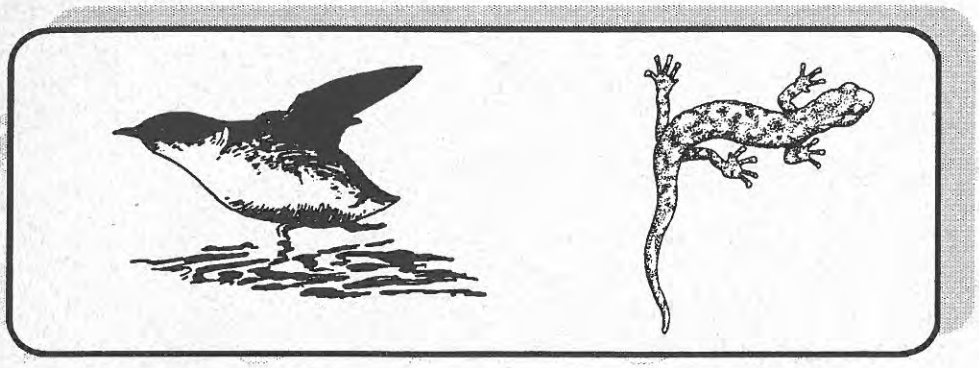
Society for Northwestern Vertebrate Biology



Pacific Northwest Amphibian and Reptile Consortium

1996 ANNUAL MEETING

20-23 March 1996

LaSells Stewart Center
Oregon State University
Corvallis, Oregon

Society for Northwestern Vertebrate Biology

FOUNDED JANUARY 7, 1920

EXECUTIVE BOARD 1995-1996

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Dear Friends--

Welcome to the 76th annual meeting of the *Society for Northwestern Vertebrate Biology*. This year's gala event is located at the LaSells Stewart Center at Oregon State University in Corvallis, Oregon (which is Latin for *Heart of the Valley*). Corvallis is an ideal location for this year's meeting, not only because of its beautiful setting amid oak and madrone woodlands, but also because the University has spawned countless biologists for academia and agencies. Many of our fine speakers are OSU alumni or budding young biologists eager to share their findings. The town also boasts a rather moderate climate (for the Northwest) and some excellent eateries and microbreweries. The nearby Coast Range and Pacific Ocean shoreline are biologically diverse ecosystems that should inspire our attendees.

This meeting promises to be exceptional because of the many events taking place. The first training session by the Society's special committee, the *Pacific Northwest Amphibian and Reptile Consortium*, kicks off the meetings on Wednesday. Because this is actual training, it is not part of the meeting *per se*. The SNVB meeting starts on Thursday with a full day of contributed papers, posters, and displays in two concurrent sessions. Viewing the live amphibian and reptile display will be on Wednesday and Thursday. On Thursday evening will be the banquet and raffle. Friday's agenda includes a Plenary Session on Inventorying and Monitoring--the charge of many biologists. As a grand finale, the ever-popular field trips will be held on Saturday.

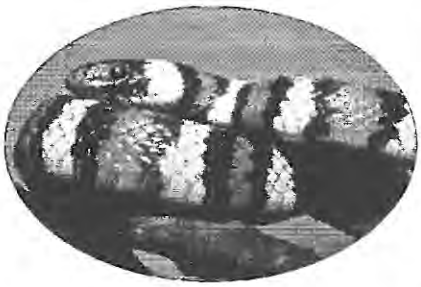
This year's annual meeting committee has done an exceptional job in putting the meeting together (the addition of the training session has doubled the work load). In particular, Bruce Bury and Deanna Olson deserve a tremendous pat on the head for sweating erythrocytes to pull this meeting off!

--Lawrence L. C. Jones, President

Annual Meeting Committee:

R. Bruce Bury, Coordinator
Janet Jones, Registration, abstracts
Lawrence Jones, Written materials, display
William Leonard, PNARC organizer
Don Major, Local organizer
Deanna Olson, Local organizer, display
Robert Storm, Local organizer and guru

Live Animal Display and Demonstrations: By popular demand, we are again displaying live amphibians and reptiles for PNARC and SNVB attendees. Most species from the Northwest are represented. Please realize that these species are adapted to life in the Northwest and many of the amphibians are sensitive to environmental change (especially increased temperature). Thus, our schedules for displaying the animals (Wednesday and Thursday) reflect a concern for their well-being and security rather than convenience for attendees. In general, animals will be available for viewing during breaks and lunches on Wednesday and Thursday. We ask that folks attending only the training visit the live displays at Wednesday lunch. There will be a 2-h viewing Wednesday night for everyone. The live animal and other displays will be dismantled on Thursday afternoon. All contributors have collected these animals with the proper state permits. The organizers consulted with and received permits from the Oregon Department of Fish and Wildlife to display these animals. *Because lunch time will be a good opportunity to see the animals and question the experts, we suggest you bring a brown bag lunch and mill about the displays (please don't feed the animals or trainees, they have specialized insect diets!). The experts will be happy to answer your questions about identification, methods, equipment, and so on. They can be identified by the sticker on their name tag and many of them will be available during lunch and break times.* Deanna Olson and Lawrence Jones organized the display.



Contributors and Procurors

- John Applegarth
- Andrew Blaustein
- Bruce Bury
- Dave Clayton
- Charles Crisafulli
- Steve Cross
- David Darda
- Gary Fellers
- Lawrence Jones
- Karen Kronner
- William Leonard
- Don Major
- Lisa Ollivier
- Deanna Olson
- Debra Patla
- Charles Peterson
- Matthew Snook
- Robert Storm
- The other one if I forgot

Field Trips: There was an overwhelming response to the herp field trips. One of the trips will be to the Willamette Valley to observe salamander eggs and frog eggs/larvae and pond turtle nests and adults of whatever can be turned up; many birds can be observed at the marshes. The other trip will be to the Coast Range to observe stream and upland species of herps, such as giant, torrent, and Dunn's salamanders and tailed frogs. We will debate if Bigfoot is a herp. Both trips will be split into 2 smaller groups for logistics and comfort. Few people signed up for the coastal trip, so it may be cancelled, or done as an on-your-own trip. The trip to the Oregon Coast Aquarium was cancelled. Kat Beal, Don Major, Christopher Pearl, Jerine Pegg, and Debbie Thaut will organize the field trips.

Posters: Poster set up will be on Thursday morning at 0800 h. They will be displayed on corkboard walls outside of C and E Hall and in the Agriculture Production Room. Poster presenters should bring lunch for noon showing to supplement the Thursday afternoon showing. We may need to break early to get to the social and banquet.

Slide Viewing: Can be done in the Weyerhaeuser Room. The Weyerhaeuser room will also be the meeting place for the SNVB Excutive Board.

AMPHIBIANS AND REPTILES OF THE PACIFIC NORTHWEST. Training Session. Austin Auditorium, Wed. 20 March.

Basic training session with emphasis on sampling methods for inventories (lecture)and identification skills (live display). Sponsored by the **Pacific Northwest Amphibian and Reptile Consortium**.

Coordinator: R. Bruce Bury. Chairs: William Leonard and Chris Thoms. Local Committee: R. Bruce Bury, Dede Olson, and Don Major. Referees (timers) Edward Arnett, R. Bruce Bury, and Lawrence Jones.

9:00 WELCOME. R. Bruce Bury, NBS.

9:05 WHAT ARE INVENTORYING AND MONITORING NEEDS? Representatives from federal, state and private agencies: Kelly McAllister, WDF&W; Cindy Barkhurst, USFS; Douglas McVean, BLM; and Edward Arnett, Weyerhaeuser.

9:45 AMPHIBIAN AND REPTILE DIVERSITY. Robert M. Storm, OSU.

10:15 ***BREAK*** Live animal display viewing

10:30 SITE SELECTION. Gary Fellers, NBS, Point Reyes, CA.

10:45 POND AMPHIBIANS. William Leonard, WA Natural Heritage Program; Char Corkran, NW Ecological Institute; Mike Adams, UW; Charlie Crisafulli, USFS.

11:45 *BROWN BAG LUNCH* (Bring lunch or eat in Student Union)--This will be an opportunity to see ***live animal display and demonstrations***. Priority for 1-day attendees.

1:15 PM WESTERN POND TURTLE. Interagency Western Pond Turtle Group.

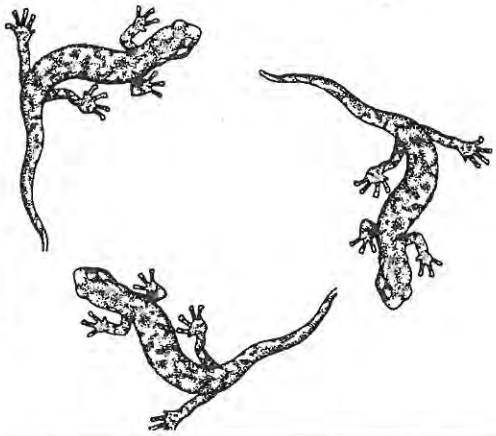
1:20 STREAM AMPHIBIANS. R. Bruce Bury, NBS; Lisa Ollivier, USFS; Bruce Hansen, USFS.

2:15 ***BREAK*** Live animal display viewing.

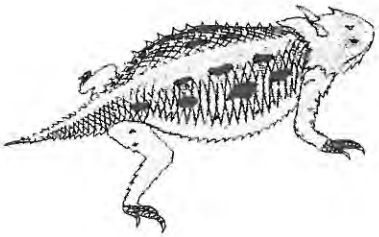
2:30 TERRESTRIAL AMPHIBIANS AND REPTILES. Don Major, NBS; Bruce Bury, NBS; David Vesely, OSU; others.

3:20 SURVEY AND MANAGE SPECIES: TERRESTRIAL AMPHIBIANS. Deanna Olson, USFS and Federal Survey and Manage Team: David Clayton, Lisa Ollivier, Charles Crisafulli, and Lawrence Jones, USFS.

3:50 CONCLUSIONS AND WRAP-UP. Deanna Olson.



4:15-5:30. PNARC Organizational meeting. Not part of training, but all interested parties are welcome. We will review progress of working groups.



7:00-9:00 PM. Live amphibian and reptile display with hands-on demonstrations. PNARC trainees and all SNVB attendees welcome.

Thurs., Mar. 21 **Forest Mammals in the Pacific Northwest,** John Hayes, Chair. Agriculture Leader Room, morning session.

9:00-9:20 AM	INTERTREE MOVEMENTS AND SPATIAL DISTRIBUTION OF NEST TREES OCCUPIED BY INDIVIDUAL RED TREE VOLES: IMPLICATIONS FOR CONSERVATION. Brian L. Biswell and E. Charles Meslow.
9:20-9:40 AM	RELATIVE ABUNDANCE AND DYNAMICS OF RED TREE VOLE (*ARBORIMUS LONGICAUDUS*) NESTS IN MANAGED FORESTS OF THE REDWOOD REGION. Lowell V. Diller and Joel L. Thompson.
9:40-10:00 AM	DISPERSAL OF THE GRAY-TAILED VOLE, *MICROTUS CANICAUDUS*, IN PATCHY ENVIRONMENTS. Natasha Nelson.
10:00-10:20 AM	LITTLE KNOWN ROOST TYPES OF THREE SPECIES OF BATS IN SOUTHERN OREGON. David R. Clayton and Stephen P. Cross.
10:20-10:40 AM	*BREAK* Live animal display viewing.
10:40-11:00 AM	MANAGEMENT IMPLICATIONS DEVELOPED FROM BAT ACTIVITY SURVEYS EAST AND WEST OF THE CASCADE MOUNTAINS, OREGON. David L. Waldien, Stephen P. Cross, and Anthony E. Kerwin.
11:00-11:20 AM	REINTRODUCTION, CURRENT DISTRIBUTION, AND ECOLOGY OF FISHERS IN OREGON: PRELIMINARY RESULTS. Keith B. Aubry and Jeffrey C. Lewis.
11:20-11:40 AM	DOCUMENTING MARTEN BEHAVIOR AT MATERNAL DENS WITH REMOTELY ACTIVATED CAMERAS. Lawrence L. C. Jones, Martin G. Raphael, J. Todd Forbes, and Laurie A. Clark.
11:40-NOON	USE OF REMOTE VIDEO CAMERAS FOR DETECTING FOREST CARNIVORES AND IN RADIO-TELEMETRY STUDIES OF FISHERS. Keith B. Aubry, Fred E. Wahl, Jeff von Kienast, Timothy J. Catton, and Scott G. Armentrout.
NOON-1:20 PM	*LUNCH* Live animal displays and poster viewing. Bring a brown bag lunch.

Birds, Reptiles, and Marine Mammals of the Pacific Northwest, John Pierce, Chair. Agric. Leader. Room, afternoon session.

1:20-1:40 PM	GROWTH OF AN INCIPIENT NORTHERN ELEPHANT SEA POPULATION NEAR PT. PIEDRAS BLANCAS, CALIFORNIA. Ronald J. Jameson and Brian B. Hatfield.
1:40-2:00 PM	AUDITORY DETECTIONS OF BREEDING BIRDS: COMPARISON OF EXPERT OBSERVERS AND TAPE RECORDINGS DURING POINT COUNT SURVEYS. Edward B. Arnett, Kevin McGarigal, Bob Altman, and Randy Floyd.
2:00-2:20 PM	DISTRIBUTION AND HABITAT RELATIONSHIPS OF BREEDING BIRDS ON A PRIVATE MANAGED FOREST IN THE WESTERN WASHINGTON CASCADES. Thomas Bosakowski.
2:20-2:40 PM	EFFECTS OF WILDFIRE ON BREEDING BIRD COMMUNITIES IN CONIFEROUS FORESTS OF NORTHEASTERN OREGON. Rex Sallabanks.
2:40-3:00 PM	OSPREY POPULATION INCREASE ALONG THE WILLAMETTE RIVER, OREGON, AND THE ROLE OF UTILITY STRUCTURES, 1976-93. Charles J. Henny and James L. Kaiser.
3:00-3:20 PM	*BREAK* Live animal display viewing.
3:20-3:40 PM	PATTERNS OF BIRD AND AMPHIBIAN ABUNDANCE IN RIPARIAN BUFFERS ALONG HEADWATER STREAMS IN THE OREGON COAST RANGES. Joan C. Hagar and David G. Vesely.
3:40-4:00 PM	MATE CHOICE IN THE RED-SIDED GARTER SNAKE, *THAMNOPHIS SIRTALIS PARIETALIS*. Ignacio T. Moore, Michael J. Greene, and Robert T. Mason.
4:00-4:20 PM	TEMPERATURE EFFECTS ON THE GROWTH AND DEVELOPMENT OF NEONATAL RED-SPOTTED GARTER SNAKES, *THAMNOPHIS SIRTALIS CONCINNUS*. Darren T. Lerner, Jennifer L. Penn, Ignacio T. Moore, and Robert T. Mason.
4:20-4:40 PM	ANNUAL CYCLES OF REPRODUCTION IN THE BROWN TREE SNAKE, *BOIGA IRREGULARIS*. Michael J. Greene, Chance McDonald, and Robert T. Mason.

Thurs. Mar. 21 **Amphibian Distribution and Ecology**, Deanna Olson, Chair. C & E Hall, morning session.

9:00-9:20 AM	DISTRIBUTION AND HABITAT RELATIONSHIPS OF AMPHIBIANS ON A PRIVATE MANAGED FOREST IN THE WESTERN WASHINGTON CASCADES. Thomas Bosakowski.
9:20-9:40 AM	AMPHIBIAN DISTRIBUTION IN CENTRAL AND SOUTHEAST OREGON. Jim David, Rick Demmer, Lisa Hatley, and Cinthia Tait.
9:40-10:00 AM	A SURVEY OF POND BREEDING AMPHIBIANS IN OLYMPIC NATIONAL PARK. Richard S. Nauman.
10:00-10:20 AM	THE EFFECTS OF HABITAT MODIFICATIONS ON A SPOTTED FROG POPULATION IN YELLOWSTONE NATIONAL PARK. Debra A. Patla and Charles R. Peterson.
10:20-10:40 AM	*BREAK* View live animal displays (but be back on time).
10:40-11:00 AM	COMPLEX INTERACTIONS BETWEEN STOCKED TROUT AND LARVAL SALAMANDERS (*AMBYSTOMA MACRODACTYLUM*) IN HIGH-ELEVATION LAKES. Torrey Tyler, William Liss, and Robert Hoffman. Dept Fish. & Wild. OSU
11:00-11:20 AM	INTEGRATING ASSOCIATIONS BETWEEN CASCADE FROG (*RANA CASCADAE*) POPULATION AND HABITAT STRUCTURE ACROSS SPATIAL SCALES. Cathy Brown, Dede Olson, and G.A. Bradshaw.
11:20-11:40 AM	GROWTH AND AGE IN ALBERTA LONG-TOED SALAMANDERS (*AMBYSTOMA MACRODACTYLUM KRAUSEI*). Anthony P. Russell, G. Lawrence Powell, and Dean R. Hall. Univ. of Calgary
11:40-NOON	MOVEMENT PATTERNS OF TERRESTRIAL ADULT NORTHWESTERN SALAMANDERS. Angela B. Stringer and Keith B. Aubry.
NOON-1:20 PM	*LUNCH* Live animal displays and poster viewing. Bring a brown bag lunch.

Amphibian Distribution and Ecology, David Darda, Chair. C & E Hall, afternoon session.

1:20-1:40 PM	EASTERN LONG-TOED SALAMANDER (*AMBYSTOMA MACRODACTYLUM COLUMBIANUM*) LARVAE RECOGNIZE CANNIBALISTIC CONSPECIFICS USING CHEMICAL CUES. Erica L. Wildy, Douglas P. Chivers, and Andrew R. Blaustein.
1:40-2:00 PM	FACTORS INFLUENCING PATHOGENIC INFECTION OF AMPHIBIAN EMBRYOS. Joseph M. Kiesecker, and Andrew R. Blaustein.
2:00-2:20 PM	ROLE OF PACIFIC GIANT SALAMANDER LARVAE IN HEADWATER STREAM BENTHIC COMMUNITIES. Michael S. Parker.
2:20-2:40 PM	MOVEMENTS AND DISTRIBUTION OF *ASCAPHUS TRUEI* ALONG TWO STREAMS IN THE WALLOWA MOUNTAINS OF OREGON. Matthew W. Snook.
2:40-3:00 PM	*BREAK* Live animal display viewing.
3:00-3:20 PM	A COMPARISON OF AMPHIBIANS AND HABITAT FEATURES IN LATE-SUCCESSIONAL AND VOLCANICALLY IMPACTED STREAMS NEAR MOUNT ST. HELENS, WASHINGTON, USA. Charles M. Crisafulli and Charles P. Hawkins.
3:20-3:40 PM	ESTIMATES OF ADULT TAILED FROG POPULATION SIZE IN THREE SMALL WATERSHEDS NEAR MOUNT ST. HELENS. Charles P. Hawkins and Charles M. Crisafulli.
3:40-4:00 PM	AMPHIBIAN COMMUNITIES IN INTERMITTENT, HEADWATER STREAMS IN YOUNG AND OLD-GROWTH FOREST STANDS. Yu Man Lee and Michael W. Collopy.
4:00-4:20 PM.	CANDIDATE SPECIES: DEFINITION, ASSESSMENT, AND CONSERVATION. Laura L. Todd.

Posters and Displays, Outside C & E Hall and in Agriculture Production Room. Posters will be attended at 4:40-5:30 PM on Thursday (and noon hour, if possible).

USE OF GLOBAL POSITIONING AND GEOGRAPHIC INFORMATION SYSTEMS TO QUANTIFY MUSTELID BEHAVIOR IN RELATION TO HABITAT DURING WINTER. Edward B. Arnett, Lawrence L.C. Jones, Martin G. Raphael, J. Todd Forbes, and Larry L. Irwin.

STATUS OF THE FERRUGINOUS HAWK IN WASHINGTON. Scott Richardson and Ann Potter.

ENDEMIC FAUNA OF THE OWYHEEAN ISLANDS OFF THE COAST OF IDAHO. II. NO NEW DATA. Lawrence L.L.L.C. Jones, Janet L.L. Jones, Uncle Nardly, J. Jay, the Professor and Mary Ann.

WASHINGTON HERP ATLAS PROJECT. Kelly R. McAllister.

USE OF REMOTE VIDEO CAMERAS FOR DETECTING FISHERS AND OTHER FOREST CARNIVORES. Jeff von Kienast, Timothy J. Catton, Scott G. Armentrout, Fred E. Wahl, and Keith B. Aubry.

DOCUMENTING MARTEN BEHAVIOR AT MATERNAL DENS WITH REMOTELY ACTIVATED CAMERAS. Lawrence L. C. Jones, Martin G. Raphael, J. Todd Forbes, and Laurie A. Clark (also an oral presentation).

WHAT DOES FORESTRY IN THE BOREAL FOREST MEAN TO AMPHIBIANS. Elke Wind.

THE OREGON BREEDING BIRD ATLAS PROJECT. Paul Adamus.

COMPARATIVE DISTRIBUTIONS OF DUNN'S SALAMANDERS, *PLETHODON DUNNI*, AND LARCH MOUNTAIN SALAMANDERS, *PLETHODON LARSELLI*, IN RELATION TO CERTAIN HABITAT CHARACTERISTICS IN THE COLUMBIA RIVER GORGE, OREGON. William Hall, Mimi Matsuda, and Keith Robillard.

WINTERING RAPTOR CENSUSES OF THE KITTITAS VALLEY, WASHINGTON, 1995 AND 1996. Nathaniel E. Seavy and Phil Mattocks.

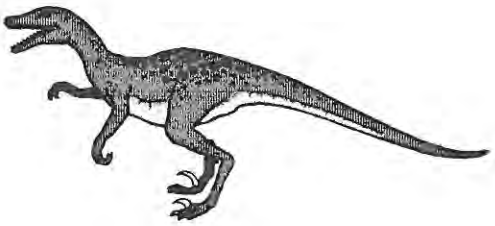
PNARC Displays and Demonstrations, Agric. Production Room.

AMPHIBIANS AND REPTILES OF THE PACIFIC NORTHWEST: A LIVE ANIMAL DISPLAY. Deanna H. Olson and Lawrence L. C. Jones, (and Kermit) coords. See list of collector s elsewhere in Program.

TECHNIQUES FOR RADIO-TELEMETRY AND PIT-TAGGING OF SALAMANDERS. Angela B. Stringer and Keith B. Aubry.

EQUIPMENT USED IN HERPETOLOGICAL INVESTIGATIONS IN THE PACIFIC NORTHWEST. John Applegarth.

A SNEAK PREVIEW OF MOLLUSCS. While you are looking under rocks for herps, keep an eye out for the other slimy critters--federal regulations require survey and manage measures for many of these species. John Applegarth.



THE HERPER'S BOOKSHELF: IMPORTANT HERPETOLOGICAL LITERATURE. *PNARC*.

AMPHIBIAN AND REPTILE VOUCHER SPECIMENS. Joe Beatty.

INVENTORYING AND MONITORING OF VERTEBRATES, Austin Auditorium, Friday, March 22.

GOAL: To examine our inventorying, monitoring, and research needs. What are the needs for agency, private, and scientific use? What can and cannot be answered by monitoring? What taxa are suitable for monitoring and what are their pro and con features? What research and statistical rigor is needed to improve monitoring?.

Moderator, morning session: R. Bruce Bury, National Biological Service, Corvallis, Oregon.

9:00 AM WELCOME, DEFINITIONS, AND A CHALLENGE. R. Bruce Bury, NBS, Corvallis, OR.
9:20 STATISTICAL CONSIDERATIONS FOR MONITORING VERTEBRATE POPULATIONS. Robert J. Steidl, OSU, Corvallis, OR.
9:45 CHAOS, ENTROPY, AND EXAPTATIONS: CIRCUMSTANCES WHEN THE NULL HYPOTHESES PERTAIN IN ENVIRONMENTAL BIOLOGY. David J. Morafka, CA State Univ., Dominguez Hills, CA.

10:10 ***BREAK***

10:25 STREAM AMPHIBIANS. Hartwell H. Welsh, USFS, Arcata, CA.
10:50 POND-BREEDING AMPHIBIANS. Charles Peterson, Idaho State University, Pocatello.
11:15 MONITORING AMPHIBIANS: CAN WE GET THE ANSWERS TO THE QUESTIONS WE ASK? Paul Stephen Corn, NBS, Ft. Collins, CO.

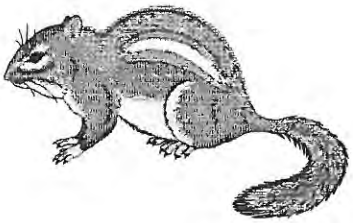
11:40 *LUNCH* (eateries in Memorial Union, OSU)

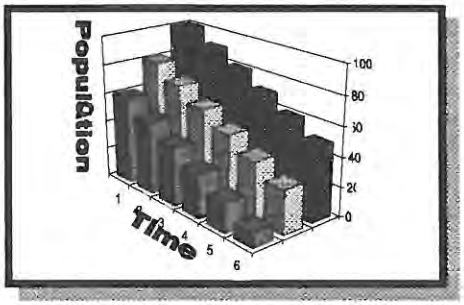
Moderator, afternoon session: Michael Collopy, Director , FRESC, NBS, Corvallis, Oregon.

1:00 PM THE MONITORING OF BIRDS:FACTS AND FANCIES. C. John Ralph, USFS, Arcata, CA.
1:30 OWLS. Eric Forsman, USFS, Corvallis, OR.
1:50 INVENTORY AND MONITORING OF REPTILES. David J. Germano, CA State Univ.

3:15 *BREAK*

3:30 BATS. Steve Cross, So. Oregon State Univ., Ashland, OR.
3:50 SMALL MAMMALS. Steve West, Univ. WA, Seattle, WA.
4:10 FOREST CARNIVORES. Keith B. Aubry, USFS, Olympia, WA and William Zielinski, USFS, Arcata, CA.
4:30 DISCUSSION AND CLOSING REMARKS.





ABSTRACTS

THE OREGON BREEDING BIRD ATLAS PROJECT. Paul Adamus, Project Coordinator, USEPA Environmental Research Lab, 200 SW 35th St., Corvallis, OR 97330.

Since the 1970's, thousands of volunteers have participated in "atlas projects" with the purpose of mapping the distribution of birds in over 30 countries, states, and counties. Yet, Oregon has never had a state-wide bird atlas project. This situation changed in 1995 when members of Oregon Field Ornithologists (OFO, the state-wide birder's organization) began organizing a five-year-long Oregon Breeding Bird Atlas Project. The result of the project will be a book of state maps showing the general nesting locations of each of Oregon's 270 breeding birds (locations of very rare species will not be shown in detail). Equally important, data from the effort will vastly improve and expand the information currently contained in computer databases of government agencies and Oregon's Natural Heritage Program -- information that is used routinely to help manage reserves and maintain their biodiversity. Since the project began last year, over 400 Oregonians have volunteered to send in their observations. Data are being compiled using the same grid used by some other Heritage Program projects. This grid divides the state into 430 hexagonal areas. Information submitted by participants is used to categorize each species' breeding status in each hexagon as "possible", "probably", or "confirmed". Participants can also report observations from a 3 mile x 3 mile square within each larger hexagon. During the first year of the effort, participants contributed reports from 350 (81%) of the hexagons and found virtually all of the 270 species expected to nest in the state. Of these species, volunteers confirmed nesting somewhere for all but 34 species.

AUDITORY DETECTIONS OF BREEDING BIRDS: COMPARISON OF EXPERT OBSERVERS AND TAPE RECORDINGS DURING POINT COUNT SURVEYS. Edward B. Arnett, Weyerhaeuser Company; Kevin McGarigal, Boggy Draw Natural Resources Center; Bob Altman, Avifauna Northwest; and Randy Floyd, Beak Environmental Consultants.

We present results of an experiment comparing observer auditory detections with tape recordings of breeding birds collected during point count surveys in managed Douglas-fir (*Pseudotsuga menziesii*) forests in western Oregon. Two different recording systems (Realistic CTR-66 and Sont TC-5000) were used to assess equipment differences and quality needed for maximizing bird detections. During point count surveys, expert observers and both tape systems recorded birds simultaneously at 5 call points in each of 10 sample stands. Once field surveys were completed, 3 different observers listened to tapes and recorded all species heard. Bird species recorded on tapes from both systems corresponded relatively well with expert observer detections. The Realistic and Sony systems recorded an average of 75 and 83%, respectively, of bird auditory detections that were estimated to be within 75 m from each call point by field observers. Forty-five different species were detected in all stands combined by field observers, while between 39 and 41 of the same species were detected on tapes (Sony; 36-37 for Realistic), depending on observer. Tape recording offers an approach for monitoring breeding bird presence, frequency of occurrence, and habitat associations, and can be conducted by personnel not knowledgeable of bird calls and interpreted later by avian experts.

USE OF GLOBAL POSITIONING AND GEOGRAPHIC INFORMATION SYSTEMS TO QUANTIFY MUSTELID BEHAVIOR IN RELATION TO HABITAT DURING WINTER. Edward B. Arnett, Weyerhaeuser Company, Lawrence L.C. Jones and Martin G. Raphael, Pacific Northwest Research Station, J. Todd Forbes, Winema National Forest, and Larry L. Irwin, NCASI.

Global Positioning Systems (GPS) and Geographic Information System (GIS) software can be used to quantify and analyze mustelid behavior in relation to habitat during winter. We designed a study to demonstrate these methods for American marten (*Martes americana*) movement patterns at micro-habitat, stand, and landscape scales in central Oregon. Marten "event points" (EPs) (e.g., kill site, subnivean access) are determined and formatted into a data outline used by GPS. Marten tracks are followed 1-3 days after fresh snow and GPS data are gathered at each EP encountered along the path for 1 hr. Data files are downloaded into a personal computer and corrected with GPS software for accuracy of $\leq$ 1 m for any given point. Data can then be converted into one of several GIS formats to plot a marten's actual path and analyzed in relation to GIS layers of habitat features, including forest cover types. Characteristics of the path shape, such as sinuosity and fractal dimension (indices of deviation from a straight line) can be compared among cover types to infer evidence of habitat selection. Use of structural features at EPs can be compared among habitats, and relative probabilities of an animal moving from one habitat type or patch to another can be calculated.

INVENTORY AND MONITORING OF FOREST CARNIVORES. Keith B. Aubry, USDA Forest Service, Pacific Northwest Research Station, Olympia, WA; and William J. Zielinski, USDA Forest Service, Pacific Southwest Research Station, Arcata, CA.

Forest carnivores (marten, fisher, lynx, and wolverine) occur at low densities, are primarily nocturnal, leave little sign, and avoid human activity. Unless they are commercially harvested by trapping, their presence can easily go undetected. However, the only trapping season currently open for any of these forest carnivores in the Pacific States is that for marten in Washington. Thus, although there is little doubt that all 4 species have suffered substantial population declines in this century, the current status and distribution of most populations in the Pacific States remains conjectural. New techniques have recently been developed to conduct inventories to detect their presence and, with some degree of certainty, their absence from a given area. These include the use of baited camera stations, sooted track boxes, and snow tracking. These detection devices can also be used to survey large areas in a relatively short period of time to provide a 'snapshot' of species' distributions that can then be compared over time to detect major changes in species' abundances and distributions. Other approaches to monitoring forest carnivore populations involving the development of statistical models for measuring population change have also been developed.

REINTRODUCTION, CURRENT DISTRIBUTION, AND ECOLOGY OF FISHERS IN OREGON: PRELIMINARY RESULTS. Keith B. Aubry and Jeffrey C. Lewis, USDA Forest Service, Pacific Northwest Research Station, Olympia, WA.

In May 1995, we initiated a radio-telemetry study of fishers (*Martes pennanti*) in an intensively managed landscape on the Rogue River National Forest in southeastern Oregon. To date, we have captured and radio-collared 4 fishers (1 male and 3 females). We captured the first female in late May, and tracked her to two maternal dens in large, moderately decayed logs. Using remote video cameras, we determined that she had two kits. Our study animals use a variety of rest sites, most of which are associated with late-successional structures such as large, hollow logs, snags, and decadent trees, and mistletoe clumps and large branches in live trees. We learned during the course of this research that 24 fishers from British Columbia and Minnesota had been transplanted near our study area between 1977 and 1981 to control porcupine populations. To determine if our study animals are from a reintroduced population and to document the current distribution of fishers in Oregon, we gathered sighting and trapping records from resource management agencies, interviewed field biologists, and sent a questionnaire to all registered trappers and hound hunters. In addition, we are attempting to identify the source population of our study animals using DNA fingerprinting. Preliminary results of all phases of this research will be presented.

USE OF REMOTE VIDEO CAMERAS FOR DETECTING FOREST CARNIVORES AND IN RADIO-TELEMETRY STUDIES OF FISHERS. Keith B. Aubry, USDA Forest Service, Pacific Northwest Research Station; Fred E. Wahl, Jeff von Kienast, Timothy J. Catton, and Scott G. Armentrout, USDA Forest Service, Rogue River National Forest.

Recent work on the development of survey techniques for forest carnivores describes the use of smoked tracking stations, snow tracking, and single-frame 35-mm and 110 camera systems, but not video systems. We experimented with both video and 35-mm remote cameras in southwestern Oregon for use in surveys of forest carnivores and in radio-telemetry studies of fishers. Although they were 5 times as expensive, video systems were more efficient at detecting martens and fishers than the 35-mm system, had fewer problems, and enabled us to gather information on reproductive ecology and behavior. For these reasons, video systems offer many advantages over 35-mm systems. We describe the improvements we made to a commercially available video system and offer recommendations for establishing video camera stations in the field.

INTERTREE MOVEMENTS AND SPATIAL DISTRIBUTION OF NEST TREES OCCUPIED BY INDIVIDUAL RED TREE VOLES: IMPLICATIONS FOR CONSERVATION. Brian L. Biswell, Forestry Sciences Laboratory, 3625 93rd Ave S.W., Olympia, WA 98512; and E. Charles Meslow, Wildlife Management Institute, 8035 NW Oxbow Drive, Corvallis, OR 97330

Nine adult and three subadult red tree voles (*Arborimus longicaudus*) were equipped with radio transmitters and tracked to determine movement patterns and the spatial distribution of arboreal nest sites. Adults were followed for 35 - 106 days and nest site usage were based on 4 - 5 daytime locations per week. During the tracking periods individuals were found to use 2 - 7 (median = 5) nest trees each. Mean distance moved between consecutive nest trees for females and males was 31.4 m (SE = 6.5) with the greatest straight line distance between consecutively occupied nest trees of 75.8 meters. When moving to a new tree, adult voles reoccupied previously constructed nest structures at least 68 percent of the time. Thirty-six percent of 39 nest trees located via telemetry contained more than a single nest and one tree contained seven nest structures. Subadult tree voles were followed for 23-40 days during which two dispersed from natal nests trees. One subadult was located in five different trees and reached a maximum straight line distance from its natal nest of 340 meters. Red tree voles freely moved between nest trees having isolated independent canopies, crossed small forest roads, streams, or large canopy gaps while traveling between nest sites; which required movement on the ground.

DISTRIBUTION AND HABITAT RELATIONSHIPS OF AMPHIBIANS ON A PRIVATE MANAGED FOREST IN THE WESTERN WASHINGTON CASCADES. Thomas Bosakowski, Beak Environmental Consultants, 12931 N.E. 126th Place, Kirkland, WA 98034.

Surveys were conducted as part of a monitoring plan for a multi-species Habitat Conservation Plan for the 54,000-acre Mineral Tree Farm, in Lewis County, Washington. The purpose of the surveys was to determine the presence, relative abundance, and distribution of amphibians on the managed forest landscape. A total of 20 streams, 14 wetlands, and three talus slopes (uplands) were surveyed in the spring of 1995 using 1-hour time-constrained searches (visual encounter surveys) with a 3-person team. A total of 11 species of amphibians were detected on the tree farm. Stream obligates (including riparian zone) were: tailed frog *(Ascaphus truei)*, Cascades torrent salamander (*Rhyacotriton cascadae*), and Pacific giant salamander (*Dicamptodon tenebrosus*). Van Dyke's salamander *(Plethodon vandykei)* occurred primarily along streams, and once in the uplands. The northwestern salamander (*Ambystoma gracile*) was a wetland obligate and egg masses were found in all wetlands sampled. The rough-skinned newt (*Taricha granulosa*) occurred primarily in wetlands and once in a stream. Cascades frog *(Rana cascadae)* occurred primarily in wetlands, occasionally near streams, and once on a talus slope. Northern red-legged frog *(Rana aurora)* occurred more often along streams and occasionally in wetlands. The Pacific chorus frog (*Pseudacris regilla*) occurred in most wetlands and two streams. Western red-backed salamander (*Plethodon vehiculum*) occurred along streams and uplands. Ensatinas (*Ensatina eschscholtzii*) occurred in uplands only. A GIS analysis of forest habitat types was run for a 200-m radius around survey points and then a multiple regression analysis was conducted to determine forest-habitat associations for each species.

DISTRIBUTION AND HABITAT RELATIONSHIPS OF BREEDING BIRDS ON A PRIVATE MANAGED FOREST IN THE WESTERN WASHINGTON CASCADES. Thomas Bosakowski, Beak Environmental Consultants, 12931 N.E. 126th Place, Kirkland, WA 98034.

Surveys were conducted as part of a monitoring plan for a multi-species Habitat Conservation Plan for the 54,000-acre Mineral Tree Farm, in Lewis County, Washington. The purpose of the surveys was to determine the presence, relative abundance, habitat selection, and distribution of breeding birds on the managed forest landscape. A total of 284 point counts (8 min duration) were established along unpaved logging roads separated by a minimum distance of 240 m. The counts were performed twice, at least 10 days apart. A total of 70 species of breeding birds were detected at point count stations during the survey. At least 14 species were detected on only one of the counts, thereby showing the value of replicating counts. Site occupancy determined from the two counts was significantly different for 17 bird species when classified as wetland, riparian, or upland. Wetland occupancy was highest for 10 species with significant differences and upland occupancy was highest for 7 species with significant differences. The remaining 23 species that were tested had distributions that were not significant from the distribution of sampled topographic types. A GIS analysis of forest habitat types was run for a 100-m radius around survey points and then a multiple regression analysis was conducted to determine forest-habitat associations for each species.

INTEGRATING ASSOCIATIONS BETWEEN CASCADE FROG (*Rana cascadae*) POPULATION AND HABITAT STRUCTURE ACROSS SPATIAL SCALES. Cathy Brown, Dede Olson, and G.A. Bradshaw. PNW Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331.

Relationships between habitat and population structure of the patchily distributed montane frog, *Rana cascadae*, are examined at multiple spatial scales. Population dynamics and the stability of regional populations may be controlled by habitat structure at the watershed scale, whereas stability or refuge potential of local populations can be determined by factors associated with the site itself. Potential breeding sites within three watersheds in the central Cascade Range, Oregon, were identified from aerial photos and verified in the field. Sites were surveyed for eggs, tadpoles, and adults to assess occupancy. The density and distribution of suitable breeding sites, general topography between sites, and distribution of connecting creeks were measured to reflect habitat structure at the watershed scale. The accumulation and duration of ponded water were measured at each site to reflect site specific habitat quality. Relationships among habitat structure at the watershed scale, site quality, and site occupancy were found. This study provides insights for conservation strategies such as the importance of maintaining linkages among populations, identification of potential corridors, and the importance of "source" populations.

LITTLE KNOWN ROOST TYPES OF THREE SPECIES OF BATS IN SOUTHERN OREGON.
David R. Clayton, Rogue River National Forest, and Stephen P. Cross, Southern Oregon State College.

Radio-telemetry studies since 1992 have documented the use of previously unknown and undescribed roost types by three species of bats in southern Oregon. Two species, *Antrozous pallidus* and *Myotis thysanodes*, have been found roosting in large, decadent, conifer snags that are associated with ridge and edge habitat. As a result of these findings, guidelines specific to management of snag roost habitat have been incorporated into new projects, including ridge-top fuel breaks and timber sales, on the Applegate Ranger District. *Plecotus townsendii* has been found consistently using relatively small cavities in large boulder fields, in addition to caves and cave-like structures. This type of habitat needs to considered in the management of this species and should be afforded the same type of protection as caves and mines.

MONITORING AMPHIBIANS: CAN WE GET THE ANSWERS TO THE QUESTIONS WE ASK?
Paul Stephen Corn, Midcontinent Ecological Science Center, 4512 McMurry Avenue, Fort Collins, CO 80525-3400.

Distribution and abundance of many species of amphibians have declined in western North America. Management of these species and species that haven't declined requires knowledge of future changes in abundance and distribution. However, designing an effective program for monitoring trends in amphibian populations is not a simple task. Data on abundance are costly to obtain. Common types of abundance data include capture-recapture population estimates or counts of animals observed, and obtained these data requires intensive use of well-trained personnel. Also, many species display large annual variation in abundance, so estimates of abundance have low statistical power for detecting trends. The North American Amphibian Monitoring Program (NAAMP) is an attempt to apply less intensive methods over large geographic areas to collect data analogous to the North American Breeding Bird Survey. The technique proposed for monitoring pond-breeding species uses road-based nocturnal surveys of breeding sites. Implementation of NAAMP in western North America faces formidable obstacles, because many species do not have audible vocalizations, and roads and wetlands are relatively scarce. Amphibian monitoring in western North America may need to focus on selected species rather than a comprehensive program.

A COMPARISON OF AMPHIBIANS AND HABITAT FEATURES IN LATE-SUCCESSIONAL AND VOLCANICALLY IMPACTED STREAMS NEAR MOUNT ST. HELENS, WASHINGTON, USA. Charles M. Crisafulli, Mount St. Helens National Volcanic Monument, and Charles P. Hawkins, Utah State University.

A number of studies have suggested that anthropogenic disturbances (e.g., clearcut logging) results in population declines and poses deliterious threats to stream-dwelling amphibians in the Pacific Northwest. However, the responses of these organisms to large-scale natural disturbance (e.g., wildfire, volcanism) is largely unknown. During August 1994 we surveyed a total of 40 streams, 19 in forests severely impacted by the 1980 eruption of Mount St. Helens and 21 in undisturbed, late-successional forests. For each stream, we estimated amphibian species presence and density, and quantified a variety of physical and biological factors thought to be important to stream amphibians. A MANOVA of physical and biological factors verse land condition showed that streams in the volcanic landscape had lower shade, higher maximum temperature, greater algal abundance and higher substate embededness than streams in undisturbed forests. Although composition of amphibian species did not differ between volcanically impacted and undisturbed streams, densities of different species and lifeforms did. Densities of adult tailed frogs and larval giant salamanders were greater in the undisturbed streams, whereas, tailed frog tadpoles were more abundant in the volcanically impacted streams. Our data suggest that the impacts and habitat alteration created by the 1980 eruption has had only modest long-lasting effects on stream-dwelling amphibians and that populations of tailed frogs and giant salamanders can either tolerate or quickly recover from extreme perturbation.

INVENTORY AND MONITORING OF BATS. Stephen P. Cross, Southern Oregon State College.

Various techniques are available to inventory and monitor bat populations and suitability depends on the specific project objectives. The most widely used methods involve capture using mist nets or harp traps. Hoop nets may also be used in certain environments and circumstances. Some species may be visually assessed at their roost sites, sometimes with photographic aids. There is potential for using ultrasonic ("bat") detectors to determine presence of some species and possibly to derive an index of activity levels. Proper timing, both temporal and seasonal, is very important for application of all these methods. Determining adequacy of sampling necessary to establish species presence and abundance needs further attention.

AMPHIBIAN DISTRIBUTION IN CENTRAL AND SOUTHEAST OREGON. Jim David, Rick Demmer, Lisa Hatley and Cinthia Tait.

Distribution and occurrence of amphibian species throughout Central and Southeast Oregon has not been well understood or documented. Recent work by the USDA Forest Service and Bureau of Land Management along with private cooperators has expanded the database considerably. Much more work remains to be done however. This presentation will present field survey data on distribution and occurrence along with general conclusions and hypotheses.

RELATIVE ABUNDANCE AND DYNAMICS OF RED TREE VOLE (*ARBORIMUS LONGICAUDUS*) NESTS IN MANAGED FORESTS OF THE REDWOOD REGION. Lowell V. Diller, and Joel L. Thompson, Simpson Timber Company, Korbel, CA 95550.

Randomly selected Douglas-fir stands ranging in age from 10 -103 years were searched for red tree vole (*Arborimus* longicaudus) nests using a line transect approach. One hundred and eighty-five nests were found in stands beginning at age 23. Density estimates of nests increased from 2.7 nests/ha in 20-29 year old stands to 6.5 in 60+ year old stands, although the relationship was not statistically significant. Nests were found in trees from 3.1 to 51.8 inches dbh in eight different tree species and on the ground, but 80.5% of the nests were located in Douglas-firs. We also report preliminary data from an ongoing study to monitor the status of nests over time in different aged young growth stands. Ten one-hectare plots were established in forest stands (two per age class) within the following age classes: 20-29 yrs, 30-39 yrs, 40-49 yrs, 50-59 yrs and 60-80 yrs. The total number and status of each nest was recorded at intervals of 4-5 months for a total of four checks to date. The maximum number of nests per plot ranged from 10 to 23 with a mean of 15.1. However, on the average, only 55.0% of the nests were active at any given check. In general, variation was high for all variables among all plots, and there were few significant trends with stand age.

INVENTORY AND MONITORING OF REPTILES. David J. Germano, California State University, Bakersfield.

In the forested habitats of the Pacific Northwest occur 2 native species of turtles, 5 species of lizards, and 12 species of snakes. Turtles can be monitored by counting individuals along appropriate habitat as they bask, diving in ponds and streams catching individuals in refuge sites, and by setting baited traps. Lizards can be censused by counting lizards during timed searches of appropriate habitat, catching and marking individuals on a grid, and by using drift fences and pit-fall traps. Snakes are relatively rare and secretive, and censusing species in this group can be done by searches along stream courses for garter snakes, suing drift fences and funnel and pit-fall traps for more terrestrial species, or by directed searches of refuge habitat (rocks, logs, etc.). I present some of the types of data that can be collected from reptiles during long-term studies of populations.

ANNUAL CYCLES OF REPRODUCTION IN THE BROWN TREE SNAKE, *BOIGA IRREGULARIS*. Michael J. Greene, Chance Macdonald and Robert T. Mason, Department of Zoology, Oregon State University, Corvallis, Oregon, 97331.

The brown tree snake (*Boiga irregularis*) is an introduced species of great concern to biologists because of the ecological and economic disaster it is causing on the Pacific island of Guam. This threat to Pacific island fauna is responsible for the extirpation of 10 native forest birds on Guam and has adversely affected many of the island's other species, including the endangered Mariana fruit bat. Individual brown tree snakes have been found on other Pacific islands including Maui, Wake and Okinawa. Of particular importance in studying the population dynamics of the brown tree snake on Guam is an investigation of the reproductive biology of this species. Using a total of 228 female and 115 male specimens collected monthly over a two year period, we investigated the annual reproductive cycle of the brown tree snake on Guam. Steroid hormone concentrations were measured and correlated with morphological and histological measurements from the gonads of both sexes allowing us to make an estimation of the brown tree snake's reproductive cycle on Guam.

PATTERNS OF BIRD AND AMPHIBIAN ABUNDANCE IN RIPARIAN BUFFERS ALONG HEADWATER STREAMS IN THE OREGON COAST RANGES. Joan C. Hagar and David G. Vesely, Department of Forest Science, Oregon State University.

We surveyed amphibians along 17 headwater streams with riparian buffers and 12 similar uncut streams, and bird communities in a subset of these same sites (12 buffered and 4 uncut streams). Amphibians were surveyed with time-constrained searches on 20- x 40-m quadrats in the spring and fall 1994 and spring 1995. Birds were surveyed along line-transects in May and June 1994. We compared the abundance of selected bird and amphibian species, bird species richness, amphibian species richness and diversity, total bird abundance, and total amphibian abundance between sites with riparian buffers and uncut sites, and among 3 riparian buffer width classes. The abundance of 5 bird species was greater in uncut sites compared to buffers and/or positively associated with buffer width. Bird species richness and the abundance of 7 bird species was greater in buffered sites compared to uncut sites. Total amphibian density and amphibian species richness were greater in uncut sites than in buffers, and were positively associated with buffer width. The density of 4 amphibian species was greater in uncut sites than buffers and/or was positively associated with buffer width. No amphibian species had higher density in buffers than uncut sites, and none were negatively associated with buffer width. We conclude that headwater riparian habitat may be more limiting for amphibians than for birds as a group, and that therefore managers should focus on the habitat requirements of amphibians when developing management plans for these areas.

COMPARATIVE DISTRIBUTIONS OF DUNN'S SALAMANDERS, *PLETHODON DUNNI*, AND LARCH MOUNTAIN SALAMANDERS, *PLETHODON LARSELLI*, IN RELATION TO CERTAIN HABITAT CHARACTERISTICS IN THE COLUMBIA RIVER GORGE, OREGON. William Hall, Mimi Matsuda, and Keith Robillard, Department of Biology, Portland State University

Dunn's salamanders (*Plethodon dunni*) and Larch Mountain salamanders (*Plethodon larselli*) are sympatric on the Oregon side of the Columbia River Gorge. Both occupy the same general habitat, however Dunn's salamanders are often found in wetter sites while Larch Mountain salamanders are typically associated with drier areas. We attempted to corroborate these observations by sampling four areas where both species have been known to occur. We searched for salamanders under rocks in areas of their known ranges. Salamanders were caught by hand, measured, photographed, and returned to their cover. Habitat characteristics including slope, aspect, elevation, canopy cover, substrate, and vegetation were recorded. Our data show that Dunn's salamanders occurred 8 to 14 times more often than Larch Mountain salamanders in areas with more extensive canopy cover. Larch Mountain salamanders were three times greater in abundance in drier and less vegetated areas. We found that slope, aspect, and elevation had no significant effect on relative abundance of these two salamanders.

ESTIMATES OF ADULT TAILED FROG POPULATION SIZE IN THREE SMALL WATERSHEDS NEAR MOUNT ST. HELENS. Charles P. Hawkins, Utah State University, and Charles M. Crisafulli, Mount St. Helens National Volcanic Monument.

Several studies have quantified the abundance of tailed frog tadpoles in streams of the Pacific Northwest, but no estimates exist of the number of adults occurring within entire watersheds. We estimate adult population size during August of 1994 in three watersheds draining into Clearwater Creek, WA: a basin largely covered by stands of old-growth forest (F1), a basin whose forest in the lower part of the basin was blown down by the the 1980 eruption of Mount St. Helens (HWF3), and a basin (NF2) in which the forest was completely blown down. We used estimates of (1) area of riffles and pools in each stream, (2) densities of 0+ age tadpoles in each habitat type, and (3) fecundity of female frogs to estimate the number of adult frogs in each basin. We estimate these basins contained 38,176 (F1), 112,901 (HWF3), and 16,225 (NF2) 0+ tadpoles. If female frogs produce 55 eggs each year, the numbers of females needed to produce the estimated number of tadpoles were 694 (F1), 2,053 (HWF3), and 295 (NF2). If females reproduce every 2 years, these estimates would need to doubled. If the sex ratio is 50:50, the minimum number of adult tailed frogs in these basins would be 1,388 - 2,776 (F1), 4,106 - 8,210 (HWF3), and 590 - 1,180 (NF2).

OSPREY POPULATION INCREASE ALONG THE WILLAMETTE RIVER, OREGON, AND THE ROLE OF UTILITY STRUCTURES, 1976-93. Charles J. Henny and James L. Kaiser, National Biological Service.

The population of ospreys nesting along the Willamette and lower Santiam Rivers in western Oregon increased from an estimated 13 pairs in 1976 to 78 pairs in 1993. The number nesting on trees (live and dead) was similar in 1976 (13 pairs) and in 1993 (12 pairs). Ospreys were first observed nesting on utility structures (poles and towers) in 1977, and that nesting segment increased at a rapid rate (from 1 pair in 1977 to 66 pairs in 1993). A logistic growth curve was fitted to the data and, assuming that the logistic growth curve was correct, the osprey population nesting on utility structures was estimated to stabilize at 86 pairs in 2004; however, the population data fitted the exponential growth curve nearly as well. Ospreys in 1993 were producing young at about twice the rate necessary to maintain a stable population. Improved water conditions and fish numbers in the Willamette River, a new enlightened attitude toward birds of prey which resulted in less shooting, and the osprey's release from DDT-related reproductive problems after the 1972 DDT ban probably contributed to the population increase. The first osprey that nested on a utility pole in the study area may have been produced on a man-made nesting platform established in 1973 at Crane Prairie Reservoir. A shortage of tree nest sites along the Willamette River may have limited the osprey nesting population in earlier years, but the seemingly learned response to nest on utility structures has resulted in nest sites being almost unlimited now.

GROWTH OF AN INCIPIENT NORTHERN ELEPHANT SEA POPULATION NEAR PT. PIEDRAS BLANCAS, CALIFORNIA. Ronald J. Jameson and Brian B. Hatfield, National Biological Service.

The Pt. Piedras Blancas Research Station (PB) of the National Biological Service was established in central California in 1978, and infrequent occurrences of northern elephant seals (NES) were recorded at the station until 1990. In fall 1990, 174 NES were counted at PB; the following spring 380 were counted. In 1992, 1 pup was born. In 1995, 605 pups were born and the spring count had increased to >3800 NES. These growth rates are beyond any documented for NES colonies in North America. In 1990 the population occupied a small cove at PB where access was restricted because it was on Federal property. By 1995 NES haulouts were distributed from 0.5 km north of PB to 1.5 km south. Most haulouts are easily accessed from California Highway 1 resulting in unprecedented public access to the seals and, for the seals, access to the highway. Consequently, a dangerous situation has developed for both seals and humans. NES show little fear of humans and appear passive. This leads many people to a false sense of security. Some approach to < 1 meter and occasionally touch or attempt to touch the seals. One human injury has already been documented and one NES was removed from the highway. If a workable management strategy isn't developed to protect both NES and humans, this dangerous situation can only worsen.

ENDEMIC FAUNA OF THE OWYHEEAN ISLANDS OFF THE COAST OF IDAHO. II. NO NEW DATA. Lawrence L.L.L.C. Jones, Janet L.L. Jones, Uncle Nardly, J. Jay, the Professor and Mary Anne. Instituto de Bunko Historico Naturale, 666 Snorkybork Lane, Wallawalla University for the Conceptually Challenged, Tumwawa, WA.

Once again our team of experts sailed into the turbid, frigid, and otherwise nasty waters of the Palousian Sea in search of the bizarre and hideous organisms of the Owyheean Aisles. For 10 long days and 14 grueling nights (and we hate gruel) we searched for the infernal archipelago. But despite the courage of the fearless crew, we got lost and never found the aisles. So we went home and hopped on a plane bound for Rio to bask in our well deserved efforts. But that didn't stop us from writing yet another ecological monograph (*Northwest Fauna* # 666) on the extra year's worth of non-data. [In fact, next year, we may not even look for the archipelago--we'll just stay home, watch some futbol, and change a few numbers for yet another publication.] The most important finding this year is that we have again found an opportunity to show our now-yellowing poster from last year, thereby saving taxpayers the money of preparing another worthless poster. So, once again, you can see those Nasty Tooth-cows, the tiny, yet prolific Dear Mouse (*Promiscuous manipulatus*), and all the other foul, malignant critters.

DOCUMENTING MARTEN BEHAVIOR AT MATERNAL DENS WITH REMOTELY ACTIVATED CAMERAS. Lawrence L. C. Jones, Martin G. Raphael, J. Todd Forbes, and Laurie A. Clark, Pacific Northwest Research Station, 3625 93rd Ave. SW, Olympia, Washington 98512.

Maternal dens are critical elements of marten habitat, but they have received little attention in published works. The behavior of martens at den sites is virtually unknown. Since 1993, we have monitored maternal dens using 35-mm and video cameras activated by infrared sensors. One or more martens were documented in 738 photographs or video events. Activity peaks occurred during morning and late afternoon. Although parturition occurs in late April or early May, kits did not appear outside the entrance until early July. Adult males were photographed at dens on numerous occasions. Because of extensive scent-marking and their sexual characters, we suspect they were there to copulate with the adult female. Specific behavioral traits included kit transfer (to other dens); scent-marking; grooming; play; and prey capture, transfer (female to kit), and consumption. Although cameras triggered with infrared sensors are somewhat problematic due to frequent false activation, we found them to be effective for recording many behavioral characteristics that would be difficult to document otherwise. Video cameras were superior to 35-mm cameras for monitoring dens. (Presented as oral and poster presentations)

FACTORS INFLUENCING PATHOGENIC INFECTION OF AMPHIBIAN EMBRYOS. Joseph M. Kiesecker, and Andrew R. Blaustein; Oregon State University, Corvallis, OR 97331 USA.

Although there is great potential for pathogens causing amphibian population reductions, pathogens have been largely neglected and not carefully documented in this regard. Indeed, mass mortality of developing amphibian eggs and larvae from pathogenic infection has been documented in several populations. Continued mortality in early life history stages may ultimately contribute to a population decline. Recently, a pathogenic fungus *Saprolegnia ferax*, has been linked with amphibian embryo mortality in the Pacific Northwest. In this paper, we document the prevalence of *S. ferax* on the embryos of several species of amphibians. The results of field experiments showed that egg survival was affected by distance to the center of a communal egg mass. Moreover, eggs laid earlier were infected with less frequency than eggs laid later. We also discuss other factors that may influence infection of embryos with *S. ferax*.

AMPHIBIAN COMMUNITIES IN INTERMITTENT, HEADWATER STREAMS IN YOUNG AND OLD-GROWTH FOREST STANDS. Yu Man Lee and Michael W. Collopy, National Biological Service and Oregon State University.

Amphibians can function as the dominant predator and prey in small, perennial, headwater streams. Few studies have focused on intermittent, headwater streams as amphibian habitat. The objectives of this study were to document and to compare amphibian communities in intermittent, headwater streams in young and old-growth forest stands during wet and dry seasons. The study area was located in the west central Oregon Cascades. A total of 16 streams, 10 in old-growth and 6 in young forest stands, were selected in 1994. Streams were sampled during late spring and summer of 1995 using a habitat-based, area-constrained protocol. Amphibian communities were dominated by 3 species, the Cascade torrent salamander (*Rhyacotriton cascadae*), Dunn's salamander (*Plethodon dunni*), and Pacific giant salamander (*Dicamptodon tenebrosus*). Species richness ranged from 0-2 species in any young forest stand (3 species total) and 0-5 species (8 species total) in old-growth stands. Dunn's salamander was the dominant species in intermittent streams in young forest stands. Cascade torrent salamander was dominant in streams in old-growth stands. Intermittent, headwater streams can provide habitat for a diversity of amphibian species during wet and dry seasons. Amphibian communities in intermittent streams in old-growth stands appear to differ in overall species composition and to have greater species richness than those in young forest stands; however, amphibian density does not appear to differ by stand type.

TEMPERATURE EFFECTS ON THE GROWTH AND DEVELOPMENT OF NEONATAL RED-SPOTTED GARTER SNAKES, *THAMNOPHIS SIRTALIS CONCINNUS*. Darren T. Lerner, Jennifer L. Penn, Ignacio T. Moore, and Robert T. Mason. Department of Zoology, Oregon State University.

The red-spotted garter snake, *Thamnophis sirtalis concinnus*, is found in varying environments from the Coastal Range to the Cascade Range of Oregon including the Willamette Valley, thus exposing individuals of this species to a variety of temperature extremes during the course of a year. We examined the effects of distinct temperature regimes on the growth and development of neonatal *T. s. concinnus* by exposing two groups of conspecific neonates to simulated winter climate extremes. In June 1995, twelve gravid females were collected in the field and housed in the laboratory (12L:12D at 17°C). In September, 200 newborns were randomly assigned to groups, housed under identical conditions (12L:12D at 17°C), and fed *ad lib.* Body mass and snout-vent length were recorded at weekly intervals from birth until December. Thereafter, surviving neonates were divided into two groups and measured bi-weekly. One half of the population was maintained at the original regime thereby simulating the "warm" condition, while the other half was subjected to a "cold" condition (0L:24D at 5°C) and denied food. The effects of these simulated environmental conditions on the differential growth rate of neonates will be addressed.

WASHINGTON HERP ATLAS PROJECT. Kelly R. McAllister, Washington Department of Fish and Wildlife.

The Washington Department of Fish and Wildlife and The Washington State Gap Analysis Project combined resources to produce a Geographic Information System's layer of distributional data for Washington's reptiles and amphibians. Museum specimen records, published records, recent inventory data and records from unpublished reports were entered to computer and merged with coordinates derived from digitized map locations. The resulting data base is maintained as an ASCII file. Hard copy reports are produced using SAS software. Files in ASCII format are also imported to ARC/INFO for producing maps or attaching new attributes such as township, range, and section, elevation, map quadrangle code, or land ownership.

MATE CHOICE IN THE RED-SIDED GARTER SNAKE, *THAMNOPHIS SIRTALIS PARIETALIS*.
Ignacio T. Moore, Michael J. Greene, and Robert T. Mason, Oregon State University.

During reproductive activity, females choose those males whose genetic contribution to the offspring will optimize their fitness. Female mate choice has never been previously demonstrated in the unique mating system of the red-sided garter snake, *Thamnophis sirtalis parietalis*. The red-sided garter snake is the most northerly living reptile in the western hemisphere and aggregations of up to 20,000 individuals will over-winter in individual hibernacula in Manitoba, Canada. Mating is characterized by a single female being courted by between 10 and 100 males in what is known as a mating ball. Eventually the female will mate with only one of these males. We randomly surveyed 900 males from the population and the participants in 450 matings. Those males that succeeded in mating in these highly competitive mating balls were longer in snout-vent length (1.006 cm, T-test, $p<0.001$) and of lower body mass (2.23 g, T-test, $p<0.001$) than the average male in the population. These results and their implications on mate choice in this species will be discussed.

CHAOS, ENTROPY, AND EXAPTATIONS: CIRCUMSTANCES WHEN THE NULL HYPOTHESES PERTAIN IN ENVIRONMENTAL BIOLOGY. David J. Morafka, Department of Biology, California State University, Dominquez Hills, 1000 E. Victoria St., Carson, CA 90747-0005.

Scientists have traditionally sought to establish linear and causal relationships which reveal profound principles governing the living world, from subcellular physiology to ecosystems. Increasingly, empirical evidence shows a biological universe which is much more difficult to model and predict, one based on chaos, entropy, the neutral gene hypothesis, and exaptations.

Here, I will review evolutionary and ecological case studies where chaos, rather than cause, better explains the observations of the biologist. First among these are the roles of "bet hedging" and exaptation in explaining desert tortoise (*Gopherus agassizii*) life history strategies and morphological character states, respectively. Whether speciation is adaptive or accidental will be explored in lizard and salamander taxa. Co-evolution and succession will be critically evaluated as effective predictors of ecosystem responses.

A biological world influenced strongly by accident, coincidence, and opportunism -- in the traditions of Kimua, Gould, and Brooks -- will be discussed in terms of the needs and goals of modern field biologists.

A SURVEY OF POND BREEDING AMPHIBIANS IN OLYMPIC NATIONAL PARK. Richard S. Nauman, USDA Forest Service, Winema National Forest, Klamath Falls, OR 97601.

Visual encounter surveys were conducted at 21 lakes in Olympic National Park. Sites ranged in elevation from 945 to 1744 meters. Five species of amphibian were detected. Cascade frog (*Rana cascadae*) and Northwestern salamander (*Ambystoma gracile*) were encountered most frequently. No Western toads (*Bufo boreas*) were found. Nine of the sites having depths >2 meters and areas >0.4 hectares were large and deep enough to support fish populations. Introduced fish, primarily Brook trout (*Salvelinus fontinalis*), were observed at five of the nine sites. The average number of amphibian species was lower in lakes with fish than in lakes without fish. Only one lake with fish lacked amphibians. Amphibians were often observed breeding in wet meadow potholes adjacent to fishless lakes in which little or no amphibian breeding activity was observed. Visual encounter surveys were effective for inventorying common, easily detected species but may have missed rare or cryptic species especially in habitats with deep sediment or thick vegetation.

DISPERSAL OF THE GRAY-TAILED VOLE, *MICROTUS CANICAUDUS*, IN PATCHY ENVIRONMENTS. Natasha Nelson, Oregon State University.

We monitored population parameters of gray-tailed voles, *Microtus canicaudus,* residing in patchy versus continuous habitats to estimate the effects of isolation and patch size on dispersal. The experiment was conducted in 16 0.2-ha enclosures planted with alfalfa. We tested the hypotheses that dispersal rates, survivorship, and reproductive rates of females would be higher in the control enclosures (1850 m^2) than three treatment enclosures that had been reduced in size and fragmented into a single large patch (625 m^2), 25 evenly-spaced small-sized patches (each 25 m^2) separated by 4-m of bare ground, 4 evenly-spaced medium-sized patches (each 156 m^2) separated by 12.5m of bare ground. In May 1995, 8 males and 8 females were introduced to the 4-patch enclosures, and 5 males and 8 females were introduced into the other treatments. We found dispersal rates in the 4-patch enclosures were one-fourth the amount in 25-patch enclosures and control animals dispersed farther than single patch animals. We found no treatment effect on time to sexual maturity or number of recruits per female. Overall, longevity was higher for dispersers versus residents. Dispersal was not sex-biased. Males dispersed at the same age and weight, and an equal distance as females, but matured faster. Large barriers resulted in a low dispersal rates with little reproductive consequences, while small-barriers resulted in high levels of dispersal, but lower survivorship which could change the social structure of voles.

ROLE OF PACIFIC GIANT SALAMANDER LARVAE IN HEADWATER STREAM BENTHIC COMMUNITIES. Michael S. Parker, Department of Biology, Southern Oregon State College.

Larvae of the Pacific Giant Salamander (*Dicamptodon tenebrosus*) are commonly the most abundant vertebrate predator in perennial, headwater streams of the Pacific Northwest. Previous studies of larval *Dicamptodon* food habits and feeding behavior showed them to be selective predators with regard to both prey type and prey size, and that their rate of prey consumption could result in significant reductions of some prey populations. To examine effects of larval salamanders on the benthic community, I conducted a field experiment by dividing three 10-m stream reaches with an impermeable plastic barrier and removing salamanders from one side while maintaining ambient densities in the other. Ends of the reaches were blocked with plastic screening impermeable to larval salamanders but transparent to the movement of benthic invertebrates. I monitored densities of invertebrates over a 3-month period. Predation by larval salamanders resulted in (1) a significant reduction in total benthic invertebrate biomass, (2) significant reductions in densities and mean sizes of large, predatory invertebrates, (3) decreased densities of common mayfly taxa, and (4) indirect positive responses in densities of small taxa (*Baetis* and chironomidae) that were the primary prey of predatory invertebrates. Results of this experiment clearly show that larval salamanders can play an important role, as top-predator, in stream communities.

THE EFFECTS OF HABITAT MODIFICATIONS ON A SPOTTED FROG POPULATION IN YELLOWSTONE NATIONAL PARK. Debra A. Patla and Charles R. Peterson, Idaho State University.

Many species of amphibians are undergoing apparent population declines. An understanding of how human disturbances affect amphibian populations is critical for their conservation. The goal of this project is to determine how specific habitat modifications may have contributed to local changes in the abundance and distribution of Spotted Frogs (*Rana pretiosa*). We compared the results of a baseline ecological study (1953-1955) with a similar study (1991-1995) of a frog population in Yellowstone National Park. Using capture-recapture records from both studies and radiotelemetry data from the later study, we investigated changes in the population's demographic characteristics, habitat use, and movement patterns. Population size in the study area has declined by about 75% since the 1950s, while the abundance of Spotted Frogs in an adjacent area has not declined. This, plus other factors, suggests that local habitat changes are responsible for the decline. Construction of a major Park highway in the 1970s bisected the study area, separating breeding pools and foraging areas from the main section of the area's only permanent stream. The frog population of the current study area exhibits changes in proportional distribution among various habitat features and changes in movement patterns that may reflect habitat loss and fragmentation resulting from road construction. Other factors contributing to the decline may include increased mortality of frogs attempting to cross the road and the downstream effects of water development projects.

THE MONITORING OF BIRDS: FACTS AND FANCIES. C. John Ralph, USDA Forest Service, Redwood Sciences Laboratory, Arcata, CA.

The monitoring of most landbirds involves the objectives of providing estimates of four parameters: population size, population trends, demographic parameters, and a link of habitat with the above bird measurements. The problems of scale, and the advantages and disadvantages of using birds over other taxa will be discussed. Most agency objectives involve an interest in the effects of their management activities, but a reality check indicates we can not monitor all the parameters, nor even come close to monitoring all taxa. Additionally, statistical limitations indicate very high costs for answering many questions that personnel commonly think are feasible, and many people question that the agencies really care about 'legal mandates'. We have arrived at standardized methods for census and demographic measures, and the vagaries of these processes will be revealed. The case studies of the Marbled Murrelet, Willow Flycatcher, and landbirds in general will be illustrated with cautionary notes about what we really have learned and what the outlook is.

STATUS OF THE FERRUGINOUS HAWK IN WASHINGTON. Scott Richardson and Ann Potter, Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia 98501.

The Ferruginous Hawk, listed as State Threatened since 1983, breeds in shrubsteppe and grassland regions of several eastern Washington counties. The state population was estimated at 20 breeding pairs in 1977, but 33 pairs were found in 1981, 64 in 1987, and 63 in 1995. The proportion of occupied territories with at least one chick was 72% in 1992, 82% in 1993, and 87% in 1994. At least 88, 87, and 92 chicks hatched in 1992, 1993, and 1994. The number of pairs at the Hanford Site has increased since the 1970's, while other areas support fewer pairs. Apparent shifts in distribution may be related to construction of artificial nest supports, changes in prey availability, and landscape alterations (e.g., shrubsteppe conversion, human developments). We present pertinent data on Washington's Ferruginous Hawks, including preliminary results from a statewide prey study and a distributional map showing nesting activity and nest structures. We also describe past and present survey methods and their effects on the completeness and accuracy of our database. A state recovery plan becomes available in the spring. The species will be considered for downlisting when Washington supports a 5-year average of at least 60 breeding pairs, distributed to reflect probable historic conditions, and with average productivity of at least 1.5 young per breeding pair per year.

GROWTH AND AGE IN ALBERTA LONG-TOED SALAMANDERS (*AMBYSTOMA MACRODACTYLUM KRAUSEI*). Anthony P. Russell, G. Lawrence Powell, and Dean R. Hall, University of Calgary.

Both skeletochronology and a somatic growth model based upon mark-recapture data were used to estimate lifespan and the relationship between size and age in two populations of long-toed salamanders (*Ambystoma macrodactylum krausei*) in the upper Bow Valley of southwestern Alberta. Skeletochronologically aged salamanders (n = 170) displayed a sigmoidal relationship between snout-vent length and age, with a great deal of variation in snout-vent length within each year class. The modified logistic-by-weight somatic growth model (based upon 47 recaptures) predicted sexual maturity at 3 years of age and adult size at 6 years, with asymptotic length approached at 15 years of age. These predictions were falsified by skeletochronology, which indicated that a snout-vent length characteristic of sexual maturity could be reached by 2 years and adult size by 3 years of age, and that the maximum lifespan attained was 10 years, with most individuals living 6 years at most. Considerable variation in growth is displayed among individuals in these populations, evidently due to factors other than simple age. Their demographic characteristics suggest that the skeletochronologically determined maximum age is real and not due to a cessation of growth, and thus of bone deposition, in these salamanders.

EFFECTS OF WILDFIRE ON BREEDING BIRD COMMUNITIES IN CONIFEROUS FORESTS OF NORTHEASTERN OREGON. Rex Sallabanks, Sustainable Ecosystems Institute.

Breeding bird communities were studied in 1995 in mixed conifer forests of northeastern Oregon, one year after the "Twin Lakes" fire burned approximately 22,000 acres on the Wallowa-Whitman National Forest. In general, the fire was found to cause small declines in overall avian abundance and species richness with these measures decreasing as the degree of burn increased. Two avian guilds (foliage feeders and overstory nesters) and five species (Golden-crowned Kinglet, Mountain Chickadee, Swainson's Thrush, Townsend's Warbler, and Varied Thrush) appeared to be negatively affected by the fire. However, one avian guild (aerial feeders) and two species (American Robin and Mountain Bluebird) were found to be positively correlated with degree of burn. Significant bird-habitat relationships were derived for 17 species of bird to identify the specific habitat variables that were correlated with a particular bird species' abundance. These functions helped explain why certain bird species responded as they did to the effects of the fire and provide forest managers with information on which habitat variables are important for which bird species. Snags, for example, accounted for 56% of the variation in the abundance of Mountain Bluebirds and therefore help to explain why this species was so common in heavily burned plots where snag densities were highest. Cavities and cavity-nesters did not differ among treatments, but they are expected to show stronger responses in subsequent years. Implications for management will be discussed.

WINTERING RAPTOR CENSUSES OF THE KITTITAS VALLEY, WASHINGTON, 1995 AND 1996. Nathaniel E. Seavy, 3645 Mud Bay Rd. #2, Olympia, WA, 98502; and Phil Mattocks, 915 East 3rd, Ellensburg, WA, 98926.

During 1995 and 1996 we organized and conducted wintering raptor censuses of the Kittitas Valley, Kittitas Co., Washington. The roads through the valley were divided into census routes, which could be surveyed by automobile in approximately 2 hrs. Censuses were conducted on 18 February of both years, with each route being censused by a team of birders (in 1996 poor turn-out required that teams census more than one route). We based methods upon those used by C.M. Anderson for wintering raptor censuses in the Skagit Valley. Estimates of densities were calculated by dividing the total number of individuals observed by the total area censused. In 1995 five routes were censused, covering approximately 160 km^2 on the northern side of the valley. Six species of raptors were observed in 1995. Red-tailed hawks (*Buteo jamaicensis*, density = .64/km^2)were the most abundant, followed by rough-legged hawks (*Buteo lagopus*, density = .27/km^2) and bald eagles (*Haliaeetus leucocephalus*, density = .27/km^2). . In 1996 only four routes were censused covering 140 km^2. Seven species were observed; bald eagles were the most abundant (density = .44/km^2), followed by red-tailed hawks (density = .2/km^2) and rough-legged hawks (density = .08/km^2). Similar to the Audubon Christmas Count, wintering raptor censuses encourage the involvement and education of people interested in monitoring bird populations, while providing valuable information on the distribution and composition of wintering raptor communities. Due to their defined focus, however, wintering raptor censuses appear to provide a more accurate tool for monitoring wintering raptor populations than the Christmas Bird Count.

MOVEMENTS AND DISTRIBUTION OF *ASCAPHUS TRUEI* ALONG TWO STREAMS IN THE WALLOWA MOUNTAINS OF OREGON. Matthew W. Snook, Southern Oregon State College.

This study is an attempt to document and compare the movements and distribution patterns among larval, juvenile, and adult tailed frogs. Previous efforts to document and compare the movements and distribution patterns among tailed frogs, using either capture/recapture techniques or artificial enclosures, have been inconclusive or concluded extreme philopatry in this species. In this study I surveyed two first order forest streams in the Wallowa Mountains (using a time constrained search) to determine the limits of longitudinal distribution of the population. Next, I constructed Pitfall Trap Arrays at regular intervals within these limits to determine movements of the terrestrial cohorts. For comparison between streams, I transformed the capture location of each individual into a "Stream Location Index" (SLI) with the frog furthest downstream assigned a value of 0 and the one furthest upstream a value of 100. The trap array design allowed me to determine upstream and downstream travel of individuals. Comparison of Stream Location Indices for all captures shows great overlap between Life History Cohorts but with larvae generally downstream of the adults. The trapping results indicate distinct upstream directional movement of the terrestrial classes. The different distribution and movement patterns suggest population coherence throughout the inhabited portion of stream. These findings suggest that the *continuity* and extent of tailed frog habitat will play a role in future conservation strategies for *Ascaphus truei.*

STATISTICAL CONSIDERATIONS FOR MONITORING VERTEBRATE POPULATIONS. Robert J. Steidl, Oregon Cooperative Wildlife Research Unit, Department of Fisheries and Wildlife, Oregon State University.

Designing a monitoring program (or any other research program) requires an investigator to make a series of interrelated decisions, ranging from which organism to study and where to study it, to which analytical methods to use for data analysis and interpretation. The quality and strength of a monitoring program rests squarely on these decisions. Understanding and addressing the statistical consequences of each of these decisions—within existing logistical and financial limitations—can guide this process and will yield monitoring strategies with greater statistical power (i.e., higher probability of detecting real changes in population parameters). The greatest gains in efficiency come during the design phase of a monitoring program; therefore, the principles of experimental and sampling design should be followed closely. Meeting a monitoring program's objectives requires: (1) defining the population of interest, and therefore, the appropriate scale of inference for results; (2) determining the response variable(s) of interest; (3) selecting an established, efficient method to measure changes in the response; (4) designing an efficient sampling framework using the tools of experimental and sampling design; (5) determining the necessary sample sizes; (6) choosing an appropriate statistical technique to analyze results; (7) evaluating and revising the monitoring strategy as appropriate. Careful design will also help researchers and decision-makers better understand the strengths, limitations, and inferences of monitoring programs.

TECHNIQUES FOR RADIO-TELEMETRY AND PIT-TAGGING OF SALAMANDERS. Angela B. Stringer, University of Washington, Seattle, and Keith B. Aubry, USFS, PNW Research Station, Olympia.

Details of terrestrial movement patterns and distribution of Pacific Northwest salamanders are poorly known. We are conducting research on movements and habitat use of adult Northwestern salamanders (*Ambystoma gracile*) using radio-telemetry and pit-tagging. Small radio-transmitters (15x9x4 mm) were surgically implanted into the peritoneal cavities of large (>25 g) salamanders. The salamanders were anaesthetized with a 0.5% solution of MS-222 and transmitters were inserted in a small incision on the side. The transmitters have a battery life of five months and a range of roughly 60 meters. The radio-transmitters will allow us to record daily and seasonal movement patterns including breeding migration. Pit-tags were implanted into Northwestern salamanders of all sizes using the same surgical procedure but with a smaller incision. The pit-tags will allow us to identify salamanders for capture-recapture studies in their terrestrial habitat and at breeding ponds.

MOVEMENT PATTERNS OF TERRESTRIAL ADULT NORTHWESTERN SALAMANDERS. Angela B. Stringer, University of Washington, Seattle, and Keith B. Aubry, USFS, PNW Research Station, Olympia.

Forest management practices may influence the quality of upland habitat and the accessibility of breeding ponds for pond-breeding salamanders in the Pacific Northwest. However, the details of terrestrial movement patterns and habitat use of salamanders are poorly known. We are conducting research on movements and habitat use of adult Northwestern Salamanders (*Ambystoma gracile*) using radio-telemetry. We are investigating both their migrations to and from breeding ponds and their non-breeding season activities. Northwestern Salamanders were captured in the fall (upland habitat) and in the spring (breeding pond) at two locations in mid-elevation Douglas-fir forest managed for timber production. Large (>25 g) salamanders were surgically implanted with radio-transmitters and rereleased at their respective capture points. After several days of initial post-release re-orientation, movement activities were characterized by a single long movement followed by an extended stay at a location point. Location points were never revisited. Movement directionality did not differ significantly from random except for those salamanders moving to or from a breeding pond. Movements tended to be temporally synchronous between salamanders and with weather changes. Approximately half of the location points were under sword ferns (*Polystichum munitum*). Other cover objects recorded were intact logs, intact stumps, decayed stumps, and slash. Salamanders movements within these location points were continuous and ranged from a few centimeters to 0.5 m depending on the cover object size.

COMPLEX INTERACTIONS BETWEEN STOCKED TROUT AND LARVAL SALAMANDERS (*AMBYSTOMA MACRODACTYLUM*) IN HIGH-ELEVATION LAKES. Torry Tyler, William Liss, and Robert Hoffman; Oregon State University.

The long-toed salamander (*Ambystoma macrodactylum*) is the top vertebrate predator in fishless high-elevation lakes in the North Cascades National Park Service Complex (NOCA) in northern Washington. The purpose of our research was to determine the effects of physico-chemical factors and stocked trout on abundance and behavior of larval *A. macrodactylum*. Trout are not native to high-elevation lakes in NOCA. Larval salamander density and behavior were assessed by snorkeling lake perimeters and carefully searching through substrate materials. In fishless lakes, larval salamander densities were positively related to Kjeldahl nitrogen concentration and negatively related to lake elevation. Kjeldahl nitrogen concentration was also positively related to crustacean and cladoceran zooplankton densities. Stomach content analysis indicated that crustacean zooplankton, especially cladocerans, were important food resources for larval *A. macrodactylum*, suggestion that increased zooplankton densities contributed to increased densities of *A. macrodactylum*. Larval salamander densities were significantly higher in fishless lakes than in lakes where reproducing trout reached high densities. There was no significant difference in larval densities between fishless lakes and lakes where fry were periodically stocked at low densities. In lakes with fish, a greater proportion of larvae were hidden in lake substrate material than in fishless lakes, presumably to escape predation. We conclude that lake nutrients, which influence zooplankton density, and high densities of trout affect larval salamander abundance and behavior in high-elevation NOCA lakes.

USE OF REMOTE VIDEO CAMERAS FOR DETECTING FISHERS AND OTHER FOREST CARNIVORES. Jeff von Kienast, Timothy J. Catton, Scott G. Armentrout, Fred E. Wahl, USDA Forest Service, Rogue River National Forest; and Keith B. Aubry, USDA Forest Service, Pacific Northwest Research Station.

During the winters of 1994 and 1995, we used video cameras to conduct surveys for fishers and other forest carnivores on the Butte Falls and Prospect Ranger Districts in southwestern Oregon. The remote video systems we used were manufactured by Compu-Tech of Bend, Oregon (model RM-680-21). The original KR-70 flood/spot lamp supplied with the cameras resulted in very low illumination at the edges of the image. To fully light the scene, we replaced this lamp with an automobile flood light attached to a tree near the bait. To increase the operating time for each unit, we used heavy duty deep-cycle 12-volt car batteries placed in polyurethane ice chests to insulate them and increase battery life. In 1994, we attempted to reduce the impact on target species by using red filters on the lights. Red light resulted in a significant loss of detail, however, which greatly limited our ability to identify individual animals. Consequently, in 1995, we replaced the red filters with clear glass. Although animals were often startled at first, they rapidly became adjusted to white light. With the exception of wolverine, river otter, and gray fox, all forest carnivores known to occur in the study area were detected with video cameras: cougar, bobcat, coyote, black bear, raccoon, ringtail, fisher, marten, spotted skunk, mink, long-tailed weasel, and ermine.

MANAGEMENT IMPLICATIONS DEVELOPED FROM BAT ACTIVITY SURVEYS EAST AND WEST OF THE CASCADE MOUNTAINS, OREGON. David L. Waldien, Oregon State University, Stephen P. Cross, Southern Oregon State College, and Anthony E. Kerwin, Pacific Northwest Museum of Natural History.

Simultaneous mist-net studies of eastside and westside Oregon Cascade pond sites in 1994 enabled us to compare activity patterns in the two areas. Westside sites yielded 348 individuals (eight species) while eastside sites produced 1475 individuals (10 species). Peak bat activity in both areas was 30-60 minutes after sunset. Observed bat activity patterns suggest that mist-net sampling from drinking sites is most efficient if conducted for three hours after sunset. Typically, most species were captured during the first two hours in both areas. However, westside sites had a resurgence of new species at three hours. Restricting length of surveys in some areas may limit opportunities to capture late arriving or rare species.

For both eastside and westside sites, time of capture patterns varied slightly inter-specifically, and were similar intra-specifically. A notable exception was *Lasionycteris noctivagans* (silver-haired bat) which peaked one hour earlier on the westside. All species of *Myotis* peaked at 30-60 minutes, while *Eptesicus fuscus* (the big brown bat), peaked at 90 minutes in both areas. Mist net results on the westside suggest that *Myotis yumanensis* (Yuma Myotis) and *Antrozous pallidus* (pallid bat) were rare in this area. However, nocturnal bridge surveys revealed that these species may be more abundant than mist netting results indicate.

EASTERN LONG-TOED SALAMANDER (*AMBYSTOMA MACRODACTYLUM COLUMBIANUM*) LARVAE RECOGNIZE CANNIBALISTIC CONSPECIFICS USING CHEMICAL CUES. Erica L. Wildy*, Douglas P. Chivers & Andrew R. Blaustein, Department of Zoology, Oregon State University, Corvallis, Oregon, USA

Intraspecific predation or cannibalism has been observed in numerous taxa. In amphibians it has been reported in at least 12 of 21 families of anurans, 7 of 9 families of salamanders and 1 family of caecilians. Specifically, cannibalism has been documented in a mountain population of larval eastern long-toed salamanders (*Ambystoma macrodactylum columbianum*). Some larvae exhibit an alternative cannibalistic morphology. These cannibal morphs, unlike typical morphs, possess a disproportionately broad head and hypertrophied vomerine teeth.

Studies of cannibalism in amphibians have focused particularly on factors leading to the presence of cannibalism within a population and describing cannibalistic morphologies. However, few studies have examined behavioral interactions of cannibalistic individuals and their prey. In a series of laboratory experiments, we documented that typical morphs exhibit an antipredator response when exposed to cannibalistic conspecifics but not when exposed to other typical conspecifics. This response can be characterized by reduction in activity level and change in spatial distribution. This antipredator response was not dependent on the diet of the cannibal morphs. This differs from some studies which have demonstrated that prey respond to predators only if that predator has recently consumed a conspecific of the prey. Typicals responded regardless of whether the cannibals were fed conspecifics or tubifex worms. Furthermore, we showed that this response was apparent only when larvae were allowed chemical but not visual stimuli from cannibalistic conspecifics.