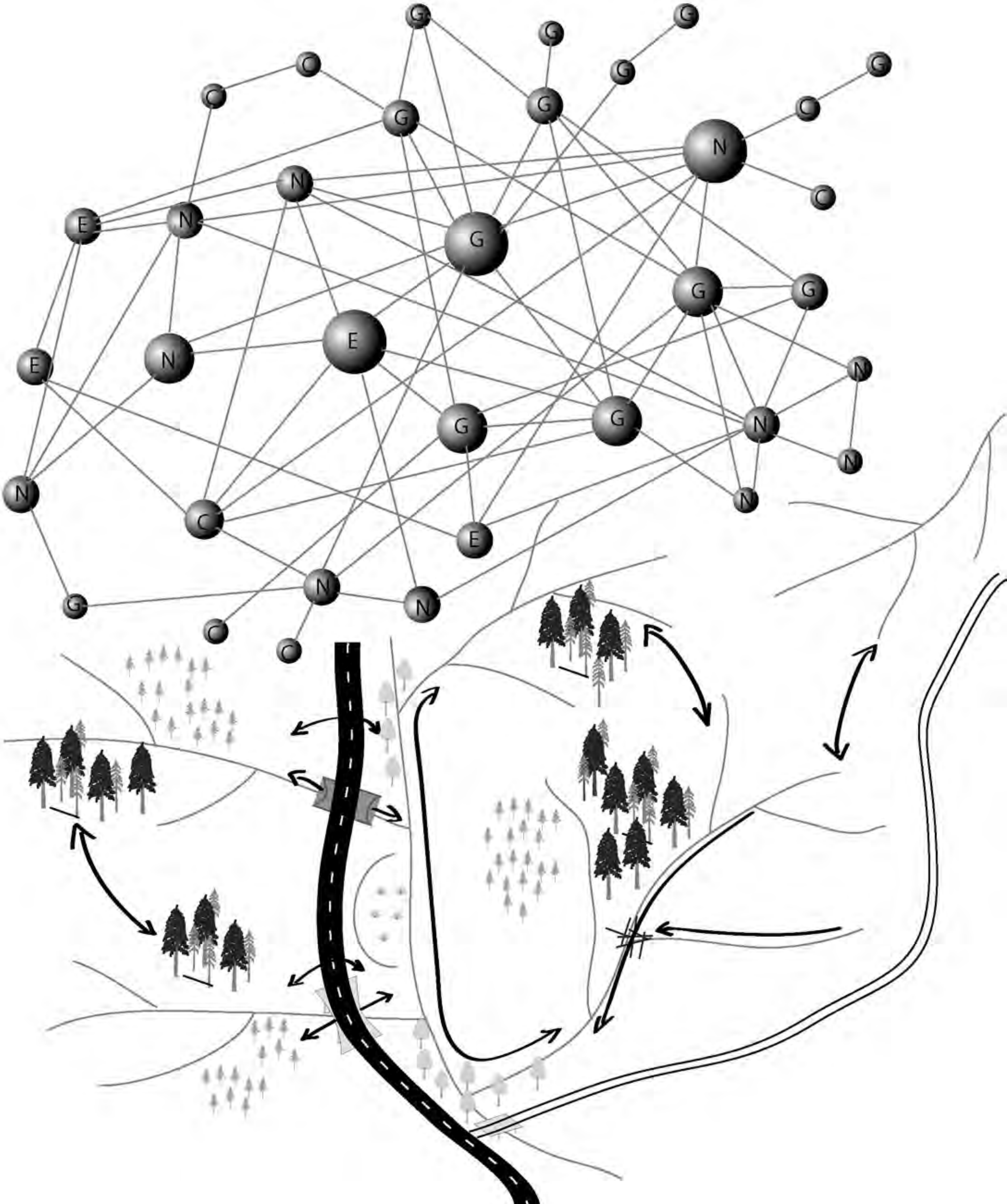
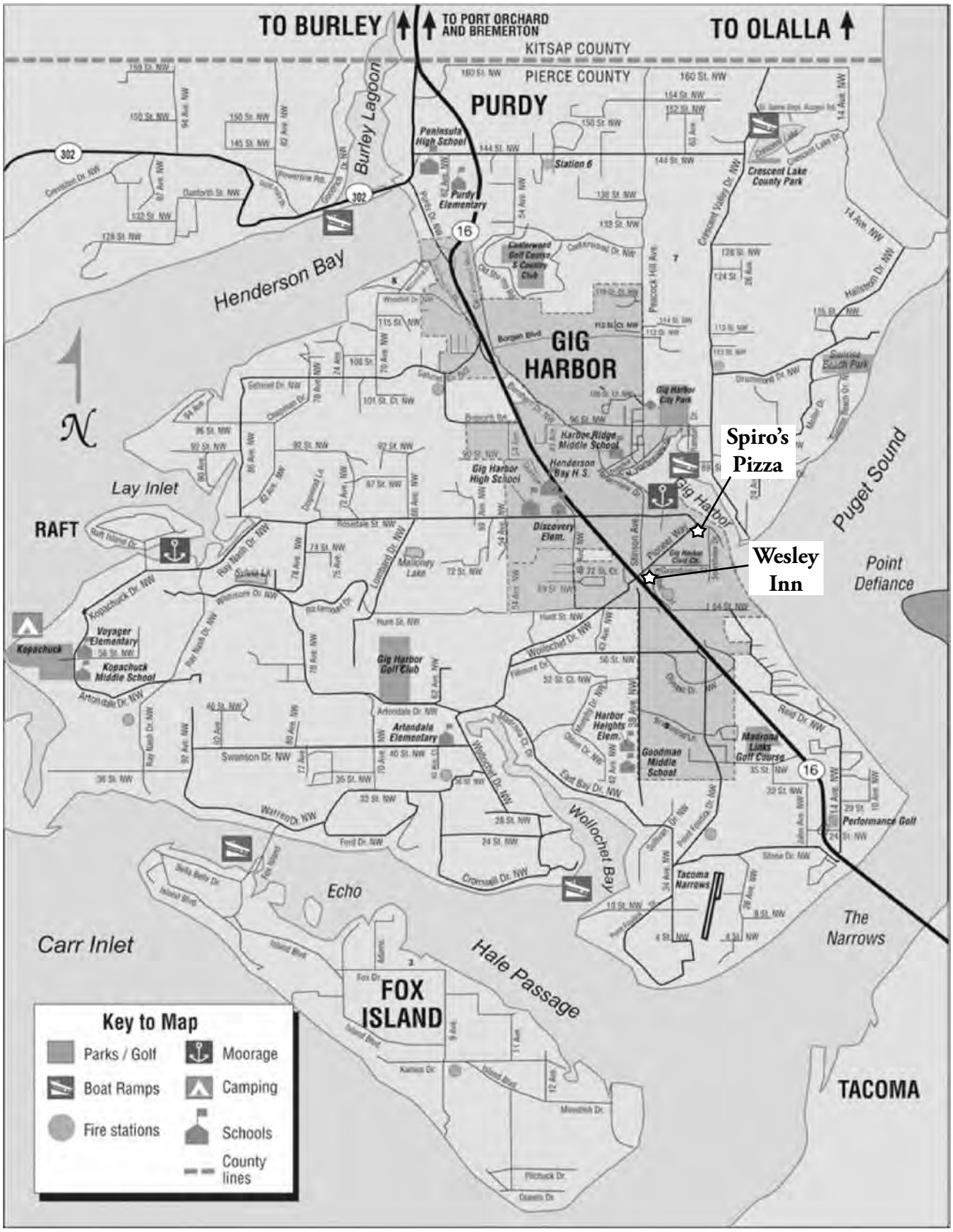
Society for Northwestern Vertebrate Biology
Washington Chapter of The Wildlife Society
2011 Joint Annual Meeting

"Maintaining Connectivity for Wildlife and Wildlife Professionals"



Gig Harbor and the Wesley Inn



Society for Northwestern Vertebrate Biology
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2011 Joint Annual Meeting

"Maintaining Connectivity for Wildlife and Wildlife Professionals"

On behalf of the Society for Northwestern Vertebrate Biology and the Washington Chapter of the Wildlife Society, it is our pleasure to welcome you to the 2011 joint conference. Our societies have co-hosted several successful meetings in the past and look forward to the continued collaboration. Since out last meeting, both SNVB and TWS have been working to increase information accessibility for our membership as well as increase membership involvement and professional development. The meeting theme this year, "Maintaining Connectivity for Wildlife and Wildlife Professionals" reflects our shared value of fostering collaborations, communicating current and future research, and providing opportunities to engage in professional development opportunities.

As part of this year's theme in maintaining professional connectivity, we hope that you take advantage throughout the conference to meet future collaborators, reconnect with friends as well as develop professional associations and new friendships not only from Washington but from other areas of the Northwest! Students will have many opportunities through the social, member's luncheons, and student mentoring session to connect with biological professionals. Biologists nationwide over the past few years have been facing additional challenges to their jobs. Not only are most federal, state, and private agencies still feeling the impacts of the current economy through reduced budgets, but the start of the predicted "mass retirement" of wildlife biologists has become extended, or positions not backfilled in some cases, due to economic times. Maintaining collaborations and connection between the new career biologist and those who have been in the field or behind the computer for awhile will help transition and maintain the historical knowledge in our fields.

Maintaining habitat connectivity is an important component to research efforts for both societies. As habitat fragmentation continues, through increased urbanization, road construction, and other land use decisions, habitats become increasingly disconnected. We are fortunate to have a diverse group of speakers for the 2011 plenary session to address habitat connectivity, research efforts in this field, and communication. Robin Baird, research ecologist with Cascadia Research Collective, will provide a fresh perspective on connectivity issues as they relate to his work with marine mammal populations, movements, habitat use and behavior in the Pacific. Kristeen Penrod, executive director of Science & Collaboration for Connected Wildlands will discuss their work to protect and restore systems of connected wildlands in California. Wendy Francis, Program Director for the Yellowstone to Yukon Conservation Initiative, will discuss the implementation of Y2Y's Biodiversity Conservation Strategy and its policy program. Finally, Liam Moriarty, Environmental Reporter for KPLU, will present his experiences reporting on science and the need for scientists to effectively communicate their work to broad audiences.

Wendy Arjo, President
Washington Chapter, The Wildlife Society

Tara Chestnut, President
Society for Northwestern Vertebrate Biology

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http://joomla.wildlife.org/Washington/

Cooperation

This meeting would not have been possible without the hard work of many board members and members from the Society for Northwestern Vertebrate Biology and the Washington Chapter of The Wildlife Society. Thank you to all who contributed to meeting planning and session coordination. Thank you, too, to all who presented posters and presentations. We wouldn't have a meeting without you. We would also like to acknowledge and thank Northwest Partners in Amphibian and Reptile Conservation for their participation and coordination of the Amphibian Inventory & Techniques Workshop, Amphibian Diseases Symposium and the amphibian field trip scheduled for Friday. The NW Section of the Wildlife Society is also meeting with us this year. Welcome to all NW Section members, and thank you for your participation. Finally, we were able to coordinate to meet this year with the Washington Cooperative Fish and Wildlife Research Unit which resulted in an increased diversity of talks and increased participation by students. These meetings are only successful with a diversity of participants. Thank you to all for joining us.

Sponsors and Contributors to the 2011 Joint Annual Meeting

The Society for Northwestern Vertebrate Biology and the Washington Chapter of the Wildlife Society would like to acknowledge the generosity of the following sponsors of the 2011 joint annual meeting:

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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.

Special Events

Student Mentoring Session

Wednesday 24 March
4:30-5:30 pm, Bleubay Room

An integral part of the annual meeting is student participation! We invite students to come meet TWS and SNVB mentors to learn more about wildlife and biology professions. Students will be able to interact with professionals from private, state and federal organizations to ask specific questions about career opportunities, experiences, and expectations. This session will also offer students a chance to get some perspective on organizational culture, learn about the different types of wildlife work that goes on within various sectors and agencies, and hopefully gain a better understanding of challenges and advancements in the profession as well as characteristics for a successful professional. Please come join us Wednesday from 4:30-5:30 pm in the Bleubay Meeting Room to expand your wildlife network!

Thursday 24 March, 5:00 - 6:00 pm, Lobby

Photography Contest

We will once again hold our annual photo contest at our meeting. This year we will have photo submissions in the following five categories: **thematic topic** (trans- boundaries for wildlife and wildlife professionals), **wildlife portraits, landscapes and habitats, biologists in action, artistic interpretation**. Photos will be displayed for viewing during socials and the poster session. Don't forget to vote for your favorite photo in each category by the end of the poster session on Thursday, March 24th. Voting will be open throughout the meeting. In addition to prizes that will be handed to winners in each category during the banquet, photographers will have the option to display their images on a photo gallery page that will be added to the SNVB website soon.

Silent Auction and Raffle

Many items donated by generous sponsors and members will be on display Thursday, March 24th during the poster session and no-host social for registrants to bid on during the annual silent auction. The silent auction is an annual fund raiser to support registration waivers for student participants at annual meetings and student scholarships, among other things. So, find some items you like and bid away! This year we will set up the raffle so that you can be in a drawing for individual items in which you are specifically interested. Raffle items will be on display during the silent auction, and drawings for items will occur at the banquet. Be sure to buy your tickets in advance and place them in the raffle bin next to the item(s) of your choice.

Annual Banquet

Thursday 24 March, 6:00 - 8:30 pm, Brookeside Ballroom

Join us at our annual banquet to socialize, eat good food, and enjoy the raffle drawing, society announcements, and more. This year we have some exciting entertainment lined up for you. Leif Olson and Matt Swope, The Always Cheese and Crackers, have been entertaining audiences for well over a decade. Hailing from Olympia and Seattle; they are wacky, animated, and talented. Leif and Matt will amaze you with feats of juggling inspired by danger, humor, and you the audience. To see more and to contact them, check out their videos on YouTube: http://www.youtube.com/user/MattSwopeJuggling#p/u/5/BTih_t58Z4I

Field Trips

Amphibian Field Trip

Friday 25 March, Trip Leader Lisa Hallock

Participants must provide their own transportation or carpool with someone else. Rubber boots encouraged. Prepare for rain. Polarized sunglasses will make it easier to see into the water if it is cloudy.

Pond-breeding Amphibians
12:00- 2:00 pm
We will visit a local park about 15 minutes from Gig Harbor. The focus will be pond-breeding amphibians. Aquatic funnel traps will be set the night before the field trip to increase our chance of seeing a variety of species and life stages. Potential species: Long-toed Salamanders (*Ambystoma macrodactylum*; egg clusters and larvae), Northwestern Salamanders (*A. gracile*; egg mass, larvae, gilled adults), Rough-skinned Newts (*Taricha granulosa*; adults), Pacific Treefrog/chorus Frog (*Pseudacris regilla*; egg masses, tadpoles, adults) and Northern Red-legged Frog (*Rana aurora*; tadpoles). North American Bullfrog (*Lithobates* [=*Rana*] *catesbeianus*) may also be present. A $4.00 toll to cross the Narrows Bridge (one way only) may be required if we visit a Tacoma Park.

Stream-dwelling Amphibians
2:00-7:00 pm?
ANYONE ATTENDING THIS PART OF THE FIELD TRIP WILL NOT BE BACK TO GIG HARBOR UNTIL EVENING
The nearest site for stream-dwelling amphibians is about 1. 5 hours from Gig Harbor near a small town called Quilcene. We would depart after the Pond-breeding field trip is over (~ 2 pm). The two steam species documented in the area are Olympic Torrent Salamander (*Rhyacotriton olympicus*; a Washington endemic) and Coastal Tailed Frog (*Ascaphus truei*). The records from this area date back to the 1950s, there is no guarantee we will be able to find them.
Please indicate on the sign-up sheet if you are interested in this portion of the field trip.

Nisqually National Wildlife Refuge Restoration

Friday 25 March, 1:00 pm
Trip Organizer: Teal Waterstrat; Trip Leader: Jesse Barham

Take a walk through one of the largest and newest estuary restoration projects in Washington. 365 hectares of Nisqually River/ McAllister Creek delta have been opened to tidal flow through the joint effort of the USFWS, The Nisqually Tribe, Ducks Unlimited, USGS, and many others. Visit the newly constructed boardwalk and observation platform over the tidelands. Come enjoy the tide's flood and ebb as juvenile salmon swim below you and birds fly and swim around you while you observe the ocean and river reestablishing an ecosystem that was lost over 100 years ago. Jesse Barham, Nisqually Restoration Biologist, will lead an informational session and 3 to 4 mile guided tour of the refuge. Bring warm waterproof clothes, water, snacks, and your binoculars. If you are driving to this field trip please bring three dollars ($3) for refuge use fee, your national parks pass, duck stamp, or other valid national lands pass.

A Look at Falconry

Friday 25 March, 1:00 pm,
Location TBA
Trip Organizer: Teal Waterstrat
Trip Leader: Sarah Coven

Come and visit with both licensed falconers and their birds near Olympia, WA. Sarah Coven will tell us about the ancient and elite world of falconry, raptor care, training, and give us an opportunity to meet the birds face to beak. If the weather permits there will also be a flight and practice hunt demonstration. Unfortunately, at the time of our conference Washington State rabbit season will be closed.

Meeting At A Glance

Wednesday 23 March

8:00 am	Registration opens – *Hotel lobby*
	Welcome and Plenary sessions in the Brookeside Ballroom
9:30 - 8:45 am	**Introductions & Welcome** – Wendy Arjo and Tara Chestnut
8:45 - 10:15 am	**Plenary I: Robin Baird**
10:15 - 10:45 am	**Plenary II: Kristeen Penrod**
10:45 - 11:00 am	*Break*
11:00 - 11:30 am	**Plenary III: Wendy Francis**
11:30 am - noon	**Plenary IV: Liam Moriarty**
noon - 1:20 pm	***SNVB Member Luncheon, Bleubay Meeting Room*** ***WA TWS Member Luncheon, CE Meeting Room***

	Brookeside Ballroom Concurrent Session I	Bleubay Meeting Room Concurrent Session II
1:20 - 2:40 pm	**Stream Amphibian Ecology, Conservation & Management**	**Avian Ecology and Behavior**
2:40 - 3:00 pm	*Break*	
3:00 - 4:20 pm	**Stream Amphibian Ecology** continues	**Avian Ecology and Behavior** continues
4:30 - 5:30 pm		Student Mentoring
5:00 - 6:00 pm	**SNVB Board Meeting** – *Il Lucano*	
6:00 - 8:00 pm	**Social** – Spiro's Pizza and Pasta (3108 Harborview Drive, Gig Harbor)	

Member Social

Wednesday 23 March, 6:00 - 8:00 pm, Spiro's Pizza and Pasta

Want a chance to interact in a casual setting with other biology and wildlife professionals? Come join us for an evening social at **Spiro's Pizza and Pasta** located at **3108 Harborview Drive** less than 1 mile from the meeting facility (see map on p. 1). Here is a chance to catch up with old friends and even meet some new ones while sampling Italian appetizers and a no-host bar. The social will be from 6-8 pm on Wednesday, March 23rd. We hope to see you there!

Meeting At A Glance

Thursday 24 March

8:00 am	Registration opens – *Hotel lobby*		
	Brookeside Ballroom Concurrent Session I	Bleubay Room Concurrent Session II	CE Room Concurrent Session III
9:00 - 10:20 am	**Washington Connected Landscapes Project**	**Amphibian Ecology & Behavior**	**Environmental Contaminants**
10:20 - 10:40 am		*Break*	
10:40 am - noon	**Citizen Outreach**	**Amphibian Ecology & Behavior** continues	**Responses of Aquatic Habitats and Species to Environmental Changes**
noon - 1:20 pm	*Lunch*	Brown bag luncheon, info and outreach: Western Governors' Association Pilot Project for the Arid lands of WA, OR & ID	**TWS-NW Section brown bag luncheon**
1:20 - 2:40 pm	**Amphibian Environmental Stressors**	**Mammal Ecology**	**Responses of Wildlife to Environmental Change**
2:40 - 3:00 pm		*Break*	
3:00 - 4:20 pm	**Amphibian Environmental Stressors** continues	**Marine Mammal Ecology**	**Washington Cooperative Fish & Wildlife Research Unit:** Meeting, Announcements and Social
5:00 - 6:00 pm		**Poster Social**	**Poster Social**
6:00 - 8:00 pm	**Banquet & Raffle**		

Friday 25 March

	Brookeside Ballroom Concurrent Session I	Bleubay Room Concurrent Session II	CE Room Concurrent Session III
9:00 - 10:20 am	**Bat Ecology and Conservation**	**The USGS Amphibian Research & Monitoring Initiative in the West: Populations, Stressors, & Methods**	**Reptile Ecology & Behavior**
10:20 - 10:40 am	*Break*		*Break*
10:40 - noon	**Habitat Restoration**		**Reptile Ecology & Behavior** continues
noon	*Sessions end*		

Field Trips

noon - 2:00 pm; 2:00 - 7:00 pm	**Amphibian Field Trips: 1. Pond-Breeding; 2. Stream-Dwelling** *with Lisa Hallock*
1:00 pm	**A Look at Falconry** *with Sarah Coven*
1:00 pm	**Nisqually National Wildlife Refuge Restoration** *with Jesse Barham*

Special Sessions & Meetings

Western Governors' Association Arid Lands Pilot Project Brown Bag Lunch
Thursday 24 March, noon -1:20 pm, Bleubay Meeting Room

The Western Governors' Association Pilot Project for the Arid Lands of Washington, Oregon, and Idaho: Integrating climate change into the development of crucial wildlife habitats and an Integrated Decision Support System
Washington, Oregon, and Idaho are partnering in the conceptualization and coordination of a transboundary wildlife mapping tool for fish, wildlife, and habitats that occur within the Columbia Plateau Ecoregion of the three states. The joint development of this mapping tool will make it easier for developers and the states to identify areas where development can occur with minimal impacts to wildlife. We will provide a brief introduction to the overall pilot, and then a more focused review and discussion of proposed methods for ensuring that the mapping tool accounts for the habitat and movement needs of wildlife into the future as climate changes.

For more information, please contact Meade Krosby, mkrosby@u.washington.edu

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NW Section of the Wildlife Society
Thursday March 24th, noon - 1:20 pm, CE Meeting Room

The NW Section of the Wildlife Society that includes Washington, Oregon, Idaho, Montana and Alaska is pleased to be holding its annual meeting jointly with the March 2011 annual meeting of the WA Chapter of the Wildlife Society and the Society for Northwest Vertebrate Biology. The Section will hold a meeting Thursday, March 24 at noon to which all are invited. This is an opportunity for the Section Officers and the NW Section Representative of The Wildlife Society to meet and visit with you. The Section is initiating an effort to strengthen its support to the State Chapters and identify the Section role in the enhancement of wildlife issues, species and habitats throughout the Northwest. We thank WA Chapter of the Wildlife Society and the Society for Northwest Vertebrate Biology for giving us this chance to meet with members. Please join us Thursday at noon in the CE Meeting Room.

Barbara Hill - President, NW Section of The Wildlife Society
Jack Connelly - Northwest Section Representative to The Wildlife Society

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Washington Cooperative Fish and Wildlife Research Unit
(Special Session Thursday 24 March, 3:00 - 4:20 pm, CE Meeting Room)

The Washington Cooperative Fish and Wildlife Research Unit (WACFWRU) is one of 40 comparable units located within 38 States. The Cooperative Research Unit Program was established in 1935 to facilitate cooperation between the Federal Government, colleges and universities, the states, and private organizations in improving the management of the nation's fish and wildlife resources. Units accomplish this by conducting natural resource management research, educating persons to intelligently manage natural resources, and providing research findings to individuals or agencies that put this information to practical use. The specific goals of the Washington Unit are (1) to conduct or support research that addresses the needs of the management agencies in the Department of the Interior (USDI) and the State of Washington, (2) to actively participate in the training of graduate students in the sciences supporting the conservation and enhancement of our fish and wildlife resources by facilitating graduate student research and by teaching, (3) to disseminate research results to the scientific community, management agencies, and the general public, (4) to gain national and international recognition for specific areas of technical expertise and research accomplishments, and (5) to facilitate an efficient and effective interaction between the cooperating resource management agencies (USDI, Washington Departments of Ecology, Fish and Wildlife, and Natural Resources) and the Unit's academic partners (University of Washington, Washington State University) toward meeting the Agencies' information needs.

Robin Baird

Robin Baird first got involved with marine mammals in 1984, volunteering with a small non-profit group in British Columbia. In 1987 he helped co-found the Stranded Whale and Dolphin Program of British Columbia. In 1988 he began graduate work focusing on mammal-eating killer whales in British Columbia, and received his Ph.D. in 1994 from Simon Fraser University. While a graduate student he co-founded the MARMAM e-mail list (in 1993, currently with 9,500 subscribers) and spent most of his free time preparing status reviews of 10 poorly-known species of whales and dolphins in British Columbia. After finishing his Ph.D. with heavy credit card debt he worked with marine mammals in the Gulf of California, Mexico for 8 months, did a seabird survey off the British Columbia coast, collaborated on a field project on bottlenose dolphins in New Zealand, and worked as a Lecturer on natural history cruises in the Antarctic, South America and Alaska, among other things. In 1996 he got a post-doctoral fellowship position at Dalhousie University in Halifax, Nova Scotia working with Hal Whitehead. There he continued his studies with killer whales and also worked with northern bottlenose whales, as well as participating in field projects in Japan. When his post-doc position was about to run out of money and facing the prospect of a third winter in Nova Scotia, in 1998 he was offered a job working in Hawaii, where he began studies of odontocetes that have continued for the last 12 years. He first became interested in false killer whales when responding to the first stranding of this species in British Columbia in 1987. In 1988 he had the opportunity to work with Steve Leatherwood on a compilation of information available on false killer whales world-wide. In 1999 he began a long-term study of false killer whales (among other species) in Hawaii, while being based consecutively on Maui, in Cambridge, England, in North Carolina, and since 2003 in Olympia, Washington, where he works as a Research Biologist with Cascadia Research Collective, a non-profit research and education organization.

MANAGEMENT OF AN ENDANGERED POPULATION OF FALSE KILLER WHALES: SCIENCE, RAISING AWARENESS, AND BUILDING A CONSITUENCY FOR LONG-TERM CONSERVATION. Robin W Baird, *Cascadia Research Collective, 218½ W. 4th Avenue, Olympia, WA 98501; rwbaird@cascadiaresearch.org.*

Collaborative research among non-profit groups and government researchers have provided evidence that there are at least two populations of False Killer Whales (*Pseudorca crassidens*) in Hawaiian waters. One of these, the Hawaiian insular population, has been determined to be a Distinct Population Segment under the Endangered Species Act (ESA), is small (estimated at ~150 individuals), and has undergone a large-scale decline since the late 1980s. In response to a petition from the Natural Resources Defense Council, NMFS has recently proposed listing this population as Endangered under the ESA. While an ESA listing is warranted, resolving some of the threats to the population (e.g., impacts from persistent organic pollutants, reduction in the prey base) will require more action than will be generated from a listing. Such threats are insidious and will require both local and international solutions. Addressing other threats (e.g., bycatch in fisheries) is problematic due to data deficiencies and a strong constituency against fishing restrictions. For the last 11 years we have been focusing on the science: undertaking an assessment of abundance, diet, toxin loads, and, using remotely-deployed satellite tags, determining range and potential critical habitat. However, effective management requires both reducing uncertainty about threats and their biology, and having a constituency to support conservation actions. Unfortunately a large proportion of the human population in Hawai'i has never even heard of this species, nonetheless care enough about it to champion conservation action. Our efforts have thus expanded to help raise awareness and build a constituency, concurrent with science.

Kristeen Penrod

Kristeen Penrod is the founder and Conservation Director of Science & Collaboration for Connected Wildlands (SC Wildlands). SC Wildlands' mission is to protect and restore systems of connected wildlands that support native wildlife and the systems upon which they rely. We work with conservation biologists, ecologists, wildlife and transportation agencies, land managers and planners, conservation organizations, and others to develop and implement regional conservation strategies. We are deeply committed to collaboration and coordination to achieve the vision of protected and restored systems of connected wildlands. SC Wildlands has successfully collaborated on several projects over the last decade, including the California Missing Linkages (Penrod et al. 2001), South Coast Missing Linkages Project (Penrod et al. 2008; www.scwildlands.org), and the California Essential Habitat Connectivity Project (Spencer et al. 2010). With 10 years of experience in science-based design of wildlife linkages, SC Wildlands is widely recognized as one of the leading providers of such services.

CALIFORNIA ESSENTIAL HABITAT CONNECTIVITY PROJECT. Kristeen Penrod, *Science & Collaboration for Connected Wildlands, P.O. Box 1052, Fair Oaks, CA 95628; kristeen@scwildlands.org.*

The California Departments of Transportation and Fish and Game commissioned the California Essential Habitat Connectivity Project because a functional network of connected wildlands is essential to the continued support of California's diverse natural communities in the face of human development and climate change. SC Wildlands was part of a consulting team that worked in collaboration with an inter-agency multidisciplinary team to address connectivity at the statewide level. The Project produced three primary products: (1) a statewide Essential Habitat Connectivity Map, (2) data characterizing areas delineated on the map, and (3) guidance for mitigating the fragmenting effects of roads and for developing and implementing local and regional connectivity plans. The Essential Connectivity Map depicts large, relatively natural habitat blocks that support native biodiversity and areas essential for ecological connectivity between them. The statewide network consists of 850 relatively intact and well conserved Natural Landscape Blocks (ranging from 2,000 to about 3.7 million acres each) with over 1,000 potential connections among them. The 192 Essential Connectivity Areas represent principle connections between the Natural Landscape Blocks within which land conservation and management actions should be prioritized to maintain and enhance ecological connectivity.

Wendy Francis

Wendy L. Francis, Program Director, has been involved with the Yellowstone to Yukon Conservation Initiative since its inception in 1993. She served on the board from 2000 to 2006, acting as its chair from 2003-2005, and was interim Executive Director in 2002-2003. Educated in biology and with a Masters in environmental law, Wendy previously held positions as Director of Conservation and Science at Ontario Nature, Interim Executive Director at the Canadian Parks and Wilderness Society (CPAWS), and Conservation Director for CPAWS Calgary-Banff. Wendy also practiced law in Calgary from 1986 to 1991 and was owner of her own conservation consulting business from 1999 to 2005. Based in Banff, Wendy is active in many physical and outdoor recreational pursuits and loves to backpack most of all.

YELLOWSTONE TO YUKON (Y2Y) CONSERVATION INITIATIVE: A TRANSBOUNDARY APPROACH TO WILDLIFE CONSERVATION. Wendy L Francis, *Yellowstone to Yukon Conservation Initiative, P.O. Box 1482, Banff, Alberta T1L 1B4; wendy@y2y.net.*

The ranges of large mammals that once occupied much of North America are now limited to the mountainous west of the continent. Even within that landscape, transportation networks, subdivision, resource exploration and development and increasing human incursions into remote areas are fragmenting habitats and populations, threatening the persistence of sensitive species. The impacts of climate change will be exacerbated by habitat fragmentation. The Yellowstone to Yukon (Y2Y) Conservation Initiative is a response to these threats, offering an inspiring vision of landscape connectivity at the continental scale. The Cabinet-Purcell Mountain Corridor (CPMC) Project will be presented as an example of successful trans-boundary conservation collaboration. Using grizzly bears as the focus of conservation planning, the CPMC Project is creating the conditions that will enable large mammal populations in southeastern British Columbia, northern Idaho and western Montana to stay connected to each other and to move in response to changing habitat conditions.

Liam Moriarty

KPLU environment reporter **Liam Moriarty** started with the station in 1996 as a freelance correspondent in the San Juan Islands. He's been KPLU's full-time Environment Reporter since November, 2006. In between, Liam was News Director at Jefferson Public Radio in Ashland, Oregon for three years and has reported for a variety of radio, print and web news sources in the Northwest. He's covered a wide range of environment issues, from timber, salmon and orcas to oil spills, land use and global warming. In December, he reported from Cancun, Mexico on COP16, the U.N. climate conference. Liam is an avid cyclist and sea kayaker.

CONVEYING A SCIENCE MESSAGE TO A GENERAL AUDIENCE: THE DEVIL IN THE DETAILS

Wednesday 23 March

8:00 am	Registration opens	*Hotel Lobby*
9:30 - 9:45 am	Introductions & Welcome **– Wendy Arjo & Tara Chestnut**	
	Plenary Session	*Brookeside Ballroom*
9:45 - 10:15 am	**Robin Baird –** Management of an Endangered Population of False Killer Whales: Science, Raising Awareness, and Building a Constituency for Long-term Conservation	
10:15 - 10:45 am	**Kristeen Penrod –** California Essential Habitat Connectivity Project	
10:45 - 11:00 am	*Break*	
11:00 - 11:30 am	**Wendy Francis –** Yellowstone to Yukon (Y2Y) Conservation Initiative: A Transboundary Approach to Wildlife Conservation	
11:30 am - noon	**Liam Moriarty –** Conveying a Science Message to a General Audience: The Devil in the Details	
noon - 1:20 pm	*Lunch* **SNVB Member luncheon, Bleubay Rm;** **WA TWS Member luncheon, CE Rm**	

1:20 pm - 2:40 pm, Concurrent Paper Presentation Sessions

	Brookeside Ballroom	**Bleubay Room**
Time	**Stream Amphibian Ecology, Conservation & Management** *Moderators:* Bruce Bury & Hartwell Welsh	**Avian Ecology & Behavior** *Moderator:* Blake Murden
1:20 pm	Ecology & conservation of stream amphibians in the NW: Introduction – Bruce Bury & Hartwell Welsh, Jr.	An experimental evaluation of avian nest survival in created snags – Andrew Kroll
1:40 pm	Comparison of *R. boylii* breeding phenology in different forks of the Trinity River basin – Jamie Bettaso	Connectivity and range expansions of North American birds – Kent Livezey
2:00 pm	Diet and habits of stream amphibians in the Pacific Northwest – Bruce Bury	Establishing breeding provenance of a temperate-wintering sparrow with light-level geolocation - Nathaniel Seavy
2:20 pm	Food web structure of headwater streams on the Olympic Peninsula: role of riparian vegetation – Peter Kiffney	Spring and summer space use by Clark's Nutcrackers in the eastern WA Cascades – Teresa Lorenz

Wednesday 23 March

2:40 - 3:00 pm *Break*

3:00 pm - 4:20 pm Concurrent Paper Presentation Sessions

Time	Brookeside Ballroom	Bleubay Room
	Stream Amphibian Ecology continues	**Avian Ecology & Behavior** continues
3:00 pm	Short-term response of Pacific giant salamanders to timber management in SW OR – Niels Leuthold	Lead shot poisoning in swans: sources of pellets in Whatcom Co., WA, and Sumas Prairie, BC – Michael Smith
3:20 pm	Rocky Mountain Tailed Frog responses to disturbance and restoration – David Pilliod	Lack of nesting habitat limits Caspian Terns in the Puget Sound region – Jessica Adkins
3:40 pm	Frogs, fish and forestry: the need for a holistic view of network processes to conserve stream biodiversity – Hartwell Welsh, Jr. (30 min talk, followed by 10 min discussion)	Forest structure within Barred Owl home ranges in central Washington – Peter Singleton
4:00 pm		Northern Spotted Owl detection and territory occupancy probabilities in the Klamath Mountains and N California – Andrew Kroll
4:30 - 5:30 pm	**Student Mentoring Session**	*Bleubay Room*
5:00 - 6:00 pm	**SNVB Board Meeting**	*Il Lucano*
6:00 - 8:00 pm	**Social at Spiro's Pizza and Pasta**	*See map on p. 1*

Thursday 24 March

8:00 am Registration opens *Hotel Lobby*

9:00 am - noon, Concurrent Paper Presentation Sessions

Time	Brookeside Ballroom	Bleubay Room	CE Room
	Washington Connected Landscapes Project *Moderator:* Elizabeth Rodrick	**Amphibian Ecology & Behavior** *Moderator:* Tara Chestnut	**Environmental Contaminants** *Moderator:* Christian Grue
9:00 am	The Washington Connected Landscapes Project: an introduction – Kelly McAllister & Joanne Schuett-Hames	Estimating occupancy and population size for *B. wrighti* in the Western Cascades – Tiffany Garcia	Reproduction and survival of Coho Salmon exposed to urban pesticides – Karensa King
9:20 am	Landscape integrity conservation: connecting the best – John Pierce	Robust designs for estimating detection probabilities for stream-breeding amphibians – Aimee McIntyre	Alarm behavior and survival in Coho Salmon modeling – Jenifer McIntyre
9:40 am	Habitat connectivity modeling for focal species in Washington – Andrew Shirk & Karl Halupka	*D. tenebrosus* seasonal behavior, habitat use & spatial ecology – Brandon Fessler	Exposure and toxic effects on Green Sturgeon after Burrowing Shrimp control in WA – John Frew
10:00 am	Synthesis of statewide results and new GIS tools – Brad McRae	*E. eschscholtzii* influence on invertebrates and carbon sequestration in mixed forest – Michael Best	Alum-based advanced nutrient removal processes and phosphorus bioavailability – Bo Li
10:20 am		*Break*	
	Citizen Outreach *Moderator:* Paul Hendricks	**Amphibian Ecology & Behavior** continues	**Responses of Aquatic Habitats & Species to Environmental Change** *Moderator:* David Beauchamp
10:40 am	New tools for citizen scientists – Karen Dvornich	Seasonal movements and overwintering of *A. boreas* along I-90 – Amber Palmeri-Miles	Informing coastal restoration in a changing climate – Ilon Logan
11:00 am	Involvement of schools in field research – Margaret Tudor	Effectiveness of amphibian mitigation on the Sea to Sky Highway – Joshua Malt	Juvenile sockeye salmon growth, geomorphic evolution, & climate change – Jennifer Griffiths
11:20 am	Protecting biodiversity in Washington State – Christian Grue	Northern Leopard Frog Recovery Program in Alberta, Canada – Kris Kendell	Pelagic piscivory under shifting environmental gradients – Adam Hansen
11:40 am	Year of the Turtle: Development of a new conservation paradigm – Deanna Olson	Recovery planning for the Oregon Spotted Frog in B.C. – Purnima Govindarajulu	Benthic community structure and response to harvest at geoduck aquaculture sites in WA – Jennifer Price

noon - 1:20 pm *Lunch*

Brown bag luncheon, info and outreach: Western Governors' Association Pilot Project for the Arid Lands of WA, OR & ID

NW Section TWS brown bag luncheon

Thursday 24 March

1:20 - 4:20 pm Concurrent Paper Presentation Sessions

Time	Brookeside Ballroom **Amphibian Environmental Stressors** *Moderator:* Marc Hayes	Bleubay Room **Mammal Ecology / Marine Mammal Ecology** *Moderator:* Diana Dishman	CE Room **Responses of Wildlife to Environmental Change** *Moderator:* Glenn VanBaricom
1:20 pm	Vulnerability of Oregon Spotted Frogs to chytrid fungus – Marc Hayes	Natural and human-made rock habitats for Pika along I-90 – Raychel Parks	Amphibian phenology and aquatic weed management – Amy Yahnke
1:40 pm	Expansion of Bullfrogs and chytrid fungus in the NW under climate change – Caren Goldberg	Ecology and conservation of Western Gray Squirrel, N. Cascades – Kathryn Stuart	Spring cattle grazing and nutritional ecology of Mule Deer – Sara Wagoner
2:00 pm	Amphibian physiological responses after chytrid exposure – Stephanie Gervasi	Flying Squirrels and forest structure: implications – Todd Wilson	California Gull diet at 2 dams along the Mid-Columbia River – Michael Schrimpf
2:20 pm	Multiple pathogen effects on Pacific Treefrogs – John Romansic	Preliminary results of North Cascades Wolverine study – Keith Aubry	Competition between Eastern & Western Gray Squirrels in the Puget Lowlands – Aaron Johnston
2:40 pm	*Break*		
3:00 pm	Amphibian saprolegniasis: would the real pathogen raise your hyphae? – Susan Brady	Genetic substructure of Pacific Harbor Seal populations, WA & OR – Diana Dishman	**WA Cooperative Fish & Wildlife Research Unit** meeting, announcements, social *see p. 10*
3:20 pm	Elevation and UV-B response in Long-toed Salamanders – Lindsey Thurman	WA Northern Sea Otter population status, trends, mortalities – Deanna Lynch	
3:40 pm	Experimental test of larval Bullfrog response to hydroperiod – Megan Cook		
4:00 pm	Pyrethroid insecticide effects on a simulated amphibian community – Lindsay Biga		

5:00 - 6:00 pm **Poster Session Social** *Bleubay and CE Meeting Rooms*

6:00 - 8:00 pm **Banquet** *Brookeside Ballroom*
Entertainment by **The Always Cheese and Crackers**

Friday 25 March

8:00 am Registration opens *Hotel Lobby*

9:00 am - noon, Concurrent Paper Presentation Sessions

Time	Brookeside Ballroom	Bleubay Room	CE Room
	Bat Ecology & Conservation *Moderator:* Hannah Anderson	**USGS ARMI in the West: Populations, Stressors, Methods** *Mod:* Stephen Corn	**Reptile Ecology & Behavior** *Moderator:* Robert Weaver
9:00 am	Modeling occupancy patterns of PNW bats with Bat Grid data – T Rodhouse (Pat Ormsbee presenting)	Tracking population trends of *Rana draytonii* & *R. sierrae* – Gary Fellers	Predicting seasonal habitat use in the Midget Faded Rattlesnake – Stephen Spear
9:20 am	Winter bat inventory strategies and results – Greg Falxa	Local extinction of Northern Red-legged Frogs: fish or Bullfrogs? – Michael Adams	Sexual isolation of two populations of Red-sided Garter Snakes – Chris Friesen
9:40 am	Interannual, seasonal, and daily activity periods of Puget Sound bats – Gregory Green	Spatial & temporal variation in Coastal Tailed Frog demography – Nathan Chelgren	Effects of UVB radiation on sex pheromone in Red-sided Garter Snakes – Anna Vigeland
10:00 am	Preparing for White Nose Syndrome in the Pacific Northwest – Pat Ormsbee	Compensatory effects of recruitment and survival on persistence – Erin Muths	Methyl ketones and reproductive isolation of garter snake species – Emily Uhrig

10:20 am *Break*

	Habitat Restoration *Moderator:* Mike Hall	USGS ARMI in the West continues	Reptile Ecology & Behavior *Moderator:* Steve Spear
10:40 am	Wetland restoration, fragmentation and conservation of the Giant Gartersnake – Patricia Valcarcel	Ecology of amphibian chytrid fungus in the aquatic environment – Tara Chestnut	Discovery of the triploid Colorado Checkered Whiptail Lizard in WA – Robert Weaver
11:00 am	Streaked Horned Lark Columbia R. island restoration trial – Hannah Anderson	Wildfire and fragmentation: effects on amphibians and nematodes – Blake Hossack	Ants as competitors for refuge sites with PNW Dipsadine snakes – Robert Weaver
11:20 am	Restoring habitats for rare species in lowland prairies – Eric Delvin	Automated Pattern Recognition Program for Leopard Frogs – David Pilliod	
11:40 am	Habitat modeling and survey techniques for Johnson's Hairstreak – Kelli VanNorman	How well do call indices represent abundance of breeding anurans? – Stephen Corn	**See p. 7 for field trip descriptions**

noon **Meeting adjourns (afternoon fieldtrips!)**

noon - 2:00 pm **Pond-breeding Amphibians** *with Lisa Hallock*

2:00 - 7:00 pm **Stream-dwelling Amphibians** *with Lisa Hallock* **(note return time!)**

1:00 pm **A Look at Falconry** *with Sara Coven*

1:00 pm **Nisqually National Wildlife Refuge Restoration** *with Jesse Barham*

Notes

DOES THE PROBABILITY OF LOCAL EXTINCTION FOR NORTHERN RED-LEGGED FROGS RELATE TO INTRODUCED FISH OR BULLFROGS? Michael J Adams, Christopher A Pearl, *US Geological Survey, Forest and Rangeland Ecosystem Science Center, 3200 SW Jefferson Way, Corvallis, OR 97331.*

Non-native fish and Bullfrogs (*Lithobates catesbeianus*) are frequently cited as contributing to the decline of ranid frogs in the western United States. Because of this, we hypothesized that non-native species, habitat, or a combination relate to the probability of local extinction for Northern Red-legged Frogs (*Rana aurora*) in western Oregon. In the first five years of an ongoing study, we found no support for the non-native species hypothesis. Instead, the probability of local extinction decreased with the extent of emergent vegetation and riparian forest.

LACK OF NESTING HABITAT LIMITS CASPIAN TERNS IN THE PUGET SOUND REGION. Jessica Y Adkins, Daniel D Roby, Ladd Bayliss, Peter J Loschl, Donald E Lyons, Yasuko Suzuki, *USGS, Oregon Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife, Oregon State University, 104 Nash Hall, Corvallis, OR 97331; jessica.adkins@oregonstate.edu.*

The Caspian Tern (*Hydroprogne caspia*) colony at the Port of Bellingham in Bellingham Bay, WA first formed in 2009, when approximately 60 breeding pairs nested on the previous site of the Georgia Pacific pulp mill and successfully produced chicks. The colony grew dramatically in 2010, when at least 1,500 pairs successfully nested at the site, making it the largest Caspian Tern breeding colony in Washington State. The formation and growth of this colony coincided with 1) the complete failure of the nesting colony at Dungeness National Wildlife Refuge in 2009 and 2010, which was previously the state's largest tern colony, and 2) implementation of the Caspian Tern Management Plan for the Columbia River Estuary, which seeks to relocate a portion of the breeding colony at East Sand Island, OR to nesting habitat in other regions of Oregon and California. In 2011 the Port of Bellingham plans to dissuade Caspian Terns from nesting at the site. Similar efforts have occurred at other urban sites around Puget Sound where terns have attempted to nest (e.g., Kitsap-Bremerton and Everett naval bases, Port of Tacoma). Natural habitats in the region are ephemeral and have not supported breeding colonies in recent years (e.g., Padilla Bay). There is no current plan by state or federal agencies to actively manage for Caspian Tern nesting habitat elsewhere in western Washington. While it is clear that Caspian Terns are highly motivated to nest in the Puget Sound region, it is unclear whether suitable, secure habitat will be available.

STREAKED HORNED LARK COLUMBIA RIVER ISLAND RESTORATION TRIAL. Hannah E Anderson, Sarah T Hamman, *The Nature Conservancy of Washington, 120 E. Union Avenue #209, Olympia, WA 98501; handerson@tnc.org.*

The Streaked Horned Lark (*Eremophila alpestris strigata*) uses islands of the lower Columbia River for breeding and over-wintering. The Army Corps of Engineers maintains the depth of the ship navigation channel by dredging the river bottom. The deposition of dredge material on these islands creates and maintains the early successional habitats preferred by Larks. The timing, location, and amount of deposited material can have dramatic effects on Larks and their habitat. Because timing and placement of dredge material is dictated by needs of the shipping lane rather than Lark habitat requirements, we investigated an alternate method to create lark habitat on these islands. We used the results of a previous habitat analysis to guide the spatial design of a restoration trial aimed at testing methods to create the early successional habitat preferred by Larks. In 2009 we mechanically treated patches of unsuitable habitat with a tractor-drawn disc using three different prescriptions. We monitored vegetation in the treatment and control plots for two years and compared results to values for vegetation in areas known to receive Lark use. Our results indicate that the vegetation factors identified as important for preferred Lark habitat can be created through mechanical treatments. However, there are limitations in its application and the preferred structure is not maintained through the second year post-treatment. To provide the most benefit to Streaked Horned Larks, the use of this mechanical method should be strategically employed to complement the directed placement of dredge material.

Notes

PRELIMINARY RESULTS FROM THE NORTH CASCADES WOLVERINE STUDY. Keith B Aubry, Catherine M Raley, *US Forest Service, Pacific Northwest Research Station, Olympia, WA 98512; kaubry@fs.fed.us;* John J Rohrer, *US Forest Service, Okanogan-Wenatchee National Forest, Methow Valley Ranger District, Winthrop, WA 98862;* Eric C Lofroth, *British Columbia Ministry of Environment, Victoria, BC V8W9M1;* Scott H Fitkin, *Washington Department of Fish and Wildlife, Winthrop, WA 98862.*

By the 1950s, it appeared that the Wolverine (*Gulo gulo*) had been extirpated from most or all of its historical range in the contiguous U.S. By 2000, an increasing number of verifiable Wolverine detections indicated that Wolverines were re-establishing themselves in the northern Cascade Range of Washington. To investigate perceived population changes and develop a reliable understanding of the Wolverine's distribution, genetic affinities, and habitat ecology in Washington, we initiated a radio-telemetry study in the North Cascades during the winter of 2005/06; in the winter of 2008/09, we expanded the study area into southern British Columbia (BC). The use of satellite-based telemetry enables us to track study animals remotely in inaccessible areas during all seasons of the year. To date, we have captured and radio-collared 5 females and 2 males. We documented the occurrence of an 8th individual using specialized "run-pole" remote-camera stations that are designed to obtain individually diagnostic photos of Wolverine throat and chest blazes. Activity areas (100% MCP home ranges) for 3 females ranged from 1,305 to 1,968 km^2, whereas those for the 2 males ranged from 1,891 to 2,795 km^2. A young, nulliparous female captured in February 2010 appeared to be a transient. Soon after she was radio-collared, she travelled well over 785 km north into central BC and into the southern Coast Range of BC, where she was apparently killed by a cougar in late March. We plan to continue radio-collaring Wolverines for at least 2 more winters, and develop a long-term monitoring program using remote cameras and hair-snagging devices.

THE ECOLOGICAL ROLE OF *ENSATINA ESCHSCHOLTZII*: INFLUENCE ON INVERTEBRATE COMMUNITIES AND CARBON SEQUESTRATION POTENTIAL IN A MIXED HARDWOOD/CONIFER FOREST IN NORTHWESTERN CALIFORNIA. Michael L Best, *Humboldt State University, 1 Harpst St., Arcata CA 95521; addsmike14@yahoo.com;* Hartwell H Welsh, Jr., *US Forest Service, Pacific Southwest Research Station, 1700 Bayside Dr., Arcata, CA 95521; hwelsh@fs.fed.us.*

Terrestrial salamanders occupy an important ecological niche in North American forests as top predators on the invertebrate community and an abundant food source for vertebrate predators. Using in situ salamander enclosures in a mixed hardwood/conifer forest we examined the effects of the salamander Ensatina (*Ensatina eschscholtzii*) on the leaf-litter invertebrate community. Leaf-litter invertebrates were collected monthly over a four month period and identified to family. Leaf-litter bags were used to quantify the amount of carbon lost over this period using mass in grams of dry leaf litter as a surrogate for carbon. Invertebrate abundance was consistent between control and treatment plots, indicating the mutual effect of environmental conditions (rainfall, temperature); however, the plots with salamanders decreased and increased more gradually. After the 4 month period the salamander plots contained 47% fewer invertebrate predators and 23% fewer invertebrate decomposers. The litter bag assessment revealed a 7-12% decrease in litter decomposition in the salamander plots. Results indicate that Ensatina are opportunistic predators that do not discriminate between potential prey species. Ensatina prey on both invertebrate predators of leaf decomposers as well as the invertebrate decomposers, with the net effect of increasing the leaf litter retention on the salamander plots. As a result the carbon sequestration potential on the salamander plots were enhanced over the control plots. These results are from our first year and are therefore preliminary; we have a second year's data yet to analyze to confirm the outcome.

A COMPARISON OF BREEDING PHENOLOGY OF THE FOOTHILL YELLOW-LEGGED FROG *(RANA BOYLII)* IN DIFFERENT FORKS OF THE TRINITY RIVER BASIN. Jamie B Bettaso, *US Fish and Wildlife Service, Arcata Field Office, 1655 Heindon Road, Arcata, CA 95521; jamie_bettaso@fws.gov*; Don T Ashton, Hartwell H Welsh Jr, *Redwood Sciences Laboratory, US Forest Service,1700 Bayview Drive, Arcata, CA 99521; dashton@fs.fed.us, hwelsh@fs.fed.us;* Scott McBain, *McBain & Trush, 980 7th Street, Arcata, CA 95521; scott@mcbaintrush.com.*

Flow regimes are measured for magnitude, frequency, duration, timing and rate of change. These variables can act as proximal cues to influence when native stream biota reproduce. The Foothill Yellow-legged Frog (*Rana boylii*) typically breeds in large river systems in the spring. We studied the breeding phenology of this frog on the managed mainstem, and unmanaged North Fork and South Fork Trinity

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Rivers in 2004-2010. In addition to breeding surveys, we also examined size of larvae and time and size at metamorphosis. In 2009, a model incorporating flow and temperature was validated with data collected on the mainstem Trinity River to assess time of oviposition and risk of egg mass desiccation. Breeding phenology is discussed in relation to flows and temperatures between these forks, as well as their influence on larval growth.

EFFECTS TO A SIMULATED AMPHIBIAN COMMUNITY OF A PYRETHROID INSECTICIDE. Lindsay M Biga, *Oregon State University, Environmental Sciences Graduate Program, Corvallis, OR 97331; lindsay.biga@science.oregonstate.edu;* Andrew R Blaustein, *Oregon State University, Department of Zoology, Corvallis, OR 97331.*

Aquatic organisms are heavily impacted by agricultural pollutants that enter lakes, ponds and streams through runoff and aerial spray. Peak application of these pesticides coincides with the vulnerable early life stages of some species in aquatic habitats, including amphibians. Their unshelled embryos and semi-permeable larval skin make amphibians a particularly sensitive vertebrate. While the effects of these pesticides are regularly studied by toxicologists in laboratory-based, single-species studies, the effects on communities are not. We conducted an outdoor mesocosm experiment from August through October 2010 using one amphibian species (*Anaxyrus boreas*), zooplankton and algae. We compared the sensitivity of the community to varying levels (0, 1 or 5 μg/L) of cypermethrin, a synthetic pyrethroid insecticide. To measure how the pond community was affected by treatments, zooplankton, phytoplankton, and periphyton abundances were sampled in each mesocosm. Amphibian growth and size were inhibited only with exposure to the high treatments. However, abundance of zooplankton decreased and abundance of both periphyton and phytoplankton increased compared to the control in all treatments. Cypermethrin's effects on aquatic life are often dismissed as negligible due to its low water solubility and tendency to adsorb to organic solids. However this experiment shows direct deleterious effects of cypermethrin on both invertebrate and vertebrate aquatic species.

AMPHIBIAN SAPROLEGNIASIS: WOULD THE REAL PATHOGEN PLEASE RAISE YOUR HYPHAE? Susan F Brady, R Steven Wagner, Daniel J Selski, James E Johnson, *Department of Biological Sciences, 400 East University Way, Central Washington University, Ellensburg, WA 98926; susan.f.brady@gmail.com.*

Water molds cause significant mortality of amphibian embryos and larvae, but there is little information regarding the virulence of individual water mold species, species interactions, effect on surviving embryos, or importance of infection pathways. The virulence and interaction of three genetically identified *Saprolegnia* species (*S. diclina, S. ferax, and S. anisospora*) was investigated using Northern Leopard Frog (*Lithobates pipiens*) and Cascades Frog (*Rana cascadae*) embryos. In addition, two saprolegniasis infection pathways were investigated by comparing survival of embryos exposed to *S. anisospora* through either hyphae or zoospores. *Saprolegnia anisospora* was the most virulent species reducing survival 32 and 51%, *S. ferax* reduced survival by 20 and 31%, and *S. diclina* was not pathogenic to these amphibian species. No obvious interaction among water mold species was detected that influenced embryo survival; however increasing water mold dosage of the two pathogenic species (*S. anisospora* and *S. ferax*) decreased survival. Embryos surviving exposure to pathogenic *Saprolegnia* species exhibited early hatching, but hatchling lengths were different, with *L. pipiens* larvae being shorter and *R. cascadae* larvae being longer than control larvae. Additionally, exposure to *S. anisospora* via direct hyphal contact significantly reduced embryo survival as compared to exposure via zoospores, suggesting that the mechanism of infection may be an important aspect of saprolegniasis. These results indicate that individual water mold species, particularly *S. anisospora*, should be considered and experimental infection methods should be carefully documented in order to accurately assess and compare water mold species virulence and the role of saprolegniasis in amphibian decline.

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DIET AND HABITS OF STREAM AMPHIBIANS IN THE PACIFIC NORTHWEST. R Bruce Bury, *US Geological Survey, Forest and Rangeland Ecosystems Science Center, 3200 SW Jefferson Way, Corvallis, OR 97331; buryb@usgs.gov;* Wynn W Cudmore, *Life Science Department, Chemeketa Community College, Salem, OR 97309; wynn.cudmore@chemeketa.edu.*

We found some resource partitioning in diets between the Coastal Giant Salamander (*Dicamptodon tenebrosus*) and the Cascade Torrent Salamander (*Rhyacotriton cascadae*). Metamorphosed *D. tenebrosus* fed primarily on terrestrial snails, polydesmid millipedes, and adult beetles. Larval *D. tenebrosus* and all *R. cascadae* fed primarily on aquatic insect larvae but *Dicamptodon* larvae consumed ephemeropteran, plecopteran, and trichopteran larvae in approximately equal amounts, whereas *R. cascadae* consumed significantly more trichopteran and significantly fewer ephemeropteran larvae than *D. tenebrosus*. Compared to available foods, *R. cascadae* are more selective or more gape limited in their feeding habits than *D. tenebrosus* larvae. Different use of microhabitats may explain the apparent shifts in food habits. We also found that adult *D. tenebrosus* frequent underground seeps and side channels, and may be major predators on large prey such as fully-grown banana slugs, other salamander species, and small mammals.

ECOLOGY AND CONSERVATION OF STREAM AMPHIBIANS IN THE NORTHWEST: INTRODUCTION. R Bruce Bury, *US Geological Survey, Forest and Rangeland Ecosystems Science Center, 3200 SW Jefferson Way, Corvallis, OR 97331; buryb@usgs.gov;* Hartwell H Welsh, Jr., *US Forest Service, Redwood Sciences Laboratory, 1700 Bayview Drive, Arcata, CA 95521; hwelsh@fs.fed.us.*

Streams and headwaters in the Pacific Northwest are home to three endemic families of amphibians and each has one genus: Giant Salamanders (genus *Dicamptodon*; 4 species), Torrent Salamanders (*Rhyacotriton*; 4 species), and Tailed Frogs (*Ascaphus*; 2 species). They all appear to require perennial, swift streams or headwaters of low temperature to which many aspects of their structure and life history can be correlated. Eggs and larvae of *Rhyacotriton* and *Ascaphus* are among the most sensitive of any amphibian to temperatures >18°C. These taxa are important in food webs and often are the predominant vertebrates of small streams and headwaters. There is concern about their status due to impacts from human-caused perturbations such as timber harvest, road construction and forest fires (human-influenced). Considerable research is occurring on these factors, yet we have a long way to go to clarify many key points. Meanwhile, basic ecological studies are needed for all these amphibians to ensure their persistence in shrinking habitat related to timber demand, land-use changes, and predicted consequences of climate change.

SPATIAL AND TEMPORAL VARIATION IN THE DEMOGRAPHY OF COASTAL TAILED FROGS (*ASCAPHUS TRUEI*): ISOLATING AQUATIC FROM TERRESTRIAL STAGE DYNAMICS. Nathan D Chelgren, Michael J Adams, *US Geological Survey, Forest and Rangeland Ecosystem Science Center, 3200 SW Jefferson Way, Corvallis, OR 97331; Nathan_chelgren@usgs.gov.*

The Trask Paired Watershed Study is a long-term study of the effects of contemporary forest management on a headwater stream system. As one component of the pre-treatment phase, we examined the demography of the Coastal Tailed Frog (*Ascaphus truei*) using capture-recapture at 14 headwater streams and four downstream reaches from 2008 to 2010. Relating environmental conditions to the abundance of aquatic larvae, as is often done, conflates responses of all life-history stages which may encounter different environmental conditions or respond differently to the same perturbation. However, the expense of studying effects on adults at large spatial scales is often prohibitive. We sampled using electrofishing during three primary periods each summer and gave larvae individual marks using elastomer. We classified tadpoles into two age-classes using a latent variable model based on limb development and mass. We isolate larval responses by tracking the change in abundance of larval cohorts over time as a proxy for survival. Parameters of the preliminary age classification model varied by headwater reach indicating differences in growth and development rates. In addition, downstream reaches had greater heterogeneity in size and developmental stage with less clear distinction to cohort than headwater reaches. This pattern is consistent with downstream dispersal that results in a mixing of individuals from different headwater streams in the downstream reaches. Our direct observations of individual movements support this interpretation.

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THE ECOLOGY OF THE AMPHIBIAN CHYTRID FUNGUS, *BATRACHOCHYTRIUM DENDROBATIDIS* (*BD*), IN THE AQUATIC ENVIRONMENT. Tara Chestnut, Chaucney W Anderson, *USGS Oregon Water Science Center, 2130 SW 5th Avenue, Portland, OR 97207; chestnut@usgs.gov;* Julie Kirshtein, *USGS Headquarters, 12201 Sunrise Valley Drive Reston, VA 20192.*

The chytrid fungus, *Batrachochytrium dendrobatidis* (*Bd*), is an aquatic amphibian pathogen implicated as a causal agent of global amphibian declines. *Bd* was first described in 1999, following widespread enigmatic declines across a spectrum of habitats ranging from those that are heavily degraded to intact wilderness. *Bd* research has focused primarily on the ecology of the pathogen in infected amphibians. Important knowledge gaps remain about the ecology of *Bd* in the environment outside of the amphibian host. We studied *Bd* in the aquatic environment at several temporal and spatial scales, and evaluated the heterogeneity of *Bd* with occupancy models. We also explored the relationship between *Bd* detection and environmental predictors using logistic regression and random forests. Our results provide scientists with a better understanding of *Bd* ecology and how to study it in the environment, and offer science that can inform managers and other decision makers involved with amphibian conservation.

AN EXPERIMENTAL TEST OF LARVAL BULLFROG RESPONSE TO HYDROPERIOD. Megan T Cook, Tiffany S Garcia, *Department of Fisheries and Wildlife, Oregon State University, 104 Nash Hall, Corvallis, OR 97331; megan.cook@oregonstate.edu.*

The invasive American Bullfrog (*Lithobates catesbeianus*) is widespread in the western United States and negatively affects native species directly and indirectly in multiple ways. Effective management requires understanding the mechanisms contributing to the success of Bullfrogs in the Pacific Northwest. We hypothesize this invasion success is partially due to plasticity in larval development and growth rates that enables use of ephemeral breeding habitats, which is uncommon in the Bullfrog's native range. We tested this hypothesis with a 6x3 factorial mesocosm experiment in the summer of 2010. Six Bullfrog clutches were collected from ephemeral and permanent wetland sites in the Willamette Valley, Oregon, and subjected to 3 hydroperiod treatments (slow draining, fast draining, and permanent) for eight weeks. There were no differences in development or growth due to hydroperiod treatments, but there were clutch differences in growth. These results indicate a lack of plasticity and a possible genetic response. Clutch effects could be due to divergence based on local conditions or geographic barriers, or due to other genetic factors. Interestingly, clutches collected from the same wetland type (ephemeral vs permanent) did not respond with similar growth. GIS analysis also discounts geographic barriers as an explanation for clutch differences. To investigate the role that historical factors may play in these clutch differences, we will run genetic analyses on each clutch and compare with the original source population(s) from the Bullfrog's native range.

HOW WELL DO CALL INDICES REPRESENT ABUNDANCE OF BREEDING ANURANS? Stephen Corn, *US Geological Survey, Northern Rocky Mountain Science Center, Aldo Leopold Wilderness Research Institute, 790 E. Beckwith Avenue, Missoula, MT 59801; scorn@usgs.gov;* Erin Muths, *US Geological Survey, Fort Collins Science Center, 2150 Centre Avenue, Building C, Fort Collins, CO 80526;* Amanda Kissel, *Department of Biological Sciences, Simon Fraser University, Burnaby, BC V5A 1S6*; Rick Scherer, *Colorado State University, Department of Fishery and Wildlife Biology, Fort Collins, CO 80523.*

Call surveys used to monitor breeding choruses of anuran amphibians generate index values that are frequently used to represent the number of male frogs present, but few studies have quantified this relationship. Improved technology has made collecting high-quality acoustic data much easier and more reliable, and the resulting wealth of data presents more options for analysis. We compared abundance of male Boreal Chorus Frogs (*Pseudacris maculata*), to call index values on a scale of 1 to 3 derived from automated recordings. Two populations in Colorado were studied from 1994 to 2009 and the numbers of frogs, estimated using capture-recapture methods, varied over two orders of magnitude, from 18 to >1800. However, single index values, such as might result from monitoring using manual surveys, were unrelated to population size. A synthetic call saturation index (CSI), the daily proportion of the maximum possible sum of index values derived from multiple recordings, was greater in larger populations, but the relationship was not highly predictive. The CSI would be a poor choice as a stand-alone index to abundance, but it could be used as a covariate in an occupancy analysis. The utility of such a use in large monitoring projects, however, requires effective computer analysis of digital sound files, which needs further development.

Notes

RESTORING SEVERELY DEGRADED HABITATS FOR RARE SPECIES IN PUGET SOUND LOWLAND PRAIRIES. Eric Delvin, *The Nature Conservancy, 120 Union Ave S.E. Olympia, WA 98501; edelvin@tnc.org;* Jonathan D Bakker, Peter W Dunwiddie, *School of Forest Resources, University of Washington, Seattle, WA 98195; jbakker@u.washington.edu; pdunwidd@u.washington.edu.*

Restoration of highly endangered Puget Sound lowland prairies has primarily focused on enhancing remnant areas by controlling invasive species and increasing native diversity. However, effective conservation requires increasing the total acreage of prairie. Our multi-year research project, begun in 2008, is developing treatments for restoring native communities in abandoned agricultural fields. Treatments include solarization, herbicide, and prescribed fire, in combination with seeding treatments of 26 native prairie forbs and grasses. Additionally, we are using a novel experimental approach that is adaptive and iterative. Treatments are replicated spatially at four sites in South Puget and North Puget Sound and temporally for three years to understand when and where they are most effective. The most successful strategies are retested in increasingly larger areas each year. The cumulative result is restoration of significant areas of prairie habitat at each site for rare invertebrate species such as Taylor's Checkerspot (*Euphydryas editha taylori*). At least one of these research areas will serve as a reintroduction site for Taylor's Checkerspot in 2012 or 2013 being led by Washington Department of Fish and Wildlife. Initial vegetative community composition results show that treatments are effective in establishing native and diverse prairie habitat in these severely degraded lands, although treatment effectiveness differs between sites and years. Results are preliminary, but may point to a whole new suite of lands for consideration of protection and restoration for Puget lowland prairies.

GENETIC SUBSTRUCTURE OF PACIFIC HARBOR SEAL (*PHOCA VITULINA RICHARDSI*) POPULATIONS ALONG THE COASTS OF WASHINGTON AND OREGON. Diana L Dishman, Deborah A Duffield, *Portland State University Department of Biology, 1719 SW 10th Avenue, Portland, OR 97201;* Harriet R Huber, *National Marine Mammal Laboratory, Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, WA 98115;* Dyanna M Lambourn, *Marine Mammal Investigations, Washington Department of Fish and Wildlife, 7801 Phillips Road SW, Lakewood, WA 98498.*

It has been assumed that the considerable dispersal ability of many marine species would prevent genetic divergence in the absence of geographic isolation. However, recent work has shown that many marine species often develop differentiation among areas within their known dispersal range. This 'paradox' of marine divergence is particularly important among marine mammal species where behavior can restrict gene flow. To investigate genetic substructure within such a species, we collected tissue samples from 63 stranded Pacific Harbor Seals (*Phoca vitulina richardsi*) in Washington and Oregon between 2006 and 2010 for population stock analysis. DNA was extracted from frozen tissues, and a 551 bp fragment of mtDNA control region and eight microsatellite loci were amplified to investigate localized genetic structure. Minimum spanning network and haplotype frequency analyses of mtDNA sequences indicated that while haplotype lineages are not isolated within a sampling region, there is some evidence of regional differentiation. On the other hand, microsatellite data suggest a lack of substructure among the animals sampled and gene flow among the geographic units. This result could be consistent with historical isolation followed by recent admixture largely mediated by male migration, or with low levels of occasional migration events that maintain gene flow among local subpopulations over a large geographic distance (among other possibilities). Regardless of which historical scenario is correct, the pattern seen across these Pacific Northwest sites suggests higher levels of exchange among these areas than previously suspected and will have important consequences for future management considerations for these stocks.

NEW TOOLS FOR CITIZEN SCIENTISTS. Karen M Dvornich, *University of Washington, School of Forest Resources, Box 355020, Seattle, WA 98195; vicon@uw.edu.*

The NatureMapping Program was co-founded in 1992 to facilitate the exchange of information between natural resource agencies, academia, land-use planners, local communities, and schools through public education and participation in data acquisition. NatureMapping introduced emerging technologies to its participants and built a website with the goal to provide tools and information. The website has grown from 300 visits in 1996 to 8 million in 2010 with a 25% annual growth rate. It is poised to provide interactive maps and queries for users of different interests and expertise. For example, Gig

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Harbor's Crescent Valley Alliance educates, bioblitzes, and conducts long-term monitoring within their Biodiversity Management Area, a part of the Pierce County Biodiversity Network. Their work and maps are on the NatureMapping website. The ease of reporting data skyrocketed with Google. Google Earth is contributing to a growing reversal of the traditional top-down approach to geographic information by putting data, maps and imagery products into the hands of the people via online on-demand access. Citizens are flooding Google with data with little consistency. NatureMapping has developed data capturing software for mobile devices and a prototype for androids that provides identification marks, photos and vocalizations of for multiple taxonomic groups. University of Washington's eScience Institute members are working on the development of annotation capabilities for the NatureMapping database while supporting complex, ad-hoc queries of multiple databases in the form of tables, graphs and online GIS mapping query tools. NatureMapping Centers have begun to use these tools for local community projects.

WINTER BAT INVENTORY STRATEGIES AND RESULTS. Greg Falxa, *Cascadia Research Collective, 218½ W Fourth Ave, Olympia, WA 98501; gfalxa@cascadiaresearch.org.*

We report on a multi-year bat monitoring effort in the southern Puget Sound region of western Washington which has documented at least 6 species of bats flying and roosting during the winter months. Our methods progressed from ultrasonic acoustic surveys at publically accessible locations to acoustic and visual surveys at rural out-buildings and agricultural structures. Recordings of bat echolocation calls document flight or foraging behavior. We found it productive to focus the winter acoustic effort at locations where roosting bats were found during our visual searches of buildings, or from observational information provided by landowners. Access to perform wildlife surveys on private property can be challenging, however we found that many of the residents in rural areas with high bat activity had developed a keen interest in the life history strategies of the bats they observe. By first discussing observational information from landowners and residents, we generally found a willingness to provide access for building searches and for placement of ultrasonic recorders. This monitoring effort has documented bat species diversity that approaches that of nearby habitat with high bat diversity, such as forest riparian corridors, and has produced several new bat species records for winter months in Thurston County. Local conservation benefits realized from this strategy include the identification of bat nursery sites for long-term monitoring, fostering attitudes for accommodating rather than exterminating or excluding bats, and a more engaged public for reporting bat and other wildlife observations.

POPULATION SIZE, SURVIVAL, LONGEVITY, AND MOVEMENTS OF RANA DRAYTONII AND R. SIERRAE AT TWO CLOSELY MONITORED SITES: TRACKING POPULATION TRENDS. Gary M Fellers, Patrick M Kleeman, David Miller, *US Geological Survey, Western Ecological Research Center, Point Reyes National Seashore, Point Reyes, CA 94956; gary_fellers@usgs.gov.*

We monitored a population of California Red-legged Frogs (*Rana draytonii*) at Point Reyes National Seashore from 2005 to 2009, and a population of Sierra Nevada Yellow-legged Frogs (*Rana sierrae*) at Yosemite National Park from 2003 to 2010. Though the regime varied somewhat in the first years of the study, we generally captured frogs for four consecutive days during each of three weeks, with 10 days between capture periods. We tagged individual frogs and used mark-recapture data to model population trends related to precipitation, sex, and year. The *R. sierrae* population averaged 43.2 adult male and 36.1 female frogs within the meadow/stream complex we studied. Survival did not differ by sex, but did vary annually. We estimated population size for *R. draytonii* using different techniques for male and female frogs. For males, we modeled population size using mark-recapture data. The number of males averaged 52.0, with greater annual variation between years, compared with *R. sierrae*. Egg mass counts were used to estimate the number of *R. draytonii* females because most females spend only a short time the breeding site we studied. There was a strong correlation between the number of male frogs and the number of egg masses each year. Annual survival rates for R. draytonii were much lower than for *R. sierrae*. Since *R. draytonii* are active all year and *R. sierrae* are only active for 4-5 months each year (when no snow on the ground), survival may be linked to the total time frogs are exposed to predation.

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TERRESTRIAL COASTAL GIANT SALAMANDER (*DICAMPTODON TENEBROSUS*) SEASONAL BEHAVIOR, HABITAT USE AND SPATIAL ECOLOGY. Brandon Fessler, Jason T Irwin, Daniel D Beck, R Steven Wagner, *Department of Biological Sciences, Central Washington University, 400 East University Way, Ellensburg, WA 98926; fesslerb@cwu.edu*; Marc P Hayes, *Department of Fish and Wildlife, 600 Capitol Way North, Olympia, WA 98501; Marc.Hayes@dfw.wa.gov.*

The Coastal Giant Salamander (*Dicamptodon tenebrosus*), one of the world's largest terrestrial Caudates, can be the dominant vertebrate predator in low-order mountain streams of the Pacific Northwest. Large gaps exist in our understanding of this species' ecology; notably, little is known about its terrestrial life history. This study aims to provide the first year-long observations of post-metamorphic Coastal Giant Salamander behavior, habitat use and spatial ecology. Using coelomic-implant radio transmitters (each with a roughly one-year battery life), we tracked seven giant salamanders from June 2010 to date; two salamanders were added to the study in September 2010. Field sites are located in the central Washington Cascades near Snoqualmie Pass. At capture, salamanders we radio-transmittered ranged in size from 35 to 167 g in mass and 124 to 183 mm snout-to-vent length. Our preliminary results suggest high site fidelity and an ability to locate and occupy previously used shelters. Movement distances were variable, with a mean distance recorded between tracking sessions of 14 ± 25 m. Relocation points were predominately < 20 m between observations, punctuated by infrequent longer distances (maximum observed 167 m). We also recorded distinct seasonality to movement frequency and time spent above ground, as well as a negative relationship between salamander mass and maximum distance between relocations.

DETERMINING EXPOSURE AND PREDICTING TOXIC EFFECTS TO GREEN STURGEON FOLLOWING INSECTICIDE APPLICATIONS TO CONTROL BURROWING SHRIMP IN WILLAPA BAY AND GRAYS HARBOR, WA. John A Frew, *Washington Cooperative Fish and Wildlife Research Unit, School of Aquatic and Fishery Sciences, University of Washington, 1122 NE Boat St., Seattle, WA 98195; jaf3@uw.edu;* Christian E Grue, *Washington Cooperative Fish and Wildlife Research Unit, US Geological Survey, University of Washington, 1122 NE Boat St., Seattle, WA 98195.*

The Green Sturgeon (*Acipenser medirostris*) is an anadromous species that feeds on benthic invertebrates in estuaries and bays. Two distinct population segments are classified under the U.S. Endangered Species Act. Green Sturgeon forage in Willapa Bay and Grays Harbor, WA – the largest oyster-growing region on the Pacific coast. The insecticide imidacloprid (IMI) has been proposed for controlling burrowing shrimp that impede the success of rearing oysters on the intertidal mudflats in both locations. Concern over the toxicity of IMI to sturgeon that may feed on shrimp within treated oyster beds may prevent the issuance of state and federal permits for the use of the pesticide. Blood samples were collected from sturgeon captured and released proximal to an experimental application of IMI. IMI residues in water, sediment, and plasma are currently being quantified using ELISA detection. A concurrent investigation into potential effects from exposure is underway using closely related White Sturgeon (*Acipenser transmontanus*) as surrogates in controlled toxicity tests. White Sturgeon were exposed to IMI at concentrations and durations simulating the fate of the insecticide in sediments. Fish were euthanized at different times post exposure and tissue samples (plasma, brain, liver) were collected. Parameter values for toxicokinetic (TK) processes will be determined by measuring the time-course of IMI concentrations in selected tissues. Toxicodynamic (TD) parameters will be estimated based on existing data. Extrapolation from a derived TK-TD model will be used for predicting toxic effects in green sturgeon from IMI exposure.

ASYMMETRY IN PREZYGOTIC SEXUAL ISOLATION BETWEEN TWO POPULATIONS OF RED-SIDED GARTER SNAKES WITH DIFFERENT MATING AGGREGATION DENSITIES. Chris R Friesen, Robert T Mason, Stevan J Arnold, *Department of Zoology, Oregon State University, Corvallis OR 97331; friesenc@science.oregonstate.edu;* Suzanne Estes, *Department of Biology, Portland State University, 1719 SW 10th Avenue, Science Building 2 rm 246, Portland, OR 97201.*

Ecological divergence mediated by natural selection is readily accepted to play a role in speciation. Mating systems can be viewed fundamentally as ecological in nature (e.g., competition for mates as a limited resource) and may also play a significant role during speciation. Models show that reproductive traits may quickly diverge via a coevolutionary arms race due to sexual conflict and sperm competition. The density of mating aggregations of garter snakes at spring emergence varies among populations which may lead to divergence because of sexual conflict and sexual selection within different social contexts.

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We found evidence of asymmetrical behavioral and postcopulatory prezygotic sexual isolation between two populations of Red-sided Garter Snakes (*Thamnophis sirtalis parietalis*). Asymmetry in reproductive isolation has been modeled as the transitory effect of rapid divergence of sexually selected traits facilitated by drift along the stable line of equilibria. Our study populations differ in several respects the most salient of which is low versus high density mating aggregations. The population with high density aggregations, and probably with the highest level of sexual conflict over mating, was also the population that exhibited homotypic mate preference and sperm precedence.

ESTIMATING OCCUPANCY AND POPULATION SIZE FOR THE OREGON SLENDER SALAMANDER (*BATRACHOSEPS WRIGHTI*) IN THE WESTERN CASCADE RANGE. Tiffany S Garcia, Katie M Dugger, *Oregon State University, Department of Fisheries and Wildlife, 104 Nash Hall, Corvallis, OR 97331;* Josh Johnson, Mike Rochelle, *Weyerhaeuser Company, 2730 Pacific Blvd. SE, Albany, OR 97322;* AJ Kroll, *Weyerhaeuser Company, WTC 1A5, Federal Way, WA 98063.*

The Oregon Slender Salamander (*Batrachoseps wrighti*) is a forest-associated species strongly associated with late successional forests and decaying downed wood, but the reclusive nature of this species makes detection and estimating population sizes difficult. Given the life history constraints for this species, we posit that sampling methods designed to detect and capture salamanders are either destructive to the habitats being sampled or, if not destructive, the techniques are largely ineffective. Additionally, few of these approaches use robust sampling and analytical designs that allow for the estimation of detection and temporary emigration rates, which are key variables in determining occupancy and/or population size. The recent application of Pollock's robust design mark-recapture models to Plethodon salamander mark-recapture survey data has proven to be very useful for estimating occupancy, temporary emigration, conditional recapture rates, and population size. In addition, this analytical approach allows for the investigation of spatial and temporal factors that affect these parameters. We have adapted sampling methodologies to reduce the destruction of habitat during sampling in forested landscapes that will preserve habitat integrity and maximize sampling efficiency. These methods will be tested during a pilot study this year, and will be presented to garner feedback on life history assumptions and survey protocol. If we're successful, these non-destructive survey techniques will be used to collect basic demographic information and life-history data on the Oregon Slender Salamander, information vital to conservation.

PHYSIOLOGICAL RESPONSES OF AMPHIBIANS AFTER EXPOSURE TO THE FUNGAL PATHOGEN, *BATRACHOCHYTRIUM DENDROBATIDIS.* Stephanie S Gervasi, *Department of Zoology, Oregon State University, 3029 Cordley Hall, Corvallis OR 97331; gervasis@science.oregonstate.edu.*

Emerging infectious diseases of wildlife are a threat to species and populations. For example, the emerging fungal pathogen, *Batrachochytrium dendrobatidis* (*Bd*), has been implicated as a driver of worldwide amphibian population declines. Although we have learned a great deal about the ecology and spatial distribution of *Bd*, less is known about how *Bd* affects physiological responses of amphibian hosts. In particular, the sublethal effects of infection may include changes to host physiological performance, including immunity. I used an assay of bacterial killing ability to quantify immunological responses of amphibians after short-term (48 hour) and long-term (7 day) exposure to *Bd*. The killing assay provides a functional measure of innate immunity; it quantifies the ability of cellular and plasma components of blood to eliminate bacteria. Across three amphibian species and at both short-term and long-term time points I observed significantly stronger innate responses (i.e., higher killing ability) in *Bd*-exposed animals, compared with controls. Innate responses provide a rapid, non-specific mechanism for responding to a variety of pathogens. However, chronically elevated innate responses are characterized by inflammation, which can be energetically costly and trigger damage to host cells and tissues. Immunopathology may not only be an important byproduct of fighting infection, but also a driving force in morbidity and mortality caused by the pathogen. Moreover, variation in physiological responses to infection, including immunity, may underlie interspecific variation in susceptibility to the fungal pathogen, *Bd*.

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PREDICTED EXPANSION OF THE INVASIVE AMERICAN BULLFROG AND AMPHIBIAN PATHOGENIC CHYTRID FUNGUS IN THE INLAND NORTHWEST UNDER CLIMATE CHANGE SCENARIOS. Caren S Goldberg, *Fish and Wildlife Resources, University of Idaho, P.O. Box 441136, Moscow, ID 83844; cgoldberg@vandals.uidaho.edu;* Dan Davis, *Clearwater National Forest, 12730 Highway 12, Orofino, ID 83544;* Erica Bree Rosenblum, *Department of Biological Sciences, University of Idaho, Moscow,* ID 83844; Bill Bosworth, *Idaho Department of Fish and Game, P.O. Box 25, Boise, ID 83707;* Lisette P Waits, *Fish and Wildlife Resources, University of Idaho, P.O. Box 441136, Moscow, ID 83844.*

Disease is a leading causative factor in global amphibian population declines. The newly-emerged amphibian chytrid fungus, *Batrachochytrium dendrobatidis* (*Bd*), is now the largest infectious disease threat to global biodiversity, with 92.5% of amphibians listed as critically endangered undergoing 'enigmatic' declines likely linked to this pathogen. The American Bullfrog (*Lithobates catesbeianus*) is a carrier of this pathogen as well as an invasive species throughout the western United States, where it outcompetes and preys on native amphibians. Both of these invasive species have been documented in warmer areas of north-central Idaho, but physiological limitations are likely to preclude them from colder sites under current climate conditions. To assess threats and locate potential sources of invasion for both species into the colder regions of this area, we documented their presence through field surveys and quantitative PCR testing (for *Bd*), modeled the regional ecological niche for each using MaxEnt, and predicted their distribution under two emissions scenarios. We found that *Bd* presence was associated with areas of higher minimum winter temperatures and Bullfrog distribution was associated with areas of higher minimum winter and summer temperatures, as predicted by physiological limitations. Both species were associated with areas of higher winter precipitation, which may indicate greater persistence of wetlands through the summer season. Under these climate warming scenarios, both invasive species are predicted to expand their range, increasing threats to native amphibian populations in this area.

RECOVERY PLANNING AND IMPLEMETATION FOR THE ENDANGERED OREGON SPOTTED FROG IN B.C. Purnima Govindarajulu, *Terrestrial Conservation Science Section, B.C. Ministry of Environment, Victoria, BC, V8W 9M1; Purnima.govindarajulu@gov.bc.ca*

In British Columbia, the endangered Oregon Spotted Frog (*Rana pretiosa*) is found in only three extant populations of less than a 150 breeding adults in most years. A Recovery Team of about 20 members guides recovery efforts and has defined the recovery goal: (a) to maintain and expand extant populations; and (b) establish 6 additional self-sustaining populations in the next 10 years. The first part of the goal is being achieved through habitat management and threat mitigation at the extant sites including invasive species control, assessment of water quality, amphibian disease survey, assessment of potential inbreeding depression, hydrological assessments, land-owner outreach and habitat restoration. The second part of the goal is more challenging. Ongoing radio-telemetry studies into habitat use and niche requirements of the Oregon Spotted Frogs will be used to inform selection of potential (re)introduction sites. Stage specific demographic parameters from the literature, and estimates from mark-recapture and enclosure studies will be used to construct demographic models and provide an understanding of lifestage-specific contribution to population regulation. Ongoing husbandry studies assess the cost and effectiveness of rearing various life-stages (egg mass, tadpole, metamorph, juvenile, and adult) in captivity. The habitat use model, the demographic analysis and the husbandry cost estimation will be combined to guide optimum reintroduction strategies to achieve the second part of the recovery goal of establishing six additional self-sustaining populations.

INTERANNUAL, SEASONAL, AND DAILY ACTIVITY PERIODS OF PUGET SOUND BATS. Gregory A Green, *ICF International, 710 Second Avenue, Seattle, WA, 98104; ggreen@icfi.com;* Steve Negri, *Tetra Tech EC, 19803 North Creek Parkway, Bothell, WA 98011.*

An acoustical bat detector was operated for 18 continuous months at the University of Washington-Bothell wetland in order to determine seasonal and daily activity of Puget Sound bats. Big Brown (*Eptesicus fuscus*), Little Brown (*Myotis lucifugus*), and Silver-haired (*Lasionycteris noctivagans*) Bats were the most common bats detected in 2009, while California Myotis (*M. californicus*) replaced Silver-haired Bats as the third most common in 2010. Yuma (*M. yumanensis*) and Western Long-eared (*M. evotis*) Myotis were the only other two bat species positively detected. In 2009, Big Brown and Silver-haired

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Bats occurred in high numbers from May 22 through June, declined to very low numbers in July, then returned to low numbers in August. Myotis combined peaked in mid-June and again in August. All bat activity declined in late June coinciding with unseasonably cold and windy days. In 2010, Big Brown and Silver-haired Bat activity was highest in June, and again declined to very low numbers by July. Myotis numbers were again highest in July. Overall Big Brown and Silver-haired Bat activity declined about 32% from 2009 to 2010, while Little Brown Bat activity doubled and California and Yuma Myotis collectively increased over three-fold. In 2009, bats fed almost exclusively in the evening before mid-June and after mid-August and almost evenly between evening and early morning in the weeks in between. Big Brown and Silver-haired Bats foraged during a relatively short period soon after sunset and just before sunrise, while Little Brown Bat foraging periods were more contracted. Over 90% of the California and Yuma Myotis flew either immediately before (mornings) or after (evenings) Big Brown and Silver-haired Bats suggesting antagonism may play a role in niche separation. The small, less-aggressive myotis appeared to daily, seasonally, and interannually avoid the presence of the larger bats.

RESPONSE OF JUVENILE SOCKEYE SALMON GROWTH TO FIVE DECADES OF GEOMORPHIC EVOLUTION AND WARMING CLIMATE ON THE ALASKA PENINSULA. Jennifer R Griffiths, Daniel E Schindler, *School of Aquatic and Fishery Sciences, University of Washington, Box 355020, Seattle, WA 98195; jeng@uw.edu.*

Summer growth is critical for juvenile Sockeye Salmon (*Oncorhynchus nerka*) survival and can determine the duration of freshwater residence and timing of outmigration. Growth is typically a density dependent process that is modified by lake productivity and temperature. In an Alaska Peninsula lake experiencing warming air temperatures and declining lake volume over the past 50 years, we assessed the importance of density dependence, temperature, and resident fish competition as well as their interactions for juvenile Sockeye growth. We assessed a range of competing models that accounted for a variety of density and environmental effects using standard model selection procedures (AICc). Despite large variability in mean length at the end of the growing season, there was a positive trend in mean length between 1961 and 2010, a time period characterized by ~2°C warming and ~50% loss of rearing habitat. Across the suite of models considered, year (proxy for lake volume) received a high weight across all models and surprisingly had a positive effect on growth. Juvenile sockeye density negatively affected growth while spring temperatures had a positive effect. The interaction between density and temperature showed relatively high weighting across all models. It appears that the positive effects of year and temperature on juvenile sockeye salmon growth currently outweigh the negative effects of density dependence. However, potentially increased mid-summer emigration rates may account for weakened density dependence and thus a broader approach may be needed to assess the effects of habitat change on overall juvenile production.

PROTECTING BIODIVERSITY IN WASHINGTON STATE: ANALYSIS, PARALYSIS, AND THE PATH TO EXTINCTION. Christian E Grue, *US Geological Survey, Washington Cooperative Fish and Wildlife Research Unit, University of Washington, Seattle, WA 98195;cgrue@u.washington.edu;* Karen M Dvornich, *NatureMapping Program, Washington Cooperative Fish and Wildlife Research Unit, School of Forest Resources, University of Washington, Seattle, WA 98195.*

Examination of the history of attempts to develop strategies to protect biodiversity in Washington State suggest that we know the species in greatest need of protection, but have been unable to implement an "on the ground" strategy to ensure their viability. At the same time, we cannot only focus on species of greatest conservation need, but must also include native species that are currently abundant. We argue that continued analysis using the latest technology and tools is not advancing the protection of biodiversity, but is actually resulting in paralysis. Will application of the latest analytical tools yield a different answer, one that would conclude conservation efforts were misdirected? Fear of action has led to inaction under this assumption. Of additional concern is the fact that wildlife management agencies are faced with multiple management responsibilities and lack adequate resources. Current/projected budget shortfalls heighten this discrepancy. Therefore, implementation and long-term success of conservation efforts will ultimately depend on actions by citizens at the local level; i.e., bottom-up vs top down. Such initiatives would not only help meet the data needs of management agencies, but would also lead to a public that is informed and involved. How do we empower citizens and local governments with the

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knowledge and tools needed to be effective partners in the conservation of natural resources? Can we as natural resource professionals accept this new role and not feel threatened by "citizen science". We provide examples of successes and describe strategies to make this vision a reality.

PELAGIC PISCIVORY UNDER SHIFTING ENVIRONMENTAL GRADIENTS: APPLICATION OF A VISUAL FORAGING MODEL TO DIEL AND SEASONAL SONIC TELEMETRY OF CUTTHROAT TROUT IN STRAWBERRY RESERVOIR. Adam G Hansen, David A Beauchamp, *US Geological Survey, Washington Cooperative Fish and Wildlife Research Unit, School of Aquatic and Fishery Sciences, University of Washington, Box 355020, Seattle, WA 98195; aghans@uw.edu;* Casey M Baldwin, *Washington Department of Fish and Wildlife, 3515 State Hwy 97A, Wenatchee, WA 98801.*

In limnetic environments, the potential foraging success of a visually feeding piscivore is determined by the intersection of its movements with the concurrent distribution of prey fish, and consequent visual conditions therein. These movements can be influenced by temporally dynamic factors that affect both visibility (i.e., light and turbidity) and other physiological processes (e.g., temperature and oxygen). How temporal mixing with prey and foraging performance might change for piscivores confronting periods of intense thermal stratification versus a destratified period in a typical salmonid-dominated reservoir has not been fully evaluated. We addressed this question by combining ultrasonic tracking data on the diel-vertical movement of piscivorous cutthroat trout (*Oncorhynchus clarki*) and available information on prey distribution with a visual foraging model to estimate prey encounter rates in relation to three distinct stratification regimes observed during summer and autumn 1997 in Strawberry Reservoir, Utah. While vertical movements of cutthroat trout were mediated by intense thermal stratification and a hypoxic hypolimnion in early and mid August, prey fish were only available during short crepuscular windows or early morning periods. Temperature and oxygen exerted little influence on the vertical movement of cutthroat trout tracked during destratification in October. During this period, cutthroat trout more consistently maintained overlap with prey, increasing their opportunities for piscivory. Comparison to independently derived fish consumption rates suggests that the timing of encounters has consequences for the capture efficiency of a piscivore, and likely related to shifts in fish behavior as optical conditions change along a diel sequence.

ASSESSMENT OF THE VULNERABILITY OF THE OREGON SPOTTED FROG (*RANA PRETIOSA*) TO THE AMPHIBIAN CHYTRID FUNGUS (*BATRACHOCHYTRIUM DENDROBATIDIS*). Marc P Hayes, *Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, WA 98501; Marc.Hayes@dfw.wa.gov;* Gretchen Padgett-Flohr, *Department of Zoology, Life Sciences II, Southern Illinois University-Carbondale, Carbondale, IL 62901; gpadgettflohr@aol.com.*

The Oregon Spotted Frog (*Rana pretiosa*) is at risk across its geographic range. Discovery of the chytridriomycete fungus, *Batrachochytrium dendrobatidis* (*Bd*), in declining populations of *R. pretiosa* raised the possibility that this etiological agent might be a contributor to these declines. This led us to experimentally examine the sensitivity of *R. pretiosa* to *Bd*. Juvenile *R. pretiosa* (4-6 g) exposed to two strains of *Bd* were followed over a 90-day post-exposure period. Though all individuals in the exposed groups became infected, no frog in either group died or showed behavioral or morphological manifestations of disease. Moreover, by the end of the exposure period, nearly all frogs had cleared their infections, and skin sloughing hypothesized as accompanying infection clearing appeared minimal. However, frogs in both exposed groups gained significantly less mass than frogs in the control group. This experiment, and the recent discovery of *Bd* in non-declining populations of *R. pretiosa*, suggests that the species is Bd resistant. We remain cautious in this conclusion, as tested animals were obtained from a population in decline; so tested frogs may be descendants of adults surviving a catastrophic epizootic. Lastly, minimal skin sloughing argues for investigating other mechanisms, such as antimicrobial peptide activity, as the basis for the clearing of *Bd* infections in *R. pretiosa*.

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WILDFIRE AND FRAGMENTATION: EFFECTS ON AMPHIBIAN POPULATIONS AND ASSOCIATED NEMATODES. Blake R Hossack, *US Geological Survey, 790 E. Beckwith Avenue, Missoula, MT 59801; blake_hossack@usgs.gov;* Winsor H Lowe, *Division of Biological Sciences, University of Montana, Missoula, MT 59812;* Paul Stephen Corn, *US Geological Survey, 790 E. Beckwith Avenue, Missoula, MT 59801.*

Projected increases in wildfire and other climate-driven disturbances will likely have widespread effects on communities worldwide. These effects may be magnified by synergisms with human disturbances, such as forest-management activities. Previous research in the Northern Rockies has documented limited negative effects of fire on amphibians, but this research has largely been restricted to protected landscapes. Previous research also has not considered how post-fire changes in habitat or host populations could affect helminth communities associated with amphibians. To determine if the effects of wildfire differ between protected vs. managed landscapes, we compared population sizes of Long-toed Salamanders (*Ambystoma macrodactylum*) and Columbia Spotted Frogs (*Rana luteiventris*) from randomly selected wetlands in burned and unburned forests in Glacier National Park and neighboring managed forests. We also compared prevalence and infection intensity by 2 widespread nematodes relative to wildfire. We found negative effects on salamanders from high-severity fire and its interaction with management. These effects were not evident in the distribution or infection intensity of a common parasitic nematode (*Cosmocercoides dukae*). In contrast, population size of frogs was positively associated with fire, with no related management effects. Infection intensity of a mutualistic nematode (*Gyrinicola batrachiensis*) in tadpoles of the Columbia Spotted Frog was also higher in burned wetlands than in unburned wetlands. Our results clarify the potential effects of wildfire outside of protected landscapes and illustrate how fire may affect communities across trophic levels.

COMPETITION BETWEEN EASTERN AND WESTERN GRAY SQUIRRELS IN THE PUGET LOWLANDS. Aaron N Johnston, *Washington Cooperative Fish & Wildlife Research Unit, School of Forest Resources, University of Washington, Box 352100, Seattle, WA 98195; aaronj5@u.washington.edu.*

Populations of State-threatened Western Gray Squirrels (*Sciurus griseus*) have declined in areas invaded by introduced Eastern Gray Squirrels (*S. carolinensis*) in Washington, but little is known about competitive interactions between these species. The Western Gray Squirrel is an ecologically important member of oak woodlands, and intensive efforts to recover this species are underway in Washington. This study began in 2007 in conjunction with a project administered by the Washington Department of Fish and Wildlife to augment a population of Western Gray Squirrels on the Joint Base Lewis-McChord. Together, we equipped Eastern and Western Gray Squirrels with radio-collars to investigate resource use and interactions between species. We experimentally removed Eastern Gray Squirrels from two sites and radiotracked both species at two control sites to measure competitive effects on Western Gray Squirrels based on spatial-partitioning metrics and fitness correlates (e.g., mass, fecundity, survival). Data collected thus far suggest exclusive use of space and some differential use of habitat between gray squirrel species. Preliminary results for spatial metrics indicate low use of former Eastern Gray Squirrel territories by Western Gray Squirrels following removal treatments. Collection of post-treatment data will be completed in Fall 2011.

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

The Alberta Conservation Association is a member of a provincial recovery team that is responsible for facilitating, monitoring, and evaluating the conservation and recovery of the Northern Leopard Frog (NLF) (*Lithobates pipiens*) in Alberta. The team is guided by Alberta Fish and Wildlife and team members and associated organizations are responsible for implementation of actions and strategies that are outlined in the recovery plan to restore and maintain the species for future generations. A number of actions have been designed to meet the objectives of the NLF recovery plan including: population and habitat monitoring, reintroductions, habitat protection, and outreach initiatives. Several reintroductions have been attempted in Alberta to re-establish the NLF in select areas. Between 1999 and 2010 we attempted two approaches for reintroduction: head-starting and egg translocation. Reintroduction efforts using egg

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translocations have demonstrated some success. A self-sustaining NLF population has been achieved at one site. In 2010, we observed introduced frogs from previous releases at four additional reintroduction sites, including the observation of a NLF egg mass. To help direct reintroductions, a genetic diversity and structure study was undertaken to determine the genetic suitability of potential source populations. A disease surveillance project was also undertaken to minimize disease transmission between amphibian species during reintroductions and to determine the presence of amphibian disease, such as "chytrid" fungus (*Batrachochytrium dendobatidis*), prior to reintroductions.

FOOD WEB STRUCTURE OF HEADWATER STREAMS OF THE OLYMPIC PENINSULA: ROLE OF RIPARIAN VEGETATION. Peter M Kiffney, *NOAA, Northwest Fisheries Science Center, Fish Ecology Division, 10 Park Avenue, Building B, Mukilteo, WA 98275; Hedmark University College, Department of Forestry and Wildlife Management, Campus Evenstad, Elverum, Norway 2408; peter.kiffney@noaa.gov;* Carol Volk, *South Fork Research, Inc., 4482 SE 145th St., North Bend, WA 98045; carol@southforkresearch.com.*

Tailed Frogs (*Ascaphus truei*) are found throughout the Pacific Northwest, and in some cases can comprise most of the vertebrate biomass in fishless headwater streams. Tailed Frog larvae have unique adaptations to living in flowing water environments, and are thought to acquire energy primarily through grazing diatoms and other alga off rock surfaces. Through a series of controlled experiments, we demonstrated that Tailed Frog larvae are food limited; thus, in natural streams, growth, body size and potentially metamorphosis to adults might be partly determined by stream productivity. Stream productivity, in turn, can be partly determined by riparian plant composition. For example, because of past logging, many streams in the PNW are bordered by riparian alder (*Alnus rubra*), which is a nitrogen-fixer providing nitrogen-rich leaf litter to stream environments. With this in mind, we collected riparian vegetation, stream biofilm and insects, and Tailed Frog larvae from 6 streams on the Olympic Peninsula, WA, with the riparian areas bordering 3 of these streams dominated by old-growth coniferous forest while the other 3 stream riparian areas were dominated by alder. Carbon and nitrogen isotopes were then used to quantify the influence of riparian vegetation on the trophic structure of these headwater food webs.

REPRODUCTION AND SURVIVAL OF COHO SALMON EXPOSED TO PESTICIDES WITHIN URBAN STREAMS IN WESTERN WASHINGTON. Kerensa A King, Christian E Grue, James M Grassley, *University of Washington, Washington Cooperative Fish and Wildlife Research Unit, School of Aquatic and Fishery Sciences, Seattle, WA 98195; kerensa@u.washington.edu.*

The research presented represents the culmination of a 5-year effort to determine the effects of a pesticide cocktail on different life stages of Coho Salmon (*Oncorhynchus kisutch*). The cocktail consisted of eight herbicides, two insecticides, a fungicide, and a common breakdown product; nominal concentrations were maximums reported after fall storm-water events. Formulated products (single AI) were used when possible and were selected from those available at retail outlets. Results suggest there were no effects on time to death of adults, brain acetylcholinesterase activity, sperm motility, fertilization success, hatching success, survival, growth of fry, gender, or immune competence, and that other factors (general water quality, habitat, or other contaminants) may be responsible for the reproductive effects observed in coho within urban streams in western Washington. Numbers of returning adults varied among treatment groups and years. In 2008, a greater number of adults exposed to the cocktail from fertilization to swim-up returned; in 2009, control returnees exceeded those exposed to the cocktail through smoltification. In both years, the percentage of returnees was low (<1%). Adults previously exposed through swim-up and controls that returned in 2008 were spawned within treatment, and gametes split between pesticide exposure and clean water to examine trans-generational effects. A total of four juvenile groups were assessed – adult treatment:juvenile treatment, adult treatment:juvenile control, adult control:juvenile treatment, adult control:juvenile control. Preliminary analyses suggest there were no effects on fertilization success, hatching success, survival, or growth of fry through 5 weeks post emergence.

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AN EXPERIMENTAL EVALUATION OF AVIAN NEST SURVIVAL IN CREATED SNAGS. Andrew J Kroll, *Weyerhaeuser Company, WTC 1A5, Federal Way, WA 98063; aj.kroll@weyerhaeuser.com;* Matt Hane, *Weyerhaeuser Company, Springfield, OR 97478;* Josh Johnston, Mike Rochelle, *Weyerhaeuser Company, Albany, OR 97321.*

Snags are critical features for managing biological diversity in forests of the Pacific Northwest, USA. However, commercial forests in this region often contain reduced numbers of snags compared to unmanaged forests and managers require effective methods to augment snag numbers in harvest units. Therefore, we created snags by topping live trees with a mechanical harvester and studied nesting use of these snags by cavity-nesting birds in clearcuts in Douglas-fir (*Pseudotsuga menziesii*) forests along the west slope of the Cascade Range and east slope of the Coast Range in Oregon, USA. We used a completely randomized design to assign 6 different treatments (single or scattered distribution by 3 different densities) to 28 different harvest units. We created 1111 snags from February 1997-April 1999 and monitored them from April-August 2008-2010. We monitored 505 nesting attempts by 10 species. We used logistic-exposure models to evaluate nest survival. Period survival rates (95% CI) were 0.55 (0.39-0.68), 0.60 (0.46-0.71), and 0.72 (0.52-0.85) across all 3 years for Chestnut-backed Chickadee (*Poecile rufescens*), Northern Flicker (*Colaptes auratus*), and House Wren (*Troglodytes aedon*), respectively (the 3 species with sufficient data to analyze). Nest survival for Chestnut-backed Chickadee was highest at the medium snag density (0.5 snag/acre); the other species did not respond to the treatment. While managers can use this technique to create snags in an economical and safe manner, this technique cannot create the tall, large snags required by some species and thus it provides only a partial solution to a critical forest management issue.

NORTHERN SPOTTED OWL DETECTION AND TERRITORY OCCUPANCY PROBABILITIES IN THE EASTERN KLAMATH MOUNTAINS AND SOUTHERN CASCADES OF INTERIOR NORTHERN CALIFORNIA. Andrew J Kroll, *Weyerhaeuser Company, WTC 1A5, Federal Way, WA 98063; aj.kroll@weyerhaeuser.com;* Stuart Farber, *WM Beaty & Associates, Redding, CA 96099.*

Numerous land managers in the Pacific Northwest monitor Northern Spotted Owls (*Strix occidentalis caurina*) as part of research and operational activities. However, the majority of available information regarding the effectiveness of survey protocols for Northern Spotted Owls is derived from research studies that have different requirements, and use different sampling techniques, than operational projects. To address this issue, we evaluated Northern Spotted Owl detection and occupancy probabilities for 63 territories in interior northern California that occur on a landscape of private timberlands and U.S. Forest Service ownership. We recorded 480 Spotted Owl (37%) and 13 Barred Owl (*Strix varia*) (1%) detections during 1282 surveys that occurred from 1995-2009. Average per visit simple (defined as either a single owl or pair of owls) detection probability was 0.93 (95% CL: 0.90, 0.96) for day surveys and 0.47 (0.43, 0.53) for night surveys. The most supported simple occupancy model included a constant local-extinction probability (estimate and 95% CL: 0.09, 0.06-0.13) and a colonization probability that declined from 1995 (0.25; 95% CI: 0.28-0.34) to 2009 (0.05; 95% CI: 0.03-0.10). As a result, simple occupancy probabilities declined ~40% from 1995 (0.81; 95% CI: 0.59-0.93) to 2009 (0.50; 95% CI: 0.36-0.63). Our results provide information about current survey protocol effectiveness and Northern Spotted Owl occupancy dynamics for a mixed ownership landscape in which Barred Owls appear to be rare.

SHORT-TERM RESPONSE OF PACIFIC GIANT SALAMANDERS TO TIMBER MANAGEMENT IN SOUTHWESTERN OREGON. Niels Leuthold, *Department of Forest Science, Oregon State University, Corvallis, OR 97331; niels.leuthold@oregonstate.edu;* Michael J Adams, *Forest and Rangeland Ecosystem Science Center, US Geological Survey, 3200 SW Jefferson Way, Corvallis, OR 97331;* John P Hayes, *Department of Wildlife Ecology and Conservation, University of Florida, Gainesville, FL 32611.*

In the Pacific Northwest, amphibians inhabit forested streams ranging from barely a trickle up to larger rivers and inhabit streams as well as the surrounding forest. Many previous studies have found a negative effect of timber management on the abundance of stream amphibians, but results have been variable and region specific. These studies have generally used survey methods that do not account for differences in capture probability, which may be important if habitat condition alter capture probabilities. In addition, most of these studies have been retrospective comparisons of stands of different ages, and focus on

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stands that were harvested under older management practices. Over the last 30 years forest management practices have changed substantially, yet little work examines how modern forest management relates to the abundance or density of stream amphibians. We examined the influences of contemporary forest practices on Pacific giant salamanders as part of the Hinkle Creek paired watershed study. We used a mark-recapture analysis to estimate Pacific giant salamander density at 100 1-m segments spread throughout the basin and then used extended linear models that accounted for correlation resulting from the repeated surveys at sites across years. Density was associated with substrate, but we found no evidence of an effect of harvest. While holding other factors constant, our top model indicated; 1) each 10 percent increase in proportion of the substrate that was small cobble or larger increased median density of Pacific giant salamanders 1.06 times, 2) each 100 hectare increase in the area drained decreased median density of Pacific giant salamander 0.93 times, and 3) increasing the fish density in the 40 m around a site by 0.01 increased median salamander density 1.02 times. Our mark-recapture analysis accounted for sampling inefficiencies at sites with captures, but sites with no captures retained densities of 0 in our extended linear analysis. At least some of these sites were likely occupied and we failed to capture individuals that were present. A Monte Carlo analysis suggested that our results were not sensitive to missing captures at some sites. We did not find evidence of a short term effect of timber harvest on the density of Pacific Giant Salamanders at Hinkle Creek.

THE IMPACT OF ALUM BASED ADVANCED NUTRIENT REMOVAL PROCESSES ON PHOSPHORUS BIOAVAILABILITY. Bo Li, *Civil & Environmental Engineering, University of Washington, Seattle, WA, 98105; libo@u.washington.edu;* Michael T Brett, *Civil & Environmental Engineering, University of Washington, Seattle, WA 98105.*

Because eutrophication is a widespread consequence of wastewater discharges, there is a strong impetus to develop new approaches to remove phosphorus (P) from wastewater treatment plant (WWTP) effluents. The Spokane WWTP currently removes 90% of the P from its influent and a pilot plant is testing various alum based processes for achieving > 99% P removal, but, it is not known how these advanced P removal technologies will affect the bioavailability of P (BAP). We tested how the percent BAP (%BAP) varied with different P removal levels using an algal growth bioassay methodology. The Spokane pilot plant reduced total P concentrations from ≈ 3 mg L^{-1} in the influent to 19 ± 4 (± SD) µg L^{-1} in the final effluent, and our results showed that as the level of P removal increased, the %BAP of the product declined sharply, r^2 = 0.98. Prior to alum treatment, the influent had an average %BAP of 79 ± 13%, and after three steps of alum based removal the %BAP averaged 7 ± 4%. Thus, this alum based P removal process was very effective at sequestering the P forms that most readily stimulate algal growth. Further, our results show the final BAP of the effluent was only ≈ 50% of the "reactive" P concentration.

CONNECTIVITY AND RANGE EXPANSIONS OF NORTH AMERICAN BIRDS. Kent B Livezey, *US Fish and Wildlife Service, 510 Desmond Drive, Lacey WA 98503; kent_livezey@fws.gov.*

Widespread range expansions of North American birds are evident in species accounts in The Birds of North America and through personal communications with the authors. A total of 111 species (19.5% of 569 species) recently expanded their breeding ranges into at least 1 new state or province. Seventeen species expanded their ranges into at least 12 new states or provinces; examples include Cattle Egret (*Bubulcus ibis*, n = 46), Brown-headed Cowbird (*Molothrus ater*, 38), Ring-necked Duck (*Aythya collaris*,18), Great Egret (*Ardea alba*,18), Herring Gull (*Larus argentatus*, 16), Bewick's Wren (*Thryomanes bewickii*, 15), Northern Mockingbird (*Mimus polyglottos*,15), Snowy Egret (*Egretta thula*,14), Great-tailed Grackle (*Quiscalus mexicanus*, 14), Glossy Ibis (*Plegadis falcinellus*, 12), Barred Owl (*Strix varia*, 12), and Brown Thrasher (*Toxostoma rufum*, 12). Thirty-eight states or provinces have at least 10 more bird species than they did centuries ago. Many of these range expansions have resulted in hybridization, brood parasitism, competition, or predation between species, challenging implementation of the Migratory Bird Treaty Act and Endangered Species Act. Human-caused increases in connectivity of habitats (n = 84) or changes to climate (5) facilitated 98% of known or suggested range expansions, so it is likely range expansions will continue.

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INFORMING COASTAL RESTORATION IN A CHANGING CLIMATE. Ilon E Logan, *School of Marine & Environmental Affairs, University of Washington, 3707 Brooklyn Avenue NE, Seattle, WA 98105; ilogan@u.washington.edu.*

Climate change presents new challenges and opportunities for the protection and restoration of coastal ecosystems. The complexity, variability, dynamism, and diversity in potential biophysical responses and adaptations to a changing climate can result in tremendous uncertainty for restoration practitioners. Despite this uncertainty, failure to explicitly take the impacts of climate change into account during coastal restoration planning will make it much more difficult, if not impossible in some cases, to meet our conservation goals. Strategies for forging ahead in spite of uncertainty include building ecological resilience, holistic thinking, adaptive management, and scenario planning. I also suggest that practitioners undergo two paradigm shifts: restore for future conditions, not past climates, and structure restoration rationale in terms of anthropogenic benefits as opposed to ecocentric purposes. To apply these strategies, I provide a planning framework for informing restoration planning and implementation in a changing climate. Restoration that is robust to climate change should begin with a spatially explicit assessment of vulnerabilities and opportunities along a given stretch of the shoreline. Identification of how constraints that result from climate change (e.g. social, economic, ecological, hydrological, geomorphological) are distributed across the landscape will lead to an ability to prioritize areas for restoration. Most importantly, consideration of the human dimensions of restoration planning (i.e. social perceptions and responses) is elevated to the same level as traditional ecological considerations. Specific restoration goals can then be achieved in a holistic approach and driven toward implementation.

SPRING AND SUMMER SPACE USE BY CLARK'S NUTCRACKERS ON THE EASTERN SLOPES OF THE WASHINGTON CASCADES. Teresa J Lorenz, *College of Natural Resources, University of Idaho, Moscow, ID 83844; lore5748@vandals.uidaho.edu;* Kimberly A Sullivan, Amanda V Bakian, *Department of Biology, Utah State University, Logan, UT 84322.*

Clark's Nutcrackers (*Nucifraga columbiana*) are important seed dispersers in western North America for several species of pine and they are coevolved mutualists for one species, Whitebark Pine (*Pinus albicaulis*). Despite their role as agents of reforestation there have been few formal studies of nutcracker space use. Such information is important for resource managers in the Northwestern U.S., where Whitebark Pine, the nutcracker's mutualistic partner, is declining. We measured spring-summer (February-August) home range size, habitat use, and forage site selection by a population of nutcrackers in Yakima County, Washington. Average home range size was 1239.47 ha (SD ± 1780.24 ha, n = 20) and nutcracker home ranges contained more Douglas-fir (*Pseudotsuga menziesii*)/Grand Fir (*Abies grandis*) but less whitebark pine habitat (Wilks' Lambda = 0.16, F[5, 14] = 14.73, P < 0.001) compared to availability. During 3482 minutes of observation nutcrackers did not forage equally in all habitat types ($\chi^2 56 = 3183.26$, P < 0.001); 2% of nutcracker foraging bouts occurred in whitebark pine habitat types, whereas 82% of foraging bouts occurred in low elevation Douglas-fir/Grand Fir and Ponderosa Pine (*Pinus ponderosa*) forests. Although prior studies show that Whitebark Pine habitat is important in autumn, our results suggest that low elevation forest types may be important during spring and summer for populations on the east slopes of the Cascades.

WASHINGTON NORTHERN SEA OTTER POPULATION STATUS, TRENDS, AND INVESTIGATIONS OF MORTALITIES. Deanna Lynch, *US Fish and Wildlife Service, Washington Fish and Wildlife Office, 510 Desmond Drive, Lacey, WA 98503; deanna_lynch@fws.gov;* Nancy Thomas, *USGS National Wildlife Health Center, 6006 Schroeder Road, Madison, WI 53711; nancy_thomas@usgs.gov;* Krysten Schuler, *Animal Health Diagnostic Laboratory, Cornell University College of Veterinary Medicine, 240 Farrier Road, Ithaca NY 14850; ks833@cornell.edu;* Steven Jeffries, *Washington Department of Fish, Wildlife, Marine Mammal Investigations, 7801 Phillips Road SW, Tacoma, WA 98498; steven.jeffries@dfw.wa.gov.*

The Northern Sea Otter (*Enhydra lutris*) in Washington State is a state endangered species. In 2010, the population was estimated to be 1,004 otters, the majority of which reside along the outer coast between Cape Flattery and Cape Elizabeth. The population has increased at about 8% per year since 1989. On average between 2002 and 2010, 20 mortalities were reported each year (range 16-28) and 6 were collected for necropsy each year (range 4-9). There was no significant gender bias in reported versus recovered carcasses. Approximately 50% of otters recovered were prime- aged between 4 and 12 years

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old and 30% were pups and subadults. Recovery was biased temporally by human visitation and spatially by suitable recovery locations. Identified sources of mortality included trauma, cardiac disease, intestinal torsion, drowning, and emaciation. The most common source of mortality was infectious diseases, such as morbillivirus (canine strain), leptospirosis, and protozoal encephalitis due to *Sarcocystis neurona, Toxoplasma gondii*, or dual infections.

ASSESSING THE EFFECTIVENESS OF AMPHIBIAN MITIGATION ON THE SEA TO SKY HIGHWAY: PASSAGEWAY USE, ROADKILL MORTALITY, AND POPULATION-LEVEL EFFECTS ON THE RED-LEGGED FROG. Joshua Malt, *BC Ministry Of Natural Resource Operations, 10470-152 Street, Surrey, BC V3R OY3; Joshua.Malt@gov.bc.ca.*

Environmental Impact Assessments typically assume that proposed mitigation measures will be effective, but post-construction monitoring is rarely done to assess if this assumption is true. I assessed the effectiveness of mitigation measures on the Sea to Sky Highway (British Columbia, Canada), using remote cameras, roadkill surveys, and mark-recapture techniques in 2009 and 2010. Mitigation measures included eight highway underpasses and drift fencing designed to minimize impacts on local amphibian species, including the Northern Red-legged Frog (*Rana aurora*), a federally-listed species at risk. Remote cameras frequently documented amphibians near passageway entrances, but the majority of amphibians did not pass through. Roadkill surveys documented that approximately 400-500 amphibians are killed annually, but roadkill rates can be reduced by half in areas where sufficient lengths of fencing are used as a barrier. These results indicate the importance of installing sufficient lengths of fencing to minimize roadkill mortality, but the benefits of this strategy must be weighed against the potential negative impacts to population connectivity. Mark-recapture results estimate the local population size of *R. aurora* to be 1500 – 1800 individuals. Given this estimate, annual roadkill has the potential to reduce juvenile and adult survival by 20% or more. A deterministic population model, using published vital rates, indicated that this reduction in survival will cause the local population to decline. The Ministry of Transportation has installed additional fencing to reduce highway mortality and address population-level impacts. Application of these results to inform the effective design and construction of future mitigation projects is discussed.

THE WASHINGTON CONNECTED LANDSCAPES PROJECT: AN INTRODUCTION. Kelly R McAllister, *Washington State Department of Transportation, 310 Maple Park SE, Olympia, WA 98504; McAllKe@wsdot.wa.gov;* Joanne P Schuett-Hames, *Washington State Department of Fish and Wildlife, 600 Capitol Way N, Olympia, WA 98501; Joanne.Schuett-Hames@dfw.wa.gov.*

Development of many kinds has compromised the connectivity of habitats and wildlife populations in Washington. Sustaining wildlife habitat connectivity, while at the same time meeting the needs of people and communities, is an increasingly difficult challenge. An effective program to maintain or improve connectivity requires a multi-faceted approach that applies the best available science to guide coordinated action by many agencies and organizations. Washington's Wildlife Habitat Connectivity Working Group (WHCWG) was formed to address this need. The WHCWG is a voluntary public-private partnership with participation from multiple government agencies, tribes, and non-governmental conservation organizations. We take a systematic approach to conserving wildlife habitat connectivity, and we call the effort the Washington Connected Landscapes Project. The primary thrusts of the project at this time include: (1) scientific analyses of landscape conditions at different spatial scales, (2) analytical tool development, (3) coordination with transboundary partners to promote connectivity conservation across Washington's borders, (4) research and adaptive management to test and improve our models, and (5) outreach and education on connectivity conservation to a broad array of stakeholders. A major product of the WHCWG is a statewide analysis (available at: www.waconnected.org) that identifies broad-scale wildlife and habitat connectivity patterns in Washington. To accomplish the statewide analysis we employed complementary focal species and landscape integrity approaches that are the subject of the next two presentations; a third presentation discusses and interprets the broad patterns evident from our results, and discusses tools that we've developed.

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IMPLEMENTING ROBUST DESIGNS TO ESTIMATE DETECTION PROBABILITIES FOR STREAM-BREEDING AMPHIBIANS. Aimee P McIntyre, *Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, WA 98501; Aimee.McIntyre@dfw.wa.gov;* Jay E Jones, *Weyerhaeuser Company, WTC 1A5, Federal Way, WA 98063;* Eric M Lund, Frithiof T Waterstrat, *Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, WA 98501;* Jack N Giovanini, Stephen D Duke, *Weyerhaeuser Company, WTC 1A5, Federal Way, WA 98063;* Marc P Hayes, Timothy Quinn, *Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, WA 98501;* Andrew J Kroll, *Weyerhaeuser Company, WTC 1A5, Federal Way, WA 98063.*

We assessed the utility of recently developed binomial mixture models for estimating amphibian detection probabilities and abundances of two stream-associated amphibian genera (Torrent Salamanders, *Rhyacotriton,* and Giant Salamanders, *Dicamptodon*). This novel approach relies on spatially and temporally replicated counts of unmarked animals. We evaluated the effect of two covariates, stream order and stream temperature, on detection probability. Detection probability estimates varied, with mean values ranging between 0.06-0.64 for Torrent Salamanders and 0.07-0.60 for Giant Salamanders. Detection probability for Torrent Salamanders varied with stream temperature, stream order, and the interaction of those two covariates. Giant Salamander detection probability was associated with both stream temperature and order; however, we found no evidence of a significant temperature by order interaction with detection. The technique we assessed, which accounts for detection probability while simultaneously estimating abundance, is readily adaptable to taxa that are difficult to sample using standard mark-recapture methods. Abundance estimates adjusted for detection probabilities provide estimates that can be used to enable confidently comparing populations through time, especially where we suspect that detection probabilities vary with select covariates.

EXTRAPOLATING LOSS OF ALARM BEHAVIOR TO POPULATION SURVIVAL IN COHO SALMON USING INDIVIDUAL-BASED AND MATRIX POPULATION MODELS. Jenifer K McIntyre, *Washington State University, Puyallup Extension & Research Center, Stormwater Research Program, Puyallup, WA; jenifer.mcintyre@noaa.gov;* David H Baldwin, Nathaniel L Scholz, *NOAA-NMFS, Northwest Fisheries Science Center, 2725 Montlake Blvd E, Seattle, WA 98112;* David A Beauchamp, *Washington Cooperative Fisheries & Wildlife Research Unit, University of Washington, School of Aquatic & Fishery Sciences, 1122 NE Boat St., Seattle, WA 98105.*

Coho Salmon (*Oncorhynchus kisutch*) in urbanizing areas of the Pacific Northwest are exposed to myriad challenges that affect the resiliency of localized populations. The small, lowland streams preferred by Coho Salmon in the Puget Sound basin are increasingly subject to reduced water quality, mainly from stormwater runoff. Copper is a common stormwater pollutant in urban streams. Numerous studies have shown that acute exposure to low, environmentally relevant concentrations of copper inhibits the olfactory system of juvenile salmon. This impairment is also associated with loss of behavioral response to olfactory alarm cues, which in turn affects predator-prey dynamics. An individual-based model (IBM) was built to simulate the effect of copper exposure during rain events in the Puget Sound basin on survival of juvenile Coho Salmon. The predation IBM was paired with a matrix population projection model to link impacts across individuals to metrics affecting a theoretical population in Puget Sound. The models projected reduced juvenile survival from copper runoff during rain events, and reduced population viability, with quasi-extinction within 20 years at bioavailable dissolved copper concentrations above 3 ppb. Although many factors contribute to observed declines in Coho Salmon populations in Puget Sound, the results of this modeling exercise suggest that sublethal exposure to contaminants may play a role.

WASHINGTON CONNECTED LANDSCAPES PROJECT: SYNTHESIS OF STATEWIDE RESULTS AND NEW GIS TOOLS FOR REGIONAL CONNECTIVITY ASSESSMENTS. Brad H McRae, *The Nature Conservancy, 1917 First Ave, Seattle WA 98101; bmcrae@tnc.org;* Peter H Singleton, *USDA Forest Service, 1133 N Western Avenue, Wenatchee, WA 98801; psingleton@fs.fed.us;* Brian L Cosentino, *Washington Department of Fish and Wildlife, 600 Capitol Way N, Olympia WA 98501; Brian.Cosentino@dfw.wa.gov;* Darren M Kavanagh, *The Nature Conservancy, 1917 First Ave, Seattle WA 98101; dkavanagh@tnc.org.*

Maintaining and restoring well-connected landscapes has become a key strategy for wildlife conservation and climate adaptation. However, translating connectivity models into products that can

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inform conservation planning for multiple species at regional scales has been challenging. We discuss two innovations from the Washington Connected Landscapes Project that can help overcome these challenges. First, we developed new GIS tools to support our statewide connectivity analysis that can be directly applied in other regional connectivity assessments. The tools combine least-cost corridor modeling with graph theory to rapidly identify and map linkages, and are capable of constructing networks connecting thousands of core habitat areas. We used these tools to map areas important for connectivity conservation using a combination of focal species- and landscape integrity-based models. These produced linkage networks for 16 representative species, plus lands exhibiting high degrees of ecological integrity (relatively intact areas with low levels of human modification). Second, we synthesized our results from focal species and integrity models, and evaluated the overlap in areas identified by the two approaches. Simple binary comparisons indicate strong overlaps among species and integrity networks, particularly in highly fragmented portions of Washington State. Our effort is the first to compare results from both species- and integrity-based approaches; we'll discuss plans for refining our analyses as well as new methods to help prioritize detailed linkage designs and conservation actions. This work is the result of the highly collaborative efforts of the Washington Wildlife Habitat Connectivity Working Group, a science-based organization composed of representatives from land and resource management agencies, non-profit conservation organizations, and universities.

COMPENSATORY EFFECTS OF RECRUITMENT AND SURVIVAL ON POPULATION PERSISTENCE. Erin Muths, *US Geological Survey, Fort Collins Science Center, 2150 Centre Avenue Building C, Fort Collins, CO 80526; erin_muths@usgs.gov;* Rick D Scherer, *Colorado State University, Department of Fish, Wildlife and Conservation Biology, Fort Collins, CO 80523; scherer@warnercnr.colostate.edu;* David S Pilliod, *US Geological Survey, Snake River Field Station, 970 Lusk Street, Boise, ID 83706; david_pilliod@usgs.gov.*

Improving estimates of population parameters and understanding the interplay of factors that regulate these parameters is critical to address the applied ecological questions that are being asked in the efforts to mitigate amphibian declines. We explore the relative contribution of survival probability and recruitment to population stability, and illustrate how changes in relative contribution can alter the impact of perturbation on persistence using data from two populations, one with and one without disease. We demonstrate that high recruitment rates are likely compensating for low survival probability in an amphibian population challenged by an emerging pathogen, resulting in a relatively slow rate of decline. In contrast, a population with no evidence of disease had high survival probability but lower recruitment rates. We suggest that the compensatory relationship between survival and recruitment may help explain, and be used to predict, population regulation and persistence for amphibians threatened with disease.

YEAR OF THE TURTLE: DEVELOPMENT OF A NEW CONSERVATION PARADIGM. Deanna H Olson, Kathryn L. Ronnenberg, *US Forest Service, Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331; dedeolson@fs.fed.us;* Priya Nanjappa, *Association of Fish and Wildlife Agencies, Washington, DC;* Terry Z Riley, *National Park Service, Fort Collins, CO;* Alvin R Breisch, *Partners in Amphibian and Reptile Conservation, Altamont, NY.*

The designation of 2011 as 'Year of the Turtle' by Partners in Amphibian and Reptile Conservation and their turtle conservation partners emerged as a novel paradigm for conservation and raising awareness in North America, with tendrils beginning to extend around the globe. Momentum of the campaign is increasing as the year progresses, drawing together dozens of partners including government agencies, conservation organizations, research scientists and citizen scientists, veterinarians, the pet industry, trade organizations, and the public. The heart of the program is the empowerment of individuals and independent groups to work within the scope of their own influence to facilitate additional focus and activities on turtle conservation, research, and education. With almost 50% of world freshwater turtles and tortoises threatened with extinction, the attention is past due. However, prognosis for many conservation success stories is optimistic with this taxon, especially in North America, where the overall threat rate is lower. In addition, cultural values for retaining our turtle natural heritage are great, and appreciation for turtles among the public is high. Highlights of the Year of the Turtle can be found at www.yearoftheturtle.org and include monthly newsletters, photo contest and associated monthly calendar, USA turtle mapping project, State of the Turtle report, and more.

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PREPARING FOR WHITE NOSE SYNDROME IN THE PACIFIC NORTHWEST. Pat Ormsbee, *USFS/BLM, 3106 Pierce Parkway, Suite D, Springfield, OR 9747; pormsbee@fs.fed.us.*

White Nose Syndrome (WNS) has decimated hibernating colonies of bats in the northeastern U. S. In 2006, bats were first observed leaving a hibernaculum in-mass during daylight in the cold of March in Albany County, New York. By 2011, WNS or its fungal causal agent had spread to 16 states and 2 Canadian provinces and resulted in some bat colony declines of 80-100%. Scientists have struggled to identify the cause of the aberrant behavior, starvation, and deaths attributed to WNS. Through extensive collaborative investigations by state, federal, and private scientists, a newly described psychrophilic (cold-loving) fungus (*Geomyces destructans*) colonizing the skin of bats has been targeted as the primary causal agent. G. destructans thrives between 5-10°C, a temperature range that also is typical of bat hibernacula. WNS is spreading at an alarming rate and human awareness, modified behavior, and preparation are critical in slowing the inevitable spread and reducing the devastating effects of WNS. An interagency team has been formed to develop a WNS Response Strategy for the Pacific Northwest. Several products have been drafted and are expected to be released before fall of 2011.

SEASONAL MOVEMENTS AND OVERWINTERING OF WESTERN TOADS (*ANAXYRUS BOREAS*) ADJACENT TO INTERSTATE 90 AT SNOQUALMIE PASS, WASHINGTON. Amber Palmeri-Miles, Jason T Irwin, April B Barreca, Susan Brady, R Steven Wagner, *Central Washington University, 400 East University Way, Ellensburg, WA 98926; palmeria@cwu.edu.*

Amphibian declines worldwide have been attributed to numerous factors, including invasive species, disease, and most importantly, habitat loss. One major contributor to habitat loss is fragmentation by roads, which act as obstacles or barriers and result in high amphibian mortality. This study examined the seasonal movements of Western Toads (*Anaxyrus* [= *Bufo*] *boreas*) adjacent to Interstate 90 (I-90), in the Snoqualmie Pass area. Western Toads are good candidates for anuran movement studies because they migrate among breeding sites, summer foraging ranges, and overwintering sites, and travel long distances relative to their size. Twenty-five Western Toads have been tracked for various durations from July of 2009 to present and eleven hibernacula were identified. Toads were outfitted with radiotransmitters (BD-2 Holohil Inc.) mounted on polyethylene tubing waist-belts. Each toad was tracked 2-3 times per week using a Telonics TR-4 receiver and RA-17 antenna. At each site a toad was located, GPS location and habitat data were collected. Western Toads show great capacity for movement (>2 km over a 2-day period) and use a wide variety of habitats. Washington's Department of Transportation is working on an expansion project along I-90 at Snoqualmie Pass and will be incorporating animal crossings above and below the road surface. Many organizations are collaborating on this project, including middle school students from Cle Elum, Washington. Identifying key areas of use by Western Toads will enable informed conservation and management decisions to reduce the impacts of I-90 on amphibians by improving habitat connectivity.

A COMPARATIVE ANALYSIS OF NATURAL AND HUMAN MADE ROCK HABITATS FOR AMERICAN PIKAS, OCHOTONA PRINCEPS, ALONG INTERSTATE 90 IN THE CENTRAL WASHINGTON CASCADE RANGE. R Parks, *Resource Management Graduate Program, 400 E. University Way, Ellensburg, WA 98926; parksr@cwu.edu;* KA Ernest, *Central Washington University, Department of Biological Sciences, 400 E. University Way, Ellensburg, WA 98926; ernestk@cwu.edu*; P Garvey-Darda, *US Forest Service, Cle Elum Ranger District, 803 West 2nd Street, Cle Elum, WA 98922; pgarveydarda@fs.fed.us.*

American Pikas (*Ochotona princeps*) are small mammals that occupy talus slopes and other rocky habitats in mountainous areas of western North America. In the Washington Cascades, pikas have been found living in human-made rock habitats, including both road-fill along highways and riprap along streams, as well as in natural talus patches. Washington State Department of Transportation (WSDOT) plans to build a number of wildlife crossing structures in this area to improve wildlife connectivity. Our objective was to provide WSDOT with data on pika habitat features that could be incorporated into the crossing structures to improve their suitability for pikas. In this study, we compare the ecological characteristics and pika use of natural and human-made rock habitat along I-90. Multivariate statistical analysis will be used to identify differences in habitat characteristics between pika-occupied and unoccupied sites, and among natural talus, road-fill, and riprap patches. Preliminary results suggest that unoccupied rocky habitats are smaller and closer to forage, and have smaller rocks, shallower crevices, and fewer rock layers

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compared to occupied habitats. Thus, the differences between human-made and natural habitats parallel the differences between unoccupied and occupied patches. Common features among different habitat types occupied by pikas, and differences between occupied and unoccupied sites, will provide critical information to WSDOT in their design of wildlife crossing structures suitable for pikas.

LANDSCAPE INTEGRITY CONSERVATION: CONNECTING THE BEST OF WHAT'S LEFT. John Pierce, *Washington Department of Fish and Wildlife, 600 Capitol Way N, Olympia, WA 98501; john.pierce@dfw.wa.gov;* Tristan A Nuñez, *School of Forest Resources, University of Washington, Seattle, WA 98105; tristan.nunez@gmail.com;* Brad McRae, *The Nature Conservancy, 1917 First Ave S, Seattle, WA 98101; mcrae@circuitscape.org;* Meade Krosby, *Department of Biology, University of Washington, Seattle, WA 98195; mkrosby@u.washington.edu;* Joshua J Lawler, *School of Forest Resources, University of Washington, Seattle, WA 98195; jlawler@u.washington.edu.*

Increasing human development in Washington associated with land conversion, urban and residential growth and road creation has resulted in a fragmented landscape with large intact isolated blocks of lands with high landscape integrity (i.e., areas with the least human footprint and high levels of naturalness) separated by large expanses of matrix lands with low landscape integrity (i.e., areas with high human footprint and low levels of naturalness). Similar to the California Essential Habitat Connectivity Project, the landscape integrity connectivity approach is for the landscape scale and not tailored to specific species. The landscape integrity approach seeks to identify the best routes for the flow of ecological processes across landscapes between large, contiguous areas with high levels of landscape integrity (i.e., core areas with relatively low levels of modification by humans). We modeled connectivity using four different resistance surfaces representing different assumptions relative to organisms' sensitivity to moving across a human-impacted landscape. Resistance-surface models were parameterized such that pathways crossing lands with low integrity incurred a high cost, and pathways crossing lands with high integrity incurred a low cost. Resistance values for low integrity lands ranged from least for the lowest sensitivity model to greatest for highest sensitivity model. A final composite landscape connectivity map was created by overlaying least-cost corridor maps to identify those areas in the matrix that were identified as important for connectivity among all four sensitivity models. This ongoing effort is part of the Washington Habitat Connectivity Working Group project (http://www.waconnected.org/).

INTRODUCING AN AUTOMATED PATTERN RECOGNITION PROGRAM FOR LEOPARD FROGS. David S Pilliod, *US Geological Survey, Forest and Rangeland Ecosystem Science Center, 970 Lusk Street, Boise, ID 83706; dpilliod@usgs.gov.*

Identification of individual animals is needed for studying population demography and movement patterns and is the basis for mark-recapture analyses. Animals with unique body markings (e.g., coloration or stripes) are easily identified by the human eye from photographs. Photo-matching provides a non-invasive alternative identification method but has been limited to small datasets because of time and effort requirements of manual searches. To improve photo-matching for research purposes, the Automated Animal Digital Identification System (AADIS) was developed. The AADIS prototype uses a spot-pattern recognition algorithm to identify individual Northern Leopard Frogs (*Lithobates pipiens*) using images of their dorsal spot pattern. The algorithm consists of multiple reduction steps that reduce false matching images at each step. The system returns the top ten ranked individuals as closest matches along with a classification of these into 'probable' versus 'not so probable' categories. The classification serves as an indication whether the query individual was previously captured or not. AADIS was tested on a dataset of 200 individuals, with a total of 854 images. AADIS identified 95% of the true matches in the top ten and classified 87% of the true matches as 'probable' in the top ten. Depending on the discriminators, the system classified 77-84% of individuals new to the database as 'not so probable' matches. Future versions of this software will adapt the spot-pattern recognition algorithms for other spotted animals by either adding or removing reduction steps suitable for animal identification.

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ROCKY MOUNTAIN TAILED FROG RESPONSES TO DISTURBANCE AND RESTORATION. David S Pilliod, *US Geological Survey, Forest and Rangeland Ecosystem Science Center, 970 Lusk Street, Boise, ID 83706; dpilliod@usgs.gov.*

Tailed frogs have been considered good indicators of headwater stream habitat quality and disturbance. I examined this supposition by investigating the responses of Rocky Mountain Tailed Frogs (*Ascaphus montanus*) to various types of disturbances, land management, and restoration. Using the density of tadpoles as a response variable, preliminary findings suggest that tailed frogs were sensitive to wildfire, but not prescribed fire. Tailed frogs disappeared from a stream following a large debris flow and channel reorganizing event, but recolonized from undisturbed upstream reaches within 1-2 years. Stream restoration in a heavily disturbed mine site resulted in variable tailed frog responses depending on restoration design. Restoration that attempted to recreate natural channel morphology resulted in rapid colonization. In conclusion, Rocky Mountain Tailed Frogs demonstrated low resistance but high resilience to extreme disturbances and fairly high resistance to moderate disturbances. These results highlight potential differences between Rocky Mountain and Coastal (*Ascaphus truei*) Tailed Frogs in their sensitivity to habitat quality and disturbance.

BENTHIC COMMUNITY STRUCTURE AND RESPONSE TO HARVEST EVENTS AT GEODUCK AQUACULTURE SITES IN SOUTHERN PUGET SOUND, WASHINGTON. Jennifer L Price, *University of Washington, School of Aquatic and Fishery Science, 1122 NE Boat Street, Seattle, WA 98105; jennyp5@u.washington.edu;* P Sean McDonald, Jeffrey R Cordell, Tim E Essington, Aaron WE Galloway, Megan N Dethier, David A Armstrong, Glenn R VanBlaricom.

Geoduck (*Panopea generosa*) aquaculture has become a lucrative and widespread practice on intertidal beaches in southern Puget Sound, WA. The techniques used to plant, grow, and harvest these clams have come under scrutiny by various public and private agencies and individuals. In June of 2008 we began a long term investigation to assess the effects of geoduck harvest at three geoduck aquaculture sites using changes in benthic invertebrate assemblages to evaluate disturbance. At each site a treatment plot of mature planted geoduck was paired with an adjacent reference plot of equal size. For several months prior to and for six months after harvest we collected benthic cores screened though 0.5 mm square mesh. Each site presents a slightly different benthic community structure and therefore may respond to harvest practices differently. Data analysis completed to date indicate that variance in infaunal data is attributable to time of year, plot status (cultured/uncultured), and harvest timeline (pre/post-harvest). As of yet we have seen little evidence to indicate that activities associated with geoduck aquaculture cause significant long-term damage or disruption to benthic ecosystems on the intertidal sand flats of southern Puget Sound.

MODELING OCCUPANCY PATTERNS OF PACIFIC NORTHWEST BATS USING DATA FROM THE BAT GRID. Tom Rodhouse, *National Park Service Upper Columbia Basin Network, 20310 Empire Ave., Suite A-100, Bend, OR 97701; Tom_Rodhouse@nps.gov;* PAT ORMSBEE, *USFS/BLM, 3106 Pierce Parkway, Suite D, Springfield, OR 97477;* Joe Szewczak, *Department of Biological Sciences, Humboldt State University, Arcata, CA 95521;* Lew Cousineau, *Computer and Information Systems Department, Central Oregon Community College, Bend, OR 97701.*

With the westward advance of white-nose syndrome and an expanding wind power industry, changes to regional bat distributions are expected to be imminent and extensive. We used capture and acoustic records collected by the Bat Grid between June and September across multiple years in Oregon and Washington to model baseline occurrence patterns of bats using occupancy models that accounted for imperfect detection. Accounting for detectability substantially increased the magnitude and precision of occupancy estimates, particularly when acoustic data were included. Our models provide robust mapped estimates of Pacific Northwest bat distributions against which future trends can be compared.

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INDIVIDUAL AND COMBINED EFFECTS OF MULTIPLE PATHOGENS ON PACIFIC TREEFROGS. John M Romansic, *Department of Zoology, Oregon State University, 3029 Cordley Hall, Corvallis, OR 97331; jmromansic@gmail.com;* Pieter TJ Johnson, *Department of Ecology and Evolutionary Biology, University of Colorado, Boulder, CO 80309;* Catherine L Searle, *Department of Zoology, Oregon State University;* Tate S Tunstall, *Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara, CA 93106;* Barbara A Han, *Odum School of Ecology, University of Georgia, Athens, GA 30602;* Jason R Rohr, *Department of Integrative Biology, University of South Florida, Tampa, FL 33620;* Andrew R Blaustein, *Department of Zoology, Oregon State University, Corvallis, OR.*

In nature, multiple pathogens are often present simultaneously, which can lead to additive, antagonistic, or synergistic effects on hosts. We investigated interactive effects of the trematode *Ribeiroia* sp. and the fungus *Batrachochytrium dendrobatidis* (*Bd*) in one amphibian host, *Pseudacris regilla* (Pacific Treefrog). We used *P. regilla* larvae in a factorial laboratory experiment with two treatments, exposure and control (no pathogen added), for each pathogen. We continued the experiment through *P. regilla* metamorphosis and observed each metamorphosed individual for four weeks after resorption of its tail. *Ribeiroia* increased the number of deformities in *P. regilla*, while *Bd* exposure increased the percentage of *Bd*-infected individuals from zero to 31%. We detected no effects on survival, growth, or developmental rate, nor any evidence of interactive effects of *Bd* and *Ribeiroia*. However, such interactive effects might occur under ecological conditions not tested here or with different host/pathogen combinations.

COMPARISON OF CALIFORNIA GULL (*LARUS CALIFORNICUS*) DIET AT TWO DAMS ALONG THE MID-COLUMBIA RIVER. Michael B Schrimpf, Julia K Parrish, *University of Washington, School of Aquatic and Fishery Sciences, Box 355020, Seattle, WA 98195-5020; schrimpf@u.washington.edu;* Nathan A Zorich, Patricia L Madson, Michael R Jonas, *US Army Corps of Engineers, Fisheries Field Unit, Bonneville Lock and Dam, Cascade Locks, OR 97014.*

Piscivorous birds are one of the many threats to juvenile salmonid (*Oncorhynchus* spp.) survival in freshwater systems, particularly along the Columbia River, where several dams create barriers to downstream movement. Concern over the impact of recently increasing numbers of gulls at dams prompted an investigation of gull diet and foraging behavior, with the ultimate goals of estimating smolt consumption by these avian predators and determining the effectiveness of avian deterrents. Here we report on the diet of California Gulls (*Larus californicus*) at the John Day Dam and the Dalles Dam in the summer of 2010. Juvenile salmonids composed a major portion of the fish taken at both dams, however gulls at the Dalles Dam also consumed a large number of Pacific Lamprey (*Lampetra tridentata*) macropthalmia during mid-June. Gulls at the Dalles Dam also relied more heavily on discarded human food sources than those at the John Day Dam, likely due to the closer proximity to an urban center. We suggest that gulls target the food sources that are most readily available at any given time, which has important implications for the likely effectiveness of various avian deterrent techniques employed at different times.

ESTABLISHING THE BREEDING PROVENANCE OF A TEMPERATE-WINTERING SPARROW WITH LIGHT-LEVEL GEOLOCATION. Nathaniel E Seavy, Thomas Gardali, Renée Cormier, Diana Humple, *PRBO Conservation Science, 3820 Cypress Drive #11, Petaluma, CA, 94954; nseavy@prbo.org.*

The migratory geography of songbirds is poorly known, especially for those that move primarily within the temperate zone. We used light-level geolocators to describe the migratory geography of a north temperate migrant, the Golden-crowned Sparrow *Zonotrichia atricapilla*. In January to March of 2010, we attached geolocator tags to 33 sparrows that wintered on the coast just north of San Francisco, California, USA. As of January 2011, we recovered four tags. We used a Bayesian state-space model to estimate the most likely migration paths and breeding locations. All four birds migrated to breed on the coast of the Gulf of Alaska but none appeared to breed at the same site. Our results suggested that Golden-crowned Sparrows migrated faster during the spring than they did when returning in the fall. For one individual there was strong evidence that the bird shifted locations between breeding and molting before migrating south. Our results provide more evidence of the contributions that geolocators can make to our understanding of the migratory geography and connectivity of small songbirds.

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HABITAT CONNECTIVITY MODELING FOR FOCAL SPECIES IN WASHINGTON. Andrew J Shirk , *University of Washington, Climate Impacts Group, Center for Science in the Earth System, Box 355672, Seattle, WA 98195; ashirk@uw.edu;* Karl C Halupka, *US Fish and Wildlife Service, Central Washington Field Office, 215 Melody Lane, Suite 119, Wenatchee, WA 98801; karl_halupka@fws.gov.*

The Washington Wildlife Habitat Connectivity Working Group modeled habitat connectivity for 16 focal species throughout a study area centered on Washington State. We selected focal species using criteria favoring species with geographic ranges, habitat associations, and vulnerabilities to human-created barriers that made them representative of habitat connectivity needs of many terrestrial species at a statewide scale. Our approach to linkage modeling involved production for each focal species of (1) a resistance surface which depicted how landscape features resist wildlife movement; (2) a delineation of important habitat concentration areas (HCAs); (3) a cost-weighted distance map that depicted the accumulation of resistance with distance from each HCA; and (4) normalized least-cost linkages between HCAs. We limited the maximum cost-weighted distance of each linkage to a species-specific value to avoid mapping improbable linkages, and normalized linkages to standardized widths. We defined a linkage network as the combination of HCAs and normalized linkages, and characterized the relative quality of linkages using three metrics. Linkage networks of focal species that were habitat generalists or inhabited more montane areas were relatively well connected, except for expected fracture zones along highways and developed areas. In contrast, linkage networks for shrubsteppe species were more fragmented and constrained to limited areas of natural habitat. Linkage maps also revealed several transboundary connections to British Columbia and adjacent states. Our linkage modeling could help organizations incorporate connectivity into conservation efforts, and provided a foundation for building future analyses that could identify priorities among linkages at finer scales.

FOREST STRUCTURE WITHIN BARRED OWL HOME RANGES IN CENTRAL WASHINGTON. Peter H Singleton, *USDA Forest Service, Pacific Northwest Research Station, 1133 N. Western Ave., Wenatchee WA 98801; psingleton@fs.fed.us.*

Interaction with Barred Owls (*Strix varia*) is an important factor contributing to Northern Spotted Owl (*Strix occidentalis caurina*) population declines in Washington. Understanding the degree of similarity between the two species fine-scale habitat associations will be important for spotted owl conservation planning. From March 2004 to September 2006 I tracked 14 radio-tagged Barred Owls at 12 pair sites in dry, mixed-conifer forest types near Leavenworth, Washington. Upon completion of the radiotelemetry study I collected data on forest stand structure and composition at sample plots within documented Barred Owl home ranges. I used multivariate vegetation community analysis techniques to group the sample plots into three forest types and compared the level of Barred Owl use across the three groups. The forest type that was used most heavily by Barred Owls was characterized by a mix of Grand Fir (*Abies grandis*) and Douglas-fir (*Pseudotsuga menziesii*), had more upper-layer (>4.9 m) canopy cover, more trees large trees (>50 cm dbh), less ground cover (<0.6 m), and more snags and logs than the other two types. Forest stands characterized as open canopy Ponderosa Pine (*Pinus ponderosa*) or pure Douglas-fir stands were used less by Barred Owls.

LEAD SHOT POISONING IN SWANS: SOURCES OF PELLETS WITHIN WHATCOM COUNTY, WASHINGTON AND SUMAS PRAIRIE, BRITISH COLUMBIA. Michael C Smith, *University of Washington, Washington Cooperative Fish and Wildlife Research Unit, School of Forest Resources, Seattle, WA 98195;smithmch@msn.com;* M Davison, *Washington Department of Fish and Wildlife, Mill Creek, WA 98012;* C Schexnider, *US Fish and Wildlife Service, Lacey, WA 98503; L WILSON, Environment Canada - Canadian Wildlife Service, PWRC, Delta, BC V4K 3N2;* J Bohannon, *Washington Department of Fish and Wildlife, Mill Creek, WA 98012;* J Grassley, *University of Washington, Washington Cooperative Fish and Wildlife Research Unit, School of Aquatic and Fishery Sciences, Seattle, WA 98195;* D Kraege, *Washington Department of Fish and Wildlife, Mill Creek, WA 98012;* S Boyd, B Smith, *Environment Canada - Canadian Wildlife Service, PWRC, Delta, BC V4K 3N2;* M Jordan, *The Trumpeter Swan Society, Plymouth, MN 55441;* C Grue,*University of Washington, Washington Cooperative Fish and Wildlife Research Unit, School of Aquatic and Fishery Sciences, Seattle, WA 98195.*

Swan populations in northwest Washington State and on the Sumas Prairie, British Columbia have lost at least 2,000 members to lead poisoning since 1999, caused by the ingestion of lead pellets. In 2001, an

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international effort was initiated to locate the source(s) of the lead. Participants include the Washington Department of Fish and Wildlife, U. S. Fish and Wildlife Service, Canadian Wildlife Service, Trumpeter Swan Society, Washington Waterfowl Association and the University of Washington (Washington Cooperative Fish and Wildlife Research Unit). A total of 251 trumpeter swans (*Cygnus buccinator*) were outfitted with radio transmitters. A blood sample was collected at capture and analyzed for lead content. Sick and dead swans have been collected throughout the winter, and carcasses examined to determine cause of death and to identify gizzard contents. Results suggest that swans arrive on the wintering grounds with low blood lead levels, but subsequently may be exposed to lethal amounts of shot. The locations of collared swans were used to identify forage areas and roost sites, and data for swans that subsequently died from lead poisoning were used to identify and prioritize areas for soil/sediment samples. This sampling identified Judson Lake (~100 acre lake spanning U.S./Canada border) as a possible source of lead pellets. Swans were deterred from using Judson Lake through parts of the last five winters (2006-07 through 2010-11) as an experimental management project. Results of this experimental management action and future research will be discussed.

USING DISTRIBUTION MODELS TO PREDICT SEASONAL HABITAT USE IN THE MIDGET FADED RATTLESNAKE (*CROTALUS OREGANUS CONCOLOR*). Stephen F Spear, The Orianne Society, 579 Highway 441 S, Clayton, GA 30525; sspear@projectorianne.org; Mark D Anderson, Douglas A Keinath, Wyoming Natural Diversity Database, 1000 E. University Ave., Dept. 3381, University of Wyoming, Laramie, WY 82071; Joshua M Parker, Department of Natural Sciences, Clayton State University, 2000 Clayton State Blvd., Morrow, GA 30260; Charles R Peterson, Department of Biological Sciences, Idaho State University, Pocatello, ID 83209; Lisette Waits, Department of Fish and Wildlife Resources, University of Idaho, Moscow, ID 83844.

Researchers are increasingly using species distribution models to map the occurrence of a species, identify important environmental variables, or predict how global climate change might shift a species' range. However, the accuracy of model output can vary depending on several factors, and few studies independently validate distribution models. We used occurrence data from the Midget Faded Rattlesnake (*Crotalus oreganus concolor*) in Wyoming to predict its distribution using the maximum entropy modeling approach. Midget Faded Rattlesnakes require rocky outcrops for denning sites, but also migrate away from the den for foraging and mating. Known denning sites were used to develop a den model and radio-telemetry points from foraging snakes were used to model foraging sites. Model selection based on AIC indicated only two variables predicted denning areas: distance to rock outcrops and temperature range between warmest and coldest months. We conducted field surveys to validate predicted denning areas and found support for the two-variable model chosen by AIC (true skill statistic = 0.7), suggesting that model selection based on AIC is suitable if independent validation data are not available. Thus, we used AIC to determine the best model for predicting foraging habitat without validation data; this model also contained only two variables: distance to rock outcrops and mean temperature during the wettest quarter. Our models demonstrate that a small number of variables can accurately predict the distribution of this species, and suggests how future climate change will shift suitable habitat for both denning and foraging for this snake.

ECOLOGY AND CONSERVATION OF THE WESTERN GRAY SQUIRREL IN THE NORTH CASCADES. Kathryn Stuart, University of Washington, School of Forest Resources, Box 352100, Seattle, WA 98195; kshipe@u.washington.edu; Stephen D West, University of Washington, School of Forest Resources, Box 35210, Seattle, WA 98195; sdwest@u.washington.edu.

The Western Gray Squirrel (*Sciurus griseus*) – listed as a Washington State threatened species in 1993 – is confined to three geographically isolated areas: the southern Puget Trough of Pierce County, southern Washington in Klickitat, Yakima and Skamania counties, and north-central Washington in Chelan and Okanogan counties. Recovery of the species has become a priority, however, distributional and life history data on the Western Gray Squirrel, particularly for the North Cascades population, is limited. This population is genetically isolated from others in Washington and ecologically unique as it exists in a mixed-conifer forest habitat composed primarily of Douglas-fir (*Pseudotsuga menziesii*) and Ponderosa Pine (*Pinus ponderosa*) that lacks oak (*Quercus* spp.), an important source of forage and maternal nests elsewhere in the range. The North Cascades are also distinguished by high average annual snowfall,

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frequent wildfire, and dynamic forest management. A history of logging and fire suppression has created dense, diseased, and fire-prone forest stands, leading to several catastrophic wildfires in recent years and intensive fire fuel reduction plans with potentially adverse effects on Western Gray Squirrels. This study began in 2008 to investigate the distribution, life history, and response of squirrels to fire management treatments in the North Cascades using radio-telemetry. Preliminary results indicate high use of fire fuel treated areas by squirrels. We also conducted a small experiment on the effectiveness of alternate educational presentations to stakeholders. All educational strategies significantly increased understanding and support for research; differences between strategies were less transparent.

ELEVATIONAL DIFFERENCES IN UV-B RESPONSE MECHANISMS BY THE LONG-TOED SALAMANDER (*AMBYSTOMA MACRODACTLUM*). Lindsey L Thurman, Tiffany S Garcia, *Department of Fisheries and Wildlife, Oregon State University, 104 Nash Hall, Corvallis, OR 97331; lindsey.thurman@oregonstate.edu; tiffany.garcia@oregonstate.edu.*

Global amphibian declines have been attributed to numerous and often synergistic causes, such as invasive species, pathogens, and ultraviolet-B (UV-B) radiation. The effects of these stressors are context dependent based on location, species, and even populations within species. As resistance to UV-B has shown inconsistencies across amphibian taxa, it can be expected that variation also occurs between populations of a single species. High-elevation populations of the Long-toed Salamander face higher UV-B radiation levels relative to low-elevation populations and these levels are predicted to increase in conjunction with continued ozone depletion. Behavioral defense strategies, including modification of oviposition behavior, may be employed by breeding *A. macrodactylum* females at high-elevations to protect embryos from UV-B induced damage. We are currently surveying at high- and low-elevations throughout Oregon to quantify oviposition site choice characteristics and associated UV-B profiles of breeding sites. In addition, we plan to compare photolyase activity, a photo-reactivating enzyme that repairs radiation-induced damage to DNA, which is measured using a bacterial-transformation assay. We hypothesize that these distinct behavioral and physiological responses are an adaptation to increased levels of UV-B radiation at high-elevations. Preliminary results indicate that the contrasting oviposition behaviors exhibited by valley and mountain populations are coupled with differences of more than 20 $\mu W/cm^2$ of ambient UV-B radiation. These responses to UV-B radiation could be leading to a population divergence within this species' range. Knowing how Long-toed Salamanders differ in stress response will provide valuable insight into the overall effects of changing environmental conditions on sensitive amphibian species in the face continued ozone depletion and associated climate change.

INVOLVEMENT OF SCHOOLS IN FIELD RESEARCH USING SCIENTIFIC METHODOLGIES. Margaret Tudor, *Washington Department of Fish and Wildlife, Education and Outreach, 600 Capitol Blvd. N., Olympia, WA 98501; margaret.tudor@wdfw.wa.gov.*

The Pacific Education Institute (PEI) was founded to integrate natural resource science into formal education's science curricula. In 2009, the state learning standards included Field Investigations that finally brought outdoor science education to a level equal to laboratory science. In 2010 another resource became available, Awakening Inquiry, a how-to curriculum to learn naturalist skills as applied to scientific field research projects. Last month it was announced that all Washington schools can use ESRI GIS software for free. With the mobile technologies developed by the NatureMapping Program a suite of tools are now available to the 2,500 schools in Washington State. The network of environmental learning centers certified to provide NatureMapping workshops, materials, and field projects reaches hundreds of these schools. Washington Department of Fish and Wildlife, the University of Washington NatureMapping Program, and PEI are teaming with Outdoor Learning Centers to create a network of field science trainers and mentors that reach out into schools and local communities with a vision of engaging citizens and K-12 students to systematically inventory species and habitats throughout our state.

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EVIDENCE FOR METHYL KETONES AS MEDIATORS OF REPRODUCTIVE ISOLATION BETWEEN GARTER SNAKE SPECIES. Emily J Uhrig, *Oregon State University, Department of Zoology, 3029 Cordley Hall, Corvallis, OR 97331; uhrige@science.oregonstate.edu;* Michael P LeMaster, *Western Oregon University, Department of Biology, 345 North Monmouth Avenue, Monmouth, OR 97361;* Robert T Mason, *Department of Zoology, 3029 Cordley Hall, Corvallis, OR 97331.*

One of the relatively few vertebrate pheromones to be chemically identified, the female sex pheromone of the Red-sided Garter Snake (*Thamnophis sirtalis parietalis*) is a series of saturated and monounsaturated methyl ketones contained within female skin lipids. During the breeding season, this pheromone is responsible for eliciting male courtship behavior. While the pheromone system of the Red-sided Garter Snake has been the subject of many studies, relatively little is known about the pheromone systems of other garter snake species. Through chemical analyses, we demonstrate that female skin lipids of the Red-spotted Garter Snake (*Thamnophis sirtalis concinnus*), Northwestern Garter Snake (*Thamnophis ordinoides*), and Plains Garter Snake (*Thamnophis radix*) contain similar methyl ketones. The methyl ketone profiles of these species differ qualitatively from one another and from the methyl ketone profile of Red-sided Garter Snakes suggesting methyl ketones may serve a role in reproductive isolation between garter snake species. Preliminary behavioral experiments, in which male Red-sided Garter Snakes preferentially courted conspecific females over heterospecific females, add further support this hypothesis.

WETLAND RESTORATION, FRAGMENTATION AND CONSERVATION OF THE GIANT GARTERSNAKE. Patricia M Valcarcel, Daniel K Rosenberg, *Department of Fisheries and Wildlife, Oregon State University, 104 Nash Hall, Corvallis, OR 97331;* Brian J Halstead, Michael L Casazza, Glenn D Wylie, *US Geological Survey, Western Ecological Research Center, 6924 Tremont Rd, Dixon, CA 95620; patricia.valcarcel@oregonstate.edu.*

The Giant Gartersnake (*Thamnophis gigas*) is a threatened species endemic to California's Central Valley. Restoration of *T. gigas* habitat is occurring and should provide higher quality habitat than the rice agricultural habitat to which *T. gigas* has been relegated. We compared home range sizes and overlap over two field seasons at a site near Sacramento, CA which contained both agricultural and restored wetlands. Snakes living in restored wetlands had larger mean home range size (95% fixed kernel) than those in agricultural habitats in both years. We used the Utilization Distribution Overlap Index to understand possible differences in space use sharing between the two habitat types. Agricultural snakes exhibited a higher degree of overlap and uniformity in their distributions than wetland snakes in both years. We also investigated operative environmental temperatures as thermoregulation requirements may affect habitat availability and movements. Hourly averages show high temperatures within terrestrial habitat likely limit available *T. gigas* habitat, especially for snakes in agriculture. Restricted movements, increased space-use sharing, and decreased available habitat suggest a fusion response to local fragmentation in agricultural habitat. The results from this case study indicate that future conservation efforts should focus on maintaining complex habitat and connectivity between habitat patches.

HABITAT MODELING AND SURVEY TECHNIQUES FOR JOHNSON'S HAIRSTREAK (*CALLOPHRYS JOHNSONI*) IN WASHINGTON AND OREGON. Kelli Van Norman, *USDI Bureau of Land Management, Oregon State Office, PO Box 2965, Portland, OR 97208; kelli_vannorman@blm.gov;* Raymond Davis, *USDA Forest Service, Umpqua National Forest, Roseburg, OR 97471;* David McCorkle, *Western Oregon University, Monmouth, OR 97361;* Dana Ross, *1005 NW 30th Street, Corvallis, OR 97330.*

The Johnson's Hairstreak (*Callophrys johnsoni*) is a rare butterfly listed as a Region 6 Forest Service and Oregon/Washington BLM sensitive species. It associates with old coniferous forests infected with dwarf mistletoe. Habitat modeling was used to identify its potential geographic distribution in Oregon and Washington. Ground-based survey techniques tested in 2009 validate the use of habitat modeling as a tool for conservation planning. Larval surveys provide better detection rates than adult surveys during the flight season. In 2010, widespread surveys were used to inventory areas in Oregon in Washington that the habitat model predicted as suitable. Genetic markers developed in 2010 are used to provide species verification of larvae.

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THE EFFECTS OF UV-B RADIATION ON THE SEX PHEROMONE OF RED-SIDED GARTER SNAKES. Anna E Vigeland, *Oregon State University, Department of Zoology, 3029 Cordley Hall, Corvallis, OR 97331; vigelana@onid.orst.edu;* M R Parker, *Monell Chemical Senses Center, 3500 Market Street, Philadelphia, PA 19104;* Robert T Mason, *Oregon State University, Department of Zoology, 3029 Cordley Hall, Corvallis, OR 97331.*

In this study, pheromone and skin lipid samples collected from Red-sided Garter Snakes (*Thamnophis sirtalis parietalis*) were exposed to either exposed to full-spectrum light or full-spectrum plus UV-B radiation, as were live male and female snakes. Behavioral studies were conducted on the snakes during exposure. After each experiment, the pheromone was purified, weighed, and qualitatively and quantitatively analyzed by gas chromatography. The results show that UV-B radiation reduces the unsaturated:saturated and the high-molecular weight:low-molecular weight methyl ketone ratios of the pheromone, which are associated with attractiveness, in directly exposed samples. The unsaturated:saturated ratio was also decreased in live female snakes. In addition, it was found that snakes do not attempt to shelter themselves from UV-B light. These results suggest that an increase in UV-B radiation, as has been occurring in the Red-sided Garter Snakes' native range in Manitoba, Canada, could have an effect on the mating behavior of the snakes.

EFFECTS OF SPRING CATTLE GRAZING ON THE NUTRITIONAL ECOLOGY OF MULE DEER IN EASTERN WASHINGTON. Sara J Wagoner, Lisa A Shipley, *Department of Natural Resource Sciences, Washington State University, Pullman, WA 88164; Shipley@wsu.edu.*

In some grassland communities, livestock grazing may reduce residual grass and promote younger, more nutritious forages. However, no study has yet directly examined how cattle grazing affects the quantity and quality of forage available to mule deer (*Odocoileus hemionus*). Therefore, we created 3 replicates of paired grazing treatments using electric fence exclosures within 3 pastures in Bluebunch Wheatgrass (*Pseudoroegneria spicata*) communities in southeastern Washington. In each grazed/ungrazed replicate, we sampled the dry biomass and nutritional quality of all plants by species. We constructed temporary pens in each grazed/ungrazed pair and measured diet composition selected by 4 tractable mule deer in each pen using bite count methods, collected representative diets for each deer in each pen, and analyzed them for digestible nitrogen and protein. In spring and fall, grazed pastures had 62% less total biomass, and significantly less perennial grass (PG) and perennial forbs (PF). As a consequence, across seasons, deer consumed about 40% less PF and annual forbs (AF), and 30% more PG in grazed pens. Using Ivlev's selectivity index, we found that deer selected for AF and subshrubs and avoided PG and annual grasses. The nutritional quality of the deer's diets and time spent foraging was similar between grazed and ungrazed pens. Instantaneous intake (g/min), daily dry matter intake (g/day) and daily digestible energy intake (kJ/day) of the deer were lower in grazed than ungrazed pastures. Our results suggest that moderate spring cattle grazing in dry, stony ecological sites reduces the amount of available digestible nutrients available to mule deer for the first year after grazing.

DISCOVERY OF THE COLORADO CHECKERED (TRIPLOID) WHIPTAIL LIZARD (*ASPIDOSCELIS NEOTESSELATA*) IN WASHINGTON STATE. Robert E Weaver, *Department of Biological Sciences, Central Washington University, Ellensburg, WA 98926; weaverro@cwu.edu;* Andy P O'Connor, *15319 Ash Way, Apt. E4, Lynwood, WA 98087;* Joshua L Wallace, *Washington Department of Fish and Wildlife, Habitat Program, 600 Capitol Way North, Olympia, WA 98501;* Jeff A King, *Frontier Middle School, 517 W. 3rd Ave, Moses Lake, WA 98831;* James M Walker, *Department of Biology, University of Arkansas-Fayetteville, Fayetteville, AR 72701.*

Lizards of the genus *Aspidoscelis* (formerly *Cnemidophorus*) are found throughout the southwestern United States, north to southeastern Oregon and adjacent Idaho. One characteristic of this genus is parthenogenesis, in which some populations consist solely of females. These populations reproduce asexually, and arise from hybridization between sexual species, or back crosses between sexual and asexual species. These species are often referred to as "weed-species" and inhabit areas previously unoccupied by the parental species. Parthenogenetic species represent nine, of the 22 species of *Aspidoscelis* that occur in the western United States. The Colorado Checkered Whiptail (*A. neotesselata*) was first described in 1997 and was formerly known only from a limited area within southeastern Colorado. During the summer of 2010 a previously unknown population of this species was discovered along Lind Coulee in southeastern Grant County, Washington. In this talk, we describe how this species was discovered and address possible

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concerns of this species as invasive. Additionally, we discuss management concerns and outline plans for study of this population.

ANTS AS COMPETITORS FOR REFUGIA SITES WITH PACIFIC NORTHWEST DIPSADINE SNAKES. Robert E Weaver, *Department of Biological Sciences, Central Washington University, Ellensburg, WA 98926; weaverro@cwu.edu.*

Among the many abiotic factors that affect the lives of snakes is the presence (or absence) or suitable refugia. In the case of small, cryptic species, such refugia are small scattered rocks, downed limbs, or may be artificial in the form of discarded sheets of wood or metal. Rocks utilized by these snakes may be thick and deeply embedded into the substrate, multi-layered, or thin with just a portion embedded. Rocks provide protection, sites for thermoregulation, egg laying sites and in many cases, ambush sites for actively hunting snakes. The importance of these microhabitat types has been documented for all three species of dipsadine snakes native to the Pacific Northwest, the Desert Nightsnake (*Hypsiglena chlorophaea*), Ring-necked Snake (*Diadophis punctatus*), and the Sharp-tailed Snake (*Contia tenuis*). In this talk I present experimental data that shows ant of the genera Pogonomyrmex, Formica, and to a lesser extent Camptonotus can prevent these small snakes from selecting otherwise suitable refugia. During experimental trials the presence of live ants and odor of adult/larvae prevented both adult and juveniles of all three species from occupying a site. I also discuss how this may impact the laying of artificial cover when surveying for these species, as well how it may impact survey efforts and the ability to detect these species in areas with an abundance of these ant genera.

FROGS, FISH AND FORESTRY: THE NEED FOR A HOLISTIC VIEW OF NETWORK PROCESSES TO CONSERVE NATIVE STREAM BIODIVERSITY IN FOREST CATCHMENTS. Hartwell H Welsh, Jr, *USDA Forest Service, Pacific Southwest Research Station, 1700 Bayview Dr., Arcata, CA 95521; hwelsh@fs.fed.us.*

I review research on entire large stream catchments in Northwest California, indicating how headwater processes, both natural and anthropogenic, influence downstream fish-bearing reaches. The implications of these relationships for salmonids and other elements of native biodiversity are explored. Comparing riparian protections from the federal Northwest Forest Plan with those of the three Pacific Northwest states, I discuss fluvial and geomorphologic process domains in stream networks and how they relate to these guidelines. Focusing in particular on headwater (1st- to 3rd-order) channels, evidence for the effectiveness of current riparian management to maintain viable populations of native amphibians is reviewed. Using evidence from multiple studies of amphibian environmental relationships, including several from the redwood bioregion, I document the ineffectiveness of current riparian protections to prevent increasing water temperatures, the introduction of fine sediments, and the loss of large woody debris by detailing the responses of headwater amphibians to these adversely altered attribute states. Combining the concepts of process domains, the stream continuum, and the dendritic network, I examine linkages between the status of biota in headwater reaches and elements like salmonids that depend on downstream conditions. This research indicates that to recover and maintain sensitive species at upper extremes and throughout stream networks will require recognizing and applying the concept of hydrologic connectivity. Embracing this concept is essential to promote adequate management of stream networks to protect all the parts and the interconnecting processes required to maintain catchment-wide ecological integrity. These results have implications for preserving stream networks worldwide.

FLYING SQUIRRELS AND THE FOREST STRUCTURE-PREDATION HYPOTHESIS: IMPLICATIONS FOR CREATING LATE-SERAL FOREST AND SPOTTED OWL HABITAT. Todd M Wilson, *USDA Forest Service, PNW Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331; twilson@fs.fed.us.*

Northern Flying Squirrels (*Glaucomys sabrinus*) may be important indicators of habitat quality for Northern Spotted Owls (*Strix occidentalis caurina*) and overall forest health in the Pacific Northwest. From 1991-2006, I used live-trapping, radio-telemetry, and habitat measures to evaluate (1) mid-term effects of variable-density thinning and (2) the relative importance of four factors that may limit squirrel populations (food, competition, predation, and dens) across 33 structurally-diverse stands in western Washington. Squirrel populations remained low in both control and treated stands twelve years post-

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thinning. Most space use by squirrels occurred above the forest floor and there were marked differences in movement patterns between the breeding and non-breeding seasons and between forest supporting low and high squirrel abundances. Stands that supported high squirrel abundances generally exhibited high amounts of structural occlusion in the midstory provided by multi-layered canopies or high bole densities. Three variables, variance in overstory tree d.b.h., area intercept at 10-m above ground, and amount of canopy gaps ≥100m^2 could be used to correctly classify 97% of stands as supporting either high or low squirrel abundances. The collective results from these studies suggest that predation may be the primary limiting factor for squirrels and that food, dens, and competition play hierarchically less important roles in regulating populations. Above-ground forest structure provides an important interface between squirrels and their predators. Efforts to restore structural complexity by thinning forests (e.g., temporarily reducing above-ground structure) may need to account for the spatial and temporal effects such activities have on squirrel populations.

AMPHIBIAN PHENOLOGY AND AQUATIC WEED MANAGEMENT. Amy Yahnke, Christian Grue, Alexandr Troiano, *University of Washington, Washington Cooperative Fish and Wildlife Research Unit, School of Aquatic and Fishery Sciences, Box 355202, University of Washington, Seattle, WA 98195; aey@u.washington.edu;* Marc P Hayes, Julie A Tyson, *Washington Department of Fish and Wildlife, Habitat Program, 600 Capitol Way North, Mailstop 43143, Olympia, WA 98501.*

Timing of amphibian development and habitat use is critical to determining the potential effects of pesticide application in aquatic environments. Current restrictions on aquatic applications are based on salmonid life histories, but little is known about amphibians. We investigated amphibian species and life stages in wetland habitats invaded by Reed Canarygrass (*Phalaris arundinacea*) to determine the potential for exposure to herbicides used to control this invasive. Weekly surveys were conducted on two sites supporting Oregon Spotted Frog (*Rana pretiosa*) breeding populations encompassing the weed control season: May-September. One of the sites included plots that were mowed the previous year. Amphibians were generally more frequently observed in mowed plots, but the basis of this difference is unclear as treatment-specific detectability is unknown. Amphibian presence for all life stages was correlated with water depth in each of the habitats. Tadpoles of Oregon Spotted Frogs, Northern Red-Legged Frogs (*Rana aurora*), and Pacific Chorus Frogs (*Pseudacris regilla*) were found in all habitats, the last tadpole was detected on 24 August. The first metamorphic frogs were observed on 8 June and the metamorphic interval for all anurans lasted until 9 September. Northwestern Salamander (*Ambystoma gracile*) larvae were the most frequently observed salamander species and life stage. Salamander larvae were present throughout the sampling period. Metamorphic Northwestern Salamanders were found between 1 July and 9 September and metamorphic Rough-Skinned Newts (*Taricha granulosa*) were found until mid-August. Amphibians were present during the entire weed management season. Information on sensitive life stages may be useful in guiding management timing.

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USE OF MITIGATED MEADOWS BY RESIDENT ROOSEVELT ELK (*CERVUS ELAPHUS ROOSEVELTI*) AT HAGG LAKE, WASHINGTON COUNTY, OREGON: FOUR YEARS OF CONSISTENT PATTERNS (2006–2010). Edmond Alkaslassy, Pamela T Lopez, *Department of Biology, Pacific University, Forest Grove, OR 97116; alkaslae@pacificu.edu.*

Henry Hagg Lake was created in 1975 when Scoggins Dam was constructed. As a result meadows that had been used by resident Elk for forage during the winter months were flooded. The loss of these meadows was mitigated by construction of 10 new meadows above the new water level. The meadows vary in size (from 3.5 acres to 29.5 acres), proximity to the paved road that surrounds the lake, solar exposure, and composition and state of vegetation (from a mowed mix of non-native and unpalatable species to recently disked and planted with non-noxious grasses and clovers). A mandatory monitoring plan began in 2006. Trained undergraduates sampled each meadow for Elk scat using plot and transect methods every two weeks from October through February in 2006/7, 2007/8, 2008/9 and 2009/10. Elk consistently used meadows on the northeastern and southeastern side of the lake and did not use meadows in other locations. This pattern may be the result of a historical migration pathway from higher elevation summer feeding grounds to lower elevation fall and winter feeding grounds; the preferred meadows also have western exposure. Visual observations of the herd (50–75 animals) indicated that the most heavily used feeding area is on private land just south of the lake.

TIME AND SIZE AT METAMORPHOSIS OF ANURANS ON SEVERAL NATIONAL WILDLIFE REFUGES IN THE WEST. Jamie B Bettaso, *US Fish and Wildlife Service, Arcata Field Office, 1655 Heindon Road, Arcata, CA 95521; jamie_bettaso@fws.gov;* Steve Morey, *US Fish and Wildlife Service, 911 NE 11th Ave, Portland, OR 97232; steven_morey@fws.gov.*

Time and size at metamorphosis is a life history trait that can exhibit some degree of phenotypic plasticity among anurans and is thought to play an important role in subsequent survival. We used a ten year data set (2000 to 2009) to examine the timing, range, and average size of metamorphosis of four native and one exotic anuran across a latitudinal gradient from 33° south to 47° north. Between Gosner stage 42 (front limb emergence) and Gosner stage 46 (metamorphosis complete), we found no significant change in average snout-vent-length (SVL) in any species. The largest average SVL at metamorphosis was consistently the introduced bullfrog, with average size at metamorphosis for most collections between 40-50mm SVL. The smallest frog at metamorphosis was the Pacific Chorus Frog (*Pseudacris regilla*) with the average size in most collections ranging between 10-20 mm SVL. Over the entire study area, Bullfrogs (*Lithobates catesbeianus*) had the greatest range of dates for metamorphosis, ranging from May to September. The large size and wide-range of timing at metamorphosis likely contribute to the Bullfrog's success as an introduced amphibian to the west.

DEVELOPING SEARCH IMAGES OF POTENTIAL WINTER ROOST SITES USED BY WESTERN WASHINGTON BATS. Casey P Broderick, *Washington Dept of Fish and Wildlife, Olympia, WA 98501; Casey.Broderick@dfw.wa.gov;* Greg Falxa, *Cascadia Research Collective, 218 ½ W Fourth Ave, Olympia, WA 98501; gfalxa@cascadiaresearch.org;* Marinka Major, *The Evergreen State College, Olympia, WA 98502; Marinkafushia@yahoo.com.*

Winter bat monitoring efforts in the Pacific Northwest have historically been focused in caves and mines. Limited winter detection of bats at these locations has led us to revise winter monitoring search efforts. The objectives of this study were to (1) determine which structural features in a rural landscape serve as winter roost sites, and (2) develop a list of potential winter roost habitats. The general search area was determined based on proximity to a known summer maternity colony. Landowner communication within the target area focused manual search efforts on properties known to have summer or winter bat activity. Daytime field efforts included gaining access via landowner permission and physical surveys of various structural features. Positive identification of potential roost sites was augmented by ultrasonic detectors and infrared image (webcam and still) recording equipment. Repeated field surveys resulted in a compilation of roost habitats that included refined representative features. Genera with an affinity for crevices were located roosting in home-deck junctions and structural imperfections on the exteriors of homes and outbuildings. Myotis spp. were observed underneath wooden and metal siding and in the corrugations of metal roofing. Townsend's Big-eared Bats (*Corynorhinus townsendii*) were located suspended from wooden rafters and along cement walls in outbuildings unfrequented by humans.

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Several bat species were detected that had not been documented in previous winter surveys. Survey strategies incorporating landowner participation involve the community and invite opportunities for bat conservation and educational outreach.

SEXY-SON OR HANDICAP: TESTING TWO MATE CHOICE HYPOTHESES USING THE FIELD CRICKET, *GRYLLUS FIRMUS*, AS A MODEL FOR VERTEBRATES. Stephanie Buxel-Florenzen, Lixing Sun, *Department of Biological Sciences, 400 East University Way, Ellensburg WA, 98926; buxels@cwu.edu.*

Sexual selection is an evolutionary process composed of two concepts: mate competition and mate choice. This study focuses on the two female mate choice hypotheses: handicap hypothesis and sexy-son hypothesis. In both hypotheses, females receive sperm as the only resource provided by males. Therefore, females must distinguish between males of good quality and males of poor quality. Female reproductive success (fitness) is measured differently between the hypotheses; it can be measured with her offspring (F1) in the handicap hypothesis, but it is not measured until her grandchildren (F2) in the sexy-son hypothesis. This fitness difference provides the rare opportunity to determine which hypothesis is more important in mate choice. While both hypotheses are well represented in vertebrates, a simplified system for efficient study is needed. This study uses the Field Cricket, *Gryllus firmus*, which has short generational gaps, large number of offspring, and is easy to maintain. Breeding treatments with either attractive or unattractive males are used to produce F1 generations. The offspring of these treatments are then placed into new treatments with both attractive and unattractive males to produce the F2 generation. Offspring of attractive and unattractive males is determined using paternity analysis. I expect that more offspring will be produced by attractive males in the F2s in sexy-son hypothesis; however, offspring will be equally distributed between males within F2s in handicap hypothesis. Since these hypotheses have never been compared, the results of this study will provide a new understanding of female fitness in vertebrates that use these hypotheses.

A COMPARISON OF HOME RANGE MAPPING TECHNIQUES FOR GOLDEN EAGLES IN WASHINGTON. Andrew A Duff, James W Watson, *Washington Department of Fish and Wildlife, 600 Capital Way N., Olympia, WA 98501; andrew.duff@dfw.wa.gov.*

With the advent of light-weight global positioning system (GPS) radio transmitters and recent advancements in resource selection analyses such as resource utilization functions (RUFs), it is important for wildlife managers to understand how different home range methods may characterize animal space use and depict utilization distributions (UDs). We used breeding season GPS satellite telemetry fixes for 9 Golden Eagles (*Aquila chrysaetos*) collected during 2005–2010 to compare 5 different home range methods. The 5 methods included the Brownian Bridge Movement Model (BBMM) and 4 types of non-parametric kernel density which differed only by the method used to select bandwidth (h) values (reference or optimal [hREF], least squares cross-validation [hLSCV], likelihood cross-validation [hCV], and plug-in [hPI]). To understand differences in home range and core area estimates obtained using these methods we calculated the volume of intersection statistic (VI) and Bhattacharyya's affinity (BA); area of the 99%, 95%, and 50% UD boundaries by volume; and an index of home range fragmentation (frequency of small islands introduced by highly discretized Argos telemetry data). For Golden Eagles we found the mechanistic BBMM method includes flight corridors in range definition, features that can be important in developing breeding season habitat protection regulations and defining the spatial extent used in developing use-availability resource selection functions (RSFs). Alternatively, fixed kernel density using hPI for bandwidth selection emphasizes high-use nesting, perching, and foraging areas which may be useful in developing RUFs.

ECOLOGICAL MODELS OF AMPHIBIAN ABUNDANCE IN PALOUSE PRAIRIE WETLANDS. Erim Gomez, Rodney Sayler, *Department of Natural Resource Sciences, Washington State University, PO Box 646410, Pullman, WA 99164; erimgomez@gmail.com; rdsayler@wsu.edu.*

We used data mining techniques to develop ecological models predicting the occurrence of over 4000 amphibians of 7 species captured during 2009 in 63 wetlands along a geographic gradient extending from the eastern Palouse Prairie bioregion to the arid Moses Lake region in central Washington. Virtually all wetlands we studied in Palouse Prairie were artificially constructed as reservoirs, conservation habitats in

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agricultural lands, or were associated other development projects (e.g., mitigation for road construction, golf courses, urban settings, ditches, fish ponds). We used a variety of parameters to explore the relationships of amphibian abundance with landscape context, land use, and trap and wetland habitats (e.g., emergent vegetation). Our ecological models reveal that generally only a few environmental variables are needed to effectively predict (R^2 ranging from 0.35 – 0.80) occurrence of different amphibian species, including: a) presence or absence of introduced fish, b) wetland permanence and landscape context (e.g., surrounding grasslands or urban areas), and c) broad biogeographic factors (e.g., sandy soils for toads). In addition, all species demonstrated at least one or more positive ecological associations with the abundant amphibian generalists, Long-toed Salamanders (*Ambystoma macrodactylum*) and Pacific Chorus Frogs (*Pseudacris regilla*), while the American Bullfrog (*Lithobates catesbeianus*) had a positive and the Northern Leopard Frogs *(L. pipiens*) a negative association with introduced fish. We present summary ecological models that illustrate the biogeographic, habitat, landscape context, and community relationships of these 7 amphibian species in Palouse Prairie wetlands.

ASSESSMENT OF AMPHIBIAN MOVEMENT AND TERRESTRIAL HABITAT USAGE IN A FRAGMENTED URBAN WATERSHED. R Jalene Littlejohn, Catherine de Rivera, *Environmental Science and Management Department, Portland State University, PO Box 751, Portland, OR 97207; rjlittle@pdx.edu; derivera@pdx.edu.*

Urbanization can have detrimental effects on amphibian populations through habitat loss and fragmentation. In addition to other consequences of fragmentation, mortality risk for amphibians increases due to crossing roads and other barriers. Management for amphibians has largely focused on wetlands but such efforts do not address many of the problems from habitat loss and fragmentation that more terrestrial frogs may face when dispersing and as adults. For example, city and regional governments in and around Portland and Gresham, Oregon have been collecting data about pond-breeding amphibian species for a number of years through egg mass monitoring programs but little is known about the movement and terrestrial habitat use by the dispersing and adult amphibians. The goal of this project is to collect data about amphibian movement from known breeding ponds into surrounding terrestrial habitat, with emphasis on urban barriers and their effect on movement patterns. Particularly, this study will focus on the habitat needs and movement of the Northern Red-legged Frog (Rana aurora). To achieve this goal, three to five sites will be selected in one urban watershed. Trapping grids of drift fences and pitfall traps will be positioned around breeding and upland habitat at each site and habitat assessments will be conducted. Mark-recapture will be used to collect data about the resident amphibians including movement to and from critical terrestrial habitat and patterns associated with surrounding barriers and connected green space. Colored elastomer markings will be used to identify individuals based on site location of capture and direction of travel. Additional biological information will be recorded at the time of capture. A sub-sample of Northern Red-legged Frog adults will be tracked using radio tags attached with adjustable bands. In partnership with local agencies, data collection will begin in Spring 2011 and continue through Fall 2012. This study will help inform watershed managers about amphibian habitat needs for more effective conservation of habitat, especially in urban areas.

SPATIAL AND TEMPORAL VARIABILITY IN THE ABUNDANCE OF ROCKY MOUNTAIN TAILED FROGS (*ASCAPHUS MONTANUS*) IN NORTHERN IDAHO. Kirk Lohman, *US Geological Survey, Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, WI 54603; klohman@usgs.gov.*

Tailed frogs are a common amphibian in many forested streams in the Pacific Northwest and the Northern Rockies. I conducted surveys for Rocky Mountain Tailed Frogs (*Ascaphus montanus*) at six sites in the Mica Creek drainage in northern Idaho during 1997-2000 and 2002-2010. My objectives were to monitor tailed frog tadpole abundance and assess annual and spatial variation in population density. Average total tadpole density ranged from a low of 1.88/m2 in 2002 to a high of 14.06/m^2 in 2009. Densities were lowest in 1997-1998, 2002-2003, and 2008, and substantially greater in 1999-2000, 2004-2007, and 2009. Within years, tadpole densities varied greatly among sites, with high density sites exceeding low density sites by 10-fold or more. The relative abundance of tadpoles among sites was similar from year to year, i.e., sites with the highest and lowest densities in 1997 also tended to have the highest and lowest densities in subsequent years. Similar patterns were observed when comparing tadpole

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biomass among years and sites. Flow regime is likely a major determinant of tailed frog abundance. Tadpole numbers were depressed in years following large spring run-off and rain-on-snow events (1997, 2002, 2008), whereas greater densities were seen in years following extended periods without high flow events (1999-2000, 2004-2007).

A GIS-BASED MODELING APPROACH TO EVALUATE THE EFFECTS OF FOREST MANAGEMENT ON QUALITY AND DISTRIBUTION OF NORTHERN SPOTTED OWL TERRITORIES. Teodora Minkova, Chris Snyder, Scott Horton, Heather McPherson, *Washington State Department of Natural Resources, 1111 Washington Street Southeast, Olympia, WA 98501; teodora.minkova@dnr.wa.gov; chris.snyder@dnr.wa.gov; scott.horton@dnr.wa.gov; heather.mcpherson@dnr.wa.gov.*

Prospective modeling is commonly used to evaluate the effect of land management activities on species of interest. Northern Spotted Owl (*Strix occidentalis caurina*) is a federally listed species with large individual territories in predominantly mature forests. Assessing potential management impacts on spotted owl populations requires landscape-level analysis. Our analysis covers the Olympic Experimental State Forest and adjacent federal lands on the western Olympic Peninsula in Washington State. We used spatially explicit, two-step modeling to predict the quality and distribution of potential Northern Spotted Owl territories under two management regimes over 100-year period. First, we used a fuzzy logic approach to index Northern Spotted Owl habitat quality at stand level. The stand habitat scores then became the primary input data for a model that projected the location, extent, and overlap of individual Northern Spotted Owl territories over time. The model rules were informed by literature on Northern Spotted Owl ecology. The model was developed and implemented using ArcGIS and Python-based scripting. The results were validated by comparing with empirical data from 30 years of Northern Spotted Owl monitoring in the area. Preliminary analyses suggest future habitat capability for 49 Northern Spotted Owl territories compared to 37 territories in present landscape. We consider this model a promising tool for environmental impact analyses in forest land planning.

INTRASPECIFIC COMPARISON OF CALIFORNIA SEA LION (*ZALOPHUS CALIFORNIANUS*) DIET ASSESSED USING FECAL AND STABLE ISOTOPE ANALYSES. Anthony J Orr, *Washington Cooperative Fish and Wildlife Research Unit, School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA 98195; torr5@u.washington.edu;* Glenn R VanBlaricom, *Washington Cooperative Fish and Wildlife Research Unit, School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA 98195; glennvb@u.washington.edu;* Robert L DeLong, *The National Marine Mammal Laboratory, Alaska Fisheries Science Center, NOAA, 7600 Sand Point Way NE, Seattle, WA 98115; robert.delong@noaa.gov;* Victor H Cruz-Escalona, *Laboratorio de Dinámica y Manejo de Ecosistemas Acuático, Centro Interdisciplinario de Ciencias Marinas, Instituto Politécnico Nacional, Ave. IPN s/n Colonia Playa Palo de Santa Rita, La Paz, Baja California Sur, México 23096; vicreshu@gmail.com;* Seth D Newsome, *Department of Zoology and Physiology, University of Wyoming, 1000 East University Avenue, Department 3166, Laramie, WY 82071; snewsome@uwyo.edu.*

The diet of juvenile and adult female California Sea Lions (*Zalophus californianus*) at San Miguel Island, California, was estimated and compared using fecal and stable isotope analyses to determine dietary differences by age. Fecal samples were collected during 2002-2006 and prey remains were identified. Stable carbon (δ13C) and nitrogen (δ15N) isotope values were determined from plasma and fur obtained from yearlings, 2- to 3-yr-old juveniles, and adult females during 2005 and 2006. Juveniles ate more than 15 prey taxa, whereas adult females consumed more than 33 taxa. Relative importance of prey was determined using percent frequency of occurrence (%FO). *Engraulis mordax*, *Sardinops sagax*, *Merluccius productus, Sebastes* spp., and *Loligo opalescens* were the most frequently occurring (%FO > 10%) prey in the feces of both juvenile and adult female sea lions, although their importance varied between age groups. Only yearlings had significantly different isotopic values than older conspecifics, indicating that older juveniles were feeding at a similar trophic level, and in similar habitats, as adult females. Whereas each method had biases, combining the two provided a better understanding of the diet of California Sea Lions and intraspecific differences.

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EFFECT OF ARGININE VASOTOCIN ON GLUCOSE PRODUCTION IN BULLFROGS (*LITHOBATES CATESBEIANUS*). Amber Palmeri-Miles, Sheila Campbell, Brandon Fessler, James Pense, *Central Washington University, 400 East University Way, Ellensburg, WA 98926; palmeria@cwu.edu.*

The hormone arginine vasotocin (AVT) is well known for its function in regulating water balance in amphibians. This hormone acts by altering skin and bladder permeability and decreasing the rate of urine production. Amphibians also cope with water stress through the production of glucose, glycerol or urea to increase tissue osmotic concentrations, though the physiological mechanisms controlling such increases are not well understood. To date only one study has examined AVT influence on glucose production in amphibians, using a salamander model (*Ambystoma mexicanum*). This study supports AVT as an agent in glucose production, though it remains unknown if this effect is specific to A. mexicanum or is a general effect among amphibians. To investigate the effect of AVT on body fluid osmolarity in Anurans, we injected American Bullfrogs (*Lithobates catesbeianus*) with AVT and monitored glucose production in the liver. Treatment Bullfrogs were injected with 1µmol/kg AVT, controls with an equal quantity of saline per body mass. Frogs were double-pithed, livers removed and homogenized, and assayed for glucose after 1.5 or 3 hours. Treatment animals increased glucose concentration by 95 and 97 percent in the 1.5 and 3 hour groups respectively when compared to controls (1.5 h control = 5.9 µmol/g, 1.5 h treatment = 11.5 µmol/g, 3 h control = 3.5 µmol/g, 3 h treatment = 11.5 µmol/g). This exploratory experiment suggests AVT control of glucose may be a shared characteristic in amphibian physiology. Further research is warranted to provide better understanding of the role AVT plays in amphibian glucose production.

MATERNAL AND ENVIRONMENTAL EFFECTS ON HATCHLING WESTERN POND TURTLES IN WASHINGTON. Melissa M Reitz, Dan Beck, *Central Washington University, 400 East University Way, Ellensburg, WA 98926; melissa_reitz@yahoo.com.*

The Western Pond Turtle (*Actinemys marmorata*) was listed as a Washington state endangered species in1993 after natural populations dwindled to only two small locals in Skamania and Klickitat counties. The primary goals of the Washington Department Fish and Wildlife are to (1) recover depleted populations and (2) re-establish Western Pond Turtles in areas of historical prevalence. These efforts are critical to ensure continued existence in the northernmost extent of their range. This study examines two populations: the native Columbia River Gorge (CRG) and the re-introduced Puget Sound (SPSWA) populations. The objectives are to (1) compare the natural to the introduced site and (2) determine which maternal and/or environmental traits have the greatest influence on hatchling quality and hatching success. Forty-one mature females over 450 g were measured, outfitted with external radio transmitters, and tracked bihourly from dusk to dawn throughout the nesting season (May-August). Soil moisture probes, humidity loggers, and temperature loggers were used to monitor environmental effects within the nest cavity. Exclosures were positioned over the nest to prevent predation, and hatchlings were weighed upon emergence. Puget Sound populations had a 37% lower hatch success, and significantly smaller hatchlings, than did the native Columbia River Gorge population. SPSWA females produced more eggs per nest than those at CRG. There were significant differences in abiotic factors between sites, which may influence hatchling success and quality. Soil moisture was highly variable between sites, demonstrating the adaptability of this species. Identifying limiting factors will be useful in selecting suitable re-introduction sites.

AN INVASION MANAGEMENT PARADOX: REMOVING REED CANARYGRASS COULD FACILITATE BULLFROG SUCCESS. Jennifer C Rowe, Tiffany S Garcia, *Department of Fisheries and Wildlife, Oregon State University, 104 Nash Hall, Corvallis, OR 97331; jennifer.rowe@oregonstate.edu.*

Wetlands of the Willamette Valley in Oregon have been rapidly converted for agricultural and commercial uses. Many that remain lack historic ecological function due to anthropogenic disturbance and biological invasion. Reed Canarygrass (*Phalaris arundinacea*) is an aggressive wetland invader that is intensively managed in this region. However, native pond-breeding amphibians in the Willamette Valley use this plant as oviposition substrate, suggesting that they have adapted to its strong presence. These native amphibians are threatened by the invasive American Bullfrog (*Lithobates catesbeianus*), a competitor and generalist predator that is tolerant of artificial and bare-ground habitats. Reed Canarygrass eradication could therefore negatively impact native amphibians both (1) directly, by reducing vegetative cover required for oviposition, protection, and foraging, and (2) indirectly, by facilitating Bullfrog invasion. To

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explore these mechanisms, we will document amphibian presence and abundance, vegetation cover and type, and analyze Bullfrog stomach contents at study sites within the Wetland Reserve Program, which offers landowners incentives to restore wetlands in agricultural landscapes. We predict that reduced cover will enhance the search efficiency of Bullfrogs on emerging post-metamorphic native amphibians. Thus, Bullfrogs will be present at higher densities, and their stomachs will contain a greater proportion of native amphibians. This study aims to establish management recommendations to improve the value of habitat for native amphibians by increasing our understanding of the potential for indirect facilitation of Bullfrogs through invasive plant removal. We will also provide insight into the understudied, context-dependent interactions between adult predators and metamorphic prey which likely have strong population-level effects.

EXOGENOUS TREATMENT WITH THE STRESS HORMONE, CORTICOSTERONE, DOES NOT AFFECT *BATRACHOCHYTRIUM DENDROBATIDIS* INFECTION IN AMPHIBIAN HOSTS. Catherine L Searle, *Department of Zoology, Cordley Hall 3029, Oregon State University, Corvallis, OR 97330;* Lisa K Belden, *Department of Biological Sciences, Virginia Tech, Blacksburg, VA 24061;* Andrew R Blaustein, *Department of Zoology, Cordley Hall 3029, Oregon State University, Corvallis, OR 97330.*

Infectious diseases are increasing in prevalence and severity worldwide. In amphibians, the fungal pathogen, *Batrachochytrium dendrobatidis* (*Bd*), has been associated with amphibian population declines in many locations. Recent emergence and spread of *Bd* may be due to a number of factors, including environmental stressors that increase host susceptibility to *Bd*. Physiological stress can increase circulating levels of the hormone, corticosterone, which at chronic levels can result in immunosuppression and increased susceptibility to pathogens. Using the larvae of three amphibian species (*Anaxyrus boreas* [*Bufo boreas*], *Rana cascadae*, and *Lithobates catesbeianus* [*Rana catesbeiana*]), we chronically elevated corticosterone levels through exogenous exposure, followed by a challenge with *Bd*. After pathogen exposure we measured whole-body corticosterone, mortality, growth, development, and infection. In all species, infection prevalence (percent infection) and infection severity were not affected by exposure to corticosterone, even though we successfully elevated stress hormone levels. Upon termination of the experiment, species differed in their overall levels of corticosterone with *A. boreas* experiencing the highest whole-body corticosterone and *L. catesbeianus* experiencing the lowest. Exposure to corticosterone reduced mass and development in *A. boreas* and reduced mass and length in *R. cascadae*. In contrast, *Bd*-exposure increased length in all species and mass in *R. cascadae*, indicating that *Bd* may have some positive effects on larval growth. This study indicates that elevated levels of corticosterone do not make larval amphibians more susceptible to Bd infection.

QUANTIFYING RETURN ON INVESTMENT FOR RIPARIAN BIRD HABITAT RESTORATION IN CALIFORNIA'S SACRAMENTO VALLEY. Nathaniel E Seavy, Thomas Gardali, *PRBO Conservation Science, 3820 Cypress Drive #11, Petaluma, CA, USA 94954; nseavy@prbo.org.*

With limited financial resources available for habitat restoration, information that ensures and accelerates success can economize effort and maximize benefits. To evaluate the cost-effectiveness of riparian bird habitat restoration, we analyzed return on investment from increasing restoration design complexity in the Sacramento Valley of California. Horticultural restoration of riparian plant communities in this region has increased local population sizes and species diversity of landbirds and other wildlife. However, the complexity of the restoration design may vary in the number of tree species planted and the planting densities of willows (*Salix* spp.) and Valley Oaks (*Quercus lobata*). Using models that describe post-restoration changes in bird abundance, we quantified the response of bird abundance to each of these three elements. We then asked restoration practitioners to estimate the cost of restoration designs that encompassed a range of each element. We combined information on the restoration response and restoration cost to evaluate the return on investment. For all three elements, our analysis indicated that the response to increasing investment is linear or accelerating. This suggests that the additional cost of planting more tree species and higher densities of willows or oaks is justified. Our results demonstrate how combining bird response data with information on restoration design and associated monetary costs provides ecologic and economic guidance to improve restoration outcomes and cost efficiencies.

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MODELING WOLF RENDEZVOUS HABITAT IN NORTHEASTERN WASHINGTON: FINDING THE NEEDLE BY MAKING THE HAYSTACK SMALLER. Jay Shepherd, Paul Frame, *Washington Department of Fish and Wildlife, Olympia, WA 98501; jay.shepherd@dfw.wa.gov;* Dave Ausband, *University of Montana, Missoula, MT 59812.*

We used the basis of a predictive model of wolf (*Canis lupis*) rendezvous habitat developed in Idaho to map wolf rendezvous habitat in northeastern Washington. The best model from the Idaho study included green leaf biomass (Normalized Difference Vegetation Index), surface roughness, and profile curvature, indicating that wolves consistently used wet meadow complexes for rendezvous sites. The model was mapped in GIS and allowed surveyors to map wolf rendezvous habitat and find all 15 wolf packs and 74% of the litters known to researchers within 4 Idaho study areas. We used ecologically correlated variables in a simplified version of the model that included slopes less than 5%, wetlands, slopes less than 35%, and streams. We also were able to include roads, gates, and ungulate survey information to augment our version of the model. Using remote cameras during the rendezvous period, we found wolves in an area stratified by our version of the model in GIS. We were then able to successfully trap and radio-collar a young wolf and document a second known pack in northeastern Washington. Rendezvous habitat predicted by our simplified version of the Idaho model can be used as a starting point to narrow the search for breeding wolf activity. Wolves are most congregated and sedentary at the time of year when they are occupying earlier rendezvous site habitat (June-August). At others times of the year and without narrowing the area to be searched, observing and documenting wolves is similar to finding a needle in a haystack.

BRAIN AChE ACTIVITY IN SHINER PERCH INHABITING OYSTER BEDS AND ADJACENT CHANNELS FOLLOWING APPLICATION OF CARBARYL TO CONTROL BURROWING SHRIMP WITHIN WILLAPA BAY, WASHINGTON. Alexandra T Troiano, Kerensa A King, Christian E Grue, James M Grassley, Cathy Ekblad, *Washington Cooperative Fish and Wildlife Research Unit, School of Aquatic and Fishery Sciences, University of Washington, Box 355020, Seattle, WA 98195; troiaa24@u.wasshington.edu.*

Carbaryl is used to control burrowing shrimp within commercial oyster beds in Willapa Bay and Gray's Harbor, Washington. The shrimp reduce oyster survival by destabilizing sediments onto which young Pacific Oysters (*Crassostrea gigas*) are seeded. Efforts to restrict/prohibit the use of carbaryl have been driven by concerns over "sublethal" effects documented in laboratory studies with salmonids, not actual exposure during operational applications. Field studies indicate exposure of salmonids to the pesticide above beds and within adjacent channels is below that associated with overt effects. We quantified exposure of Shiner Perch (*Cymatogaster aggregata*) to carbaryl (Sevin 80 WP) above oyster beds and/or within adjacent channels following aerial applications (8.9 kg ai/ha) 2 weeks apart at the mouth of the Willapa River. We assumed perch would incur greater exposure to the pesticide than salmonids because of greater site fidelity and consumption of benthic invertebrates. Perch were captured at high tide at the center of three beds at 6, 30 and 54 h post spray, and at low tide within three adjacent channels 24, 48 and 72 h post spray; and 24 h prior to, and 24, 48 and 72 h after, the second application. Perch captured in channels at the north end of the Bay served as negative controls. Brain AChE was not inhibited in perch from beds or adjacent channels at any sampling time compared to controls. In comparison, enzyme activity in juvenile Chinook Salmon (*Oncorhynchus tshawytscha*) captured in the channels was inhibited <14%, returning to normal levels within 72 h.

MONITORING TRANSPORTATION PROJECTS WITH WILDLIFE PASSAGE STRUCTURES IN SNOHOMISH COUNTY. Terri Wentworth-Davis, *Snohomish County Public Works,3000 Rockefeller Avenue, Everett, WA 98201; t.wentworthdavis@snoco.org;* Anna Michel, Sean Den Adel, Liam Holmes, Thomas Murphy, Jocelyn Oakley, *LEAF School at Edmonds Community College, 20000 68th Avenue West, Lynnwood, WA 98036; annam3x@yahoo.com; waskimsnow@yahoo.com; liamjholmes@hotmail.com; tmurphy@edcc.edu; jocelyn.oakley@edcc.edu.*

As more roads are built and the widths of existing roads increase, wildlife habitat becomes increasingly fragmented and wildlife mortality from vehicle collisions increases. Snohomish County Public Works has recently begun to incorporate wildlife passage structures into its transportation projects to allow wildlife to cross roads safely and maintain habitat connectivity. In partnership with Snohomish County

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Public Works, students from the LEAF School (Learn and Serve Environmental Anthropology Field School) at Edmonds Community College monitor four transportation projects in Snohomish County that include wildlife passage structures. Students monitor each site using motion sensor cameras and track transects to determine what kinds of wildlife are present, their relationship to the highway and the impact or proposed impact of the passages for pre and post-construction sites. Remote-sensing camera images and field observations from September 2010 to present support the need for wildlife passages and demonstrate the functionality of the post-construction projects.