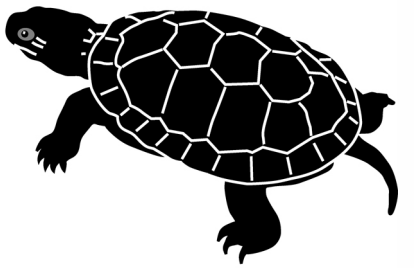
Many items donated by generous sponsors and members will be on display Thursday February 19th during the poster session and no-host social for registrants to bid on during the annual silent auction. There will also be a short raffle that evening at the banquet that will include an assortment of interesting items and memorabilia.

Field Trips

Captive Rearing and Recovery: Putting the Pieces Together

(Saturday 21 Feb., 9:30* am - 12:30+ pm)

Captive rearing is often employed to bring rare species back from the brink. We see flashy news coverage of the release site, but where's the rest of the story? What goes on backstage at the Oregon Zoo? Join us for a close-up look at endangered animals in captivity. We'll see tiny turtles, fledgling frogs and larval Lepidoptera. We'll also learn about efforts to rescue captive condors and put pygmy rabbits on a road to recovery. Afterwards, explore the Zoo at your leisure. Transportation can be arranged as needed. There is no cost for the field trip, but a conservation donation is welcome.



Contact Mary Linders to sign up or for additional information.

*Depart Skamania Lodge at 8:30 am.
Limit: 20

Ridgefield National Wildlife Refuge Tour

(Saturday 21 Feb., 7:30 am - noon)

The tour will be on Saturday, Feb 21 (0730-1200) on Ridgefield NWR. The group will meet at the entrance kiosk of the River S Unit by 0730 where we will carpool and drive to the Roth Unit. This unit is closed to the general public. The Roth Unit is a mix of small open meadows, a tidal slough and lake, and riparian habitat. This unit is a preferred site of Dusky Canada Geese and contains the largest Sandhill Crane night roost along the lower Columbia River in WA. Other species that are possible to see include all of the winter woodland songbirds, raptors and waterfowl; black-tailed deer, otter, and coyotes may be encountered. We will drive to the unit and once there, we will be walking the remainder of the trip. Bring boots or shoes for wet conditions, raingear, water and food, binoculars and spotting scope. Since we will be touring a closed area, all participants must stay for the duration of the trip. Ridgefield NWR is about 60 miles from Skamania Lodge, so allow at least 1.5 hours for the commute. A map and directions to the refuge will be distributed at the meeting. The trip is limited to 15 participants.

Contact Joe Engler to sign-up or for additional information.

There is a possibility that the Refuge may be closed due to bridge repair work. If that happens, we will go to Pierce NWR in the Columbia River Gorge, near Skamania Lodge.

Limit: 15

Meeting At A Glance

Wednesday 18 February

7:30 am	Registration opens – *Conference Center Lobby*
9:00 am - 12:10 pm	**Long-term Ecological Research Symposium** – *Stevenson Ballroom A*
9:00 am - 5:00 pm	**Amphibians and Forest Management Symposium** – *Stevenson Ballroom B*
9:00 am - 5:10 pm	**Invasive Species Research & Management Symposium** – *Stevenson Ballroom C/D*
5:30 - 7:30 pm	**Amphibians and Forest Management Poster Session** and no-host bar
7:00 - 8:30 pm	SNVB board meeting

Thursday 19 February

7:30 am	Registration opens – *Conference Center Lobby*
9:00 - 9:15 am	**Introductions & Welcome** – *Stevenson Ballroom*
9:15 - 10:30 am	**Plenary Session: Charles Fowler, Pieter Johnson, and Fred Swanson** *Stevenson Ballroom*
10:30 - 11:00 am	Coffee break

	Stevenson Ballroom A Concurrent Session I	Stevenson Ballroom B Concurrent Session II
11:00 am - 12:20 pm	**Avian Response to Forest Management**	**Conservation and Recovery** *Ryan O'Donnell*
moderator:	*Jaime Stephens*	
12:20 - 1:20 pm	Lunch (SNVB and WA TWS member lunch)	
1:20 - 2:40 pm	**Foundations of Conservation** *A.J. Kroll*	**Connectivity and Road Dynamics** *Elke Wind*
2:40 - 3:10 pm	Coffee break	
3:10 - 4:30 pm	**Open Landscapes** *Hannah Anderson*	**Wetlands and Streams** *April Barreca*

5:30 - 7:00 pm	**General Poster Session** – *Stevenson Ballroom*
7:00 - 10:00 pm	**Banquet - Steven Beissinger**, raffle, auction results, awards

Meeting At A Glance

Friday 20 February

7:30 am	Registration opens – *Conference Center Lobby*	
	Stevenson Ballroom A Concurrent Session I	**Stevenson Ballroom B** Concurrent Session II
9:00 - 10:00 am	**Amphibian Populations** *Robert Weaver*	**Population Sustainability** *Kelly McAllister*
10:00 - 10:30 am	Coffee Break	
	Special Plenary Session – Stevenson Ballroom	
10:30 am - 12:10 pm	**Perspectives in Wildlife Management** *Tara Chestnut*	

Saturday 21 February

7:30* am - 12:00 pm **Field Trip I:** Ridgefield National Wildlife Refuge Tour
with Joe Engler
* meet at the entrance kiosk of the River S Unit by 7:30 for carpool to Roth Unit

9:30* am - 12:30+ pm **Field Trip II:** Captive Rearing and Recovery: Putting the Pieces Together
with Mary Linders
*depart Skamania Lodge 8:30 am for Oregon Zoo in Portland

Wednesday 18 February

Long-term Ecological Research Symposium – *Stevenson Ballroom A*

A.J. Kroll & Aimee McIntyre, Organizers; Angela Battazzo, Moderator

9:00 - 9:10 am	**Introduction –** Angela Bettazzo, Washington Dept. of Transportation
9:10 - 9:35 am	**Peregrine Falcons** – Daniel Varland, Rayonier
9:35 - 10:00 am	**Oregon Spotted Frogs** – Marc Hayes, Washington Dept. of Fish and Wildlife
10:00 - 10:30 am	*Break*
10:30 - 10:55 am	**Marbled Murrelets –** Thomas Bloxton, U.S. Forest Service
10:55 - 11:20 am	**Western Pond and Western Painted Turtles** – R. Bruce Bury, U.S. Geological Survey
11:20 - 11:45 am	**Northern Spotted Owls** – Stan Sovern, U.S. Forest Service
11:45 am - 12:10 pm	**Steelhead** – Dan Rawding, Washington Dept. of Fish and Wildlife
12:10 pm	*Lunch*

Amphibians and Forest Management Symposium – *Stevenson Ballroom B*

Organizer and Moderator: A.J. Kroll

9:00 - 9:10 am	**Introduction –** A.J. Kroll, Weyerhaeuser
9:10 - 9:30 am	**Challenges of monitoring headwater amphibians –** Lowell Diller, Green Diamond
9:30 - 10:00 am	*Discussion*
10:00 - 10:30 am	**Break**
10:30 - 10:50 am	**Gene flow in giant salamanders –** Craig Steele, Washington State University
10:50 - 11:10 am	*Discussion*
11:10 - 11:30 am	**Van Dyke's and Dunn's Salamanders** – Aimee McIntyre, Washington Dept. of
11:30 - 11:50 am	*Discussion* Fish and Wildlife
12:00 - 1:00 pm	**Lunch**
1:00 - 1:20 pm	**Sampling design, analytical techniques, and inferential issues –** A.J. Kroll,
1:20 - 1:40 pm	*Discussion* Weyerhaeuser
1:40 - 2:00 pm	**Overview of stream-associated amphibian studies addressing forestry practices**
2:00- 2:20 pm	*Discussion* **–** Marc Hayes, Washington Dept. of Fish and Wildlife
2:20 - 2:40 pm	**Population dynamics and demography –** John Richardson, Univ. of British Columbia
2:40 - 3:00 pm	*Discussion*
3:00 - 3:30 pm	**Break**
3:30 - 3:50 pm	**Headwater amphibian response to thinning with riparian buffers**
3:50 - 4:10 pm	*Discussion* – Dede Olson, U.S. Forest Service
4:10 - 4:30 pm	**Effect of forest canopy openings on stream amphibians –** J. MacCracken, Longview
4:30 - 4:50 pm	*Discussion*
4:50 - 5:00 pm	Concluding discussion

Wednesday 18 February

Invasive Species Research and Management in the Columbia River Basin: Estuary to Headwaters Symposium – *Stevenson Ballroom C/D*

Organizer and Moderator: Tara Chestnut

9:00 - 9:25 am	**The new pioneers: Invasive species in the Columbia Basin –** Paul Heimowitz, USFWS
9:25 - 9:50 am	**Aquatic nuisance species –** Kevin Aitkin, USFWS
9:50 - 10:15 am	**Columbia Basin Fish Accords –** Phil Roger, CRITFC
10:15 - 10:40 am	**Break**
10:40 - 11:05 am	**Impoundments as invasion hubs –** Pieter Johnson, University of Colorado, Boulder
11:05 - 11:30 am	**Out musseled? Protecting the Columbia Basin** – Paul Heimowitz, USFWS
11:30 - 11:55 am	**Shipping transport of aquatic invasive species** – Rian Hooff, OR DEQ
11:55 am - 1:00 pm	**Lunch**
1:00 - 1:25 pm	**Flowering Rush in the Columbia Basin –** Virgil Dupuis, Salish Kootenai College
1:25 - 2:10 pm	**Current status of four invasive plant species –** Lynda Moore and Vanessa Howard
2:10- 2:25 pm	**Break** Morgan, PSU
2:25 - 2:50 pm	**Long-term monitoring and invasive species management –** Fred Bergdolt, WSDOT
2:50 - 3:15 pm	**Mechanisms behind successful bullfrog invasions** – Tiffany Garcia, OSU
3:15 - 3:40 pm	**Nutria management and research in the PNW** – Trevor Sheffels, PSU
3:40 - 3:55 pm	Break
3:55 - 4:20 pm	**New Zealand Mudsnail in the Columbia Estuary** – Val Brenneis, UC Davis
4:20 - 4:45 pm	**Non-indigenous species: a risk to salmon?** – Beth Sanderson, NOAA
4:45 - 5:10 pm	**The Silent Invasion: an Oregon Field Guide Special** – Ed Jahn, OPB

5:30 pm **Special showing of The Silent Invasion** (with no-host bar available next door)

5:30 - 7:00 pm	**Amphibians and Forest Management Poster Session** and no-host bar *Stevenson Ballroom B*
7:00 - 8:30 pm	SNVB board meeting

Symposium abstracts, alphabetical by author, begin on:

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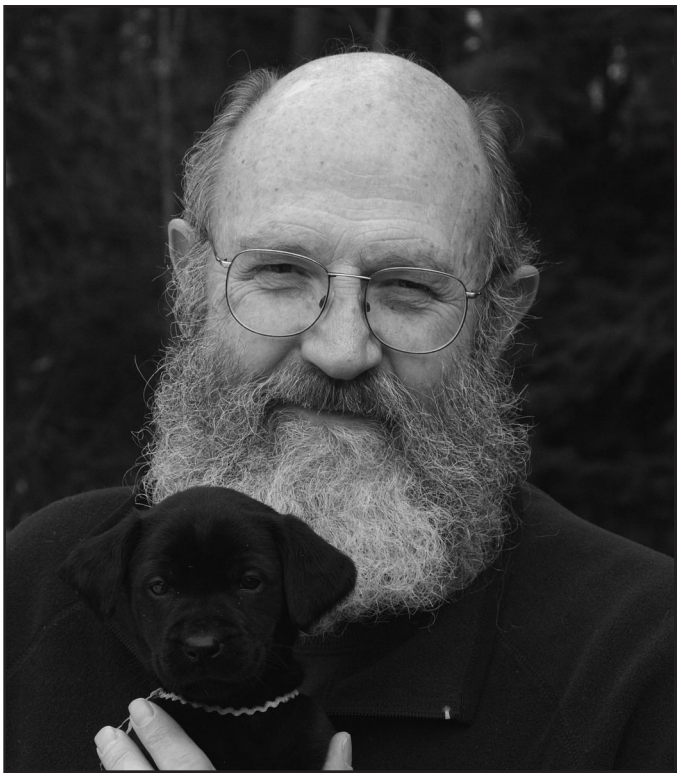
p. 28 – Invasive Species Research and Management

Charles W. Fowler

Plenary Session



Charles W. Fowler earned his Ph.D. from the University of Washington in 1973, has taught at five universities, and currently holds academic positions at two in addition to his position as Systemic Management Studies Program Leader at the National Marine Mammal Laboratory, Alaska Fisheries Science Center (NOAA, National Marine Fisheries Service [NMFS]) in Seattle, WA. His 29 years with the NMFS includes service as chief U.S. scientist to the North Pacific Fur Seal Commission, and as scientist on the Scientific Committee of the International Whaling Commission.

MANAGEMENT: FROM FALLACIES AND FAILURES TO SUCCESS AND SUSTAINABILITY. **Charles W Fowler.** *National Marine Mammal Laboratory, Alaska Fisheries Science Center/NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115-6349; Charles.Fowler@noaa.gov*

We are faced with environmental problems of magnitudes that stagger the imagination. Current forms of management are failing and the explanation lies largely in fallacious thinking. Current management is based on the belief that we can establish management objectives by converting partially related, incomplete, and fragmentary information to policy. This involves a fallacy – the fallacy of false equality. Politics, opinion, and human values are integral to the process and form a huge barrier between science and management. By contrast, sustainability and consistency can be found by combining and extending the concepts of biomimicry and ecological footprint to the species level. In this presentation, examples of this process will illustrate an objective form of management that provides quantitative goals for sustainable human interactions with other species, with ecosystems, and the biosphere. Specific cases will involve fisheries management, including harvest selectivity to typify evolutionary applications. Other cases will involve the sport harvest of ungulates and the maximization of biodiversity.

Pieter T. J. Johnson

Plenary Session

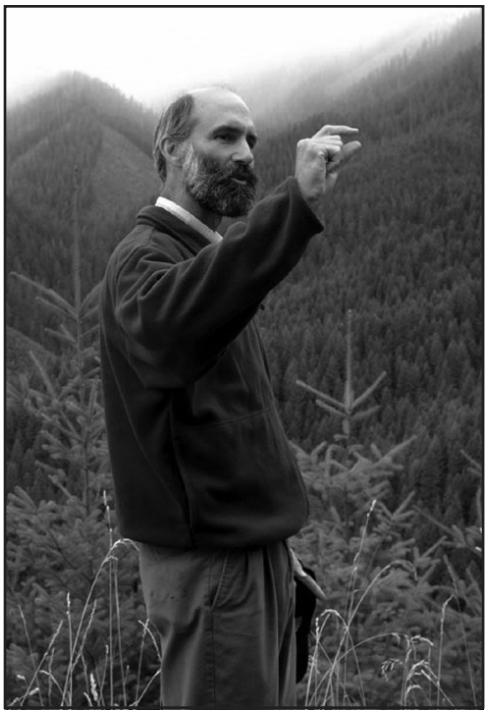
Pieter T. J. Johnson is an Assistant Professor in the Ecology and Evolutionary Biology Department at the University of Colorado, Boulder. His research focuses on two pervasive forms of biological change in aquatic ecosystems: disease emergence and species invasions. Both have important consequences not only for individuals and populations but also for entire ecological communities and ecosystem services. Since 1996, Dr. Johnson has investigated the causes and consequences of limb deformities in North American amphibians, including missing, extra and severely misshapen limbs. This research has highlighted the importance of *Ribeiroia ondatrae*, an emerging trematode pathogen that is highly sensitive to environmental change. Additional projects include studies of (a) the interactions between invasive bullfrogs and the chytridiomycete, *Batrachochytrium dendrobatidis*, and how they jointly affect western populations of the Northern Leopard Frog, (b) the influence of climate change on host-parasite interactions, and (c) how ongoing biodiversity losses affect pathogen transmission in multi-species communities. To read more on these projects and on Dr. Johnson, please visit his website (http://www.colorado.edu/eeb/facultysites/pieter).

SICK AND TWISTED: USING MALFORMED FROGS TO PROMOTE AN ECOLOGICAL UNDERSTANDING OF DISEASE. Pieter T J Johnson. *Ecology and Evolutionary Biology, Ramaley N122, CB 334, University of Colorado, Boulder, CO 80309-0334; pieter.johnson@colorado.edu*

Worldwide increases in number of human and wildlife diseases have challenged ecologists to understand how large-scale and long-term environmental changes affect host-parasite interactions. Recently, increased observations of deformed amphibians in North America have generated controversy surrounding the likely causes and concern over the phenomenon's implications. Over the past 10 years, we have used amphibian deformities as a model system to explore the ecological basis of disease emergence. By combining experiments, broad-scale field sampling, long-term data and ecological theory, our results highlight the importance of understanding diseases at multiple temporal and spatial scales. In both experimental studies and field surveys, we have linked outbreaks of malformations in numerous species to infection by a multi-host parasite (*Ribeiroia ondatrae*), which sequentially infects aquatic snails, amphibians and water birds. Under natural conditions, low frequencies of limb abnormalities may enhance parasite transmission by increasing the vulnerability of infected frogs to predation by birds – the parasite's definitive host. However, growing evidence suggests that environmental changes have increased the local abundance of *Ribeiroia*. We highlight the significance of community- and ecosystem-level changes: increases in nutrient pollution (eutrophication) in wetland environments and decreases in aquatic community diversity. Field data in conjunction with recently conducted experiments indicate that aquatic eutrophication – through its effects on the parasite's snail hosts – indirectly promotes infection and malformation levels. Similarly, decreases in snail and amphibian diversity promote increases in *Ribeiroia* infection and pathology. Thus, although trematode exposure is the proximate cause of malformations, infection levels are affected strongly by human activity and ecosystem-level changes.

Frederick J. Swanson

Plenary Session



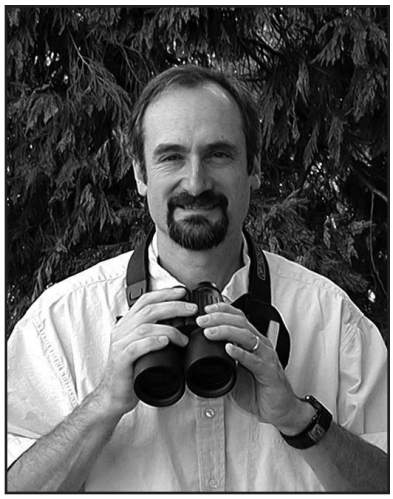
Fred J. Swanson is a research geologist and ecosystem scientist with the US Forest Service, Pacific Northwest Research Station, and Professor (courtesy) in the Departments of Forest Ecosystems and Society and Geosciences, Oregon State University. For many years he has studied the interactions of physical processes, such as fire, flood, landslides, volcanic eruptions, and forestry operations, including roads, with forest and stream ecosystems. Much of this work has taken place at the H.J. Andrews Experimental Forest in the Oregon Cascades, Mount St. Helens, and elsewhere in the Pacific Northwest. He is co-editor or co-author of the books "*Sediment Budgets and Routing in Forested Catchments*" (1982. USDA Forest Service); "*Bioregional Assessments: Science at the Crossroads of Management and Policy*" (1999, Island Press); "*Road Ecology: Science and Solutions*" (2002, Island Press); "*Ecological Responses to the Eruption of Mount St. Helens*" (2005, Springer); and "*In the Blast Zone: Catastrophe and Renewal on Mount St. Helens*"(2008, Oregon State University Press).

LESSONS FROM SUSTAINED, PLACE-BASED RESEARCH: CREATING SEEDBED FOR DISCOVERY. **Frederick J Swanson.** *USDA Forest Service, Pacific Northwest Research Station, 3200 Jefferson Way, Corvallis, OR 97331; fswanson@fs.fed.us*

More than half a century of watershed and ecological research at the H.J. Andrews Experimental Forest in the Oregon Cascades attests to the benefits of planned and serendipitous learning through sustained, place-based work. Tracing some of the historical threads of this work reveals that it is difficult to anticipate what and how research may be relevant to society in the future. The accidental studies of old growth and northern spotted owl ecology in the 1970s did not find their powerful social relevance for 10-15 years. Initial studies of effects of logging and roads on streamflow appeared to document "recovery" of watershed function within about a decade, but longer-term observations have revealed some previously unanticipated watershed behaviors that reverse effects from short-term studies. Observation of a cutthroat trout population over more than 20 years revealed a positive biological response to a major flood, while some other species experienced population decrease. The roles of dead wood in forests and streams have been examined from many disciplinary points of view using observation programs spanning more than three decades and experiments with design lives up to 200 years. These findings and their translation into management and policy result from: a strong research-management partnership which conducts long-term applied studies and discusses concepts and findings with the public; long-term ecological research and environmental monitoring, which provide a base for addressing issues of the day; highly interdisciplinary work that requires trust and sustained effort, which are facilitated by work in an experimental forest or similar site.

Steven R. Beissinger

Banquet speaker



Steven R. Beissinger is a Professor of Conservation Biology and holds the A. Starker Leopold Chair in Wildlife Biology at the University of California, Berkeley. He served as Chair of the Department of Environmental Science, Policy & Management from 2001-04. Steve teaches courses in conservation biology, demography of small populations, and behavioral and population ecology. His current research focuses on (1) ecology of endangered or exploited birds; (2) long-term response of California birds and mammals to climate change, and (3) avian parental care strategies. Steve has worked throughout the U.S. and internationally (Venezuela, Guyana, Puerto Rico, and Cuba), and has published over 140 scientific articles. He is senior editor of the books *Population Viability Analysis* (University of Chicago Press, 2002) and *New World Parrots in Crisis: Solutions from Conservation Biology* (Smithsonian Press, 1992). Beissinger is a Fellow of the London Zoological Society and the American Ornithologists' Union, where he chaired the conservation committee and was elected as a councilor. He has served on the Marbled Murrelet Recovery Team, U.S. National Committee to IUBS, and the U.S. National Committee of Diversitas. He serves on the editorial boards of Conservation Biology, Ecology Letters, and Ecology, and the Board of Directors of the National Audubon Society. He is a research associate of the Smithsonian Institution and the Museum of Vertebrate Zoology. Professor Beissinger earned a B.S. and M.S. in zoology at Miami University, and a Ph.D. in Natural Resource Ecology at the University of Michigan. Dr. Beissinger joined the faculty at Berkeley after spending eight years as a professor at Yale University and two years as an NSF Postdoctoral fellow at the Smithsonian Institution's National Zoo.

IMPACT OF A CENTURY OF CLIMATE CHANGE ON MONTANE SMALL MAMMAL AND BIRD COMMUNITIES IN CALIFORNIA: THE GRINNELL RESURVEY PROJECT. Steven R Beissinger, *Museum of Vertebrate Zoology and Dept. of Environmental Science, Policy & Management, University of California, Berkeley, CA 94720-3114; beis@nature.berkeley.edu*

While global warming has clearly affected the phenology of species and contributed to range expansions, contractions of species' ranges are less well documented. Assessments of effects of climate change on the distribution of biodiversity have been limited by use of historical surveys of short time spans with low spatial resolution, or by confounding effects of land use change. Furthermore, range shifts are uncertain when confounded by false absences due to limited historic sampling and inability to control for changes in detectability between sampling periods. We repeated a detailed, early 20th century survey of small mammal and bird diversity across a 3000 m elevation gradient spanning the long-protected landscape of Yosemite National Park (YNP), where average annual minimum temperate has increased by ~3ºC, and further north in Lassen National Park (LNP). Using occupancy modeling to control for variation in detectability, we show substantial (~ 500 m on average) upward changes in elevational limits for half of 28 small mammal species monitored in YNP. Ranges of formerly low-elevation species expanded and high-elevation species contracted, leading to changed community composition at mid and high elevations. Responses were idiosyncratic among closely-related and ecologically-similar species. Birds were resurveyed at 46 locations along two elevational transects in YNP and LNP. Nearly 50% of 70 species moved upward in elevational range, 10% moved downward, and 40% showed no change. Our results provide the first glimpse into range shifts of montane California mammals and birds in response to climate warming.

Thursday 19 February

7:30 am	Registration opens	*Conference Center Lobby*
9:00 - 9:15 am	Introductions & Welcome	*Stevenson Ballroom*
	Plenary Session	*Stevenson Ballroom*
9:15 - 9:40 am	**Charles Fowler –** Management: From fallacies and failures to success and sustainability	
9:40 - 10:05 am	**Pieter Johnson –** Sick and twisted: Using malformed frogs to promote an ecological understanding of disease	
10:05 - 10:30 am	**Fred Swanson –** Lessons from sustained, place-based research: Creating a seedbed for discovery	

11:00 am - 12:20 pm, Concurrent Paper Presentation Sessions

Time	Stevenson Ballroom A	Stevenson Ballroom B
11:00 am - 12:20 pm	**Avian Response to Forest Management** *Moderator:* Jaime Stephens	**Conservation and Recovery** *Moderator:* Ryan O'Donnell
11:00 am - 11:20 am	Effects of fuels treatmens on avian communities – Jaime Stephens	Genetic structure and diversity of Mountain Goat populations – Andrew Shirk
11:20 am - 11:40 am	Wildlife use of mechanically created snags – Timothy McBride	Reintroducing Fishers to Olympic National Park – Jeffrey Lewis
11:40 am - 12:00 pm	Northern Spotted Owl dispersal habitat assessment tool – Heather McPherson	Taylor's Checkerspot Butterfly reintroduction – Mary Linders
12:00 pm - 12:20 pm	Evaluation of avian nest survival after salvage logging – Andrew J. Kroll	Reproductive success of endangered Pygmy Rabbits – Meghan Martin

12:20 - 1:20 pm **Lunch (provided: SNVB and WA TWS member lunch)**

Thursday 19 February
1:20 pm - 4:30 pm Concurrent Paper Presentation Sessions

Time	Stevenson Ballroom A	Stevenson Ballroom B
1:20 pm - 2:40 pm	**Foundations of Conservation** *Moderator:* A. J. Kroll	**Connectivity and Road Dynamics** *Moderator:* Elke Wind
1:20 pm - 1:40 pm	Ozette Breeding Bird Survey, population and land cover – Scott Horton	Amphibian road mortality – Elke Wind
1:40 pm - 2:00 pm	Overwintering of Cascades Frogs in Washington – April Barreca	Snakes on a lane – Darcy Pickard
2:00 pm - 2:20 pm	Status of Striped Whipsnake in Washington – Lisa Hallock	Effectiveness of tunnels in providing amphibian passageways – Barbara Beasley
2:20 pm - 2:40 pm	Prey preference of the Night Snake – Robert Weaver	Statewide wildlife habitat connectivity analysis – Kelly McAllister
2:40 - 3:10 pm	**Coffee break**	
3:10 pm - 4:30 pm	**Open Landscapes** *Moderator:* Hannah Anderson	**Wetlands and Streams** *Moderator:* Rex Crawford
3:10 pm - 3:30 pm	Butterfly habitat enhancement in Puget lowland prairies – Cheryl Fimbel	Costs and benefits of bullfrog eradication efforts – Purnima Govindarajulu
3:30 pm - 3:50 pm	Restoring Taylor's Checkerspot habitat in SW Washington – David Wilderman	Physiological response of larval tailed frogs to thermal stress – Gwendolynn Bury
3:50 pm - 4:10 pm	Factors associated with Dusky Canada Goose nesting – Nicole Maggiuli	Beaverworks within human works – practical solutions – Jake Jacobson
4:10 pm - 4:30 pm	Long-billed Curlew nesting habitat and reproductive success – Heidi Newsome	Actively managing a small stream fauna in the Devils Garden – Stewart Reid

5:30 - 7:00 pm General Poster Session *Stevenson Ballroom*

7:00 - 10:00 pm Banquet, raffle, auction results, awards

Steven Beissinger – Impact of a century of climate change on montane small mammal and bird communities in California: the Grinnell Resurvey Project

Friday 20 February

7:30 am Registration opens *Conference Center Lobby*

9:00 - 10:00 am, Concurrent Paper Presentation Sessions

Time	Stevenson Ballroom A	Stevenson Ballroom B
9:00 am - 10:00 am	**Amphibian Populations** *Moderator:* Robert Weaver	**Population Sustainability** *Moderator:* Kelly McAllister
9:00 am - 9:20 am	Effects of the amphibian chytrid fungus on toads – David Pilliod	Biases in the protection of peripheral frog populations – Ryan O'Donnell
9:20 am - 9:40 am	Spatial population ecology of California Newts – Pete Trenham	Modeling Mountain Goat gene flow – Andrew Shirk
9:40 am - 10:00 am	Northern Leopard Frog recovery program – Kris Kendell	Streaked Horned Lark habitat analysis – Hannah Anderson
10:00 - 10:30 am	**Coffee Break**	
10:30 am 12:10 pm	**Special Plenary Session: Perspectives in Wildlife Management** *Stevenson Ballroom*	
10:30 am - 10:50 am	Amphibian chytrid fungus: global patterns – Dede Olson	
10:50 am - 11:10 am	Developing a wolf conservation and management plan – Harriet Allen	
11:10 am - 11:30 am	Amphibian declines in the southern Pacific Northwest – Hartwell Welsh	
11:30 am - 11:50 am	An interactive website for data on forest carnivores – Keith Aubry	
11:50 am - 12:10 pm	Responses of stream amphibians to timber harvest – R. Bruce Bury	

12:10 pm **Meeting adjourns (Field Trips Saturday!)**

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WESTERN TURTLES AS LONG-LIVED SPECIES SERVING AS SENTINELS OF FUTURE GLOBAL CLIMATE CHANGE. **R Bruce Bury,** *U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, 3200 SW Jefferson Way, Corvallis, OR 97331; buryb@usgs.gov*

The greater Pacific Northwest is home to two aquatic turtles. The Western Pond Turtle, *Actinemys* (formerly *Clemmys*) *marmorata*, occurs west of the Cascade crest whereas the Western Painted Turtle, *Chrysemys picta*, frequents the "eastside" and extends down the Columbia River Gorge into the Willamette Valley and somewhat into Washington. Growth rates can be assessed from rings in each species up to age 10, sometimes longer. Their hard shells allow permanent marking. Recently, I recaptured several turtles marked decades ago. One was an adult female marked 40 years ago, and two were medium-sized turtles marked in 1970. Approximately 15% of the population (n = 600 turtles) appears to persist beyond 30 y of age. Because of their longevity, turtles offer platforms to record changes in responses to environmental conditions. We can compare growth curves, age to maturity, and maximum size of turtles between different decades. These population features may reveal effects of projected global climate change. Marked individuals also allow for estimates of population size and tracking of abundance trends over time. It is vital to not only archive locations and data on individuals in accessible files, but also to publish the results in the scientific literature.

OREGON SPOTTED FROGS AT CONBOY LAKE: ANATOMY OF A LONG-TERM DATASET. **Marc P Hayes,** *Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, WA 98501; hayesmph@dfw.wa.gov.;* **Joseph D Engler,** *US Fish and Wildlife Service, Branch of Refuge Biology, 1211 SE Cardinal Court, Suite 100, Vancouver, WA 98683; Joe_Engler@fws.gov*

In 1998, we initiated population monitoring via egg mass counts for the largest remaining population of Oregon Spotted Frogs (*Rana pretiosa*) known to exist across its geographic range. We chose to monitor egg mass numbers due to their high detectability (immobile and shallow water location) and their ability to accurately reflect the breeding population of females (high confidence in one-to-one correspondence between egg masses and females). These data have revealed dramatic population changes that would otherwise have not been recognized. Between 1998 and 2001, this population underwent a dramatic decline tied to stranding mortality resulting from an inability to maintain water levels over the pre-hatching period. This pattern led the USFWS to initiate a massive hydrological restoration effort, mostly completed in the late summer/early fall of 2001, resulting in population recovery through at least 2004. Since 2005, this population has sustained a second decline linked to the amphibian chytrid fungus, *Batrachochytrium dendrobatidis*. Data from 2008 imply some population recovery, however only continued monitoring will allow this trend to be confirmed.

NESTING HABITAT AND NEST SUCCESS OF THE MARBLED MURRELET IN FORESTS AROUND THE OLYMPIC PENINSULA, WASHINGTON, USA. **Martin G Raphael and Thomas D Bloxton, Jr,** *USDA Forest Service, Pacific Northwest Research Station, 3625 93rd Ave SW, Olympia, WA 98512; mraphael@fs.fed.us and tbloxton@fs.fed.us*

The Marbled Murrelet (*Brachyramphus marmoratus*) is a threatened seabird that nests in old forest in the Pacific Northwest. Few murrelet nests have been described in Washington. From 2004 to 2008, we captured 158 murrelets in waters surrounding the Olympic Peninsula, and used radio telemetry to follow movements and observe their nesting behavior and habitat selection. We documented 20 nests, 5 on Vancouver Island, BC, 14 on the Olympic Peninsula, and 1 in the Washington Cascade Range. Of the 18 nests for which we determined an exact location, 1 was on a cliff face and 17 were on conifers, mostly Douglas-fir (*Pseudotsuga menziesii*, n = 8), Western Hemlock (*Tsuga heterophylla*, n = 5), and Western Redcedar (*Thuja plicata*, n = 3.). Mean diameter of nest trees was 136 cm (range 79 – 248 cm). Mean elevation was 673 m (range 150 – 1277). Most nests (75%) occurred on national park or wilderness lands in large, intact patches of older forest. Nest locations averaged 20.2 km from the nearest marine water (range 4 – 58 km). Most nests failed: of 20 nests, only 4 (20%) were successful. Low nesting rate, and low nesting success, suggest the population of murrelets in this area does not produce enough young to support a stable population, yet adjacent at-sea surveys have not shown a significant population decline from 2000 to present. We suspect that populations are supplemented by birds from outside our study area, but the source of those birds is unknown.

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MONITORING WIND RIVER STEELHEAD: CHALLENGES, INSIGHTS, AND RESULTS FROM THE DEVELOPMENT OF AN ANADROMOUS POPULATION MONITORING PROGRAM. **Dan Rawding and Charlie Cochran,** *Fish Program, Washington Department of Fish and Wildlife, 6 Cedar Lane, White Salmon, WA 98672; rawdidr@dfw.wa.gov and cochrpcc@dfw.wa.gov;* **Patrick Connolly and Ian Jezorek,** *U.S. Geological Survey, Columbia River Research Laboratory, 5501-A Cook-Underwood Rd, Cook, WA 98605; pconnolly@usgs.gov and ian_jezorek@usgs.gov*

The index of wild adult Steelhead (*Oncorhynchus mykiss*) abundance in the Wind River from summer snorkel surveys exhibited a sharp decline in the 1990s. This decline precipitated a multi-agency effort to develop a monitoring program to understand the population dynamics, determine the cause of the decline, and recommend recovery actions that would address the cause of the decline. Based on our limited resources, we established monitoring programs for various Steelhead life history stages including adult, parr, and smolt for the entire population, and for key areas within the watershed. We present the rationale for our spatial and temporal approach to monitoring, and the results from our long-term monitoring program include correlation between populations, variability in measured metrics, life history strategies, and the application of this long-term dataset to develop a study design to assess the effectiveness of proposed dam removal from a key subwatershed.

DEMOGRAPHY OF NORTHERN SPOTTED OWLS ON THE EAST SLOPE OF THE CASCADE RANGE, WASHINGTON. **Stan G Sovern,** *Pacific Northwest Research Station, USDA Forest Service, 802 West Second Street, Cle Elum, WA 98922; ssovern@fs.fed.us*; **Eric D Forsman,** *Pacific Northwest Research Station, USDA Forest Service, 3200 Southwest Jefferson Way, Corvallis, OR 97331; eforsman@fs.fed.us;* **Margaret Taylor,** *Pacific Northwest Research Station, USDA Forest Service, 802 West Second Street, Cle Elum, WA 98922; margytaylor@fs.fed.us*

We used mark-recapture methods to monitor a population of Northern Spotted Owls (*Strix occidentalis caurina*) in the eastern Cascades in Washington from 1989-2008. We used the Cormack-Jolly-Seber (CJS) method in program MARK to estimate apparent survival and recapture rates in 4 meta-analysis workshops in 1993, 1998, 2003, and 2009. We used the reparameterized Jolly-Seber (RJS) method to estimate the population rate of change (λ). The 2003 CJS analysis included 1,570 captures/recaptures from 724 individual owls. Apparent survival estimates varied by time, and recapture probability varied between sexes and was positively correlated with the proportion of owls that nested each year. The RJS estimate of λ varied by time, and averaged 0.94 (95% CI = 0.090-0.98), indicating a population decline of approximately 6%/y 1992-2003. There was some evidence of a negative effect of Barred Owls (*Strix varia*) on spotted owl survival. The 2009 analysis was completed in January, 2009, and indicated the spotted owl population has continued to decline at approximately 6%/y. The Cle Elum spotted owl demography study is one of 8 long-term studies funded through the 1994 Effectiveness Monitoring Plan for the spotted owl under the Northwest Forest Plan. These studies, which are well distributed throughout the range of the Northern Spotted Owl, enable us to draw inferences to most of the federal lands in the range of the owl. Results from the recent analysis will be available in late summer, 2009.

PEREGRINE FALCON SURVIVAL AND RE-SIGHTING FREQUENCIES ON THE WASHINGTON COAST, 1995—2003. **Daniel E Varland,** *Rayonier, 3033 Ingram Street, Hoquiam, WA 98550; daniel.varland@rayonier.com*; **Larkin A Powell,** *School of Natural Resources, 419 Hardin Hall, University of Nebraska-Lincoln, Lincoln, NE 68583; lpowell3@unl.edu*; **Mary Kay Kenney,** *6811 Cooper Point Road NW, Olympia, WA 98502; MaryKayKenney@comcast.net*; **Tracy L Fleming,** *2516 NE 148th Street, Vancouver, WA; tlfleming@aol.com*

We estimated survival for Peregrine Falcons (*Falco peregrinus*) in beach-dune habitat along the Washington coast. We captured and color-banded 76 Peregrine Falcons during 438 surveys by vehicle on three coastal beaches in Washington from January 1995 to May 2003. We captured 45 females and 31 males; 68% (52) were < 1 y old and 32% (24) were > 1 y old. Based primarily on photographs (N = 72) showing plumage coloration, 76% (N = 55) of the individuals captured were *F. p. pealei*, 7% (N = 5) were *F. p. anatum*, 3% (N = 2) were *F. p. tundrius*, and 14% (N = 10) showed intermediate characteristics and

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could not be identified to subspecies. Thirty-nine (51%) of the color-banded individuals were observed alive at least once after banding. Using program MARK, we estimated that the apparent survival rate (Φ) for all age and sex classes over a 3-mo interval was 87.9 ± 2.0% (± SE) and the annual survival rate was 59.7 ± 5.4%. We found relatively high use of the study areas by peregrines in fall, winter, and spring, and low use in summer. Re-sighting probabilities (*p*) were lower in summer compared with other seasons. During fall, winter, and spring, the 3-mo re-sighting probability (*p*) was 45.4 ± 7.9% for juveniles, 35.9 ± 5.0% for adult females, and 16.7 ± 4.5% for adult males.

Additional Notes

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CHALLENGES OF MONITORING HEADWATER AMPHIBIANS: SEARCHING FOR A PATTERN AMONG THE WARTS. **Lowell Diller, Ryan Bourque and Cristina Dressel,** *Green Diamond Resource Company, 600 Riverside Road, Korbel, CA, 95550; ldiller@greendiamond.com, rbourque@greendiamond.com and cdressel@greendiamond.com*

Since 1997, we have been monitoring Southern Torrent Salamanders (*Rhyacotriton variegatus*) and Coastal Tailed Frogs (*Ascaphus truei*) in order to develop and implement an aquatic habitat conservation plan on private timberlands in coastal northern California. The goal was to compare changes in populations of these amphibians by employing a paired sub-basin design using randomly selected streams in sub-basins with (treatment) and without (control) timber harvest. Locating suitable control streams limited this approach and, initially, 30 and 18 monitoring reaches were established for torrent salamanders and tailed frogs, respectively. Estimating relative abundance of torrent salamanders was problematic because the process of annually searching for animals appeared to have lasting negative impacts on their habitat. Our solution was a biennial "lighter-touch" occupancy survey, but we were concerned about the scope of inference and lack of detection probabilities using this approach. Currently, we are developing a new sampling scheme that is less intensive at the stream reach level, but includes more sample sites and provides for an estimate of detection probabilities. Estimating larval populations of tailed frogs has been successful, but high annual variation made interpreting the results problematic. A mark-recapture study of post-metamorphic tailed frogs indicated that the adults appeared to be less variable compared to the larval populations, but it required substantial effort to obtain a useful estimate. To make mark-recapture more efficient, we believe it is essential to develop an effective and low-cost capture method for adult tailed frogs.

OVERVIEW OF STREAM-ASSOCIATED AMPHIBIAN STUDIES ADDRESSING FORESTRY PRACTICES IN TIMBER-MANAGED LANDSCAPES. **Marc P Hayes,** *Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, WA 98501; hayesmph@dfw.wa.gov*

Studies attempting to understand stream-associated amphibian responses to forestry practices on timber-managed landscapes have been the focus of diverse studies for nearly three decades. However, results have been contradictory. Inconsistent results may be attributable to variability associated with amphibian populations and habitat complexity. First-generation studies rarely accounted for this variability, which potentially resulted in an inability to distinguish whether lack of difference among treatments was real or a result of variability masking differences. Subsequent studies greatly improved the understanding of habitat contributions to variability through the identification of selected components, such as lithology, that had some influence on amphibian occupancy or abundance. Yet, remaining variability has remained unacceptably large; and both the behavior and seasonal patterns of these cryptozoic animals seem to represent the largest contributor. Emergence of detectability estimation procedures provides a potential basis to reduce this animal-related variability, setting the stage for a third generation of studies. For utility of this new approach to be fully realized, comprehensive understanding of how detectability of cryptozoic amphibians changes by life stage, both in space and time, is needed.

SAMPLING DESIGN, ANALYTICAL TECHNIQUES, AND INFERENTIAL ISSUES ASSOCIATED WITH STUDYING AMPHIBIAN RESPONSES TO FOREST MANAGEMENT. **Andrew J Kroll,** *Weyerhaeuser Company, WTC 1A5. Federal Way, WA 98063-9777; aj.kroll@weyerhaeuser.com*

Conservation of native biological diversity is an increasingly prominent component of intensive forest management in the Pacific Northwest of the United States. In particular, potential impacts of timber harvest on forest-dwelling amphibians are a concern due to widespread commercial management of forests across the geographic distribution of several species, including endemic taxa such as *Ascaphus*, *Dicamptodon*, and *Rhyacotriton*. Reductions in extent of late-successional forest have raised questions about long-term viability of amphibians on intensively-managed landscapes, although significant variation in research results suggests that within-stream biotic and abiotic characteristics and species differences may interact with management actions to influence amphibian responses. The basic

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ecology of many species remains unexplored, including competition, dispersal, and habitat selection, and research in these areas, as well as short- and long-term amphibian responses to commercial harvest operations, is needed. Regular, long-term monitoring of stream-associated amphibian (SAA) responses should be conducted and effects associated with past and current management actions segregated, when possible. Many habitat studies have concentrated on stream features measured at local reach scales (50 – 150 m) and understanding the scale of potential land management impacts on SAA populations at a landscape level will require implementation of studies at larger spatial and longer temporal scales. To provide reliable inference, studies should 1) employ rigorous sampling designs (e.g., with temporal and spatial replication) and analytical techniques that permit estimation of detection probability; 2) occur at spatial and temporal scales appropriate to the questions being posed; and 3) be designed to estimate population responses to potential impacts.

EFFECTS OF FOREST CANOPY OPENINGS ON STREAM AMPHBIANS IN WASHINGTON AND OREGON. **James G MacCracken and Jennifer L Stebbings,** *Longview Timberlands, LLC, Box 667, 10 International Way, Longview, WA 98632; jgmaccracken@longviewtimber.com*

The productivity of headwater streams is often limited by closed canopies. Stream reaches were randomly assigned to 4 levels of shade retention (≈ 0%, 33%, 67%, and 100%). Light regimes, water temperature, periphyton accumulation, and amphibian abundance, body condition, and growth rates were monitored for 2 years pre- and post-treatment. Post-treatment trends in light reaching the streams were consistent with treatment objectives, being greatest in the 0% reaches and declining monotonically with increasing shade (r = -0.99, P = 0.001). In conjunction, periphyton accumulation more than doubled with canopy reductions. The maximum water temperature averaged 12-17˚C. Maximum temperatures increased pre- to post-treatment by 0-23%, increasing monotonically with reduced shade. In addition, maximum water temperature was 8-30% higher in treatment reaches compared to controls, post-treatment, but the difference was greatest in the 33% reaches. Numbers of Tailed Frogs (*Ascaphus truei*) did not vary greatly among treatments, pre- or post-treatment periods, or ecoregions, but were 85% lower in 2004, a poor sampling year, than 2005-2007. Giant salamander (*Dicamptodon* spp.) counts were 103% greater following shade reductions and were also 41% greater in the Cascade Range than the Coast Range. Cascade Torrent Salamander (*Rhyacotriton cascadae*) counts were also lower in 2004 (72%), but were 77% greater in streams with the least vegetation cover. Columbia Torrent Salamander (*R. kezeri*) captures increased 170% pre- to post-treatment across all treatments. Tailed frog adults and metamorphs had better body condition (P = 0.03 and 0.004, respectively) pre- to post-treatment in the 0 and 33% shade retention treatments. Body condition of both torrent salamander species varied in complex ways with shade levels, pre- and post-treatment. However, condition of giant salamanders did not vary appreciably during the study. Growth rates of tailed frog larvae were 45-65% greater (P = 0.012) with reduced cover and 55% greater in the Coast Range. Differences in growth rates of tailed frog metamorphs among shade levels and periods were small (P = 0.108-0.135), but growth rates were greater, post-treatment in both the 0 and 67% treatments (P = 0.08). Growth rates of the salamanders were consistently greatest (13-170%, P = 0.10-0.84) in the 0% treatment and least with 100% shade retention. Overall, canopy openings increased stream productivity. Tailed frogs appeared to respond positively to increased primary productivity. Canopy openings had small to moderate positive effects on stream salamanders.

DUNN'S AND VAN DYKE'S SALAMANDERS IN THE GENUS PLETHODON: COMPLICATIONS ASSOCIATED WITH RESEARCH AND MONITORING. **Aimee P McIntyre and Marc P Hayes,** *Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, WA 98501; aimee.mcintyre@dfw.wa.gov and marc.hayes@dfw.wa.gov*

Van Dyke's and Dunn's Salamanders (*Plethodon vandykei* and *P. dunni*) are two stream-associated amphibians endemic to the Pacific Northwest. They have been the focus of relatively few studies as compared to stream-breeding amphibians in the region. We report on habitat associations and population parameter estimates for the Van Dyke's Salamander. The primary difficulty related to monitoring terrestrial salamanders in the Pacific Northwest is the lack of accounting for probability of detection when interpreting results. For example, in our study of population parameters including detection probability, we saw a 2- to 4-fold change in the probability of detection of Van Dyke's Salamander in two habitat

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types in the South Cascades. Furthermore, detection probability was estimated as < 0.1 at both sites, indicating that we may need to fine tune our sampling protocols for *Plethodon* in order to increase our ability to detect the species when it is present, and thus limit the chances of false negatives when sampling for species occupancy at a site. Because detection probabilities may change as a function of sample method, habitat complexity, and season, abundance surveys should routinely include detection probabilities. What appear to be conflicting data regarding habitat associations for some species may simply reflect changes in surface activity resulting in different individual probabilities of detection.

HEADWATER AMPHIBIAN RESPONSE TO THINNING WITH RIPARIAN BUFFERS IN WESTERN OREGON. **Deanna H Olson,** *US Forest Service, Pacific Northwest Research Station, 2300 SW Jefferson Way, Corvallis, OR 97331; dedeolson@fs.fed.us*

In 1994, I designed the Riparian Buffer Study to be implemented in western Oregon to address two overarching goals: 1) characterize the aquatic-dependent vertebrate fauna in managed forest headwater drainages; and 2) examine the response of this fauna to forest density management with alternative riparian buffer widths. Riparian buffers as designed for the study are no-entry areas along 1st- and 2nd-order headwater streams. Four buffer widths were designed: a streamside retention buffer that retained only those streamside trees contributing to bank stability; a variable-width buffer with a 15-m minimum width that could be enlarged if local site conditions warranted protection; and the one and two site-potential tree height riparian reserve widths developed for the US federal Northwest Forest Plan. Phase I of this project examining the effects on instream, bank-dwelling, and upland amphibians of the first-entry of thinning in the first ~5 years post-treatment is now completed. Several key findings warrant consideration for headwater forest management. First, torrent salamanders (*Rhyacotriton* spp.) were associated with spatially intermittent streams; these habitats and connectivity areas among them may be important to consider for protection within these species' ranges. Second, the combined thinning and riparian buffer treatments appear to be a benign disturbance to this fauna; no consistent treatment effects were detected initially after thinning or 5-years after thinning (instream and bank analyses conducted with > 3,000 animals found in/along 68 stream reaches at 11 study sites). Phase II examining a 2nd entry of thinning is being implemented at this time.

POPULATION DYNAMICS AND DEMOGRAPHY OF STREAM-ASSOCIATED AMPHIBIANS IN SOUTHWESTERN BRITISH COLUMBIA. **John S Richardson,** *University of British Columbia, Department of Forest Sciences, 3041 – 2424 Main Mall, Vancouver, BC V6T 1Z4; john.richardson@ubc.ca*

Management of at-risk species requires estimates of demographic rates and population dynamics, and also details about how those rates vary with and without human influence. For stream-associated amphibians the estimates of numbers are largely based on larval stages, rightly or wrongly. Larval stages of Coastal Giant Salamanders (*Dicamptodon tenebrosus*) and Tailed Frogs (*Ascaphus truei*) were sampled in streams of the Chilliwack River valley east of Vancouver, Canada. Tailed frog tadpoles were sampled for relative abundance using area-constrained searches in 10 streams over 4 years to estimate variation in numbers and to examine association with forest harvesting history. Using depletion estimates for tadpoles indicated that a single pass detected only about 45% of tadpoles. Giant salamanders were trapped over 8 years in another 10 streams using mark-recapture methods (PIT tags or elastomer marks). Variation in numbers and survival rates between years and sites were large, and of roughly the same magnitude. We have also experimentally tested some hypotheses about the controls on larval growth and survival rates. At our latitude, results suggest that larval growth and survival are largely controlled by productivity of their food resources, although results for terrestrial stages clearly show this not to be the whole picture. The context dependence of the mechanisms modulating density-dependent feedback on populations is consistent with the hypothesis that forest management affects these processes. However, the mechanisms by which land use affects populations, and the magnitude of those effects, vary spatially and with life stage.

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GENE FLOW IN GIANT SALAMANDERS (*DICAMPTODON*). **Craig A Steele,** *School of Biological Sciences, Washington State University, Pullman, WA 99164; steele@wsu.edu*

Two commonly encountered stream-associated amphibians within the Pacific Northwest are the Pacific Giant Salamander (*Dicamptodon tenebrosus*) and Cope's Giant Salamander (*D. copei*). These two species have partially overlapping ranges and can often be found within the same stream. These species are largely indistinguishable morphologically but have extreme differences in life history traits. *Dicamptodon tenebrosus* regularly metamorphosis into a terrestrial adult but metamorphosis is rare in *D. copei*. The different frequencies of metamorphosis should influence the ability of each species to disperse overland, consequently affecting relative rates of gene flow between populations. Patterns of gene flow based on microsatellite data were assessed for each species where they occur in sympatry from 11 streams located in managed forests. Samples indicate minimal population-level genetic structuring and no pattern of isolation by distance for *Dicamptodon tenebrosus*, whereas *D. copei* displayed a high degree of population-level genetic structure and significant isolation by distance. Analyses indicate 8 genetic clusters for *D. copei* but only one genetic cluster for *D. tenebrosus* within the study site. The results provide information about the genetic structuring of each species as well as implications for their management.

Additonal Notes

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AQUATIC NUISANCE SPECIES: REGULATIONS AND RESPONSIBILITIES. **Kevin Aitkin,** *Washington Fish and Wildlife Office, U.S. Fish and Wildlife Service, 510 Desmond Drive SE, Suite 102, Lacey, WA 98503; kevin_aitkin@fws.gov*

Invasive species, including both aquatic and terrestrial nuisance species, are defined as non-native species that have caused or have the potential to cause significant economic or environmental harm or present a threat to human health. Introductions of invasive species have caused significant economic and ecological problems throughout North America. Invasive species are now considered the second leading threat to biodiversity, after habitat loss, in the United States. Regionally, the interest in aquatic nuisance species has grown with the recent establishment of both Quagga Mussels (*Dreissena rostriformis bugensis*) and Zebra Mussels (*D. polymorpha*) west of the 100th Meridian. With Zebra and Quagga mussels knocking at the door of the Pacific Northwest, natural resource managers have also become interested in the regulations addressing the problem. This presentation will provide an overview of primarily federal regulations and responsibilities pertaining to aquatic nuisance species.

MANAGING INVASIVE PLANT SPECIES ON WETLAND MITIGATION SITES IN WASHINGTON STATE. **Fredrick S Bergdolt,** *Washington State Department of Transportation, 310 Maple Park Avenue, Olympia, WA 98504; bergdof@wsdot.wa.gov*

The Washington State Department of Transportation uses adaptive management as a tool to address complex resource management issues on wetland mitigation sites statewide. Critical steps in this process include establishing resource management objectives, developing management plans, and designing credible monitoring strategies. While the agency implements many elements of this process successfully, opportunities for improvement are possible. This presentation describes the agency's use of adaptive management to control invasive plant species on wetland mitigation sites. The benefits of a well planned and thoroughly executed weed control program include improvements in habitat quality and condition for wildlife, and a reduction in costs for monitoring and management over the long term. Weed control during the initial phase of invasive species colonization is easier and more cost effective than eradicating plant populations that are already well-established. With more than twenty years of experience managing invasive species on wetland mitigation sites, many lessons have been learned at each step in the adaptive management process. These lessons are widely applicable to other invasive species management and monitoring programs. This presentation will conclude with a discussion of process improvements that may produce better and more reliable results in the future.

INTEGRATION OF AN INTRODUCED CONSUMER INTO AN ESTUARINE FOOD WEB: DIRECT AND INDIRECT EFFECTS OF THE NEW ZEALAND MUDSNAIL IN THE COLUMBIA RIVER ESTUARY. **Valance E F Brenneis,** *Department of Environmental Science & Policy, University of California, Davis, One Shields Avenue, Davis, CA 95616*

Introduced species interact with recipient communities via direct and indirect interactions. The New Zealand Mudsnail (*Potamopyrgus antipodarum*) can achieve high densities in invaded systems, potentially causing negative effects on native consumers and their predators. New Zealand Mudsnails are increasingly found in bays along the Pacific Coast of North America but there are few studies of the interactions between mudsnails and native species in estuarine systems. I examined interactions between New Zealand Mudsnails, the amphipod Americorophium salmonis, and the isopod *Gnorimosphaeroma insulare*, in the presence of native predators including Pacific Staghorn Sculpin (*Leptocottus armatus*), Threespine Stickleback (*Gasterosteus aculeatus*), juvenile Starry Flounder (*Platichthys stellatus*), and Signal Crayfish (*Pacifastacus leniusculus*). Results from this laboratory experiment show that while all predator species consume mudsnails, crayfish consume significantly more snails than do fish. In addition to this direct effect, mudsnail presence increases crayfish and sculpin predation on amphipods. The presence of obvious epibenthic prey (mudsnails) may increase foraging by these predators, resulting in increased consumption of cryptic, subsurface prey (amphipods). While crayfish digest mudsnails effectively, a proportion of snails (20-50%) consumed by fish survived gut passage intact, indicating that fish derive little energetic benefit while serving as a potential transport vector for mudsnails. The effects of New

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Zealand Mudsnails in this estuarine system include positive direct and indirect effects on crayfish, mixed direct and indirect effects on fish predators, and negative indirect effects on amphipods.

FLOWERING RUSH: AN INVASIVE AQUATIC MACROPHYTE INVADING THE COLUMBIA RIVER BASIN. **Virgil Dupuis,** *Salish Kootenai College, P. O. Box 70, Pablo, MT 59855; virgil_dupuis@skc.edu;* **Peter Rice,** *Division of Biological Sciences University of Montana, 32 Campus Drive, Missoula, MT 59812; peter.rice@umontana.edu*

Flowering Rush (*Butomus umbellatus*), the single member of the plant family Butomacea, is an invasive aquatic macrophyte established in Flathead Lake, Montana, headwaters of the Columbia River. Native to the Middle East, Europe, and western Asia, Flowering Rush was first identified in the St. Lawrence River in 1906. It has spread throughout the northeast and upper midwest US and southern Canada. It was first identified in Flathead Lake in 1964, and since it has established in the Pablo National Wildlife Refuge-Flathead Irrigation System, the Clark Fork River, and Noxon and Cabinet Gorge Reservoirs. In Idaho, Flowering Rush is present in Lake Pend Oreille and the Snake River-Aberdeen-Springfield Irrigation System. In Washington it is found in the Yakima River and in Silver Lake, Whatcom County. Flowering Rush aggressively forms monotypic stands in littoral zones of reservoirs, shallow bays, and slow moving streams. It survives as an emergent or fully submerged plant, where it dominates and eventually excludes native plants. It hinders irrigation water delivery and interferes with recreation by clogging waterways and provides habitat for hosts harboring the human parasite "swimmers itch." Higher order implications are not understood, such as changes in water quality, food web interactions with native and introduced fish, sedimentation and depositional processes, and the effects of water level management on invasion success. Ducks, geese, Tundra Swans (*Cygnus columbianus*), and Muskrats (*Ondatra zibethicus*) feed heavily at times on Flowering Rush and likely contributes to spread. Digging is reported to perhaps contain small infestations if complete rhizome removal occurs; however digging infestations of any size in an aquatic habitat with complete removal is unlikely. Cutting and ripping Flowering Rush dislodges rhizomes capable of floating away and starting new plants. Three aquatic herbicides, applied at low pool and full pool, are being tested in Flathead Lake to evaluate efficacy of controlling Flowering Rush. Our project team is organizing an effort to investigate the ecological affects of Flowering Rush and develop management strategies with a multi-disciplinary and multi-institutional regional approach.

MECHANISMS BEHIND THE SUCCESSFUL INVASION OF BULLFROGS (*RANA CATESBEIANA*) IN THE NORTHWEST UNITED STATES. **Tiffany S Garcia, Rebbecca Hill, and Benjamin Emmert,** *Fisheries and Wildlife Department, 104 Nash Hall, Oregon State University, Corvallis, OR 97331; tiffany.garcia@oregonstate.edu*

Understanding the mechanisms that allow populations of some species to successfully expand in novel environments is essential for developing management strategies to limit the spread and ecological impact of biological invasions. Bullfrogs (*Rana catesbeiana*) are one of the 100 worst invasive species in the world. These frogs are native to eastern North America, but have become established in 25 additional countries on three continents and are involved in declines of many native species, particularly other amphibians, via predation and/or competition. We hypothesize that larval phenotypes of invasive Bullfrogs in the Pacific Northwest have diverged from the native range, and that local adaptation and/or phenotypic plasticity are the mechanisms facilitating this Bullfrog invasion. Preliminary studies conclude that Bullfrog populations at the southern extreme of the Pacific Northwest invasion range are capable of metamorphosing at an accelerated rate. The consequences of this phenotypic divergence are dependent on the mechanism of change. We propose using molecular genetic techniques to estimate genetic divergence in Pacific Northwest populations across the invasion range, common garden experiments to determine if larval developmental rates are genetically based, and species distribution models to estimate potential invasion range in the Pacific Northwest. This integrated method of investigation is a powerful and unique approach for understanding invasion mechanisms and will serve as a useful model for future studies of invasive species. We will present our preliminary findings and initial experimental designs.

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THE NEW PIONEERS: INVASIVE SPECIES IN THE COLUMBIA BASIN. **Paul Heimowitz,** *U.S. Fish and Wildlife Service, 911 NE 11th Avenue, Portland, OR 97045; paul_heimowitz@fws.gov*

When Lewis and Clark paddled through the Columbia Basin, they did not become tangled in Eurasian Watermilfoil (*Myriophyllum spicatum*), hear the deep croaks of Bullfrogs (*Lithobates catesbeianus*), or view golden expanses of Yellow Starthistle (*Centaurea solstitialis*). But over the next two centuries, these and scores of other invasive plants and animals have arrived in the region. Many were introduced intentionally, but most came as hitchhikers in agricultural products, in ships, and through dozens of other pathways. Although there are many examples of the economic, ecological, and social detriments caused by invasive species in the Columbia Basin, a complete tally of invaders and their impacts has yet to occur. Meanwhile, new arrivals continue, like the Amur Goby (*Rhinogobius brunneus*), recently found in the lower Columbia. Zebra and Quagga Mussels (*Dreissena rostriformis bugensis* and *D. polymorpha*), Bighead and Silver Carp (*Hypophthalmicthys nobilis* and *H. molitrix*), and other infamous invaders lurk just beyond the horizon. Climate change, further habitat alteration, and other human influences that will affect the distribution of invasive species complicate our ability to anticipate future problems. History suggests that most of the hundreds of invasive species already in the Columbia Basin are here for the long haul, although their impacts can be reduced. Tough choices lie ahead regarding the degree to which new introductions will continue. With robust and basin-wide prevention, detection, and rapid response programs, new invasions to the region are not inevitable.

OUT-MUSSELED? PROTECTING THE COLUMBIA BASIN THROUGH EARLY DETECTION AND RESPONSE PREPAREDNESS. **Paul Heimowitz,** *U.S. Fish and Wildlife Service, 911 NE 11th Avenue, Portland, OR 97045; paul_heimowitz@fws.gov*

Efforts to protect Western waters from invasive freshwater mussels took a sharp turn in 2007 when Quagga Mussels (*Dreissena rostriformis bugensis*) were found in Lake Mead. Since then, Quagga Mussels have spread through the Southwest, and their more infamous congener, the Zebra Mussel (*D. polymorpha*), has arrived as well. Although no longer referencing the western extent of these invaders, the 100th Meridian Initiative remains a strong partnership aimed to reduce further spread. The Columbia represents one of the last major United States watersheds without documented Zebra and Quagga Mussels. However, periodic interceptions of mussel-infested boats in the Northwest expose significant vulnerability. Preventing an introduction is still top priority, but capacity for early detection and rapid response is gaining emphasis. Recognizing that eradication success becomes more likely when an introduction is caught early, monitoring programs are in place to find settled mussels and their veliger larvae. Risk-ranking models help target "hot spots" in the basin, and efforts are underway to better address the formidable challenge of finding low density levels of larvae in large quantities of water. But locating the "needle in the haystack" is not enough; agencies must be able to act quickly to contain an incipient invasion once discovered. For that purpose, the Columbia Basin Team of the 100th Meridian Initiative recently adopted a rapid response plan that defines the organization and tactics to employ in the event invasive mussels are found in Columbia Basin waters. The team has started implementing a cycle of response exercises to improve preparedness over time.

PREVENTING INTRODUCTIONS OF AQUATIC INVASIVE SPECIES FROM SHIPPING TRANSPORT PATHWAYS. **Rian V Hooff,** *Oregon Department of Environmental Quality, 811 SW 6th Avenue, Portland, Oregon 97204; hooff.rian@deq.state.or.us.*

Commercial shipping activities constitute an important and vital economic engine throughout the Pacific Northwest (PNW). An unintentional consequence of increased global trade, however, is the transport and introduction of species to ecosystems outside their historic ranges. A primary pathway

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for introducing aquatic invasive species (AIS) to waterways of the PNW is through the incidental operations associated with shipping transport, such as ballast water transfer. Ballast water, originally sourced from distant ports and used to provide vessel stability during transit, provides many benthic and planktonic taxa the ability to 'hitchhike' across vast ocean distances to colonize freshwater and marine port habitats. Approximately 600,000 m^3 of ballast water are discharged into the lower Columbia River each month (roughly equivalent to the volume of 250 Olympic-sized swimming pools). Through stakeholder involvement and the development of mandatory ballast management practices, west coast states have led the way in developing environmentally protective measures aimed at reducing the risk of introducing aquatic invasive species from these shipping pathways. Although mid-ocean ballast exchange requirements reduce the risk of transporting AIS between ports, research suggests that it does not fully prevent the transport of potentially harmful AIS. More protective measures, such as ship-board treatment of ballast water, may be required in the future.

THE SILENT INVASION: AN OREGON FIELD GUIDE SPECIAL. **Ed Jahn,** *Oregon Public Broadcasting, 7140 SW Macadam Ave, Portland, OR 97219; EJahn@opb.org, http://www.opb.org/programs/invasives/*

After centuries of people traveling from one place to another and transporting invasive species with them, does any of this really matter? Why not just let nature take its course? The reality is that long-distance travel is easier and more common than ever, which means we're transporting more invasive species than ever before. Quietly but consistently, these invasives are threatening native species, consuming our natural areas, infesting our gardens and making us all pay for the consequences. Increasing our awareness and vigilance as we travel and move goods around the planet will help stem the tide of invasive species and save us money and natural resources in the long run. And there are many organizations throughout the state, the country, the world, making change happen now. With a problem this big, it might appear there's nothing we as individuals can do to prevent the inevitable. What we discovered while making *The Silent Invasion* is that the opposite is true – the actions of individuals are crucial to stopping the spread of invasive species and are our greatest reason for hope. Individuals can make simple changes that can effectively block the pathways of invasion. Individuals can be the eyes in the field for identifying new outbreaks and controlling them before they get established. And individuals can lend a hand to eradicate established invaders and reclaim our native landscapes. All of us play a role in this problem and all of us can be part of the solution.

IMPOUNDMENTS AS INVASION HUBS FOR NON-NATIVE AQUATIC SPECIES. **Pieter T J Johnson,** *Ecology and Evolutionary Biology, Ramaley N122, CB 334, University of Colorado, Boulder, CO 80309-0334, USA*; **Julian D Olden,** *School of Aquatic and Fishery Sciences, Box 355020, University of Washington, Seattle, WA, 98195, USA*; **M Jake Vander Zanden,** *Center for Limnology, University of Wisconsin, 680 North Park Street, Madison, WI 53706-1492, USA*

Freshwater ecosystems are at the forefront of the global biodiversity crisis, with more declining and extinct species than terrestrial or marine environments. Hydrologic alterations and biological invasions represent two of the greatest threats to freshwater biota, yet the importance of linkages between these drivers of environmental change remains uncertain. Here, we quantitatively test the hypothesis that impoundments facilitate the introduction and establishment of aquatic invasive species in lake ecosystems. By combining data on human boating activity, water body physicochemistry, and distributional data for five freshwater nuisance invaders in the Laurentian Great Lakes region (USA), we show that nonindigenous species are 2.4 to 300 times more likely to occur in impoundments relative to natural lakes, and that impoundments frequently support multiple invaders. Comparisons of the contemporary and historical landscapes further revealed that impoundments enhance the invasion risk of natural lakes by increasing their proximity to invaded water bodies, highlighting the role of human-altered ecosystems as critical "stepping-stone" habitats for the continued spread of freshwater invaders.

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CURRENT STATUS OF FOUR INVASIVE PLANT SPECIES IN THE COLUMBIA RIVER SYSTEM. **Lynda K Moore,** *Aquatic Bioinvasions Policy and Research Institute, Portland State University, PO Box 751, Portland, OR 97207-0751; lkmoore@pdx.edu*; **Vanessa Howard Morgan,** *Aquatic Bioinvasions Policy and Research Institute-Center for Lakes and Reservoirs, Portland State University, PO Box 751, Portland, Oregon 97207-0751; vhoward@pdx.edu.*

We will discuss four non-indigenous plant species that are either present or threaten to invade the Columbia River system: Cordgrasses (*Spartina* spp.) threaten productive mudflats and marshes of the lower estuary, and the first documented population of Smooth Cordgrass (*Spartina alterniflora*) on the Columbia was found last summer. We will discuss potential impacts on wildlife, susceptible habitats, survey efforts and treatment options. Purple Loosestrife (*Lythrum salicaria*) biological control programs have proven successful in non-tidal areas but produce variable results in areas under tidal influence. We will present preliminary results from a study investigating environmental factors influencing the establishment of loosestrife biological control agents in tidally influenced areas, identifying a critical host plant stem density. Native and non-indigenous lineages of Common Reed (*Phragmites australis*) are present in the Pacific Northwest. Growing up to three meters tall, the introduced Eurasian lineage (*P. australis* subsp. *australis*) has become highly invasive in other regions of the United States and may be spreading downstream from infestations in Washington. Oregon Department of Agriculture recently completed a risk assessment of Common Reed as a first step towards listing this species as a noxious weed. Hydrilla (*Hydrilla verticillata*) is a highly invasive submersed aquatic plant, listed as a noxious weed in numerous states and also at the federal level, but with a limited distribution in the Pacific Northwest. Recent infestations found in Idaho plus numerous scattered reports from northern states across the U.S. add urgency to early detection efforts and raising general awareness regarding this detrimental aquatic invader.

COLUMBIA BASIN FISH ACCORDS: SALMON HABITAT RESTORATION AND INVASIVE SPECIES MANAGEMENT. **Phil Roger,** *Columbia River Inter-Tribal Fish Commission, 729 NE Oregon St., Ste. 200, Portland, OR 97232; rogp@critfc.org*

In 1977, the four Columbia River treaty tribes formed the Columbia River Inter-Tribal Fish Commission (CRITFC) to provide fisheries coordination, technical assistance, and protection of treaty fishing rights. The tribes, individually and acting through CRITFC, work to restore healthy, sustainable salmon populations and other fishes throughout the Columbia River Basin. CRITFC's mission is to ensure a unified voice in the overall management of the fishery resources, and as managers, to protect reserved treaty rights through the exercise of the inherent sovereign powers of the tribes. CRITFC and its member tribes, the Nez Perce, Umatilla, Warm Springs, and Yakama, are actively involved in salmon restoration efforts throughout the Columbia River Basin. The Columbia Basin Fish Accords are the foundation for a new working relationship between tribes, states, and federal agencies with responsibility to manage and protect salmon and other natural resources in the Pacific Northwest. The partnership details specific commitments of the federal government to help the Columbia River's fish populations. These include incorporating an adaptive management approach into hydropower operations, continuing the operation of the Fish Passage Center, and seeking a streamlining of the Independent Scientific Review Panel process used to evaluate and approve salmon restoration projects. This presentation will discuss opportunities to address invasive species as part of our implementation of the Columbia Basin Fish Accords.

NON-INDIGENOUS SPECIES OF THE PACIFIC NORTHWEST: AN OVERLOOKED RISK TO SALMON? **Beth Sanderson, Katie Barnas and Michelle Rub,** *NOAA Fisheries, Northwest Fisheries Science Center, 2725 Montlake Boulevard E. Seattle, WA 98112; Beth.Sanderson@noaa.gov*

Non-indigenous species are recognized as one of the major threats to global diversity and have been cited as a cause of decline in 42% of species listed under the US Endangered Species Act. The Pacific Northwest is home to more than a thousand aquatic and terrestrial non-indigenous species, yet the effects of most of these species on native populations, communities and ecosystems remain unknown. During their life cycle, salmonids traverse large geographic areas spanning freshwater, estuary and ocean

habitats where they encounter numerous non-native species. To date, the cumulative impact of non-indigenous species on salmonids has not been described or quantified. We examine the extent to which introduced species are a potentially important risk to threatened and endangered salmon, ultimately by contributing to higher levels of life-cycle mortality. We identify and categorize all documented introduced species in the Pacific Northwest, including fish, invertebrates, birds, plants, amphibians and others. Where data exist, we quantify the impact of non-indigenous and range-expansion species on populations of threatened and endangered salmonids. For example, bird and fish predators are reported to consume 0-40% of juvenile salmon in some habitats. These data indicate that the impact of non-indigenous species on salmon is equal to or greater than commonly addressed impacts (habitat, harvest, hatcheries and hydro-system) and suggest that managing non-indigenous species impacts may be imperative for the recovery of these fish.

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REPORT ON NUTRIA MANAGEMENT AND RESEARCH IN THE PACIFIC NORTHWEST. **Trevor R Sheffels and Mark D Sytsma,** *Portland State University, Center for Lakes and Reservoirs, Post Office Box 751-ESR, Portland, OR 97207; sheffels@pdx.edu*

The Nutria (*Myocastor coypus*) is an invasive semi-aquatic rodent native to South America that was introduced to Oregon and Washington in the 1930s for fur farming. Feral populations were documented in 1939, and these populations have remained in the region to this day. Ecological damage caused by the species includes soil erosion resulting from burrowing activity, habitat destruction caused by over-consumption of vegetation, and potential transport of diseases transmittable to humans and pets. The Center for Lakes and Reservoirs at Portland State University has taken a lead role in addressing these issues and has completed an initial regional status report. The report includes information on the results of the regional Nutria management workshop hosted by the Center for Lakes and Reservoirs, the status of the regional distribution and relative density map currently being created, and the preliminary effort to coordinate the development of an official regional management plan. The complete report is available online at http://www.clr.pdx.edu/docs/CLR_nutria_report.pdf. Nutria nuisance issues are increasing in the Pacific Northwest as populations continue to increase and expand into urban environments. This increasing contact with humans coincides with an increasing potential for conflict. Current management and control strategies are proving to be only temporarily effective at best, as they generally occur only at the local scale. Research currently being conducted by the Center for Lakes and Reservoirs is focused on differences between regional urban and non-urban Nutria populations and associated management implications.

Additional Notes

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DEVELOPING A WOLF CONSERVATION AND MANAGEMENT PLAN FOR WASHINGTON. **Harriet Allen,** *Washington Department of Fish and Wildlife, 1111 Washington Street SE, Olympia, WA 98501; Harriet.Allen@dfw.wa.gov*

The Gray Wolf (*Canis lupus*) is an endangered species in Washington under both state and federal law. Historically, wolves were found throughout most of Washington; they were extirpated by the 1930s through human persecution, with the exception of a few individuals that dispersed periodically into the state. Wolves are expected to disperse into Washington from Idaho, Montana, Oregon, and British Columbia. Washington's first fully confirmed breeding wolf pack in recent years was discovered in Okanogan County in July 2008. In response to the eventual return of wolves and state management responsibility following federal de-listing, the Washington Department of Fish and Wildlife (WDFW) began developing a wolf conservation and management plan in 2006. State law requires conservation of listed species through preparation of recovery or management plans, which direct WDFW to address the threats to listed species. The Washington Wolf Conservation and Management Plan is being developed to ensure a self-sustaining population of gray wolves in the state and to address potential conflicts. A citizen group representing a broad spectrum of values regarding wolves was appointed to advise WDFW in developing the plan. The group was challenged to reach consensus on a draft plan. A draft plan was completed in summer 2008 and peer-reviewed in late 2008. An additional blind peer review will occur in early 2009, with a 90-day public-review in late summer 2009. The final plan will be presented to the Washington Fish and Wildlife Commission for consideration at the end of 2009.

STREAKED HORNED LARK COLUMBIA RIVER ISLAND HABITAT ANALYSIS. **Hannah E Anderson,** *The Nature Conservancy of Washington, 120 E. Union Ave #209, Olympia, WA 98501; handerson@tnc.org*; **Scott F Pearson,** *Washington Department of Fish and Wildlife, Olympia, WA 98501; pearssfp@dfw.wa.gov*; **Matt Stevenson,** *Core GIS, 355 NW 47th St, Seattle, WA 98107; matt@coregis.net*

The Streaked Horned Lark (*Erimophila alpestris strigata*) is a federal candidate for listing under the Endangered Species Act and a Washington state endangered species. This subspecies uses islands of the lower Columbia River for breeding and over-wintering. The US Army Corps of Engineers maintains the depth of the navigation channel by dredging the river bottom. The deposition of dredge material on adjacent islands creates and maintains early successional habitats preferred by Streaked Horned Larks. The timing, location, and amount of deposited dredge material can have dramatic positive or negative effects on Streaked Horned Larks and their habitat. Keeping an adequate amount of habitat in appropriate successional stages and managing deposition sites is critical to maintaining Columbia River lark populations. We georeferenced aerial imagery from 1996 and 2008 and used statistical clustering to derive spatially explicit vegetation classifications. We analyzed Streaked Horned Lark occupancy and abundance data (2005-2008), existing vegetation (2008), and digitized historic dredge material deposition locations (1996-2008) to examine the relationship between these variables. Our goal is to determine how long it takes newly deposited dredge material to become suitable Streaked Horned Lark habitat and how long it remains suitable. The results of this spatial analysis can be used to determine the timing and location of deposition that minimizes the negative effects of this activity to larks and hopefully maximizes the positive effects. This information will also be used to determine how much habitat the lark population may require to persist on the lower Columbia at its current size.

AN INTERACTIVE INTERNET WEBSITE FOR ARCHIVING AND RETRIEVING DATA ON FOREST CARNIVORE SURVEYS IN THE PACIFIC STATES. **Keith B Aubry and Catherine M Raley,** *USDA Forest Service, Pacific Northwest Research Station, 3625 93rd Avenue Southwest, Olympia, WA 98512; kaubry@fs.fed.us; craley@fs.fed.us*; **Fredrick V Schlexer,** *USDA Forest Service, Pacific Southwest Research Station, 1700 Bayview Avenue, Arcata, CA 95521; rschlexer@fs.fed.us*

We recently developed an interactive Internet website that provides current and future biologists with a permanent archive and retrieval system for data obtained from standardized forest carnivore surveys conducted anywhere in Washington, Oregon, and California. This tool is now available for professional use. Data on all survey efforts are included, regardless of their success or failure to detect target species,

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because both positive and negative results provide useful information for the conservation of Fishers (*Martes pennanti*) and American Martens (*Martes americana*). The website is also designed to provide a permanent archive and retrieval system for all verifiable records of the 5 forest carnivores of greatest conservation concern in the Pacific states: Canada lynx (*Lynx canadensis*), Wolverine (*Gulo gulo*), Fisher, coastal marten (west of Interstate Highway 5), and mountain Red Fox (*Vulpes vulpes*) (> 3,000 ft. elev.). Thus, interested users will be able to generate reliable and up-to-date distribution maps at any spatial scale for these 5 taxa that are based solely on physical evidence of their occurrence. Due to their inherent unreliability, no anecdotal records of any kind are included in the website database. The purpose of this talk is to introduce potential users to the website, and explain its layout and design, the content of its database, and its functionality.

OVERWINTERING OF CASCADES FROGS IN WASHINGTON. **April B Barreca and Jason T Irwin,** *Central Washington University: Biological Sciences 400 East University Way, Ellensburg, WA 98926; BarrecaA@cwu.edu and IrwinJ@cwu.edu*

Cascades Frogs (*Rana cascadae*) are listed as "near threatened" by the World Conservation Union and are classified as a "species of concern" by U. S. Fish and Wildlife Service. An understanding of the basic ecology and biology of this species is urgently needed for preventing their decline in the Pacific Northwest. Radio tracking methods are being used to monitor overwintering Cascades Frogs at a wetland complex at 1745 m (6000 ft) in the Wenatchee National Forest near Blewett Pass. It is unknown where Cascades Frogs spend the winter. Some frog species overwinter on the bottom of ponds that do not freeze completely, but other related frog species like the Wood Frog (*Rana sylvatica*) hibernate terrestrially. Data from 2007/08 winter indicate that Cascades Frogs are not freeze tolerant and overwinter in a free-flowing spring from November to April. Air temperatures remained below freezing from December through April while water temperatures remained above freezing at 1-3°C. Dissolved oxygen in the spring was moderate at 6.4-8.2 mg/L. The presence of adequate overwintering habitat could dictate the regional abundance of montane amphibians.

A CRITICAL REVIEW: DO UNDERGROUND TUNNELS PROVIDE EFFECTIVE PASSAGEWAYS FOR AMPHIBIANS? **Barbara Beasley,** *P.O. Box 927, Ucluelet, BC, V0R 3A0; beasley@island.net*

Local populations of amphibians around the world have been known to decline, become genetically isolated, and even become extinct as a result of roads and traffic. A variety of underground passage systems have been designed to reduce amphibian mortality on roadways, and connect habitats. In most cases, follow-up monitoring has not been done to determine if underpasses effectively safeguard populations. So much effort and money goes toward installation that there is little left to test their effectiveness afterward. Underpass systems that have been monitored have met with variable success. I reviewed 25 reports that included some type of assessment of the effectiveness of underground tunnels installed as passageways for amphibians. Only five authors provided convincing evidence that underpasses provided safe passage and reduced road mortality by 70%. Six described systems that had failed, and 14 authors presented a mixed review. This presentation is meant to stimulate discussion and information-sharing about underpass systems. Should we be optimistic that, with continued development, underpasses will provide viable solutions, or should we be choosing an alternative way to mitigate or prevent the impacts of roads on amphibian populations?

PHYSIOLOGICAL RESPONSE OF LARVAL TAILED FROGS, ASCAPHUS TRUEI, TO AN ECOLOGICALLY RELEVANT THERMAL STRESS. **Gwendolynn W Bury,** *Western Washington University, 516 High Street, Bellingham, WA 98225; Gwen.Bury@gmail.com*

Human alterations have affected many forested streams of the Pacific Northwest. Headwater streams and their associated organisms are important parts of watersheds, and have many effects on downstream waters. I sought to determine whether the summer maximum temperatures in small streams cause physiological stress to tadpoles of the Tailed Frog, *Ascaphus truei*. I obtained 40 *Ascaphus* tadpoles in northern Washington for laboratory testing: half were exposed to 3 days of a daily temperature cycle similar to that experienced in open sunlit streams (low 10°, high 23°C), and the other half to 3 days of

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a daily cycle similar to that of shaded streams (8–13°C). On the third night, the water temperatures fell to the low of the warm stream (10°C) and then I determined their resting rate of oxygen consumption as an estimate of physiological stress. The tadpoles that experienced temperatures at higher daily peaks consumed significantly more oxygen (61%) than the cool stream tadpoles. Because the *Ascaphus* tadpoles subjected to the warm treatment had relatively high rates of oxygen consumption, it can be concluded that just a few days of exposure to warm temperatures cause physiological stress in *Ascaphus* tadpoles. Hence, streams in logged areas may become warm enough in the summer to directly cause physiological stress in *Ascaphus* tadpoles. This finding argues for protection of a very low thermal regime in low-order streams.

RESPONSES OF STREAM AMPHIBIANS TO TIMBER HARVEST: A LONG-TERM PERSPECTIVE. **R Bruce Bury,** *U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, 3200 SW Jefferson Way, Corvallis, OR 97331; buryb@usgs.gov*

Over the last 40 years, I have sampled streams for amphibians in Northwestern forests. Both general searches across the landscape and highly detailed multi-year studies indicate reduced frequency and relative abundance of Tailed Frogs *(Ascaphus truei*) and Torrent Salamanders (*Rhaycotriton* spp.) in streams subjected to clear-cut timber harvest. In contrast, there were often reduced numbers but not occurrence for Giant Salamanders (*Dicamptodon* spp.). Laboratory experiments show that *Ascaphus* and *Rhyacotriton* are among the most sensitive of any amphibian to elevated water temperatures (Critical Thermal Maxima of 27-29°C). Siltation also appears to reduce populations. Both of these environmental changes result from clear-cut logging. Ongoing studies have sampled amphibians in 1984-85, 1995 and 2005 from the same streams in western Oregon. Preliminary evidence suggests little or slow recovery of *Ascaphus* and *Rhyacotriton* 4-6 decades post-harvest. There was recovery in *Dicamptodon* over this time frame, which was expected as this salamander is ubiquitous in Northwest streams. Despite inherent variance in populations likely related to habitat preferences or other interactions, timber harvest remains the primary threat to persistence of stream amphibians. This issue will only be exacerbated with projected effects from global climate change.

BUTTERFLY HABITAT ENHANCEMENT IN PUGET LOWLAND PRAIRIES IN WESTERN WASHINGTON. **Cheryl Fimbel, Carri Marschner, Hannah Anderson, Grace Diehl and Sarah Hamman,** *The Nature Conservancy of Washington, 120 E. Union #215, Olympia, WA 98501; cfimbel@tnc.org, cmarschner@tnc.org, handerson@tnc.org, gdiehl@tnc.org and shamman@tnc.org*; **Birdie Davenport,** *Washington Department of Natural Resources, PO Box 280, Castle Rock, WA 98611; roberta.davenport@dnr.wa.gov*; **Rod Gilbert and Jeff Foster,** *Fort Lewis, Public Works ATTN: AFZH-PWT / MS-17, Box 339500 / Bldg 1210, Fort Lewis, WA 98433; Roderick.gilbert1@us.army.mil and Jeffrey.r.foster@us.army.mil;* **Dave Hays and Ann Potter,** *Washington Department of Fish and Wildlife, 600 Capitol Way N. Olympia, WA 98501; haysdwh@dfw.wa.gov and potteaep@dfw.wa.gov*; **Mary Linders,** *Washington Department of Fish and Wildlife, 600 Capitol Way N. Olympia, Washington 98501; Fort Lewis Fish and Wildlife, Public Works ATTN: AFZH-PWT / MS-17, Box 339500 / Bldg 1210, Fort Lewis, WA 98433; lindemj@dfw.wa.gov*; **David Wilderman,** *Washington Department of Natural Resources, PO Box 47014, Olympia, WA 98504; david.wilderman@dnr.wa.gov*

Two Puget lowland prairie butterfly species, the Taylor's Checkerspot (*Euphydryas editha taylori*) and Mardon Skipper (*Polites mardon*), are candidates for listing under the federal Endangered Species Act. Reintroduction of these two species is a primary goal of Puget Prairie conservation partners. Suitable habitat is the primary limiting factor to reintroduction due to prairie habitat loss and degradation. Butterfly plant resources have declined in recent years on remaining prairies, while non-native grasses and forbs continue to invade. In 2007, The Fort Lewis Army Compatible Use Buffer (ACUB) initiative supported the convening of a cooperative, interdisciplinary and interagency butterfly habitat enhancement team to develop and implement habitat improvements for these rare butterflies on formerly occupied sites. Progress to date includes: a cooperative approach to identification and evaluation of 14 management units across 10 prairie sites; development of restoration targets and 2-year work plans; nectar plant surveys to guide location of enhancement efforts; weed control treatments underway (prescribed fire, herbicide spraying,

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conifer removal, and mowing); propagation and planting of native plants and seeds; and standardized vegetation monitoring established to evaluate treatment success across multiple prairies. Future efforts will continue these actions, while also refining restoration targets and increasing coordination of habitat enhancement treatments with releases of Taylor's Checkerspot larvae. This collaborative approach benefits from the expertise of numerous partners and serves as a model for integrating research and monitoring into habitat restoration and adaptive management to support butterfly reintroduction efforts across multiple prairie sites.

SUMMARIZING COSTS AND BENEFITS OF BULLFROG ERADICATION EFFORTS FROM AROUND THE WORLD: IMPLICATIONS FOR BULLFROG MANAGEMENT.
Purnima Govindarajulu, *Wildlife Science Section, BC Ministry of Environment, PO Box 9338 Stn Prov Govt, Victoria, BC V8W 9M1; Purnima.Govindarajulu@gov.bc.ca*

Native to eastern North America, the American Bullfrog (*Rana catesbieana*) has been introduced around the world through the aquaculture and aquarium trades. Escaped and released bullfrogs have established populations in Asia, Europe, North and South America. The Global Invasive Species Database now lists bullfrogs as one of the 100 worst invaders for their impact on native fauna through competition and predation. In response, conservation agencies need to develop bullfrog management programs. We summarize the costs, benefits, and success of 10 bullfrog control efforts from Europe and North America. The incentives for bullfrog control were primarily twofold: 1) to prevent a small incipient bullfrog population from establishing; or 2) to conserve native endangered species. Eradication of bullfrogs from small (< 1 hectare), contained (< 5 km^2 total area of spread), isolated (> 5 km from closest source population) wetlands were reasonably successful and cost between $20,000 and $40,000 per year, for 5 to 7 years. Cost of bullfrog control in widespread and well established populations ranged from $5000 to $40,000 per pond across multiple ponds leading to projects costs up to $450,000 per year. None of these efforts have achieved eradiation. The large egg mass size (> 12,000 eggs), density dependent growth and survival, population control through cannibalism, and long distance migration capability (potentially > 5 km), are life-history characteristics that contribute to the low probability of successful eradication efforts. In most cases, benefits of control are assumed but there have been few quantitative estimates of response of native fauna.

THE STATUS OF THE STRIPED WHIPSNAKE (MASTICOPHIS TAENIATUS) IN WASHINGTON.
Lisa A Hallock, *Washington Natural Heritage Program, Department of Natural Resources, P.O. Box 47014, Olympia, WA 98504-7014; Lisa.hallock@dnr.wa.gov*

The Striped Whipsnake (*Masticophis taeniatus*) reaches the northern extent of its geographic range in Washington state. It has been documented from 17 locations in the Columbia Basin since first described from the state in 1941. Concern about the species' status was triggered by the lack of observations during large scale herpetological inventories in the 1990s, including surveys at historical sites. A study was initiated at the only known extant site with the goal of learning more about habitat use and behavior in the hope that this information would increase inventory success at other sites. Radio-tracking seven snakes produced significant conservation information about the local population, including the locations of two hibernacula. In addition, radio-tracked snakes moved to locations where freshly shed skins were present in the fall. These were easily identified as the shed skins of Striped Whipsnakes. In mid to late October, the entire study site (approx. 1 mi square) was searched for shed skins. Whereas each individual Striped Whipsnake took an average of 10.5 h to find without radio-telemetry, a shed skin took only 2.6 h and success was not dependent on suitable weather conditions. Based on this, all non-converted historical sites were surveyed for shed skins in late October 2006 and 2007. Only one additional historical site had Striped Whipsnake shed skins present during the surveys. Conservation efforts are now underway to protect the two known sites and inventory efforts will be expanded to non-historical sites.

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THE OZETTE BREEDING BIRD SURVEY, 1971-2007: A 36-YEAR RECORD OF BIRD POPULATION AND LAND COVER CHANGE. **Scott Horton,** *Washington State Department of Natural Resources - Olympic Region, 411 Tillicum Lane, Forks, WA 98331; scott.horton@dnr.wa.gov*

The North American Breeding Bird Survey (BBS) is a long-term, large-scale program to monitor population status and trends. BBS routes consist of 50 point-count stations, 0.5 miles apart along roadside transects. The Ozette route is Washington's northwestern-most. Commercial forestry is the dominant land use, thus the land-cover mosaic changed dramatically, ~70% of land within 1 mile of the route was clearcut during this study. Estimated land cover around mid-study (1991) was: 11% mature forest, 21% pole-timber, 54% open or closed-canopy sapling, 3% open-canopy forested wetland, 3% pasture or developed, and 9% fresh or salt water. Conifer forests dominate but >1/4 of the vegetated land had ≥ 50% hardwood cover in 1996. Excluding seabirds, 90 species were recorded but 5 species of common forest birds accounted for nearly 50% of total counts. Patterns of abundance remained rather constant over the 4 study decades; the top 10 species in each decade comprised only 15 species overall. BBS regional trends (1966-2007) suggest 21 of 57 common upland species are declining. Seventeen of those 21 species were encountered on the Ozette route. I classified those species based on their local habitat associations as "commensal" (3), "early seral forest" (8), "forest generalist" (3), or "mature forest" (3). On the Ozette route, 1 (possibly 2) of the commensal species declined, but none of those forest species did. I suggest that locally-declining agricultural activity played a role in decline(s) among commensals and that the shifting but non-declining mosaic of forest cover was sufficient to support populations of forest species.

BEAVERWORKS WITHIN HUMANWORKS – PRACTICAL SOLUTIONS. **Jake Jacobson,** *Surface Water Management, a Division of Snohomish County Public Works, 3000 Rockefeller Avenue, Everett, WA 98201; jake.jacobson@snoco.org*

Beaver (*Castor canadensis*) populations have grown in Snohomish County, a rapidly developing county in Puget Sound. In response, Surface Water Management (SWM) has developed practical and effective strategies for managing road flooding problems caused by beaver. Historically, beaver populations have been loosely managed by market trapping but changes in Washington State wildlife laws have removed that option. Simply removing beaver dams to relieve flooding is a very short term solution because the beaver will quickly rebuild. Beaver ponds provide for sediment and floodwater storage, improve water quality, and increase riparian area productivity. SWM focuses on learning to co-exist by managing water levels and influencing dam construction site selection. SWM uses a combination of structures, including Clemson Pond Levelers, Flexible Levelers, Diversion Barriers, Offset Barriers, and simple trickle tubes to actively influence beaver pond water levels or dam locations. SWM has installed these devices, sometimes in combination, at more than 50 sites and has monitored the success and failure of each installation. Several devices have been in place for almost 10 years.

NORTHERN LEOPARD FROG RECOVERY PROGRAM IN ALBERTA, CANADA. **Kris Kendell,** *Alberta Conservation Association, 101-9 Chippewa Road, Sherwood Park, AB T8A 6J7; kris.kendell@ab-conservation.com*; **Dave Prescott,** *Alberta Fish and Wildlife Division, #404, 4911 51st Street, Red Deer, AB T4N 6V4; dave.prescott@gov.ab.ca*

The Alberta Conservation Association is part of a provincial recovery team for the Northern Leopard Frog (NLF) (*Rana pipiens*) in Alberta. The team is responsible for implementation of actions and strategies that will help maintain viable NLF populations for future generations. Population and habitat monitoring, reintroductions, habitat protection, and outreach initiatives have been key actions designed to meet the objectives of the NLF recovery program. Results from a detailed inventory revealed that some populations at the core of the species range appear to be relatively healthy, although many populations remain isolated and at significant risk of extirpation if current habitat conditions decline. Importantly, the inventory identified source populations for reintroduction and identified habitat threats. Stewardship projects at select sites have been implemented to mitigate the negative impacts from cattle and other threats on important NLF habitat. To help direct reintroductions, a genetic diversity and structure study was undertaken to determine the genetic suitability of potential source populations for the reintroduction of NLF to various locations in Alberta. A disease surveillance program was also initiated to minimize

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disease transmission among amphibians during reintroductions. Attempts to re-establish viable NLF populations in the province have met with limited success; however at one site a self-sustaining population was achieved. We believe that the recovery of the NLF in Alberta is achievable. It is our intention to apply knowledge acquired from previous successes and failures at reintroduction, both within Alberta and from other jurisdictions, to maximize the probability of success.

AN EXPERIMENTAL EVALUATION OF AVIAN NEST SURVIVAL AFTER SALVAGE LOGGING IN DRY FORESTS OF THE OREGON CASCADES. **Andrew J Kroll,** *Weyerhaeuser Company, WTC 1A5, Federal Way, WA 98063-9777 aj.kroll@weyerhaeuser.com*; **Edward B Arnett,** *Bat Conservation International, Austin, TX 78746, earnett@batcon.org*; **Bob Altman,** *American Bird Conservancy, Corvallis, OR 97330, baltman@abcbirds.org*

Salvage logging of dead and dying trees in overstocked forest stands is one tool that managers can employ to reduce the risk of stand-replacement fires. However, little information exists to describe the relative impacts of different types of harvest prescriptions on the demographics of wildlife populations. We evaluated experimentally how a "pay-as-cut" prescription influenced avian nest survival on 12 treatment units in Lodgepole Pine (*Pinus contorta*) forests on the Fremont and Winema National Forests, OR, from 1997-1999 (3 treatment and 3 control units in each forest). We monitored nest fate for all species. We used a two-stage modeling approach in which we first modeled variation from nest type (ground, canopy, or snag), nest height, and body size (small, ≤ 14 g; medium, 14-35 g; and large, > 35 g) to account for ecological factors that cannot be altered through management, rather than modeling nest survival for each species independently. We fated 426 nests over the 3 year study (101, 196, and 129), and estimated that annual nesting survival for all species and all units combined was 0.70, 0.67, and 0.60. Nest survival was positively associated with nest height, negatively associated with body size, and associated with district (nest survival on the Fremont was significantly greater than on the Winema). Despite significant changes to elements of forest structure from the harvest prescription, we found no evidence to support a harvest effect on nest survival. The localized impacts of this prescription appeared to maintain high rates of nesting survival for most species.

REINTRODUCING FISHERS (*MARTES PENNANTI*) TO OLYMPIC NATIONAL PARK: PROGRESS FOR YEAR 1. **Jeffrey C Lewis,** *Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, WA 98501; lewisjcl@dfw.wa.gov*; **Patti J Happe,** *Olympic National Park, 600 E. Park Ave., Port Angeles, WA 98362; Patti_Happe@NPS.gov*; **Kurt J Jenkins,** *US Geological Survey, Forest and Rangeland Ecosystem Science Center, Olympic Field Station, 600 E. Park Ave., Port Angeles, WA 98362; Kurt_Jenkins@USGS.gov*

A three–year reintroduction project was initiated in 2007 to release 100 Fishers (*Martes pennanti*) from British Columbia to Olympic National Park. The Fisher had been extirpated in Washington as the result of historical over-trapping and loss and fragmentation of suitable habitat. In the fall of 2007 and winter of 2008 we captured and released 18 Fishers (12 F, 6 M) in Olympic National Park in January and March of 2008. Each Fisher was equipped with a radio-transmitter and relocated via aerial and ground telemetry. Measures of Fisher movements, survival, home range establishment and reproduction were used to evaluate reintroduction success and to guide future releases. Preliminary results indicate that Fishers made extensive movements after being released. Distances of > 30 km between successive relocations were common for both males and females. Fishers commonly traversed rugged and unforested terrain, crossed rivers, and moved through unmanaged and managed forest landscapes. Three of the 18 Fishers died during year 1 (2F, 1M), and two males could not be monitored for the entire year because of radio interference and a transmitter failure. While our preliminary results did not indicate that released females reproduced in year 1, we did document unusually high survival rates, as well as the timing, prevalence and location of home range establishment of released Fishers. The release of an additional 80 Fishers over the next two years of the project is expected to increase the likelihood of successful reproduction as well as the establishment of a self-sustaining population.

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REINTRODUCING TAYLOR'S CHECKERSPOT: A SEARCH FOR SOLUTIONS IN SOUTH PUGET SOUND, WASHINGTON. **Mary J Linders,** *Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, WA 98501-1091; lindemjl@dfw.wa.gov*

Captive rearing and translocation methods are being developed for Taylor's Checkerspot Butterfly (*Euphydryas editha taylori*) to identify a process for re-establishing populations of this rare butterfly in South Puget Sound, Washington. Successful invertebrate reintroductions are rare and initial success is heavily influenced by weather conditions at the time of release. A highly gregarious nature and a single source population make reintroduction of Taylor's Checkerspot even more challenging. Maximizing survival and identifying the optimal life stage for release are key steps in the process of methods development. In 2007-2008, cumulative egg to postdiapause survival at the Oregon Zoo was 97.0 percent, with 598 of 617 hatched larvae emerging from diapause. In spite of poor weather and a late spring, release of 340 postdiapause larvae between two plots produced numerous adult butterflies during a 2008 flight season that lasted 16 days. More adults were generally observed in the vicinity of East Plot, where larvae were released in groups of five compared to West Plot, where larvae were released singly. Apparent differences in habitat quality (particularly thatch density) between release plots may have contributed to these findings. Adult behaviors observed at the release site include nectaring, territorial displays by males, mating chases, and routine movements back and forth across the release site. In contrast to adult Taylor's Checkerspots emerging in spring 2007, only one butterfly was observed flying away from the site in a direction in which no other checkerspot was ever observed. Male checkerspots are known to disperse at low densities. Factors which increase the likelihood of encounter with other adults will likely be important in the initial stages of population establishment. Distribution of adults at both the source and the release site suggest nectar plants and trees may play key roles in aggregating adults on large open expanses of prairie such as those found in South Puget Sound.

FACTORS ASSOCIATED WITH DUSKY CANADA GOOSE NESTING ON ARTIFICIAL NEST ISLANDS OF THE WESTERN COPPER RIVER DELTA, ALASKA. **Nicole M Maggiulli and Bruce D Dugger,** *Department of Fish and Wildlife, Oregon State University, Nash Hall, Room 104, Corvallis, OR 97331; nmaggiul@hotmail.com and Bruce.Dugger@oregonstate.edu*

The population of Dusky Canada Geese (*Branta canadensis occidentalis*; hereafter, Dusky Geese) nesting on the western Copper River Delta (CRD) in south-central Alaska has been in decline since the late 1970s. An artificial nest island (ANI) program was implemented on the western CRD in 1983 in an effort to increase nest success. We used data from the ANI program to identify factors associated with island use by nesting Dusky Geese and nest success from 1996-2005. We generated a series of candidate models and used logistic regression with model selection techniques to determine how variables representing pond characteristics, vegetative characteristics, distance to predator corridors, the previous year's island use and nest success (previous year's island status), and interactions with larid species were associated with ANI use and nest success for each year. There was annual variability in factors associated with island use and nest success; however, use of islands was most consistently and strongly associated with the previous year's island status. Islands used the year before were more likely to be used the following year and this pattern was strongest for islands with successful nests the previous year. There was some evidence of a negative association between island nest success and average island shrub height. However, annual variability in factors associated with nest success on ANIs suggests more complex factors are responsible for the variability in nest success. The presence of alternate prey (and maybe predator abundance) may be more important to Dusky Goose nest success on ANIs than habitat features.

MATE PREFERENCE AND FAMILIARITY INCREASE REPRODUCTIVE SUCCESS IN THE ENDANGERED LAGOMORPH *BRACHYLAGUS IDAHOENSIS*. **Meghan S Martin,** *Portland State University, P. O. Box 751, Portland, OR 97207-0751; meghan@meghanmartin.com*; **David Shepherdson,** *Oregon Zoo, 4001 SW Canyon Rd., Portland, OR 97221-9704; David.Shepherdson@oregonzoo.org*

Success of captive breeding programs centers on consistent reproduction among captive animals, however, many individuals fail to reproduce even when presumably fully reproductive and healthy. Mate choice is directly related to population dynamics and can be vitally important to the conservation of a species

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and to captive breeding programs. Mate choice has been shown to affect multiple reproductive success parameters including, but not limited to, mating success, offspring production, offspring survivorship, and offspring fecundity. This experiment evaluated the effect of prior familiarity with a mate and mate preference on reproductive success of female endangered Columbia Basin Pygmy Rabbits (*Brachylagus idahoensis*). Prior familiarity with a mate increased litter production 41% compared to females that were naïve to their mating partner. Females mated to familiar males were also more likely to have kits that survived to emerge from natal burrows (twice as many kits survived versus naïve matings) and to breeding age (25% of kits survived to breeding age versus 6% for naïve matings). Mate preference also increased litter production. 71% of females mated to their preferred mate produced litters as compared to only 31% of females mated to their non-preferred mate. We recommend that the captive breeding program manipulate breeding environments in order to familiarize females with future male partners and, when possible, provide females with a choice of one or more males and allow her to mate with the male that she prefers.

STATEWIDE WILDLIFE HABITAT CONNECTIVITY ANALYSIS. WASHINGTON WILDLIFE HABITAT CONNECTIVITY WORKING GROUP. **Kelly R McAllister,** *Washington Department of Transportation, 310 Maple Park Avenue SE, Olympia, WA 98501-2361; mcallke@wsdot.wa.gov*; **Joanne P Shuett-Hames,** *Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, WA 98501-1091; Joanne.Schuett-Hames@dfw.wa.gov*

Maintaining and improving habitat connectivity is critical to protecting many of Washington's wildlife species. Habitat fragmentation and loss of connectivity occurs when habitat is altered due to changing land use and development, or natural processes that alter vegetation and habitat structure. Rapid human population growth and potential impacts of climate change threaten to further fragment habitat and disrupt movement, putting vulnerable wildlife populations at risk. Broad-scale analysis is essential for assessing threats to habitat connectivity and developing strategies to avoid or mitigate those threats. In Washington State, state and federal agencies, non-governmental organizations, and universities have formed the "Washington Wildlife Habitat Connectivity Working Group" to address this need. This group contains state species experts, field biologists studying wildlife movement, and habitat connectivity modelers to ensure this effort is guided by the best available science. We are using a focal-species approach driven by state-of-the-art GIS mapping and analysis methods. The first step is to accomplish a statewide wildlife habitat connectivity analysis; future efforts will focus on more detailed ecoregional analyses. Analysis results will include identification and prioritization of areas important for connectivity. The project is supported by the Washington Governor's Office and the State Biodiversity Council, and is a component of Washington's response to the Western Governors' Association Wildlife Corridors Initiative. The project results will help guide conservation, land use, and transportation planning to be more effective at maintaining wildlife habitat connectivity. Cross-border collaboration with agencies and organizations in British Columbia, Idaho, and Oregon is anticipated.

WILDLIFE USE OF MECHANICALLY CREATED SNAGS ON A COMMERCIAL FOREST LANDSCAPE. **Timothy C McBride,** *Hancock Forest Management, 17700 SE Mill Plain Blvd., Suite 180, Vancouver, WA 98683; tmcbride@hnrg.com*

Wildlife species dependence on snags has been well documented. However, naturally occurring snags on commercial forest landscapes are limited and, where they exist they can provide hazardous working conditions for logging contractors. To ameliorate the effects of modern clear-cut harvesting operations on snag retention and ultimately wildlife habitat for a variety of cavity dependent species, creating snags from green trees using mechanical timber harvesters can result in retention of critical wildlife habitat in clear-cut areas and young plantations. Treated and natural snags retained after harvest were located using GPS and evaluated for wildlife use in recent harvest areas and young plantations on managed forestlands near Glenwood, Washington and Kapowsin, Washington. More than 3,700 individual snags were inventoried on 14 plantations 15 years old and younger. Evaluation of each snag included identification of tree species, measuring height and diameter, assessing bark, wood and crown characteristics, wildlife use signs, and indicators of wood rot. Initial observations indicate use of mechanically treated snags by Northern Flicker (*Colaptes auratus*), Hairy Woodpecker (*Picoides villosus*), Western Bluebird (*Sialia mexicana*) and Chestnut-backed Chickadee (*Poecile rufescens*).

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NORTHERN SPOTTED OWL DISPERSAL HABITAT ASSESSMENT TOOL. **Heather McPherson, Lowell Dickson and Joshua Holafsky,** *Washington Department of Natural Resources, 1111 Washington Street Southeast, Olympia, WA 98501; heather.mcpherson@dnr.wa.go,; lowell.dickson@dnr.wa.gov and joshuaholafsky@dnr.wa.gov*; **Sean Gordon,** *USDA Forest Service, Pacific Northwest Research Station, Portland Forestry Sciences Laboratory 620 Southwest Main, Suite 400, Portland, OR 97205; sgordon@fs.fed.us*

The Washington Department of Natural Resources has developed an evaluation tool to assess Northern Spotted Owl (*Strix occidentalis caurina*) dispersal habitat on forested state trust lands by using software produced by the U.S. Forest Service called the "Ecosystem Management Decision Support" system or EMDS.The Northern Spotted Owl Dispersal Assessment Tool (NSO DAT) uses an intuitive approach for evaluating a number of different habitat indicators (e.g., canopy cover, snags, etc.) and then combining these evaluations into an overall assessment score. Habitat indicators are judged by evaluation criteria, which measure whether those indicators score above or below the assessment objective. Evaluation criteria curves have inflection point values derived from a variety of sources, including literature, existing data sets, professional judgment or a synthesis of these sources. One of the advantages of NSO DAT model is it allows more flexible criteria to produce a finer gradation of results and moves away from a strictly yes or no threshold criterion. The NSO DAT has been used to evaluate proposed Northern Spotted Owl Dispersal Management Areas in three alternatives for a Draft EIS on forested state trust lands.

LONG-BILLED CURLEW (*NUMENIUS AMERICANUS*) NESTING HABITAT AND REPRODUCTIVE SUCCESS ON NATIONAL WILDLIFE REFUGES WITHIN THE COLUMBIA BASIN OF OREGON AND WASHINGTON. **Heidi Newsome,** *U.S. Fish and Wildlife Service, Mid-Columbia River Refuge Complex, 64 Maple Street, Burbank, WA 99323*; *Heidi_Newsome@fws.gov*; **Susan Haig, Elise Elliot-Smith and Jessica Stocking,** *U.S. Geological Survey, Biological Resources Division, Forest and Rangeland Ecosystem Science Center, 3200 SW Jefferson Way, Corvallis, OR 97333*

The Long-billed Curlew (*Numenius americanus*) is categorized as "highly imperiled" in the U.S. Shorebird Conservation Plan due to historic and current population declines. Little is known about Long-billed Curlew reproductive success within the Columbia Basin, making it difficult to evaluate relative habitat quality or to manage habitats for birds breeding on national wildlife refuges within the ecoregion. Objectives of this study were to estimate the total number and density of nesting pairs, and to evaluate nest success in relation to habitat variables such as vegetation type, distance to water, and proximity to agriculture. During 2007 and 2008, curlew nests were located using focal observation and rope dragging. Nests were aged using egg floatation and monitored until hatch. Nineteen and 23 nests were located in 2007 and 2008, respectively. Taking into account exposure time, nest success was estimated to be 23.6% and 32.9%. Multiple habitat variables were measured and nest habitat type was evaluated at 5 m and 50 m radius. At the 5-m scale, 30 nests were in Grass (75%), six in Crop (15%), two in Steppe (5%) and two in Forb (5%). At 50m radius, more nests were classified in Steppe habitat (n = 17;40%) and fewer were in Grass (n = 17; 40%). All nest habitat measurements exhibited dramatic variability and overlap between successful vs. unsuccessful nests. Furthermore, we did not detect any relationship between success and habitat type. However, curlews breed at low densities in this region and failure to detect differences may have been due to small sample sizes, and to difficulties related to the compressed nesting cycle of Long-billed Curlew within the Columbia Basin.

FROGS ON THE EDGE: PREDICTED AND ACTUAL BIASES IN THE PROTECTION OF PERIPHERAL POPULATIONS IN THE UNITED STATES. **Ryan P O'Donnell,** *Department of Biology and the Ecology Center, Utah State University, 5305 Old Main Hill, Logan, UT 84322-5305; Ryan@biology.usu.edu*; **Andrew P Rayburn,** *Department of Wildland Resources and the Ecology Center, Utah State University, 5230 Old Main Hill, Logan, UT 84322-5230; aprayburn@gmail.com*

A common conservation tool for states is to create lists of species that are of management concern. These lists often include species simply because of their periphery in a state, regardless of whether they are globally widespread and common. In the United States, state size increases from east to west. We used

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simulation models to investigate whether this geographic pattern has the potential to cause a geographic bias in the proportion of amphibians listed for protection at the state level because of their periphery. Then, we investigated whether the pattern of bias found in the simulations existed as a bias in listing. Simulation analyses indicated that the distribution of states results in a pattern of more peripheral populations predicted in the eastern part of the country when species range size is small to medium and more peripheral populations in the central part of the country when species range size is large. Actual species range distributions differed from simulations; there were more peripheral populations in the central part of the U.S. Despite this pattern, species were more likely to be protected as result of their peripheral status in western states. When the need for protection was controlled for, this bias still existed in the data, indicating that, relatively speaking, western states over-protect and central states under-protect peripheral populations. This geographic bias in the protection of peripheral populations is expected to bias the ability of states to detect and prevent amphibian range contractions, which are expected to occur as a result of global climate change.

AMPHIBIAN CHYTRID FUNGUS: GLOBAL PATTERNS. **Deanna H Olson and Kathryn L Ronnenberg,** *US Forest Service, Pacific Northwest Research Station, 2300 SW Jefferson Way, Corvallis, OR 97331; dedeolson@fs.fed.us and kronnenberg @fs.fed.us;* **Matthew C Fisher,** *Dept Infectious Disease Epidemiology, St Mary's Hospital, Imperial College, London W2 1PG UK*

With almost one-third of worldwide amphibians being threatened with losses or extinction, understanding the threats to this vertebrate class is paramount. The amphibian chytrid fungus, *Batrachochytrium dendrobatidis* (*Bd*), is becoming recognized as both an infectious disease and invasive species with profound effects on global amphibian biodiversity. In some regions of the world, losses attributed to *Bd* are documented in single species, whereas elsewhere, assemblages of amphibian species appear to be affected. In 2008, *Bd* was listed as a notifiable disease by the World Organization for Animal Health (OIE) due to its biosecurity risk. Understanding the geographic and taxonomic scope of the disease is a first step in developing research directions and management guidance. Our Global *Bd* Mapping Project was initiated with this overarching goal in mind. Furthermore, our global *Bd* database has enabled distributional and taxonomic analyses of patterns, including habitat modeling at the world scale using available environmental metrics such as climate parameters. We have compiled over 2,000 sites worldwide where *Bd* has been sampled. We have found the occurrence of the disease is associated with locations known to have enigmatic amphibian declines, i.e., losses that have been previously unexplained. In our model of *Bd* global habitat associations, a temperature metric is the most significant predictor of *Bd* detection. This suggests that the distribution of *Bd* will respond to scenarios of global climate change. The distribution of *Bd* is a moving target due both to its invasive tendencies and the hypothesized altered prevalence rates as climate conditions change. Maintenance of global *Bd* mapping through the website spatialepidemiology.net\bd will allow scientists and managers to gauge its spread and address areas of potential risk to future infections.

SNAKES ON A LANE. **Darcy Pickard,** *ESSA Technologies Ltd., Suite 300 – 1765 West 8th Avenue, Vancouver, BC V6J 5C6; dpickard@essa.com***; Mike Sarell and Allison Haney,** *Ophiuchus Consulting, RR#5 S53A C4, Oliver, BC V0H 1T0; ophiucon@vip.net*

Road mortality of snakes was observed for a 25-km rural road segment in southern British Columbia for most years from 1988 through 2008. The data were collected with varying degrees of effort ranging from one road cruise every three weeks to six road cruises per week from April to October each year. This study is a retrospective analysis to determine: population declines of listed species, the key periods of road mortality, key habitat factors influencing road mortality, the potential use of road mortality data as an index of abundance, and to provide recommendations to improve future data collection. Four species of listed snakes were observed over the course of the study: Racer (*Coluber constrictor*), Great Basin Gopher Snake (*Pituophis catenifer deserticola*), Rubber Boa (*Charina bottae*), and Western Rattlesnake (*Crotalus oreganus*). Gopher Snakes (45%) and Western Rattlesnakes (31%) comprised the majority of the observations. A third (33%) of the observations occurred during September, the period when the snakes are returning to their dens. We are also exploring which factors (e.g., habitat type, gully features, distance to den, etc.) influence the frequency of observations using regression analysis, with the hope that this information will prove useful for mitigation efforts. The high frequency of Gopher Snake

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observations on the road combined with low frequency of Gopher Snake observations at den sites led us to explore the possibility of using road mortality as an index of abundance for this species. Given limiting funding levels and the difficulty of finding Gopher Snakes using other methods such as den counts, live-trapping, and cover boards, road mortality may provide a reasonable long-term index of abundance for local populations in areas with roads. Despite some limitations encountered with the dataset during this retrospective analysis, road mortality observations are a relatively low-cost method for obtaining a wide variety of data and with a few adjustments (e.g., formalizing effort measurements) they could be useful on a wider scale in temperate climates.

SURVIVAL WITH DISEASE: EFFECTS OF THE AMPHIBIAN CHYTRID FUNGUS ON TOAD POPULATIONS. **David S Pilliod,** *U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, Snake River Field Station, 970 Lusk St., Boise, ID 83706; dpilliod@usgs.gov*; **Erin Muths,** *U.S. Geological Survey, Fort Collins Science Center, Fort Collins, CO 80526; erin_muths@usgs.gov*; **Rick D Scherer,** *Department of Fish, Wildlife and Conservation Biology, Colorado State University, Fort Collins, CO 80523; scherer@cnr.colostate.edu*

Chytridiomycosis is an important component of amphibian decline worldwide, but there is little information about its effects on the demography of infected populations. We used capture-recapture data from two infected populations and one uninfected population of Boreal Toads (*Bufo boreas*) in the Rocky Mountains, U.S.A. to examine a priori hypotheses about the effect of the amphibian chytrid fungus (*Batrachochytrium dendrobatidis*, *Bd*) on survival probability (Φ_i) and population growth (λ_t). Preliminary results suggest that probability of survival was lower (Φ = 0.53 – 0.64) at the two sites where *Bd* was present relative to the site where the disease was not detected (Φ = 0.77). Estimates of survival probability for individuals that tested positive for *Bd* were > 20 % lower than for individuals that tested negative. We found that *Bd* was not lethal to all toads: some toads tested negative for *Bd* after previously testing positive. The finite population growth rate of the *Bd*-free population was more stable ($\lambda \sim 1$) than the populations with *Bd*. Although the average prevalence of *Bd* was 57% in the diseased populations, neither showed rapid signs of decline over the 6 years of this study.

FISHES, FROGS, SNAKES, SANDPIPERS AND OTTERS: THOUGHTS ON ACTIVELY MANAGING A SMALL STREAM FAUNA IN THE DEVILS GARDEN. **Stewart B Reid,** *Western Fishes, 2045 East Main Street, Ashland, OR 97520; WesternFishes@opendoor.com*

Turner Creek is a small stream tributary to the upper Pit River in northeastern California. It contains one of three populations of the Modoc Sucker, *Catostomus microps*, a federally endangered fish. Attempts to protect the species from perceived threats have included the construction of a barrier, poisoning of the entire stream, removal of garter snakes, suppression of non-native Green Sunfish (*Lepomis cyanellus*) and Brown Bullheads (*Ameiurus nebulosus*), complete extirpation of Largemouth Bass (*Micropterus salmoides*), and an ongoing project to remove all Bullfrogs (*Lithobates catesbeianus*). All of these actions have had intended, unintended and unknown consequences on the stream's faunal composition, which in turn alter predator-prey and competitive relationships within the aquatic and riparian-dependent terrestrial community. Major alterations have included: exclusion of two native migratory fishes that may either compete with or prey upon the Modoc Sucker, complete resetting of the system requiring mostly natural recolonization of 10 km of stream, complete removal of a highly effective non-native piscivore, and ongoing removal of all lifestages of Bullfrog, a species which may compete with suckers as tadpoles and is an active predator on fishes, amphibians, snakes, birds and predatory insects, but which also consumes potential predators and may act as an alternative prey resource thereby reducing pressure on the Modoc Sucker. While the dynamic consequences of our management are little understood, the stream appears to be functioning well, perhaps in spite of us, and the Modoc Sucker population remains apparently robust.

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MODELING MOUNTAIN GOAT GENE FLOW IN THE CASCADE RANGE OF WASHINGTON. Andrew Shirk and David Wallin, *Western Washington University, Bellingham, WA 98225; shirka@cc.wwu.edu and David.Wallin@wwu.edu*

The Mountain Goat (*Oreamnos americanus*) population of the Cascade Range, Washington has declined by nearly 70% since 1960, most likely due to high hunter harvest rates. The Cascade landscape, altered by roads, development, and timber harvest in modern times, may act to resist dispersal and thereby fragment this population. As Mountain Goats continue to recover from their recent decline, migration and gene flow will likely be important factors in maintaining genetic diversity within sub-populations and to re-colonize vacant habitat. We used a landscape genetics approach to better understand how this modern landscape affects connectivity. Our genetic data consisted of 135 samples genotyped at 18 polymorphic microsatellite loci. We estimated gene flow between sample locations for multiple models of landscape resistance using Circuitscape, a software package based on graph and circuit theory. We then selected the most supported model based on the correlation between estimated gene flow and genetic distance between individuals. Based on the most supported model, we found an interstate bisecting the range, development, and low elevation valleys limit connectivity and in the Cascades. We conclude by discussing the implications of reduced gene flow on population viability.

GENETIC STRUCTURE AND DIVERSITY OF MOUNTAIN GOAT POPULATIONS IN WASHINGTON: IMPLICATIONS FOR MANAGEMENT AND CONSERVATION. Andrew Shirk and David Wallin, *Western Washington University, Bellingham, WA 98225; shirka@cc.wwu.edu and David.Wallin@wwu.edu*

The Mountain Goat (*Oreamnos americanus*) population of the Cascade Range, Washington has declined by nearly 70% since 1960, most likely due to high hunter harvest rates. Reduced hunting pressure in recent decades has allowed several large sub-populations to recover, however, many small sub-populations continue to decline. The Cascade landscape, altered by roads, development, and timber harvest in modern times, may limit gene flow and, in conjunction with the reduced effective population size, cause inbreeding depression in these small remnant groups. In this study, we sought to determine the genetic structure of Mountain Goats in Washington, assess their genetic diversity, and determine whether historic translocations from the Olympic range to the Cascades resulted in improved genetic diversity within nearby populations. Using a novel, spatially explicit approach, we found that the areas with the lowest diversity and highest inbreeding corresponded to the areas most affected by population decline or were at the periphery of the range. In contrast, the areas with the greatest diversity coincided with relatively stable populations existing in a zone of high admixture between the north and south Cascades. We also found that Olympic goats translocated to the Cascades in the 1980s appear to have survived and interbred with Cascade goats and their descendents have high genetic diversity and low inbreeding levels, indicating translocation may be a viable means to restore diversity to small remnant populations otherwise isolated from dispersal.

IMPLEMENTING FUELS TREATMENTS IN RIPARIAN HABITAT: EFFECTS ON AVIAN COMMUNITY COMPOSITION AND REPRODUCTIVE SUCCESS. Jaime L Stephens and John D Alexander, *Klamath Bird Observatory, PO. Box 758, Ashland, OR 97520; jlh@klamathbird.org and jda@klamathbird.org*

Historically, fire played an important role in maintaining riparian habitats in coniferous forests of southwestern Oregon. Fire is thought to have burned in riparian areas at frequencies and intensities similar to upland areas. However, riparian areas are not included in the current implementation of extensive fuel treatments. This study compared the biological integrity of basins that were treated in the upland only, following current practice, with basins treated in both the upland and riparian. We present results that illustrate short-term effects of prescribed burning on avian composition and diversity within the two treatments. We further assess the effects on the reproductive success of six species: Cassin's Vireo

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(*Vireo cassinii*), Hutton's Vireo (*V. huttoni*), Pacific-slope Flycatcher (*Empidonax difficilis*), Black-headed Grosbeak (*Pheuticus melanocephelus*), Western Tanager (*Piranga ludoviciana*), and Oregon Junco (*Junco hyemalis*). Differences in reproductive success are compared before and after treatments and evaluated in the context of habitat and arthropod abundance variables. The results from this study will inform land managers faced with decisions regarding fuels reduction planning.

WHY DID THE NEWTS CROSS THE ROAD? - SPATIAL POPULATION ECOLOGY OF POND-BREEDING CALIFORNIA NEWTS. **Pete Trenham,** *Salamander Research Institute, 1475 Grant Street, #1, Bellingham, WA 98225; ptrenham@yahoo.com*

During the breeding seasons of 1995-96, 1996-97, and 1997-98, I captured, marked, and recaptured California Newts (*Taricha torosa*) at 12 breeding ponds distributed along a 3-km transect in Monterey County, California. My goal was to evaluate the degree to which ponds supported independent subpopulations in the sense of metapopulation theory. Over the three field seasons, the vast majority of recaptured newts were found in the pond where they were first marked, with just 2.8% of between-year recaptures in different ponds. The average distance moved between ponds was 338 m and the maximum was 835 m. Although these data might suggest that that most individuals do not move far from their home breeding pond, other observations suggest a very different picture. In surveys of 100 m long roads segments located 1.2 to 2.7 km from the study ponds I found large numbers of marked newts an average of 1.7 km from their pond of origin. Thus it appears that highly accurate homing over long distances, and not limited mobility, keeps the subpopulations in these ponds largely independent. In a situation like this, maintaining habitat connectivity between aquatic and terrestrial habitats will be at least as important for conservation, and far more challenging, than maintaining connectivity among neighboring patches of breeding habitat.

PREY PREFERENCES OF THE NIGHT SNAKE (*HYPSIGLENA CHLOROPHAEA*): INVERTEBRATES VERSUS VERTEBRATES AND PREY SIZE. **Robert E Weaver and Kenneth V Kardong,** *School of Biological Sciences, Washington State University, Pullman, WA, 99163; weaverr@wsu.edu and kkardong@wu.edu*

Night Snakes (*Hypsiglena chlorophaea*) were collected during 2008 from 3 localities in Washington State, maintained in glass aquaria on a 12:12 light cycle, and fed a variety of known prey items. Water was available at all times. We collected odors from 3 possible invertebrate prey species: spider (*Tegenaria* spp.), scorpion (*Paruroctonus borealis*), and field crickets (*Gryllus* spp.). We then compared the responses of snakes to these invertebrate odors to known vertebrate prey odors. Further, to test whether H. chlorophaea can assess the size of potential prey, odors were collected from adult and juvenile garter snakes (*Thamnophis* spp.). We presented all odors on pre-moistened 13 cm cotton swabs held 2.5 cm in front of snake's snout. For each trial we recorded the number of tongue flicks/60 seconds, and the latency to first tongue flick. There was no significant difference in tongue flicks or latency between either spider, scorpion, or cricket odors to water or a pungency control. Snakes did respond with greater tongue flicks, and a decreased latency to a vertebrate odor over each invertebrate odor and water control. Snakes responded with increased tongue flicks to small snake odors over large snake odors. Our study is the first to show that at least for the invertebrates tested, H. chlorophaea does not exhibit a chemosensory response to these invertebrate prey odors, a result which is supported by current field work. This study is also the first to show that a snake can assess the size of potential prey via an odor stimulus.

AMPHIBIAN DECLINES IN THE SOUTHERN PACIFIC NORTHWEST: A REVIEW OF CURRENT PROJECTS TO INVESTIGATE THEIR STATUS ON NORTHWEST CALIFORNIA LANDSCAPES. **Hartwell H Welsh, Jr, Karen L Pope, Garth R Hodgson, Don T Ashton, and Clara A Wheeler,** *USDA Forest Service, Pacific Southwest Research Station, Redwood Sciences Laboratory, 1700 Bayview Drive, Arcata, CA 95521; hwelsh@fs.fed.us*

The herpetology research group at the Redwood Sciences Lab, in collaboration with graduate students at Humboldt State University and the University of California at Davis, has been studying the natural history, demography, and landscape ecology of amphibian assemblages in aquatic and terrestrial environments of Northern California for 23 years. A primary focus of our research has been the interactions between

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amphibian life histories and various human resource extraction practices and their effects on amphibian declines. In this talk, I discuss four studies that are a continuation of this trajectory. The first study explores links between geomorphic processes and the distributions of herpetofaunal species assemblages. The second study details the mating strategy and breeding patterns of the Foothill Yellow-legged Frog (*Rana boylii*) in a natural (undammed) stream system and their implications for altering natural flow regimes. The third study involves monitoring remnant populations of the Cascades Frog (*Rana cascadae*) in the Lassen Region of California, with a pilot experiment designed to recover populations in two mountain meadow systems. And the fourth study examines the use of stream amphibians as biometrics of ecosystem stresses resulting from changes in water temperature and fine sediment loads.

RESTORING TAYLOR'S CHECKERSPOT HABITAT IN GRASSLAND BALDS OF SOUTHWEST WASHINGTON. **David Wilderman,** *Washington Department of Natural Resources, 1111 Washington Street Southeast, Olympia, WA 98504; david.wilderman@dnr.wa.gov*; **Roberta Davenport,** *Washington Department of Natural Resources, 601 Bond Road, Castle Rock, WA 98611; roberta.davenport@dnr.wa.gov*

Bald Hill Natural Area Preserve (NAP), located near Yelm, Washington encompasses a patchwork of grassland bald habitats that supported Taylor's Checkerspot (*Euphydryas editha taylori*) as recently as 2006. Observations of shrub and tree encroachment in balds, lack of connectivity between balds, and low larval host and nectar plant abundance led to initiation of restoration activities in 2007. Coniferous trees and shrubs are being removed or controlled within balds and in areas that historically connected balds. Introduced species, including Orchard Grass (*Dactylis glomerata*), Scotch Broom (*Cytisus scoparius*), and Velvetgrass (*Holcus lanatus*) are also being treated through herbicide application and hand-pulling. Native grassland species are being used to restore degraded areas and to augment larval host and nectar resources. Pending treatments include removal of larger coniferous trees via helicopter, continued planting and seeding of native plant species, and experimental prescribed burning. To date, we have removed small conifers and controlled shrubs on nearly four acres, treated introduced species on one and one-half acres, and planted approximately 1500 plugs of native species. Seeds of 13 native grassland species have been collected from the site and are being used for propagation of transplants as well as for seed increase beds. Preliminary seeding trials indicate that direct seeding may be useful for annual species and for locations where transplanting is not practical. Planting and seeding has included native grasses, as well as larval host and nectar species such as Harsh Paintbrush (*Castilleja hispida*), Rosy Plectritis (*Plectritis congesta*), Small-flowered Blue-eyed Mary (*Collinsia parviflora*), and Spring Gold (*Lomatium utriculatum*).

AMPHIBIAN ROAD MORTALITY: EFFORTS OF A YOUTH GROUP. **Elke Wind,** *E. Wind Consulting/Nanaimo Young Naturalists' Club, Suite A – 114 Fifth Street, Nanaimo, BC V9R 1N2; ewind@telus.net*

The Nanaimo Young Naturalists' Club members aged 10 and up have been studying the effects of automobile traffic on amphibian populations along a 9-km rural road on Vancouver Island since 2006. They obtained a small amount of funding in 2007 to meet three main objectives: study ways of reducing the impact of the road and associated traffic on local amphibians, work with the Ministry of Transportation on the issue, and increase public awareness. To date, the group has conducted more than 30 road surveys and observed over 2200 amphibians. All nine native amphibian species have been found on the road with the vast majority being dead. Nearly 70% of amphibians encountered have been Rough-skinned Newts (*Taricha granulosa*), which may be particularly susceptible to road traffic due to their diurnal activity. "Hot spots" of amphibian migration along the road were identified, and temporary fencing was installed in one of these areas to direct amphibian movements towards an existing culvert. However, the majority of culverts examined during the fall migration exhibited high water volume and flow rates and appeared unsuitable as wildlife underpass systems. More research is needed to determine the impact of current mortality rates as a result of road traffic on local populations, as well as the effectiveness of culverts as safe passages. Media coverage of this issue has increased public awareness in the local area and throughout the province.

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MONITORING FOREST CARNIVORES ON THE GIFFORD PINCHOT NATIONAL FOREST, MOUNT ADAMS RANGER DISTRICT. **Jocelyn Akins,** *Cascades Carnivore Project, 1514 Belmont Avenue, Hood River, OR 97031; cascadescarnivore@gmail.com*; **David Anderson,** *Southwest Region, Washington Department of Fish and Wildlife, PO Box 68, Trout Lake, WA 98650; anderdpa@dfw.wa.gov*

We have initiated a long-term monitoring program through the establishment of stations consisting of a remote digital camera, a hair snare, and an attractant, as well as a winter tracking program. Efforts involve citizen scientists as the project recognizes the importance of partnering the public with wildlife managers to address regional conservation concerns. Our goals are to determine occupancy of elusive or historically present carnivores such as the Cascade Red Fox (*Vulpes vulpes cascadensis*), Wolverine (*Gulo gulo*), Fisher (*Martes pennanti*), Gray Wolf (*Canis lupus*), and Lynx (*Lynx canadensis*), and to understand their origins through genetic analysis. As well we are investigating habitat use in resident carnivore populations, such as the American Marten (*Martes americana*), Black Bear (*Ursus americanus*), Mountain Lion (*Puma concolor*), Coyote (*Canis latrans*), and Bobcat (*Lynx rufus*). Interim results confirm the presence of the Cascade Red Fox at several locations while no other rare species has been confirmed outside of anecdotal sightings. All resident species of interest, excepting the Bobcat, have been documented. Station locations are set to target specific species and range in elevation from 3300 to 6600 ft. The status of forest carnivores is not well monitored in the district; certain species may be threatened due to human activities such as hunting, winter recreation, and logging. Future work includes determining the impact of winter recreation uses on forest carnivore populations. By understanding the impacts of these activities on forest carnivores, we can determine how they may help or hinder the conservation needs of vulnerable species.

DIVERSITY OF WATER MOLDS INFECTING AMPHIBIAN EMBRYOS. **Kori K Ault, R Steven Wagner, Holly Pinkart and James E Johnson,** *Department of Biological Sciences. Central Washington University. 400 East University Way. Ellensburg, WA 98926-7537; aultko@cwu.edu, wagners@cwu.edu, pinkarth@cwu.edu and jjohnson@cwu.edu*

Water molds, primarily in the genus *Saprolegnia*, have been implicated in large-scale mortality of amphibian eggs under a variety of environmental conditions. Although a number of water mold species infect amphibian eggs, the pathogens involved in die-offs or used in ecological studies often remain unidentified or identified as only one of three species (*S. ferax*, *S. parasitica* or *S. diclina*). Lack of adequate identification makes it difficult to assess factors of the host-parasite interaction that contribute to saprolegniasis in amphibians. Furthermore, recent work indicates that the diversity of *Saprolegnia* infecting amphibian embryos may be significantly higher than what was previously known. We used Denaturing Gradient Gel Electrophoresis (DGGE) to assess the diversity of *Saprolegnia* on amphibian eggs from a single pond in central Washington. Unlike traditional morphological methods of identification, which have proven ineffective, and isolation methods, which often recover only the fastest growing taxa, DGGE allows us to quickly identify all the different potentially pathogenic organisms associated with a single embryo using small fragments of DNA. In this study, we found that most infected eggs contain multiple bands representing different species of water molds. These fragments will be sequenced and identified to species using a DNA barcoding procedure. This method has an advantage over simple DNA barcoding because it assures that we capture all the taxa growing on an individual egg. Based on these results, we strongly recommend that ecological studies of amphibian saprolegniasis take into account the diversity of and potential interactions between these pathogenic water molds.

USING REPEATED PRESENCE/ABSENCE SURVEYS TO DETECT TREND IN STREAM ASSOCIATED AMPHIBIAN ABUNDANCE ON MANAGED FORESTS. **Eric Beach,** *Green Diamond Resource Company, 215 N 3rd St. Shelton, WA 98584; ebeach@greendiamond.com*

A suite of stream associated amphibians that include Cope's Giant Salamander, (*Dicamptodon copei*), Olympic Torrent Salamander (*Rhyacotriton olympicus*), and Coastal Tailed Frog (*Ascaphus truei*) are used as Habitat Conservation Plan (HCP) effectiveness monitoring indicators in perennial, non-fish bearing streams on the foothills of the Southern Olympic Mountains. Adaptive management discussions will be initiated if monitoring results indicate declines in abundance or changes in the spatial distribution of these amphibians. Our monitoring approach uses site occupancy probabilities to reflect the status of

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the amphibian population. Given the life history characteristics of the target species, the detection of animals is difficult and detection rates are generally less than 1. Recent methodologies allow the use of repeated presence/absence surveys to account for imperfect detection of these species. These methods provide unbiased estimates of detection probability and occupancy. Prior work indicates that detection and occupancy rates may vary by environmental variates such as the lithology underlying the stream network. By stratifying our sample population by the covariates that shape detection rates we account for a portion of the variation in detection probability. The variation of detection probability within strata may be inferred as variation in animal abundance. Thus estimates of abundance can be made from repeated occupancy sampling. Heterogeneity detection probability models are used to estimate the underlying distribution of amphibians. Annual, repeated sampling of sites will provide unbiased estimates of the vital rates of stream-associated amphibians over the course of the HCP implementation (i.e., through 2050).

QUERIES ABOUT QUARRIES: WHAT ARE THEIR EFFECTS ON WETLAND HABITAT?
Barbara Beasley, *P.O. Box 927, Ucluelet, BC, V0R 3A0; beasley@island.net*

Gravel extraction potentially alters wetland habitats by modifying local ground water flow rates, water levels and water quality. As a result, wetlands could be degraded, for example, they could experience shortened hydroperiods causing them to dry up before amphibian larval development is complete. I propose to examine the effects of an expanding gravel quarry on an adjacent 4-ha wetland used by breeding Red-legged Frogs (*Rana aurora*), Northwestern Salamanders (*Ambystoma gracile*), Pacific Treefrogs (*Pseudacris regilla*) and Rough-skinned Newts (*Taricha granulosa*) on the west coast of Vancouver Island. The purpose of presenting this poster is to learn from the experience of others who have addressed similar issues. Please stop by and share your ideas about how best to monitor the potential effects of gravel extraction on an adjacent wetland, and how to mitigate, compensate or restore altered hydrology and water quality.

DISTRIBUTION AND PERSISTANCE OF LARVAL ASCAPHUS TRUEI IN STREAMS ON MANAGED SECOND GROWTH FORESTS IN NORTH COASTAL CALIFORNIA.
Ryan Bourque, Cristina Dressel and Lowell Diller, *Green Diamond Resource Company, 600 Riverside Road, Korbel, CA, 95550; rbourque@greendiamond.com, cdressel@greendiamond.com and ldiller@greendiamond.com*

We studied the distribution and persistence of Coastal Tailed Frog (*Ascaphus truei*) larvae in headwater streams of managed second-growth forests in north coastal California. This study is part of an aquatic habitat conservation plan, with the objective to document long-term changes in larval *A. truei* populations and assess potential impacts of forest management activities. Larval distribution was initially determined in 1995 from occupancy surveys conducted at 73 randomly selected stream segments, which found that 74% of all surveyed streams (80% excluding geologically unsuitable areas) had tailed frogs. In 2008 we revisited 90% of the streams previously surveyed and 20 new randomly selected streams. We detected larvae at 81% of all streams surveyed, and 82% of sites initially visited in 1995. The detection probability was 91% for the survey method used. These preliminary findings demonstrate that occupancy rates of *A. truei* increased in headwater streams of the redwood forest region, and suggest that populations will persist under current silviculture management practices.

COMPARING EFFICACY OF TWO HERBICIDES IN TREATMENT OF TALL OATGRASS ON SOUTH PUGET SOUND PRAIRIES.
Casey Dennehy and Cliff Chapman, *The Nature Conservancy of Washington, 120 E. Union Ave #215, Olympia, WA 98501; cdennehy@tnc.org*

The South Puget Sound prairie ecosystem is one of the most unique habitats in Washington state and is considered one of the most endangered ecosystems in North America. The primary biological threat to South Puget Sound grasslands is the establishment of non-native noxious weeds, which can modify the composition, structure and function of the landscape by degrading the prairie and displacing native vegetation. One of the most destructive invasive species that occur on these grasslands is Tall Oatgrass (*Arrhenatherum elatius*). Tall Oatgrass proliferates rapidly and has the ability to create dense monoculture stands that exclude species that rely on native vegetation for survival. Aggressive management to control

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invasive species is a high priority in restoring South Puget Sound prairie habitats. In previous years, Poast (sethoxydim) has been the herbicide of choice to control Tall Oatgrass and other invasive grasses; however, concerns about non-target toxicity have led managers to try other herbicides. To date there had been no comparisons between additional herbicides available for use. We compared efficacy of two grass-specific herbicides, Poast and Fusilade DX (Fluazifop), on removal of Tall Oatgrass at a prairie site on Fort Lewis. Our data show that Fusilade DX was significantly more effective than Poast at reducing cover of Tall Oatgrass in treatment plots. Because it was more effective, is less toxic, and is less mobile, we recommend the use of Fusilade DX over Poast to treat invasions of tall oatgrass.

ECOLOGICAL GENETICS OF THE THREATENED COASTAL GIANT SALAMANDER (*DICAMPTODON TENEBROSUS*) IN BRITISH COLUMBIA. **Rachael Y Dudaniec and John S Richardson,** *University of British Columbia, Department of Forest Sciences, 3041-2424 Main Mall, Vancouver, BC V6T 1Z4; rachael.dudaniec@ubc.ca and john.richardson@ubc.ca*

Although the Coastal Giant Salamander (*Dicamptodon tenebrosus*) is widely found along the west coast of the United States, in Canada the species only occurs in a 100 km^2 area within ~60 small streams of the Chilliwack River Valley of British Columbia. There, the species is considered threatened by forestry practices and other human land uses, while little is known of the life-history, dispersal and behaviour of this salamander. Searches for *D. tenebrosus* were conducted over two months of 2008 in 19 streams representing a variety of forest ages and habitat characteristics. We used molecular data (microsatellites) to examine genetic structure and gene flow within and across sites in relation to stream habitat variables and forest characteristics. Habitat use of larval *D. tenebrosus*, abundance, size class, and body condition differed markedly between sites (N = 425 salamanders). Preliminary molecular data show that allelic richness in British Columbian populations is comparably lower than those from the United States, further contributing to this species' vulnerability to habitat disturbance and population decline. Information obtained from both molecular (e.g., dispersal, inbreeding) and ecological (e.g., landscape features, habitat use) data will aid in the management of *D. tenebrosus*, as well as other amphibians threatened by forestry practices.

SURVEYS FOR BIRDS, MAMMALS, AND REPTILES ALONG A TRANSMISSION LINE CORRIDOR IN DOUGLAS COUNTY, WASHINGTON. **Mike Hall,** *Parametrix, 411 108th Avenue Northeast, Suite 1800, Bellevue, WA 98004; mhall@parametrix.com*; **Jim Koloszar,** *Parametrix, 700 NE Multnomah, Suite 1000, Portland, OR 97232; jkoloszar@parametrix.com*

During spring and autumn 2008, we conducted surveys for birds, mammals, and reptiles along the 41-mile transmission line corridor for the Wells Hydroelectric Project operated by the Douglas County Public Utilities District. In addition to documenting the presence and habitat use of birds during the breeding and fall migration seasons, we collected data to document the use of transmission structures by raptors and corvids, and evidence of avian collisions with the transmission line and associated structures. Particular emphasis was devoted to documenting the presence and habitat associations of rare, threatened, and endangered (RTE) species. More than 100 bird species were observed during point-transect surveys; the most common species were those associated with shrub-steppe habitat, which is the most common native vegetation cover type in the study area. Eleven raptor or corvid nests were detected within or adjacent to the study area, eight of which were on electrical transmission towers. Six bird carcasses were found during survey efforts; none showed clear evidence of collision. Two avian RTE species were documented in the study area. These were Sage Thrasher (*Oreoscoptes montanus*) and Golden Eagle (*Aquila chrysaetos*), both state candidate species. No RTE mammals or reptiles were observed.

A CONSERVATION ASSESSMENT FOR THE OLYMPIC TORRENT SALAMANDER (*RHYACOTRITON OLYMPICUS*). **Betsy L Howell,** *Olympic National Forest, USDA Forest Service, 1835 Black Lake Boulevard. Suite A, Olympia, WA 98512; blhowell@fs.fed.us*; **Christopher R Roberts,** *P.O. Box 405, Kalama, WA 98625; crroberts0@yahoo.com*

The goal of this Conservation Assessment was to provide the most up to date information known about the Olympic Torrent Salamander (*Rhyacotriton olympicus*), including life history, habitat, potential threats, management considerations, and data and information gaps. This species is of concern because

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of its limited distribution and sensitivity to disturbance of stream and seep habitats. The information presented in the Conservation Assessment was compiled to help manage the species in accordance with Forest Service Region 6 Sensitive Species (SS) policy and Oregon/Washington Bureau of Land Management Special Status Species (SSS) policy. *R. olympicus*, one of four torrent salamanders in the Pacific Northwest, is found only on the Olympic Peninsula. Most of the documented locations are known from federal lands, either Olympic National Park (77%) or Olympic National Forest (15%). The species is associated with permanent, cool or cold-water sources, such as seeps, waterfalls, headwaters, and edges of larger streams. Potential threats include the presence of culverts and roads, timber harvest, and chemical applications. Approximately 39% of the range of *R. olympicus* is within federal ownership and 65% of those acres are in congressionally reserved lands (the Park and wildernesses within Olympic National Forest). Management considerations include protecting headwater stream habitat, expanding riparian reserve boundaries, and replacing culverts that do not allow for amphibian passage. Data gaps include distribution of the species across the peninsula, particularly in the southern part of its range, microclimate needs, and a better understanding of terrestrial movements.

TERRESTRIAL AMPHIBIAN DISTRIBUTIONS AND THEIR HABITAT ASSOCIATIONS ON MANAGED HEADWATER FOREST LANDSCAPES IN THE OREGON COAST RANGE. **Matthew R Kluber and Deanna H Olson,** *USDA Forest Service, Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331; mkluber@fs.fed.us and dedeolson@fs.fed.us*; **Klaus J Puettmann,** *Department of Forest Ecosystems and Society, Oregon State University, 321 Richardson Hall, Corvallis, OR 97331; klaus.puettmann@oregonstate.edu*

Since the 1950s forested landscapes of the Pacific Northwest have become increasingly patchy, dominated by early-successional forests. Several amphibian species associated with forested headwater systems have emerged as management concerns, especially after clearcutting. Given that headwater streams comprise a large portion of the length of flowing waterways in western Oregon forests, there is a need to better understand how forest management affects headwater forest taxa and their habitats. Forest management strategies that consist of only partial canopy removal and retention of riparian buffers may help ameliorate some of the negative effects that clearcutting has had on amphibians in managed forests. Our study investigates effects of upland forest thinning coupled with riparian buffer treatments on riparian and upland headwater forest amphibians, habitat attributes, and species-habitat associations. Amphibian captures and habitat variables were examined 5 to 6 years post-thinning within forest stands subject to streamside-retention buffers and variable-width buffers, as well as unthinned reference stands. Distance from stream was found to be associated with amphibian abundance. However, no effect of treatment was seen. Our results suggest that ground surface conditions (e.g., amount of rocky or fine substrate) play a role in determining the response of riparian and upland amphibians to forest thinning along headwater streams. Moderate thinning and preservation of conditions in riparian and nearby upland areas by way of variable-width and streamside-retention buffers may be sufficient to maintain suitable habitat and microclimatic conditions vital to amphibian assemblages in managed headwater forests.

EFFECTS OF SEA LEVEL RISE ON BEACH SPAWNING HABITAT. **Kirk Krueger, Ken Pierce, Timothy Quinn, Dan Penttila, David Price, Kurt Perry and Tiffany Hicks,** *Washington Department of Fish and Wildlife, 1111 Washington Street Southeast, Olympia, WA 98501;Kirk.Krueger@dfw.wa.gov, Kenneth.PierceJr@dfw.wa.gov, Timothy.Quinn@dfw.wa.gov, penttdep@dfw.wa.gov, David.Price@dfw.wa.gov, perrykvp@dfw.wa.gov, and Tiffany.Hicks@dfw.wa.gov*

Sea level is expected to rise significantly in this century and scientists expect the rise in sea level to affect the structure and function of the Salish Sea ecosystem. Protecting and restoring the Salish Sea ecosystem given these effects constitute important management and policy challenges. Fishes that spawn on beaches, such as Surf Smelt (*Hypomesus pretiosus*) and Pacific Sand Lance (*Ammodytes hexapterus*), might be especially affected due to loss of suitable spawning habitat. Because these fishes are important forage for many other species, population decline due to loss of their spawning habitat might cascade through the Salish Sea food web. Further, the effects of sea level rise on these fishes might be especially detrimental where human activities constrain natural beach processes. We use a dataset that describes the spatial distribution of Surf Smelt and Pacific Sand Lance spawning on several beaches of Puget Sound

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and predictions of sea level rise to model some likely effects to the spawning habitat and spawning success of these fishes on Camano Island. Some implications of our results to Puget Sound are discussed.

AMPHIBIAN POPULATIONS AND ECOLOGICAL CONNECTIVITY: MONITORING MOVEMENT ALONG THE I-90 CORRIDOR IN THE EASTERN CASCADE RANGE OF WASHINGTON. **Michelle Lester, April Barreca, Susan Brady, Brenna Hill, Jason T Irwin and R Steven Wagner,** *Central Washington University Department of Biological Sciences Graduate Program, 400 E University Ave, Ellensburg, WA 98926; lesterm@cwu.edu, barreca@cwu.edu, belmonts@cwu.edu, hillb@cwu.edu, irwinj@cwu.edu and wagners@cwu.edu*

High-traffic roads often isolate local animal populations, especially low-mobility organisms such as amphibians, often decreasing their abundance and long-term viability. In order to assess abundance, map distribution and develop a baseline monitoring protocol and evaluate the road affect on amphibian populations in the I-90 corridor, we compared several different capture methods, including funnel trapping, minnow trapping, visual encounter surveys, rubble rousing, dip netting and pitfall trapping with drift fences throughout a 15-mile stretch of Interstate 90, between June and October, 2008. In addition, various marking techniques were compared at four different sites to assess efficiency of each monitoring method as well as effectiveness of current crossing structures which included: elastomer tags, toe-clipping and radio transmitters. Overall, 627 individuals of seven different species were marked using elastomer tags, toe clipping and radio transmitters. Funnel traps provided the most captures (N = 268) followed by dipnetting (N = 201) and visual encounter surveys (N = 130). Recapture rates were low with only six Cascades Frogs (*Rana cascadae*). These preliminary results indicate that current crossing structures are insufficient in connecting amphibian populations north and south of I-90. However, based on the challenges of dense vegetation and labor intensive monitoring methods that likely facilitated low recapture rates, we recommend the use of PIT tags and antennae installed within crossing structures to examine movement. We also recommend the use of Cascades Frog, Pacific Chorus Frog (*Pseudacris regilla*) and Northwestern Salamander (*Ambystoma gracile*), widespread and locally abundant species with different habitat needs, as focal species in assessing roadway movements and connectivity.

ESTIMATING INDIVIDUAL DETECTION PROBABILITY AND ABUNDANCE FOR STREAM-ASSOCIATED AMPHIBIANS USING MULTIPLE VISIT SURVEYS. **Eric M Lund, Aimee P McIntyre and Marc P Hayes,** *Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, WA 98501; eric.lund@dfw.wa.gov, aimee.mcintyre@dfw.wa.gov, marc.hayes@dfw.wa.gov*; **Jay Jones, Steven D Duke and Andrew J Kroll,** *Weyerhaeuser Company, Federal Way, WA 98063-9777; jay.jones@weyerhaeuser.com, steve.duke@weyerhaeuser.com, and aj.kroll@weyerhaeuser.com*

Most stream-associated amphibian studies have used count data to index abundance. Inferences based on comparisons of these indices over time or space assume that detection probability remains constant. As part of an experimental study to examine the effectiveness of different riparian buffer prescriptions on non-fish-bearing stream basins, we employed a recently developed statistical method to estimate individual capture probability and abundance using data collected from in-stream amphibian surveys repeated over multiple sampling occasions during the pre-harvest interval. We conducted these surveys for focal amphibians (*Ascaphus truei*, *Rhyacotriton*, and *Dicamptodon*) in 45 30-m plots in 18 study basins across southwest Washington state, using a longitudinal light-touch method whereby all moveable objects on the streambed that were gravel-sized or larger were overturned. We sampled plots on 3 visits spaced 1-4 days apart in July-August 2008; 31 of the 45 plots were sampled again during a second set of 3 visits in September 2008. We estimated detection probabilities to be less than 0.40 for all 3 taxa. Repetition of these multiple pass surveys following completion of harvest treatments will allow for a comparison of detection probabilities over time as well as incorporation of the probabilities into unbiased estimates of abundance before and after harvest. We describe additional applications of this methodology and future research plans.

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MONITORING IMPLEMENTATION OF LARGE, STRUCTURALLY UNIQUE TREES ON WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCE LANDS COVERED BY LAND MANAGEMENT'S HABITAT CONSERVATION PLAN. **Danielle Munzing,** *Washington Department of Natural Resources, 1111 Washington Street Southeast, Olympia, WA 98501; danielle.munzing@dnr.wa.gov*

According to the Washington State Department of Natural Resources' (DNR) Habitat Conservation Plan (HCP), implementation monitoring documents the types, amounts, and locations of forest management activities carried out on DNR-managed lands in HCP planning units. In 2008 we monitored the implementation of the Large, Structurally Unique Tree Strategy (also known as Leave Tree Strategy) throughout Western Washington on DNR's HCP managed lands. We monitored 41 harvested timber sale units by counting all leave trees and collecting data on diameter at breast height, species, blow down, live trees, snags, and overall pattern of leave trees across each timber sale unit. Preliminary results show that 36 out of the 41 units monitored left at least 90% of the total leave trees required to meet DNR's HCP commitment. Leave trees on the remaining 5 units met at least 80% of the required number of leave trees. The amount of blown down leave trees ranged between 0 and 46%. Snags were deficient (0.2 snags per acre), in terms of meeting the HCP requirement of 3 snags per acre. Our monitoring indicates that DNR is meeting requirements for overall number of leave trees; however the agency may want to consider methods for snag recruitment. The results from our leave tree monitoring will be useful to both foresters in the field and upper level management.

AGGREGATIVE RESPONSE OF A MOBILE INVERTEBRATE PREDATOR TO OREGON SPOTTED FROG EGG MASSES AT TIME OF TADPOLE EMMERGENCE. **Michael S Parker,** *Department of Biology, Southern Oregon University, 1250 Siskiyou Blvd., Ashland, OR 97520; parker@sou.edu*

Aquatic Hemiptera are common predators of anuran tadpoles in a variety of habitats. Here, I present results of a field study that demonstrates a strong aggregative response by the backswimmer Notonecta unifasciata to Oregon Spotted Frog (*Rana pretiosa*) tadpoles at an isolated wetland in SW Oregon. Both visual counts and sweep net sampling revealed that at the time of tadpole emergence and dispersal from the egg mass, Notonecta density within 0.5 m of oviposition sites increased significantly compared to non-oviposition sites with similar habitat characteristics. There was a positive correlation between water depth and predator abundance among oviposition sites suggesting that oviposition site characteristics may influence predation rates on dispersing tadpoles. *R. pretiosa* is a communal breeder and egg masses are typically deposited in shallow water over dense vegetation. After hatching, tadpoles congregate on top of the remaining egg mass jelly near the water surface where they can put on substantial growth before dispersing. These life history characteristics likely reduce susceptibility to mobile, nektonic predators.

ANNUAL PATTERNS OF INTERTIDAL SPAWNING HABITAT USE BY SURF SMELT AND PACIFIC SAND LANCE AROUND CAMANO ISLAND, WASHINGTON. **Timothy Quinn, Dan Penttila, Kirk Krueger, David Price, Kurt Perry, Tiffany Hicks and Brian Benson,** *Washington Department of Fish and Wildlife, 1111 Washington Street Southeast, Olympia, WA 98501; Timothy.Quinn@dfw.wa.gov, penttdep@dfw.wa.gov, Kirk.Krueger@dfw.wa.gov, David.Price@dfw.wa.gov, perrykvp@dfw.wa.gov and Tiffany.Hicks@dfw.wa.gov*

Marine shoreline development can negatively affect intertidal spawning habitat for Surf Smelt (*Hypomesus pretiosus*) and Pacific Sand Lance (*Ammodytes hexapterus*). For example, Surf Smelt eggs are sensitive to the removal of shade along the shoreline and shoreline armoring can starve beaches of fine sediments on which forage fish species spawn. To help understand how human development might affect these beach-spawning fish, we collected spawning data every two weeks at 51 Camano Island beaches from September 2007 through August 2008. Samples were taken along transects at two tidal elevations (+10.0 ± 0.7 ft MLLW and ~ +8.0 ft MLLW). We estimated egg density and egg mortality and summarized live and dead egg counts (combined samples at each transect) by site and through time for both species. Surf Smelt spawning activity is spread over an 8-month period with peak activity in late summer and early fall. Surf Smelt egg mortality peaks in spring just before peak spawning activity. Egg mortality for Surf Smelt reaches nearly 75% during June and July and is relatively high compared to Sand

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Lance egg mortality. A small percentage of sites (20%) appear to support the vast majority of Surf Smelt spawning activity around Camano Island and these sites as well as sites with little or no spawning activity appear to be spatially clustered. Sand Lance egg counts were much smaller than Surf Smelt egg counts even during peak spawning. Spawning activity is strongly seasonal with peak abundance in early winter. The spatial distribution of Sand Lance eggs was highly skewed with the vast majority of eggs coming from a single site. In the near future we will assess the contribution of beach characteristics, including human disturbance, to egg abundance and egg mortality.

RESTORATION OF RIPARIAN WILDLIFE HABITAT IN CALIFORNIA'S CENTRAL VALLEY. **Nathaniel E Seavy,** *PRBO Conservation Science, Petaluma, CA 94954 and Department of Environmental Science and Policy, UC Davis, Davis, CA 95616-8576; nseavy@prbo.org*; **Thomas Gardali and Christine A Howell,** *PRBO Conservation Science, Petaluma, CA 94954*

Riparian areas are important for wildlife because they provide breeding, migration, and wintering habitat and connect aquatic resources with terrestrial systems. In California's Central Valley, riparian habitat has been severely degraded by agricultural development, urbanization, and hydrological modifications, resulting in the loss of more than 90% of the historic riparian habitat. Since 1993, PRBO Conservation Science has been conducting studies to evaluate and enhance restoration activities designed to improve wildlife habitat. In the Sacramento Valley, we have measured the response of birds to different restoration designs and used this information to recommend restoration practices that will benefit bird communities. In the San Joaquin Valley, we are using bird monitoring to evaluate one of the most ambitious riparian restoration efforts in North America. Now, the need to prepare ecosystems for climate change has increased the urgency of riparian restoration. Our own experience and feedback from restoration practitioners indicates that one-on-one interactions between ecologists and land managers are critical components of this process. Our collaborative research program is providing relevant and accessible information to decision makers to advance the protection and restoration of riparian habitats.

TORRENT SALAMANDER MOVEMENT ECOLOGY: PERSPECTIVE ON A "SEDENTARY" SPECIES. **Julie A Tyson and Marc P Hayes,** *Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, WA 98501; tysonjat@dfw.wa.gov and hayesmph@dfw.wa.gov*

Torrent salamanders (genus *Rhyacotriton*) are potentially characterizable as the most sedentary amphibians in the Pacific Northwest. Maximum reported movements for any life stage span only 22 m. In the course of a manipulative study examining amphibian response to different levels of shade, we opportunistically obtained 60 captures of larval Olympic Torrent Salamanders (*R. olympicus*) that had escaped from stream enclosures. Within the same year (season), 34 unique individuals moved distances ranging up to 122 m over intervals spanning 2 to 119 days. Thirteen of these animals moved 2 to 100 m further than the maximum reported for any *Rhyacotriton* life stage. Further, 4 unique individuals recaptured over intervals of 352 to 415 days in different calendar years moved 2 to 93 m. Though our data consist of escapees from stream enclosures, they illustrate that larval torrent salamanders are capable of moving distances substantially greater than previous reports. Moreover, design of all previous studies that have some ability to describe movements in *Rhyacotriton* have not attempted recaptures outside a limited footprint, which makes underestimation of movement scale unavoidable. These findings strongly suggest that movement scale in *Rhyacotriton* merits re-investigation.

SEX-SPECIFIC IDENTIFICATION OF *ASCAPHUS TRUEI* AT MATURITY. **Frithiof T Waterstrat,** *Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, WA 98501; waterftw@dfw.wa.gov*; **April B Barreca,** *Central Washington University, 400 East University Way, Ellensburg, WA 98926; BarrecaA@cwu.edu*; **Marc P Hayes,** *Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, WA 98501; hayesmph@dfw.wa.gov*

Examination for a cloacal tail is the typical mode of field determination of sex in male Coastal Tailed Frogs (*Ascaphus truei*). As males mature they also exhibit secondary sexual characteristics: nuptial pads; textured patches specific to the chest, chin, and digits of the front feet; and enlarged forearms. Determination of sex in females typically represents a default (absence of the male pattern). We are interested in the

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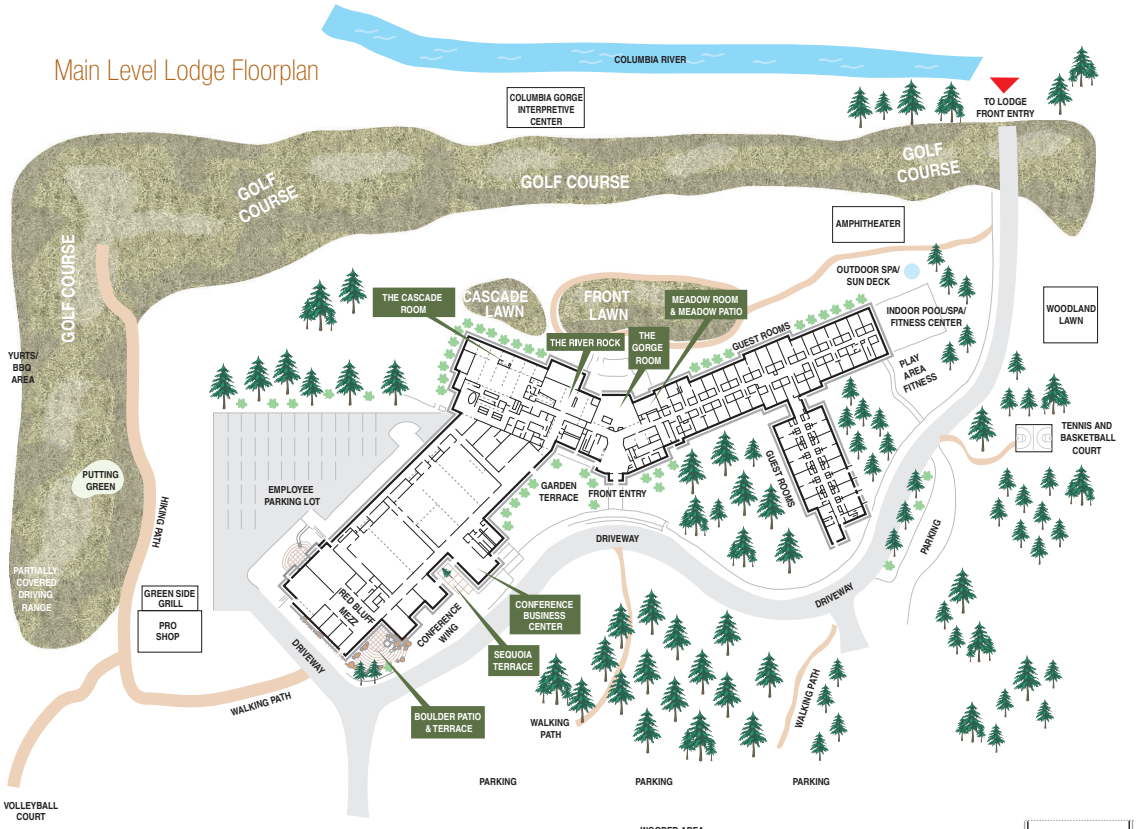
concordance between external sex determination and presumably more precise determination based on gonadal examination. We had concern that using a smaller male default size might overestimate mature female numbers, or alternatively using mean adult size might underestimate male numbers and overestimate female numbers. We determined the sex of over 300 frogs by external examination from collections made at seven localities during late summer/early fall 1984 and 1985, scoring or measuring the aforementioned sexual characteristics. We then dissected these frogs to verify gender, assessed gonad development and measured gonad size to evaluate sexual maturity. Identification of maturity from plotted gonad-to-body-size data by visual examination versus using piece-wise regression differed for males and females. Regression fit of all female data has a high variance, the largest source of which likely reflects biennial reproduction, though pooling localities also contributes. Partitioning reproductive from non-reproductive adult females results in estimates of size at maturity for the two methods converging. Our continuing analyses of these data seek to minimize variance in estimates in size at maturity for both sexes.

AMPHIBIAN PRODUCTION IN STORMWATER DETENTION PONDS, KING COUNTY, WASHINGTON. **Amy Yahnke,** *College of Forest Resources, University of Washington, Seattle, WA 98195; aey@u.washington.edu*; **Christian Grue,** *Washington Cooperative Fish and Wildlife Research Unit, Box 355020, School of Aquatic and Fisheries Science, University of Washington, Seattle, WA 98195; cgrue@u.washington.edu*; **Marc Hayes,** *Washington Department of Fish and Wildlife, Olympia, WA 98501; marc.hayes@dfw.wa.gov*

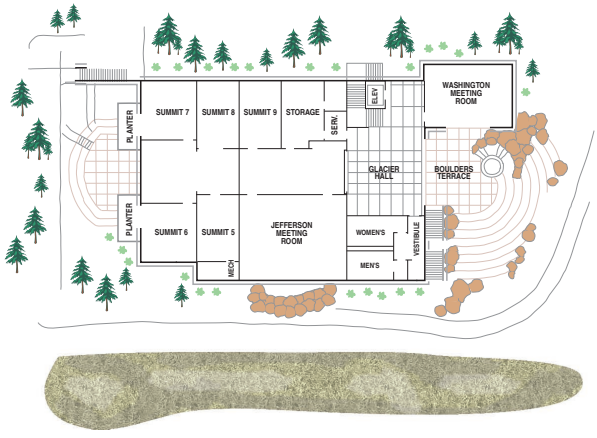
In King County, Washington, stillwater-breeding amphibians commonly use stormwater ponds as breeding habitat. However, frequent water level fluctuations, short hydroperiods, and contaminant loading (metals, nutrients, oils, and pesticides) may limit reproductive success. Conversely, the open canopies and warmer waters typical of the ponds may attract breeding animals and promote faster development, resulting in larger metamorphs, potentially enhancing survival. Through surveys of egg masses, larvae and post-metamorphs, we are assessing the reproductive success of two native amphibians, Northern Red-legged Frogs (*Rana aurora*) and Northwestern Salamanders (*Ambystoma gracile*) across a gradient of three stormwater pond categories based on their adjacent upland habitat structure. In these 2-cell (inlet [I] and outlet [O]) ponds, we are also monitoring the basic water quality parameters to which developing amphibians are exposed and collecting water samples for pesticide analyses. This study will provide novel data about a poorly explored area of urban ecology: the potential influence of stormwater ponds on amphibian populations. We present preliminary results for the first year of study (2008) that suggest stormwater ponds with open canopies and access to terrestrial habitat support greater amphibian production (egg masses: *R. aurora* – 128 I, 248 O; *A. gracile* – 62 I, 363 O) than those surrounded by residential yards (*R. aurora* – 0 I, 2 O; *A. gracile* – 8 I, 1 O) and those with closed canopies in more forested settings (*R. aurora* – 27 I, 74 O; *A. gracile* – 56 I, 78 O). Results of initial pesticide analyses will also be presented.

SKAMANIA LODGE CONFERENCE CENTER FLOORPLANS

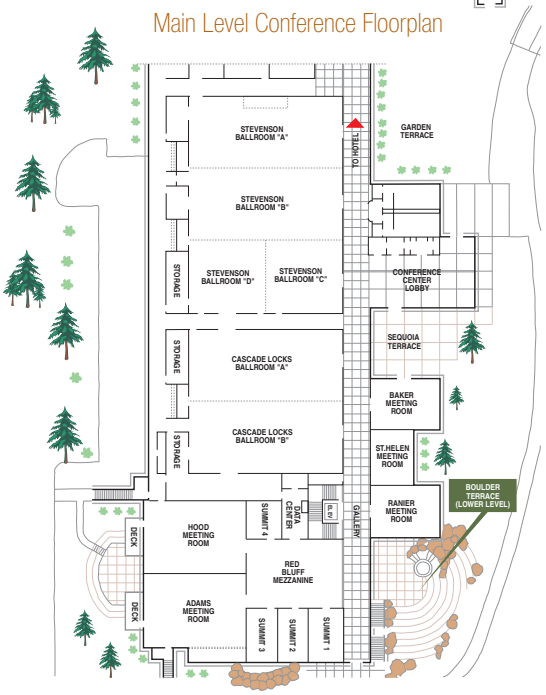
Main Level Lodge Floorplan



Lower Level Conference Floorplan



Main Level Conference Floorplan



1311 S.W. Skamania Lodge Way PO Box 189 Stevenson, WA 98648 1.800.376.9116 www.skamania.com