

SOCIETY FOR NORTHWESTERN VERTEBRATE BIOLOGY

P R O G R A M



ROSARIO RESORT
ORCAS ISLAND
WASHINGTON
MARCH 23-25, 1995

Dear Friends:

Welcome to world famous Rosario Resort and Spa on Orcas Island in the beautiful San Juan Islands. We are glad to have you as our guests for the annual meeting and the gala 75th anniversary of the *Society for Northwestern Vertebrate Biology*. I hope you will have a memorable experience here and look forward to your involvement with the Society in the coming years.

I wish to thank the staff of Rosario Resort and Spa for their tremendous effort to make this meeting a success, especially at a time when they are undergoing renovation. In particular, I wish to thank Linda Peth, the meeting and conference coordinator for Rosario. I also wish to thank everyone on the Meeting Committee for the many hours spent to make this meeting not only a reality, but also a special occasion. The efforts of the invited speaker chairpersons is commendable. They were given the task of finding and inviting speaker of their sessions, scheduling them, and introducing them for their talks. I thank the contributed paper chairs for their commitment to the meeting, especially those who should be on their honeymoon!

-- Lawrence L.C. Jones, President

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Society for Northwestern Vertebrate Biology

FOUNDED JANUARY 7, 1920



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SCHEDULE OF EVENTS

THURSDAY, March 23, 1995

- 11:00 AM - 6:00 PM Registration, *Discovery House*.
- 11:00 AM - 1:00 PM Pacific Northwest Amphibian and Reptile Consortium committee meeting.
- 2:00 PM - 5:20 PM **Presentations:** Managed Forests.
Contributed Papers: Mammals and Birds.
- 2:00 PM - 7:00 PM Poster viewing.
- 5:30 PM - 7:00 PM **SNVB** Executive Board Meeting.
- 7:00 PM - 11:00 PM 75th Anniversary and awards banquet.

FRIDAY, March 24, 1995

- 7:15 AM - 8:00 AM Continental Breakfast.
- 8:00 AM - 11:20 AM **Presentations:** Coastal Fauna.
Amphibians and Reptiles.
Neotropical Migrants and Biogeography.
- 8:00 AM - 4:00 PM Poster viewing.
- 11:20 AM - 12:40 PM Luncheon, **SNVB** General Membership meeting.
- 12:40 PM - 4:00 PM **Presentations:** Marbled Murrelets.
Contributed Papers, Herpetology.
Mammals.
- 5:00 PM - 9:30 PM Clambake, *Moran State Park*.

SATURDAY, 25 March 1995

- 11:00 AM- 3:00 PM Pelagic trip for marine mammals and birds, depart *Deer Harbor*.
- 10:00 AM- 2:00 PM Orcas Island land-based trip, depart *Rosario*.

CONTEMPORARY RESEARCH ON WILDLIFE IN MANAGED FORESTS

Thursday, March 23, Afternoon

Chair: Edward Arnett, Weyerhaeuser Company

2:00 - 2:20 PM	Martin G. Raphael, Richard S. Holthausen, Kevin S. McKelvey, and Eric D. Forsman. The contribution of federal and non-federal habitat to persistence of the northern spotted owl on the Olympic Peninsula, Washington.
2:20 - 2:40 PM	Douglas Runde. Habitat management planning for private timberlands: the Weyerhaeuser Company's approach and progress.
2:40 - 3:00 PM	Andrew B. Carey. Conservation of biodiversity in managed forests.
3:00 - 3:20 PM	John G. Cook, Robert A. Riggs, Arthur R. Tiedemann, Larry L. Irwin, and Larry D. Bryant. Large-ungulate herbivory effects on ecosystem dynamics in the Blue Mountains Ecoregion of Oregon and Washington.
3:20 - 3:40 PM	Rex Sallabanks. Bird-habitat relationships in industrial forested landscapes of the inland northwest.
3:40 - 4:00 PM	<i>BREAK</i>
4:00 - 4:20 PM	Carol Chambers. Diurnal breeding bird responses to alternative stand management in the central Oregon Coast Range.
4:20 - 4:40 PM	Katherine Kelsey. Responses of headwater stream amphibians to forest practices in western Washington.
4:40 - 5:00 PM	John P. Hayes, Michael D. Adam, and Patrick Hounihan. Riparian area management and bat populations.
5:00 - 5:20 PM	Edward B. Arnett. Wildlife use of slash piles in managed ponderosa pine and mixed conifer forests of southcentral Oregon.

CONTRIBUTED PAPERS: MAMMALS AND BIRDS

Thursday, March 23, Afternoon

Chair: Bob Bicknell, Washington Department of Fish and Wildlife

2:00- 2:20 PM	J. L. Smith, W. A. Michaelis, K. Sloan, J. Musser, and D. J. Pierce. An analysis of elk poaching losses and other mortality sources in Washington using biotelemetry.
2:20 - 2:40 PM	Lawrence L. C. Jones and Martin G. Raphael. A comparison of resting and denning sites of the American marten in dissimilar habitats of the Pacific Northwest.
2:40 - 3:00 PM	Karen L. Morris, Christy L. Kimpo, Greg A. Morris, and James C. Ha. The influence of proximity to humans on population density and home range of mountain beaver (<i>Aplodontia rufa</i>).
3:00- 3:20 PM	Janelle G. Corn and Beatrice Van Horne. Are Townsend's ground squirrels on the Snake River Birds of Prey Area food limited?
3:20 - 3:40 PM	Heide D. Wetmore, Douglas E. Runde, and Patricia A. MacLaren. Bat distribution and foraging activity in southwest Washington.
3:40 - 4:00 PM	<i>BREAK</i>
4:00-4:20 PM	Burr J. Betts. Individual variation in echolocation calls of big brown and silver haired bats.
4:20 - 4:40 PM	James W. Watson and Brenda L. Cunningham. Bald eagle responses to experimental human activity.
4:40 - 5:00 PM	No scheduled speaker.
5:00 - 5:20 PM	No scheduled speaker.

COASTAL FAUNA

Friday, March 24, Morning

Chair: Gregory Green, Parametrix, Inc.

8:00 - 8:20 AM	Howard Garrett, Ken Balcomb, and David Ellifrit. Puget Sound killer whales.
8:20 - 8:40 AM	D. John Pierce, Pam Erstad, and Steve Jefferies: Seabird interactions with non-treaty sockeye gill net fishery in north Puget Sound.
8:40- 9:00 AM	Patrick J. Gearin, Steven J. Jeffries, and Cyreis Schmitt: Diet and annual food consumption of California sea lions and harbor seals in Puget Sound
9:00 - 9:20 AM	David R. Nysewander. Overview of the marine bird and waterfowl task within the Puget Sound Ambient Monitoring Program.
9:20-9:40 AM	Harriet R. Huber, Steve Jeffries, Robin Brown, and Robert DeLong. Harbor seal stocks in Washington and Oregon: evidence from genetic and tagging studies.
9:40 - 10:00 AM	<i>BREAK</i>
10:00 - 10:20 AM	Mary Mahaffe, Camille Bennett, and Wendy Parson. Surf scoters and pigeon guillemots as contaminant monitors.
10:20 - 10:40 AM	Steven J. Jeffries and Ronald Jameson: Status of sea otters in Washington State.
10:40 - 11:00 AM	R. Ian Goudie: Ecological considerations for sea ducks: toward their conservation and management
11:00 - 11:20 AM	John Calambokidis, Gretchen H. Steiger, Gregory A. Green, and Kenneth C. Balcomb: Biology of humpback whales off Oregon and Washington

AMPHIBIANS AND REPTILES

Friday, March 24, Morning

Chair: R. Bruce Bury, National Biological Service

8:00 - 8:20 AM	Michael J. Adams. Distribution patterns of aquatic amphibians on the Fort Lewis Military Reservation.
8:20 - 8:40 AM	William P. Leonard. Amphibian and reptile inventory at McChord Air Force Base, Pierce County, Washington.
8:40- 9:00 AM	Kelly P. McAllister, William P. Leonard, and Sandy Andelman. Past distribution and current status of the northern leopard frog (<i>Rana pipiens</i>) in eastern Washington.
9:00 - 9:20 AM	Charles Crisafulli. Amphibian surveys in the southwest Washington Cascade Range.
9:20-9:40 AM	Elke Wind. Habitat associations of the wood frog (<i>Rana sylvatica</i>) and the boreal toad (<i>Bufo boreas</i>) in the mixed-wood boreal forest of north-central Alberta.
9:40 - 10:00 AM	BREAK
10:00 - 10:20 AM	Linda Dupuis. The status of tailed frogs (<i>Ascaphus truei</i>) in British Columbia.
10:20 - 10:40 AM	Deanna Olson. Aquatic vertebrate communities in western Oregon forests: amphibians can dominate stream ecosystems.
10:40 - 11:00 AM	David Skelly, Earl E. Werner, and Spencer A. Cortwright. Succession and the metapopulation dynamics of amphibians: a long-term study.
11:00 - 11:20 AM	No scheduled speaker.

NEOTROPICAL MIGRANT BIRDS (early AM)
BIOGEOGRAPHY (late AM)

Friday, March 24, Morning

Chairs: Sandy Andelman, The Nature Conservancy (Neotropical Migrants)
David Nagorsen, Ministry of the Environment (Biogeography)

8:00 - 8:20 AM	Mathias Leu. The feeding ecology of loggerhead shrikes (<i>Lanius ludovicianus</i>) in disturbed strubsteppe habitat in Washington.
8:20 - 8:40 AM	Michael Smith. Birds and bombs: Hanford's role in conservation of upland breeding birds in the Columbia Basin.
8:40- 9:00 AM	Matthew Vander Haegen, Frederick Dobler, and John Pierce. Shrub-steppe bird response to habitat variables in eastern Washington.
9:00 - 9:20 AM	Edward B. Arnett and Douglas E. Runde. Breeding bird monitoring and research on Weyerhaeuser Company land in Oregon and Washington.
9:20-9:40 AM	Robert Altman. Integrated monitoring for neotropical migratory landbirds at Bachelor Point, Ridgefield National Wildlife Refuge.
9:40 - 10:00 AM	BREAK
10:00 - 10:20 AM	David W. Nagorsen. Historical biogeography of insular mammal faunas in the Pacific Northwest.
10:20 - 10:40 AM	Lisa Hartman and Don Eastman. Ecology and distribution of introduced raccoons on the Queen Charlotte Islands, British Columbia.
10:40 - 11:00 AM	John F. Lehmkuhl, Camryn Lee, William Gaines, Heather Murphy, Mallory Lenz, and Susan Piper. Impacts on vertebrates of the 1994 wildfires in the northeastern Washington Cascades.
11:00 - 11:20 AM	Kelly Cassidy and Richard Johnson. Modeling mammal distributions, or how to learn how little we know.

ECOLOGY AND CONSERVATION OF THE MARBLED MURRELET

Friday, March 24, Afternoon

Chair: S. Kim Nelson, Oregon State University

12:40 - 1:00 PM	Thomas E. Hamer and S. Kim Nelson. Characteristics of marbled murrelet nests and nesting habitat in North America.
1:00 - 1:20 PM	S. Kim Nelson. Marbled murrelet nest success and habitat characteristics.
1:20- 1:40 PM	Leonard S. Young, Charles W. Turley, and Gerald E. Hoyer. Estimating marbled murrelet habitat from forest inventory data.
1:40 - 2:00 PM	Stephanie K. Hughes and Kevin M. Jordan. Locating and documenting marbled murrelet nests: a technical perspective.
2:00-2:20 PM	Irene Manley and John Kelson. At-sea population size and distribution of marbled murrelets in Barkley Sound, British Columbia: 1982 vs 1994.
2:20 - 2:40 PM	<i>BREAK</i>
2:40- 3:00 PM	Steven Courtney, Sherri L. Miller, Linda L. Long, Brian P. O'Donnell, C. John Ralph, and Martin G. Raphael. Distribution and productivity of marbled murrelets in the San Juan Islands.
3:00 - 3:20 PM	Howard B. Stauffer. Sampling for marbled murrelets at far inland sites in California: are they there?
3:20 - 3:40 PM	Teresa Matsumoto. Sampling for marbled murrelets at far inland sites in California: how robust is our design.
3:40 - 4:00 PM	No scheduled speaker.

MAMMALS

Friday, March 24, Afternoon

Chair: James G. Hallett, Washington State University

12:40 - 1:00 PM	Stephen D. West. A comparison of terrestrial small mammal communities between riparian zones and adjacent uplands in managed forests of western Washington.
1:00 - 1:20 PM	Margaret A. O'Connell and James G. Hallett. Organization of shrew assemblages in the Pacific Northwest.
1:20- 1:40 PM	Amy Blacklaw Clark. The effects of commercial thinning on northern flying squirrels (<i>Glaucomys sabrinus</i>) and Townsend's chipmunks (<i>Tamius townsendii</i>) in managed forests of southwestern Washington.
1:40 - 2:00 PM	Elizabeth E. Holmes. Local movement patterns of bushy-tailed woodrats.
2:00-2:20 PM	Jerry O. Wolff, Eric M. Schaubert, and W. Daniel Edge. The effects of habitat fragmentation on the demography and social structure of the gray-tailed vole.
2:20 - 2:40 PM	BREAK
2:40 - 3:00 PM	Eric M. Rominger. Late winter foraging dynamics of woodland caribou in the southern Selkirk Mountains.
3:00 - 3:20 PM	Keith B. Aubry. Comparison of red fox and coyote food habits in subalpine forests.
3:20 - 3:40 PM	Sean D. Farley, Charles T. Robbins, Christy Welch, and Grant E. Hilderbrand. Nutritional physiology research with black bears (<i>Ursus americanus</i>) and grizzly bears (<i>U. arctos</i>).
3:40 - 4:00 PM	Levon P. Yengoyan. Habitat utilization and home range size of the bobcat in managed forests in western Washington.

CONTRIBUTED PAPERS: HERPETOLOGY

Friday, March 24, Afternoon

Chair: Linda Dupuis, University of British Columbia

12:40 - 1:00 PM	A. Lance Everette. Methods for photographing live amphibian voucher specimens.
1:00 - 1:20 PM	Paul Stephen Corn. Long-term trends in a montane population of chorus frogs.
✓ 1:20 - 1:40 PM	Patricia A. MacLaren, Douglas E. Runde, and Heide D. Wetmore. Distribution and abundance of stream-dwelling amphibians in southwestern Washington.
1:40 - 2:00 PM	Jonathan Beck and Charles R. Peterson. Distribution, relative abundance, habitat associations, and movement patterns of longnose snakes in southwestern Idaho.
✓ 2:00 - 2:20 PM	John S. Richardson and William E. Neill. The Pacific giant salamander in British Columbia: habitat use and demography.
2:20 - 2:40 PM	BREAK
✓ 2:40 - 3:00 PM	Paul E. Bartelt and Charles R. Peterson. The use of radio telemetry to study the movements and habitat use of western toads.
3:00 - 3:20 PM	No speaker scheduled <i>Chuck Peterson</i>
3:20 - 3:40 PM	No speaker scheduled
3:40 - 4:00 PM	No speaker scheduled

*Habitat Modifications of Spotted frogs
→ Pop*

POSTERS AND DISPLAYS

Viewing Thursday 2:00 PM - Friday ca. 4:30 PM

Sydney Cannings. The British Columbia Conservation Data Centre

Andrew B. Carey, Karma E. Gerth, Suzanne M. Wilson, David Thysell, Todd M. Wilson, and Lisa J. Villa. Ecosystem management: an experiment in managed stands.

Karma Gerth, Andrew B. Carey, Suzanne M. Wilson, and Angela O. Bargmeyer. Tooth wear as an indicator of age class in shrews

John P. Hayes, William H. Emmingham, Stephen D. Hobbs, Robert G. Anthony, Nobuya Suzuki, Michael D. Adam, and Jennifer Weeks. The influence of commercial thinning on wildlife populations and stand structure: a new COPE study.

Gary M. Koehler. Black bear mortality and habitat utilization investigations.

Lawrence L. L. C. Jones, Janet L. L. Jones, Uncle Nardly, J. Jay, Barnabas Zokynov, and Commander Salamander. Endemic fauna of the Owyheean Islands off the coast of Idaho.

Debra Patla and Charles R. Peterson. The effects of habitat modifications on a spotted frog population in Yellowstone National Park.

Douglas B. Ransome and Thomas P. Sullivan. Food limitation and habitat preference of northern flying squirrels and red squirrels.

Greg Sieglitz. Airborne videography: a remote sensing tool for Oregon's natural resource managers.

J. Smith et al. An analysis of elk poaching losses and other mortality sources in Washington using biotelemetry.

ABSTRACTS

DISTRIBUTION PATTERNS OF AQUATIC AMPHIBIANS ON THE FORT LEWIS MILITARY RESERVATION. Michael J. Adams, University of Washington.

The 34,400-ha Fort Lewis Military Reservation contains some of the least disturbed wetland habitats in the Puget Sound lowlands. Amphibian surveys from 1992 to present located eight of the nine species of amphibians that historically occurred in Fort Lewis wetlands. No spotted frogs were found. Bullfrogs have been introduced on the base and are abundant in all permanent waters. Pacific giant salamanders and western red-backed salamanders have limited distributions that reflect their specialized habitat requirements. Several populations of the western toad have been found in the Rainier Training Area, but none on the main body of the base. They appear to be using small forest bogs for breeding. Red-legged frogs, pacific chorus frogs, northwestern salamanders, long-toed salamanders, and rough-skinned newts are abundant and wide-spread. Red-legged and chorus frogs are often rare in areas occupied by introduced fish and bullfrogs but, preliminary data suggest that their distribution may be best explained by habitat variables. Tests of this hypothesis are underway. Survey techniques included time-constrained searches, shoreline transects, call surveys, and aquatic funnel traps. Aquatic funnel trapping was found to be the most reliable technique for Fort Lewis wetlands.

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INTEGRATED MONITORING FOR NEOTROPICAL MIGRATORY LANDBIRDS AT BACHELOR POINT, RIDGEFIELD NATIONAL WILDLIFE REFUGE. Bob Altman, Avifauna Northwest, Boring, Oregon.

Three techniques - constant-effort mist-netting, point count censusing, and nest monitoring - were utilized to monitor populations of small landbirds in a mature cottonwood/ash riparian forest fragment along the Lower Columbia River during 1993 and 1994. Capture rates from constant-effort mist-netting were high in both years, although indices of productivity were low, particularly in 1993. Song sparrow and Swainson's thrush were the two most frequently banded species, together accounting for nearly half of the birds banded in each year. The return rate for birds banded in 1993 and recaptured in 1994 was approximately 20 percent, with particularly high site fidelity for Swainson's thrush (43 percent). Differences between years in abundance and species richness from point count censusing may have been due to observer variability and weather. Brown-headed cowbird was the most abundant species recorded during point count censusing in both years. Local management practices such as cattle grazing and agriculture likely contribute to the abundance of the brown-headed cowbird. Nest monitoring was initiated in 1994 to address the issue of low indices of productivity and high abundance of cowbirds. Minimal evidence of cowbird parasitism was recorded, although the low level of effort for nest monitoring combined with limited sample sizes, particularly for NTMB species typically parasitized by cowbirds, render these data inconclusive. Inherent limitations in the type of information provided by each monitoring method necessitates the collection and integration of data from multiple methods to ascertain the health and viability of small landbird populations.

WILDLIFE USE OF SLASH PILES IN MANAGED PONDEROSA PINE AND MIXED CONIFER FORESTS OF SOUTHCENTRAL OREGON. Edward B. Arnett, Weyerhaeuser Company, Environmental Forestry Research.

Logging residues are typically piled and burned for fire protection, insect reduction, and site preparation prior to reforestation, but may provide important microhabitats for a wide variety of wildlife species. To date, few studies have evaluated use of slash piles by wildlife or analyzed habitat variables associated with wildlife use of piles. A study to assess wildlife use of slash piles in 3 different management areas on Weyerhaeuser's Klamath Falls Tree Farm in southcentral Oregon was initiated in 1994. The design involved random selection of 100 slash piles for sampling within each of the 3 areas. Wildlife use of slash piles was quantified by tracking after fresh snowfall, and data will be collected through winter 1996-97. Habitat data will be collected in summer 1995 to allow logistic regression analysis of variables potentially influencing use of piles. Subsequent recommendations for pile construction and placement to potentially maximize use by wildlife will be provided to operations foresters for future implementation.

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BREEDING BIRD MONITORING AND RESEARCH ON WEYERHAEUSER COMPANY FOREST LAND IN OREGON AND WASHINGTON. Edward B. Arnett and Douglas E. Runde, Weyerhaeuser Company, Environmental Forestry Research.

Including private landowners in avian conservation and management efforts is important to the overall success of nongame bird programs. Avian monitoring and research is supported by Weyerhaeuser Company as a basis for development and validation of nongame bird management strategies in commercially managed forests. Weyerhaeuser expanded efforts to inventory and monitor bird populations associated with managed Douglas-fir forests in western Oregon and Washington in 1994. Objectives included determining bird species composition and relative abundance, distribution, and habitat associations. Point-count surveys for breeding birds were conducted in managed timber stands within five watersheds: one in Oregon and four in Washington. Roadside point-counts, similar in concept to Breeding Bird Survey routes, also were conducted throughout three watersheds in southwest Washington. An experiment comparing tape recordings of birds to detections by field observers was implemented to evaluate the accuracy and effectiveness of using tape recorders to survey breeding birds. In 1995, Weyerhaeuser will initiate a cooperative study to evaluate breeding bird relationships with lodgepole pine salvage logging and expand cooperative monitoring efforts throughout Company ownership in Oregon. A brief discussion of monitoring and research findings and future plans will be presented.

COMPARISON OF RED FOX AND COYOTE FOOD HABITS IN SUBALPINE FORESTS. Keith B. Aubry, USDA Forest Service, Pacific Northwest Research Station, Olympia, WA 98512.

From July 1979 to November 1981, I collected 442 red fox and 132 coyote scats in the Sunrise area of Mt. Rainier National Park and in the Crystal Mountain area of Mt. Baker-Snoqualmie National Forest. Elevations ranged from about 1500 to 2000 m and habitats consisted of a mosaic of subalpine meadows and patches of mountain hemlock, subalpine fir, and Pacific silver fir. Red foxes are native to this habitat and are permanent residents, whereas coyotes invaded the Cascade Range in historic times, and are primarily summer residents; very few coyote scats were collected from Jan.-May. Although the majority of scats were collected during the snow-free months, seasonal patterns are evident. Mammals were the most important component of the yearly diet for both species. However, grasshoppers and strawberries were the predominant food items for both species from July-Sept. In the winter months, snowshoe hares were the most common mammalian prey, whereas in summer, both species preyed heavily on the northern pocket gopher, southern red-backed vole, and heather vole. Other mice, ungulates (presumably as carrion), sciurids, and birds were used throughout the year by both species, but at relatively low frequencies. Insectivores and pikas were absent in winter diets. Red fox and coyote food habits were similar and, as reported elsewhere, reflect an opportunistic strategy.

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THE USE OF RADIO-TELEMETRY TO STUDY THE MOVEMENTS AND HABITAT USE OF WESTERN TOADS. Paul E. Bartelt and Charles R. Peterson, Dept. of Biological Sciences, Idaho State University, Pocatello, ID 83209-8007.

We used miniature radio-transmitters to determine the movement patterns and habitat use of adult western toads (*Bufo boreas*) at two sites on the Targhee National Forest. The 1.7-g transmitters each had a 7-cm whip antenna and were temperature sensitive. All transmitters were attached around the waist of the toads by a plastic belt. Since May of 1993 we have telemetered a total of 11 toads for different lengths of time. From May until September we located each animal every two to three days and at least once per month during hibernation. We flagged the location of each toad and later recorded the coordinates with a geographic positioning system. Microhabitat measurements included air temperature, humidity, and the amounts of different cover types. We used a geographic information system to map the movements of the toads in relation to macrohabitat features (i.e., cover types) digitized from aerial photos. The males did not travel far from the breeding pond, but the females traveled up to 2.5 km from the breeding sites. The females' movements did not appear to be dependent upon the presence of standing water. We most often found the toads under logs, litter, or rodent burrows, especially at edges between macrohabitat types. We believe that radio-telemetry will provide an effective technique for studying the habitat relationships of many frogs and toads. The results from such studies should improve our understanding of their habitat requirements and provide information critical to their conservation and restoration.

DISTRIBUTION, RELATIVE ABUNDANCE, HABITAT ASSOCIATIONS, AND MOVEMENT PATTERNS OF LONGNOSE SNAKES IN SOUTHWESTERN IDAHO.
Jonathan M. Beck and Charles R. Peterson, Idaho State University, Pocatello, Idaho 83209-8007.

In Idaho, the longnose snake (*Rhinocheilus lecontei*) is listed as a "Sensitive Species" due to its limited distribution and apparent rarity. An understanding of its natural history is required to effectively manage this species. We used drift fences with funnel traps to determine the distribution, relative abundance, and habitat associations of longnose snakes in the Birds of Prey Natural Area in southwestern Idaho. Over a two-year period, we trapped at 45 sites systematically chosen to incorporate eight vegetation/habitat types. Longnose snakes are widespread but apparently uncommon. We captured them at 10 (22%) of the 45 sites. However, out of 605 total snake captures, only 19 were longnose snakes, ranking them as the seventh most abundant snake species out of a total of 8 captured. We only captured longnose snakes in three of the eight vegetation/habitat types. Shrub cover and sandy to sandy-loam soil were common to all 10 sites where we captured longnose snakes. To study the movement patterns and habitat selection of individual snakes, we used miniature (1.7-g) radio transmitters. Relative to other snake species, longnose snakes move a moderate amount (typically in the 100's of meters over the course of the activity season). We plan to use GIS to combine our trapping data with the vegetation/habitat map to predict longnose snake occurrence elsewhere in southwestern Idaho.

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INDIVIDUAL VARIATION IN ECHOLOCATION CALLS OF BIG BROWN AND SILVER-HAIRED BATS. Burr J. Betts, Eastern Oregon State College.

Scientists and wildlife managers are using interspecific differences in echolocation call structure to survey bat species and to study habitat use and feeding behavior. However, we have little data on intraspecific variation, which may cause misidentification. I measured individual variation in call structure of 15 big brown bats (*Eptesicus fuscus*) and 27 silver-haired bats (*Lasionycteris noctivagans*) with the Anabat equipment that is currently popular in the Pacific Northwest. Search calls were recorded from free-flying, light-tagged bats after release. The central 50% of the notes in one sequence for each individual were measured for maximum frequency, minimum frequency, note duration, duration of the constant frequency component, proportion of the note that is constant frequency, and time between notes. There was significant variation between individuals for all parameters for both species. Inter-specific differences occurred in maximum frequency, note duration, and the duration and proportion of the constant frequency part of the note. However, at least with the Anabat system in Northeast Oregon, there is still enough individual variation that the distributions overlap considerably for each of these measures and misidentification of many individuals is still possible. The proportion of the note that was constant frequency provided the least overlap and is thus the best parameter for differentiating the calls of the two species. This study supports the idea that caution is necessary in using echolocation calls for identifying species.

BIOLOGY OF HUMPBACK WHALES OFF OREGON AND WASHINGTON. John Calambokidis and Gretchen H. Steiger, Cascadia Research, 218½ W. Fourth Ave., Olympia, WA 98501; Gregory A. Green, Parametrix, 5808 Lake Washington Blvd. NE, Kirkland, WA 98033; and Kenneth C. Balcomb, Center for Whale Research, Friday Harbor, WA 98250.

Humpback whales were historically hunted off the west coast of Oregon and Washington. Some 1,933 humpback whales were landed at Bay City, Washington, from 1911 to 1925. Highest numbers were taken in July and August. Humpback whales were previously considered migrants *en route* to feeding grounds in Alaska. We summarize the distribution of humpback whales off Washington and Oregon from sightings made primarily from aerial surveys between 1989 and 1994 and examine movements, stock structure, and population size using photographic identification of individual whales from vessel surveys. Humpback whale sightings were made from late March to mid-October with the highest number of sightings in May and September. Sightings were widely distributed along the shelf, slope, and offshore waters of both Oregon and Washington. Seasonal distribution shifts were observed but varied among years. Individual identification of whales revealed extensive movements and interchange of whales along the coast of California, Oregon, and Washington during the spring, summer, and fall, with the northern boundary of this distinct feeding aggregation occurring in the vicinity of the Washington-British Columbia border. No interchange of whales has been documented between these animals utilizing the coastal waters of California to Washington and the large concentrations of humpback whales that feed in Alaskan waters, refuting past assumptions about these whales being migrants *en route* to Alaska. The humpback whales feeding off Washington and Oregon migrate in the winter primarily to breeding grounds off mainland Mexico.

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THE BRITISH COLUMBIA CONSERVATION DATA CENTRE. Sydney G. Cannings, Wildlife Branch, B.C. Ministry of Environment, Lands and Parks.

The B.C. Conservation Data Centre (CDC) is a data bank that is designed to provide a centralized, objective source of information on rare and endangered plants, animals, and plant communities. The major features of the system are: 1) The information is *organized and computerized* for easy access and sorting. 2) The work is *focused* on rare and endangered taxa and ecosystems. 3) It is *on-going and dynamic*. By focusing efforts, the CDC can monitor sites of concern to ensure that the information is up to date and relevant. 4) It is *networked* with 80 other similar centres throughout North, Central, and South America, all of which use the same software and methodology. We ask (and hopefully answer) the following questions: 1) What are the rare and endangered species and ecosystems of British Columbia? To answer this, every species and plant community is assigned a provincial and global rank that is based on an objective set of criteria. 2) Exactly where are these rare or endangered elements? Every occurrence of tracked species or communities is recorded in detail and mapped at 1:50,000 on topographic maps. 4) What are the highest priority unprotected sites? Information from the CDC can be used to: 1) Establish protection priorities for government and non-government conservation agencies. 2) Inform proactive processes such as provincial, regional, and municipal land use plans. 3) Assist the environmental impact assessment process. 4) Inform natural resource managers in industry and government.

ECOSYSTEM MANAGEMENT: AN EXPERIMENT IN MANAGED STANDS. Andrew B. Carey, Karma E. Gerth, Suzanne M. Wilson, David Thysell, Todd M. Wilson, and Lisa J. Villa, Pacific Northwest Research Station, Olympia, Washington; and Jim Trappe, and Wes Colgan, Oregon State University

Our recent research has shown that arboreal and forest-floor small mammals are more abundant in old growth than in young forests. Differences in abundance of fallen trees, snags, and understory development can account for much of the variability in mammal populations across young and old stands. Additionally, we have shown that spotted owl habitat use reflects mammalian prey abundance and degree of understory development. We hypothesize that synergistic effects on trophic pathways among plant, fungal, invertebrate, and vertebrate populations can be enhanced in managed stands thereby restoring many characteristics of old-growth forests. Our experimental methods in young managed stands entail creating cavities in live trees to benefit flying squirrels and other cavity-users. Also, we created three levels of overstory density to produce understory diversity and enhance tree growth. Our experimental design consists of four randomized blocks. Two blocks have substantial coarse woody debris and two blocks have virtually none. Each block has four 13-ha stands and four treatments: no intervention, cavities-added, variable density thinning with underplanting, and cavities plus thinning. There are four replicates of each treatment. Cavity and thinning treatments were applied in 1992-1993. Underplanting occurred in the spring of 1994. Pretreatment and ongoing sampling includes vascular plants, coarse woody debris, fungi, forest-floor small mammals, arboreal rodents and mammalian diets.

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CONSERVATION OF BIODIVERSITY IN MANAGED FORESTS. Andrew B. Carey, Pacific Northwest Research Station, Olympia, WA.

Since 1982, I have led teams collecting data to be used to contrast plant and vertebrate communities in old growth with those in managed forests: forest birds (including the spotted owl) and amphibians in the Coast Ranges, arboreal rodents in the Klamath Mountains, Coast Range, Western Cascade Range, Puget Trough, Olympic Peninsula, and Northern Cascades; forest-floor small mammals in the Coast Range, Puget Trough, and Olympic Peninsula. I published region-wide perspectives on forest ecosystem development and the organization of vertebrate communities. From these reviews I designed the Forest Ecosystem Study (FES: a manipulative experiment) that is now in its fourth year. Connie Harrington and I designed a second manipulative experiment (the Habitat Development Study, HDS) that is now in its second year. The FES tests hypotheses about old-growth legacies, variable-density thinnings, artificially providing cavities, and forest ecosystem development including development of fungal, plant, arboreal rodent, and small-mammal communities. The HDS focusses on variable-density thinning, artificially augmenting coarse woody debris, and forest ecosystem development including fungal, plant, small-mammal, arboreal rodent, and amphibian communities. Next, I developed a biodiversity pathway (BDP) for management of second-growth western hemlock forests to sustain long-term production of both ecologic and economic goods and services from the ecosystem. The BDP begins with conservation of biological legacies at harvest, planting to ensure tree species diversity, pre-commercial thinning, and multiple variable-density thinnings, some of which include coarse woody debris augmentation; final harvest age ranges from 90 to 150 years to maintain 30% of the landscape in late-seral forest and 50-70 years in the remainder of the landscape. As part of the Washington Landscape Management Project, the BDP is being simulated and compared to timber-production and preservation pathways using SNAP-II, a scheduling and harvest simulator with net present value estimates and indices of ecosystem function. Options, costs, and financing for conservation of biodiversity in Washington's second-growth forests are being developed.

MODELING MAMMAL DISTRIBUTIONS, OR HOW TO LEARN HOW LITTLE WE KNOW. Kelly Cassidy, University of Washington, and Richard Johnson, Washington State University.

As part of the Gap Project, we are mapping the predicted distributions of the terrestrial mammals of Washington State. Distribution maps are based primarily on macrohabitat association, range limits, elevation limits, and occasionally, soil association. One outcome of this mapping effort has been the highlighting of systematic deficiencies in basic information about mammal distribution, status, and habitat requirements. Some recurring problems are that (1) many areas of the state are almost completely unsampled for any species, (2) there is no information about trapping NON-success, (3) there is insufficient information about macrohabitat requirements, (4) important information is often inaccessible through common databases, and (5) there is great disparity in our knowledge of some mammalian orders compared to others. These problems and their effect on our project will be discussed.

DIURNAL BREEDING BIRD RESPONSES TO ALTERNATIVE STAND MANAGEMENT IN THE CENTRAL OREGON COAST RANGE. Carol L. Chambers, Oregon State University.

I compared diurnal breeding birds responses to three alternative stand management treatments and control in the east-central Oregon Coast Range. Treatments were (1) uncut control, (2) group selection harvest ($\frac{1}{3}$ of volume removed in 0.2-ha patches), (3) two-story ($\frac{3}{4}$ volume removed uniformly), and (4) modified clearcut (1.25 green trees/ha retained). Bird abundance and habitat data (e.g., snags, logs, shrub, and tree cover) were collected 1 year prior to and 2 years following harvest. I did not detect a difference in bird species diversity among treatments, but species richness was higher in two-story stands ($x = 24$) than in other treatments ($x = 18$ to 21). Similarity between bird communities prior to and following harvest declined as timber volume harvested increased (% community similarity: control = 75%, group selection = 70%, two-story = 37%, clearcut = 27%). Community similarity for group selection treatments was most similar to controls. Bird communities in two-story stands were more similar to those found in clearcuts. Resident species comprised the majority of observations in clearcut and two-story treatments (e.g., rufous-sided towhees, dark-eyed juncos); neotropical migratory species dominated control and group selection communities (e.g., hermit warblers, Wilson's warblers). Shrub (< 5 m) and overstory (26-50 m) cover, conifer, and hardwood basal area decreased in two-story and clearcut treatments but remained similar to controls in group selection stands. Other habitat features (e.g., snags, logs, litter depth) showed no detectable change. Only one bird changed in abundance between control and group selection treatments (chestnut-backed chickadee abundance increased following group selection harvest). Five species declined following harvest in two-story and clearcut treatments (Pacific-slope flycatchers, chestnut-backed chickadees, winter wrens, golden-crowned kinglets, hermit warblers). Clearcutting and two-story treatments most dramatically altered plant and animal species composition; group selection seemed to have the least impact on species associated with mature forests.

THE EFFECTS OF COMMERCIAL THINNING ON NORTHERN FLYING SQUIRRELS(*GLAUCOMYSSABRINUS*)AND TOWNSEND'S CHIPMUNKS(*TAMIAS TOWNSENDII*) IN MANAGED FORESTS OF SOUTHWESTERN WASHINGTON. Amy Blacklaw Clark, College of Forest Resources, AR-10, University of Washington, Seattle, WA 98195.

As part of a long-term study on the effects of commercial thinning, I compared capture rates of northern flying squirrels and Townsend's chipmunks in Douglas-fir (*Pseudotsuga menziesii*)/western hemlock (*Tsuga heterophylla*) managed forests. Animals were captured in Tomahawk 201 live traps placed on the ground and in trees on four control and four treatment girds (10.24 hectares each). Two pre-treatment (fall 1993 and spring 1994) and one post-treatment (fall 1994) trapping sessions were completed. Preliminary capture rate comparisons do not indicate changes in abundance for either species as an immediate effect of thinning. Pre-treatment capture rates of northern flying squirrels may be positively associated with coarse woody debris and vine maple (*Acer circinatum*). Captures of Townsend's chipmunks were not clearly associated with any habitat variables. In addition, I will discuss characteristics of northern flying squirrels day-time den sites, located by radio-telemetry.

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LARGE-UNGULATE HERBIVORY EFFECTS ON ECOSYSTEM DYNAMICS IN THE BLUE MOUNTAINS ECOREGION OF OREGON AND WASHINGTON. John G. Cook, National Council of the Paper Industry for Air and Stream Improvement, Robert A. Riggs, Boise Cascade Corporation, Arthur R. Tiedemann, U.S. Forest Service, PNW Station, Larry L. Irwin, National Council of the Paper Industry for Air and Stream Improvement, and Larry D. Bryant, U.S. Forest Service, PNW Station.

Support is growing for integrated land management programs that can ensure long-term maintenance of ecosystem structure, function, and biodiversity. Success of such programs requires detailed understanding of how various disturbance factors influence ecosystem processes and attributes. Relatively little work has focused on influences of herbivores on ecosystem processes, but a growing body of literature indicates that maintaining high ecological densities of large herbivores can have undesirable effects on biodiversity, soil fertility, and floral and faunal productivity. Data from a series of large ungulate exclosures in the Blue Mountains Ecoregion illustrate that herbivory has greatly influenced composition of understory vegetation, including reductions in the abundance of palatable shrubs and forbs and increases in grasses and sedges. These effects may have long-term, detrimental influences on a variety of ecosystem attributes and account for declining productivity of big game populations, the latter through negative feedback relations. Considerable research will be required to assess the magnitude of herbivory effects, identify the long-term implications, and identify appropriate management strategies that minimize the potentially negative effects of large ungulate herbivory.

ARE TOWNSEND'S GROUND SQUIRRELS ON THE SNAKE RIVER BIRDS OF PREY AREA FOOD-LIMITED? Janelle Corn and Beatrice Van Horne, Department of Biology, Colorado State University, Fort Collins, CO 80523.

Many birds and mammals balance energy requirements over long time intervals, storing food or fat to survive periods of fasting. Limits to this process must be identified in order to predict the effects of habitat alteration and climate change on population persistence through time. Townsend's ground squirrel (*Spermophilus townsendii*) were trapped on 20 sites in the Snake River Birds of Prey Area over 4 years. Patterns of mass change indicate that animals below a minimal mass may not survive the June-January period of torpor. Females that survive at very low mass have reduced reproductive success during subsequent active seasons. We measured body composition of live trapped ground squirrels, and torpor bout duration of captive ground squirrels. Using these data and estimates of fattening rates, energy content of diets, burrow temperatures, and metabolic rates, we tested whether a minimum body size for survival reflects minimal energy needed to survive through torpor. We contrasted male and female, and juvenile and adult, body size limits for differences in fattening rates and fat accumulation that might be explained by different selection pressures faced by each of these groups. Townsend's ground squirrels face large energy demands during torpor that may not be met in years when food is scarce during prehibernation fattening.

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LONG-TERM TRENDS IN A MONTANE POPULATION OF CHORUS FROGS. Paul Stephen Corn, National Biological Service, 4512 McMurry Avenue, Fort Collins, Colorado 80525-3400.

A population of chorus frogs, *Pseudacris triseriata*, has been monitored periodically since 1961 and annually since 1986. Numbers of breeding males, estimated from capture-recapture data, averaged 815 per year for six years between 1961-1967 and 96 per year from 1986 to 1994. The cause of the population crash, which apparently occurred in the mid-1970's, is unknown. The number of males between years has varied 7-140% since 1986, but the trend in the last eight years is toward increasing population size. The population crash may have constituted a genetic bottleneck. Phenotypic frequencies of color morphs differ between the 1960's and the past eight years. Numbers of frogs are compared to regional climate variables to test for effects of weather on population size.

DISTRIBUTION AND PRODUCTIVITY OF MARBLED MURRELETS IN THE SAN JUAN ISLANDS. Steven Courtney, NCASI, and Sherri L. Miller, Linda L. Long, Brian P. O'Donnell, C. John Ralph, and Martin G. Raphael, U.S. Forest Service.

We surveyed the numbers of adult and juvenile marbled murrelets (*Brachyramphus marmoratus*) in the San Juan archipelago in July and August 1994. Murrelets were highly aggregated. Distributions were consistent over the period surveyed. Possible causes of aggregation will be discussed. Aging of birds was not always consistent. Our results indicate a generally good breeding season. However, the proportion of juveniles unexpectedly decreased during the survey. Possible causes of this decline will be discussed.

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AMPHIBIAN SURVEYS IN THE SOUTHWEST WASHINGTON CASCADE RANGE. Charles M. Crisafulli, USDA Forest Service, Mount St. Helens National Volcanic Monument, Amboy, WA 98601.

Visual encounters were conducted at forty sites in the Southwest Washington Cascade Range during spring 1994. Sites included old-growth, mature, and young (70-90 yrs) forest stands that regenerated following wildfire. The primary emphasis was placed on the Larch Mountain Salamander (*Plethodon larselli*), but all herptile species encountered were measured. A total of 274 animals were captured representing 15 taxa: 12 amphibians and 3 reptiles. Five species contributed to 90% of the total captures. Few observations were made of the remaining 10 species. Four previously unknown *P. larselli* localities were found; two of which supported numerous individuals. Macrohabitat characteristics and specific microhabitat use suggest that this species is more widely distributed and less of a habitat specialist than is commonly believed. Visual encounter surveys provide an expedient means of conducting extensive level inventory work but tend to yield few captures per unit effort and have some assumptions that are difficult to adhere to.

MONITORING ANURAN VOCALIZATIONS USING AUTOMATED RECORDING SYSTEMS. Michael E. Dorcas and Charles R. Peterson. Department of Biological Sciences, Idaho State University, Pocatello, Idaho.

Recent concerns over amphibian declines have led to an increased need for surveys and monitoring programs. The detection of anuran vocalizations has been a valuable technique in these efforts. Automated recording systems can increase the effectiveness of calling surveys. Advantages include: (1) the ability to sample multiple sites for extended periods of time; (2) decreased disturbance of calling anurans; (3) consistent sampling without the need for experienced field personnel; and (4) a permanent sampling record. If combined with environmental measurements, data from automated recording systems can be used to optimize when, where, and under what conditions to sample. Potential problems include: (1) noise interference from wind, water, and the calls of other species; (2) theft or vandalism; and (3) protection of equipment from the environment. Portable, automated, recording systems can now be assembled for less than \$250 US. Components include a tape recorder, a microphone, a voice clock, a timer, a battery, and a weather resistant case. In the future, pattern recognition software should greatly reduce the time required to transcribe tapes. So far, we have successfully used automated recording systems to study spatial, temporal, and environmentally induced variation in the calling behavior of anurans in Idaho, Utah, and South Carolina. For the reasons described above, we believe that automated recording systems will prove helpful in developing standardized survey and monitoring programs for anuran species that call.

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THE STATUS OF TAILED FROGS (*ASCAPHUS TRUEI*) IN BRITISH COLUMBIA. Linda Dupuis, Centre for Applied Conservation Biology, University of British Columbia, #270-2357 Main Mall, Vancouver, BC V6T 1Z4.

The status of the tailed frog is virtually unknown in British Columbia. Several U.S. studies have demonstrated that logging has an adverse effect on larval populations. Scientists attribute declines to increased water temperature and siltations. B.C.'s headwater creeks are not protected - with the exception of some understory (shade) retention along creeks affecting spawning grounds downstream. Moreover, riparian habitats bordering creeks are declining and are virtually absent in some biogeoclimatic zones. This study examines tailed frog larval densities in undisturbed (old-growth), clearcut, and buffered creeks. The objectives were to (1) assess the abundance and distribution of tailed frogs in mid-coast B.C., (2) determine which habitat features tadpoles were strongly associated with, and (3) consider potential effects of logging on larval populations. Larval populations are highly clustered at landscape, regional, and local levels. The primary factor affecting their number seems to be substrate. Indeed, creeks with gravel beds and boulder lags contained more tadpoles than rubbly creeks with little coarse material. Larval populations were often further reduced in logged-over creeks, if these were filled with detritus (reduced flow), and/or fine materials were prevalent at the base of the channel. Forested buffer strips improve tadpole densities markedly, such that numbers rival those of undisturbed creeks. Buffered creeks have less fine material clogging the interstitial spaces between rocks, which larvae rely on to escape bedload movement events, than do their clearcut counterparts.

METHODS FOR PHOTOGRAPHING LIVE AMPHIBIAN VOUCHER SPECIMENS.
A. Lance Everette, USDA Forest Service PNW Research Station, Olympia, WA.

The traditional method of collection of amphibian voucher specimens for deposition in a research museum, requires the killing and preservation of individuals. However, storage in formalin or alcohol results in the fading of pigmentation and a subsequent loss of information regarding inter- and intraspecific variation. Permanent removal of individuals for voucher specimens is also undesirable when dealing with localized and sensitive populations. Some museums now accept photographic voucher specimens. During a pilot study of amphibian diversity on the Olympic Peninsula, I developed techniques for photographing live voucher specimens. Using shutter speed/aperture bracketing, I shot photographs of dorsal, ventral and side views of 11 specimens from 6 species. Color, speckling, dorsal stripes and costal grooves were targeted in photographs. Additional photographs were taken, when necessary, to verify species or gender. Diagnostic traits associated with each species were found to be easily identifiable from photos. Photographic techniques are valuable in that specimen species, and possibly gender, can be identified on film in a controlled field setting without requiring permanent removal of the amphibians.

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NUTRITIONAL PHYSIOLOGY RESEARCH WITH BLACK BEARS (*URSUS AMERICANUS*) AND GRIZZLY BEARS (*U. ARCTOS*). Sean D. Farley, Charles T. Robbins, Christy Welch, and Grant Hilderbrand, Departments of Zoology and Natural Resource Sciences, Washington State University, Pullman, WA.

An organism's use of habitat is shaped by nutritional and behavioral constraints which can be key bottlenecks to the recovery of endangered species and management of critical habitat. Recent efforts to recover grizzly bears (*Ursus arctos*) throughout black bear (*U. americanus*) range have demonstrated the need to fully understand habitat and nutritional requirements critical in the bears' life cycle. The Bear Research and Education Center at Washington State University is one of the few locations in the world able to provide the facilities and specialized techniques needed to conduct nutritional ecology research on black and grizzly bears. Research projects just completed at the Center have developed methods for measuring the body composition of wild bears *in-vivo*, quantified the relationship between body composition and mass changes during hibernation, and measured the maternal costs of lactation and cub production. Ongoing research includes foraging trials with captive bears and field observations of wild animals to quantify the relationship(s) between berry patch density, berry intake rate by bears, and bear body size and weight gain. Feeding trials are also being conducted to validate the use of carbon, nitrogen, and sodium isotopes (^{13}C , ^{12}C , ^{15}N , ^{14}N , and ^{22}Na) for determining food source, quantity consumed, and feeding trophic level of wild bears, as well as the feasibility of analyzing museum specimens for identifying historical feeding behavior of extirpated populations and species.

PUGET SOUND KILLER WHALES. Howard Garrett, Ken Balcomb, and David Ellifrit, Center for Whale Research, 1359 Smuggler's Cove Road, Friday Harbor, WA 98250.

A population of *Orcinus orca* resides in Puget Sound for most of each year. Their diet, range, social behavior, kinship system, and linguistic vocabulary are distinct from other orca populations that inhabit Puget Sound and surrounding waters. The "southern community" of orcas, presently numbering over ninety animals, consists of three pods: J pod (22 whales), K pod (18 or 19 whales), and L pod (approx. 55 whales). The matrilineal sub-pods are composed of older females with their offspring. Offspring of both sexes continue association with their mothers until her death. The population totalled 93 in 1994, which is 36% higher than its size of 68 when censused in 1976. All three southern resident pods were cropped during 1967-73 in a live-capture fishery for aquaria. At least 48 southern residents, mostly immature whales, were taken or killed during captures. The last surviving captive is in good health at Miami Seaquarium and is seen as a viable candidate for release back to Puget Sound.

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DIET AND ANNUAL FOOD CONSUMPTION OF CALIFORNIA SEA LIONS AND HARBOR SEALS IN PUGET SOUND. Patrick J. Gearin, National Marine Mammal Laboratory; and Steven J. Jeffries and Cyreis Schmitt, Washington Department of Fish and Wildlife.

California sea lions, *Zalophus californianus*, and harbor seals, *Phoca vitulina*, are two of the most important upper level marine predators within the Puget Sound Basin. Because of their large body mass, population size, and daily food requirements, they are capable of consuming large proportions of the standing stock biomass within this relatively small, inland marine basin. Both species have dramatically increased in abundance in Puget Sound over the last 20 years; California sea lions from near zero to 500-600 (Everitt et al. 1979; Gearin et al. 1987; NMFS 1995). Harbor seals from a few hundred to near 3,000 by 1992 (Huber 1992). Concurrent declines in many marine fish stocks over the last 20 years (Schmitt et al. 1995) raise questions about the potential impacts sea lions and seals may have had on Puget Sound fish stocks. Food habit studies of California sea lions in Puget Sound indicate that they feed primarily on Pacific hake (and other gadid fishes), herring, salmonids, spiny dogfish, and market squid (Everitt et al. 1981; Gearin et al. 1986, 1988). Harbor seals within Puget Sound and Hood Canal feed primarily on Pacific hake (and other gadids), flatfishes (Family Bothidae and Pleuronectidae), herring, midshipman, sculpins, and surfperch (Everitt et al. 1981; Calambokidis et al. 1978). The estimated average annual food consumption for California sea lions was 891-1,782 metric tons per year for 1986-94. Harbor seals consumed an estimated 2,593-2,859 metric tons per year based on 1992 population levels. Diet studies and food consumption estimates for pinnipeds need further refinement before potential impacts on fish stocks can be evaluated.

TOOTH WEAR AS AN INDICATOR OF AGE CLASS IN SHREWS. Karma E. Gerth, Andrew B. Carey, Suzanne M. Wilson, and Angela O. Bargmeyer, USDA Forest Service, PNW Forestry Sciences Laboratory

In our ecosystem study of mammalian prey species in second growth Douglas-fir forest, we use tooth wear as an index for determining age classes for the dusky shrew (*Sorex monticolus*) and Trowbridge's shrew (*Sorex trowbridgii*). By recognizing four distinct patterns of wear on the upper incisors and unicuspid of shrews, we are not only able to distinguish young from adults, but also to separate cohorts within each of these two generations. These four cohorts reveal a multi-layered age and reproductive structure of shrew communities during the summer months. By using tooth wear as an indicator of age class, we found consistent differences between sexes. Reproductive males are disproportionately represented in age class 4 and exhibit extremely worn teeth. Parous females, however, are typically in age class 3. The differences within this generation, however, are not correlated with other morphological characteristics (i.e. weight, body length). Several factors could explain age structure imbalance between the sexes including sex-based differences in diet and survival rate. The tooth wear index is simple and has been used by others in the past to establish age classes for shrews. Using such an index to partition populations into specific cohorts may prove useful in better understanding factors influencing species populations and the structure of shrew communities.

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ECOLOGICAL CONSIDERATIONS FOR SEA DUCKS: TOWARD THEIR CONSERVATION AND MANAGEMENT. R. Ian Goudie, Canadian Wildlife Service, Pacific Wildlife Research Centre, 5421 Robertson Road RR#1, Delta, BC V4K 3N2 CANADA.

Sea ducks comprise the tribe Mergini and spend large portions of their life on marine habitats. For the most part, they exploit near-short habitats and feed by diving to extract mollusks and crustaceans, and in some cases fish (mergansers). Sea ducks have a long history of conservation problems reflecting back to the extinction of Labrador Ducks in eastern North America to the current *threatened* listing of Spectacled and Stellers Eiders in the United States. Sea ducks display a life history more akin to sea birds, i.e., delayed sexual maturity, low recruitment, deferred breeding, and relatively long life (15 to 20 years). A Leslie matrix model of a Harlequin Duck population exemplifies the sensitivity of sea ducks to adult mortality. Current knowledge suggests that man-related mortality (e.g., from hunting, oil spills) is likely additive to natural mortality. Additional mortality exceeding 3 to 5% of the adult population on an annual basis is not sustainable over the longer term. This sensitivity coupled with strong philopatry to wintering and breeding sites supports the need to manage sea ducks very conservatively. For the most part, sea ducks have been treated similarly to Mallards and other "sport" ducks. This may account for many of the current sea duck conservation problems. Even under ideal conditions sea duck populations may only grow at rates of 6 to 12% per year; hence our ability to recover declining populations is limited. A conservative approach to sea duck management is essential and will require radical changes to our system which is viewed currently as reactive rather than proactive.

CHARACTERISTICS OF MARBLED MURRELET NESTS AND NESTING HABITAT IN NORTH AMERICA. Thomas E. Hamer, Hamer Environmental, and S. Kim Nelson, Oregon Cooperative Wildlife Research Unit, Oregon State University.

We summarize the characteristics of 61 tree nests and nesting stands of the marbled murrelet (*Brachyramphus marmoratus*) located between 1974 and 1993 from southcentral Alaska to central California. Evidence of breeding 30 to 60 km inland was common in Washington, Oregon, and California. Throughout the Pacific Northwest (British Columbia, Washington, Oregon) and California, murrelets nested in low elevation old-growth and mature coniferous forests, with multi-layered canopies (> 2), a high composition of low elevation conifer trees ($\bar{x} = 91\%$), and on the lower two-thirds of forested slopes, with moderate gradients ($\bar{x} = 23\%$ slope). Stand canopy closure was often low ($\bar{x} = 50\%$), suggesting use of canopy openings for access to nest platforms. Nests in the Pacific Northwest were typically located in the largest diameter old-growth trees available in a stand ($\bar{x} = 211$ cm); many trees were in declining condition and had multiple defects. It is likely that western hemlock (*Tsuga heterophylla*) and Sitka spruce (*Picea sitchensis*) constitute the most important nest trees, with Douglas-fir (*Pseudotsuga menziesii*) also being important south of British Columbia. Many processes contributed to creating nest platforms; mistletoe blooms, unusual limb formations, and tree damage, commonly observed in old-growth and mature stands, created suitable nesting platforms. Therefore, the stand structure and the processes occurring within a stand may be just as important as tree diameter in producing suitable nesting platforms and habitat. Moss cover was also an important indicator of suitable murrelet nesting habitat.

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ECOLOGY AND DISTRIBUTION OF INTRODUCED RACCOONS ON THE QUEEN CHARLOTTE ISLANDS, B.C. Lisa H. Hartman, B.C. Ministry of Environment, and Donald S. Eastman, B.C. Ministry of Environment.

The introduction of raccoons (*Procyon lotor*) to the Queen Charlotte Islands, B.C., poses a significant threat to large populations of burrow-nesting seabirds which breed in that area. This 4-year study investigated their current and potential impact on seabirds by comparing their ecology on and adjacent to a colony island, and describing their distribution throughout the archipelago. Analysis of scats ($n = 63$) indicated that raccoons forage almost exclusively in the intertidal zone in areas devoid of seabirds, but on colony islands switch to prey heavily on breeding seabirds. Locations of active animals were concentrated on the shoreline in the area devoid of seabirds but occurred inland significantly more often on the colony island. In a single-season study of predation, raccoons were responsible for an estimated 52% of total seabird losses; characteristic evidence of predation included decapitated adult birds, broken eggs, and diggings. Surveys of 61 islands in the archipelago indicated that raccoons have crossed distances of up to 950 m and have reached at least 11 colony islands. The accessibility of many colony islands to raccoons, the severity of raccoon predation on seabirds, and the ability of raccoons to subsist on intertidal fauna in the absence of seabirds all indicate a pressing need for monitoring and control efforts aimed at preventing their colonization of seabird islands.

THE INFLUENCE OF COMMERCIAL THINNING ON WILDLIFE POPULATIONS AND STAND STRUCTURE: A NEW COPE STUDY. John P. Hayes, William H. Emmingham, Stephen D. Hobbs, Robert G. Anthony, Nobuya Suzuki, Michael D. Adam, and Jennifer Weeks, Coastal Oregon Productivity Enhancement, Hatfield Marine Science Center, Newport, OR 97365.

Commercial thinning has been proposed as a means to meet various resource needs in Coast Range forests. However, fundamental questions concerning the response of wildlife populations in young stands to thinning activities remain unanswered. The Coastal Oregon Productivity Enhancement (COPE) Program has begun a study to examine the influence of commercial thinning on wildlife populations in managed plantations. The study involves subjecting relatively large treatment areas (at least 70 acres) to different thinning intensities in the northern Oregon Coast Range. Data on the response of bird, amphibian, and small mammal populations will be monitored over time. In addition, responses of vegetation are also being examined, from the perspectives of wildlife habitat, stand development, and natural regeneration of conifers. Pre-treatment data collection began in spring 1994 and the stands were thinned between the summer of 1994 and the spring of 1995. In this poster we present an overview of the study along with some preliminary pre-treatment data.

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RIPARIAN AREA MANAGEMENT AND BAT POPULATIONS. John P. Hayes, Michael D. Adam, and Patrick Hounihan, Coastal Oregon Productivity Enhancement Program, College of Forestry, Oregon State University, Corvallis, Oregon 97331.

As part of an ongoing study of bat populations in the Oregon Coast Range, we used Anabat II bat detectors to monitor activity of bats in logged and unlogged riparian areas. We recorded bat activity over a period of 55 nights at three study sites in the Oregon Coast Range during the summers of 1993 and 1994. Total bat activity in unlogged areas averaged 4.1 to 7.7 times higher than activity levels in adjacent logged habitats. The abundance of several taxa of insects differed between logged and unlogged habitats. Hypotheses to explain the differences in levels of bat activity are discussed. Our data indicate that relatively small-scale disturbances can significantly influence utilization of habitat by bats and that active management of riparian areas should consider the potential impacts on bat populations.

LOCAL MOVEMENT PATTERNS OF BUSHY-TAILED WOODRATS. Eli Holmes,
University of Washington, Zoology Department.

From August 1992 through September 1994, I studied the local movement patterns and nest use patterns of a population of **Bushy-tailed woodrats** (*Neotoma cinerea*) on the west slope of the Cascades. Using spool-and-line tracking, I obtained detailed recordings of runway, nest, and scent mark use for eight woodrats (four male and four female). Female woodrats exhibited nest fidelity throughout and between seasons, while males changed nests multiple times. Males and females appear to defend their nests as nest visitation between woodrats was recorded only once. Individual woodrats tended to use the same runway systems used by neighboring woodrats. Although the woodrats travelled hundreds of meters in an evening, scent mark visitation was generally restricted to within 50 meters of the home nest.

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HARBOR SEAL STOCKS IN WASHINGTON AND OREGON: EVIDENCE FROM GENETICS AND TAGGING STUDIES. Harriet R. Huber, National Marine Mammal Laboratory; Steven Jeffries, Washington Department of Fish and Wildlife; Robin Brown, Oregon Department of Fish and Wildlife; and Robert L. DeLong, National Marine Mammal Laboratory.

Harbor seals are the most abundant pinniped in Washington and Oregon. Because of the differences in timing of pupping, it has long been believed that there are two stocks of harbor seals in the northwest, one in coastal Washington and Oregon, the other in the inland waters of Washington. Tagging studies by WDFW and ODFW, begun in the early 1980s, showed significant movements of seals between coastal Washington and Oregon. Tagging studies by WDFW and NMML in the early 1990s indicated movements of harbor seals between Canadian and U.S. waters and between northern and southern Puget Sound. Studies of mtDNA sampled from 5 areas in Washington and Oregon showed that seals from inland waters shared common haplotypes not found in coastal seals and coastal seals shared common haplotypes not found in seals from the inland waters. Although genetic sample sizes are small, they confirm the finding of two stocks of harbor seals implied by pupping phenology and tagging studies. Separating stocks of harbor seals is necessary to determine the effects on local seal populations of mortality from treaty and non-treaty fisheries and tribal subsistence takes. The Washington and Oregon coastal stock is estimated at 27,500 to 30,000 harbor seals and the inland waters stock at 15,700 to 18,400 harbor seals.

LOCATING AND DOCUMENTING MARBLED MURRELET NESTS: A TECHNICAL PERSPECTIVE. Stephanie K. Hughes and Kevin M. Jordan, Arbonaut Access.

The location of marbled murrelet nesting sites has alluded researchers for many years. As surveying efforts intensified to study behavior, so did climbing efforts to locate nests. The methods and equipment used by climbers to access the canopy varies greatly. In this paper we discuss the benefits of a minimal-impact system developed specifically for locating and documenting marbled murrelet nests. As researchers establish long-term study sites of marbled murrelet nesting behavior, impact to the site, and possible disturbance of nesting activity has become an issue. The timing of when and how to climb is critical to the long-term success of marbled murrelet nesting sites.

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STATUS OF SEA OTTERS IN WASHINGTON STATE. Steven Jeffries, Washington Dept. of Fish and Wildlife, Marine Mammal Investigations, 7801 Phillips Road S.W., Tacoma, WA 98498; and Ronald Jameson, National Biological Service, 200 S.W. 35th Street, Corvallis, OR 97333.

Washington's current sea otter (*Enhydra lutris kenyoni*) population resulted from the reintroduction of this species into the coastal waters off the Olympic Peninsula in 1969 and 1970. The original stock from which this population was established came from Amchitka Island, Alaska. Few surveys were conducted to monitor the success of this translocation prior to 1977. Since then, however, surveys have been conducted annually by biologists from the Washington Department of Fish and Wildlife and the National Biological Service. Results of these surveys show that sea otters have been reestablished in the area from Destruction Island to Neah Bay. Survey results from 1994 show a maximum count of 360 sea otters distributed over this area. Areas of concentration can be found in the vicinity of Destruction Island, Cape Johnson, Yellow Banks, Sand Point, Cape Alava, and Mukkaw Bay. Scattered individuals and small groups occur throughout this area as well. The Washington population has been increasing at a finite rate of 12.1% per year since 1989 when the current survey methods were initiated. As this population continues to grow and expand its range, we expect areas of conflict to develop in the areas where their range extends into locations where tribal fisheries for sea urchins occur. Additional mortality can be expected as treaty rights of various coastal tribes are exercised to harvest sea otters for ceremonial and subsistence purposes.

OREGON STATEWIDE MARBLED MURRELET DATABASE: FROM OBSERVATION TO CONSERVATION. David H. Johnson, Oregon Department of Fish and Wildlife.

A statewide marbled murrelet database was established in Oregon in 1994. The database was designed to track summary information from observations made at independent survey stations. There are a number of crucial steps in designing a database which allows users to compile several thousand records into a single layer suitable for those involved with conservation assessment or recovery planning efforts. Additionally, individual records have legal as well as biological ramifications. This paper will describe database aspects of: (a) structure and utility, (b) data acquisition, (c) supporting the internal needs of data contributors, (d) data protection and confidentiality, (e) scientific credibility and legal challenges, (f) reality checks, and (g) database funding.

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A COMPARISON OF RESTING AND DENNING SITES OF THE AMERICAN MARTEN IN DISSIMILAR HABITATS OF THE PACIFIC NORTHWEST. Lawrence L. C. Jones and Martin G. Raphael, 3625 93rd Ave. SW, Olympia, WA 98512.

Resting and maternal denning site structures are important habitat features for the American marten (*Martes americana*). In order to better understand variation in these structures, it is important to document differences from dissimilar habitats. The habitats of our two marten study areas (western Washington, eastern Oregon) differ in vegetation species, canopy tree cover and diameter, timber harvest methods, and other features. To evaluate differences in selection of dens, we have collected 3,455 locations on martens, including 693 uses of 501 resting sites and 163 uses of 43 maternal den sites. Martens in Washington used mostly (71% of all uses) large-diameter, live or standing dead trees (snags) for both resting and denning structures, year-round. Slash and debris pile use accounted for only 12% of the total. In Oregon, resting sites were mostly slash piles (59%); tree use was infrequent (14%). During the winter, we observed a proportional increase in the use of logs. Trees and snags accounted for 48% of the dens, whereas slash piles accounted for 36% of the use. Our data suggest that retention of slash may contribute resting and foraging sites, but large-diameter trees and snags *may* be more important features for maternal denning sites. We anticipate additional research, including experimental manipulation of slash, to help determine the relative importance of standing versus downed wood.

ENDEMIC FAUNA OF THE OWYHEEAN ISLANDS OFF THE COAST OF IDAHO. Lawrence L.L.L.C. Jones, Janet L.L. Jones, Uncle Nardly, J. Jay, Barnabas Zokvnov, and Commander Salamander. Instituto de Bunko Historico Naturale, 666 Snorkybork Lane, Wallawallawa University for the Conceptually Challenged.

This little studied archipelago in the Palousian Sea boasts some of the most unique and unusual ecosystems known in the Northwest. Accordingly, the native fauna is quite unique: over 100% of the species found here are endemic. Chuck Darwin was the last naturalist to ever visit these terribly difficult islands to find and was amazed by what he saw. In his epic novel, *Organs of the Species*, he wrote, "...the beastes of these inhumane isles are so bizarre and foul, it makes me skin crawl. Let's split." In the summer of 1995, we were invited to investigate the mysterious sea-borne pinnacles. We were astounded by what we saw. There were three major habitat types, the Lentil fern Hills, the Forests of Ill-Smell, and the hideous Cliffs of Despair. Wherever we roamed, we encountered the ubiquitous Ultimate Chicken, the tiny, yet prolific Dear Mouse, *Promiscuous manipulatus*, and the Potatoe frog, *Spudacris vanilla* (Quayle). The forests supported the largest assemblage of vertebrates, including the Dead Frog and the Forest Pushbird. Denizens of the Lentil fern Hills included the elusive Tooth-cows. The Cliffs support few species of vertebrates, since they usually fall off. Major predators include the Proteropterox, the Flesh-eating Eagle, and the Night Stalker.

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RESPONSES OF HEADWATER STREAM AMPHIBIANS TO FOREST PRACTICES IN WESTERN WASHINGTON. Kathryn A. Kelsey, University of Washington.

Concerns regarding the effects of logging on stream breeding amphibian populations prompted a study to survey stream habitat and abundance of tailed frogs (*Ascaphus truei*) and Pacific giant salamanders (*Dicamptodon tenebrosus*) before and after logging of managed second-growth forest in western Washington. I surveyed ten low-order streams during each of the summers 1992, 1993 and 1994. Stream habitat surveys and amphibian searches were performed at each stream. Of the ten streams surveyed, five have been clearcut leaving variable-width buffers along the stream. One stream was clearcut with no buffer along the stream. The remaining four sites served as forested controls. Correlations of stream habitat characteristics and amphibian abundance reveal threshold levels of large organic debris necessary for sizable populations of stream amphibians. The presence of cobbles and boulders indicate habitat suitable for both species. Comparisons of amphibian abundance before and after timber harvest reveal a significant impact of timber harvest on tailed frog populations ($p < .05$). Pacific giant salamander populations did not show a significant response to timber harvest ($p > .05$). Results suggest that tailed frog populations are more susceptible to changes in adjacent forest structure that can increase light and sediment inputs to stream than are Pacific giant salamanders.

BLACK BEAR MORTALITY AND HABITAT UTILIZATION INVESTIGATIONS.
Gary M. Koehler, Washington Department of Fish and Wildlife.

The Washington Department of Fish and Wildlife is continuing large mammal investigations. During the spring of 1994, a black bear (*Ursus americanus*) study was initiated. Radio-equipped bears were captured in one eastern and one western Washington study area. Objectives of the study are to document mortality sources and factors associated with black bear mortality in Washington State. Other objectives include habitat use in a variety of habitats occurring throughout the state and obtaining information on black bear density. This study is scheduled to continue through 1997.

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**IMPACTS ON VERTEBRATES OF THE 1994 WILDFIRES IN THE
NORTHEASTERN WASHINGTON CASCADES.** John F. Lehmkuhl, Pacific Northwest
Research Station, Wenatchee, WA; Camryn Lee, William Gaines, Heather Murphy,
Mallory Lenz, and Susan Piper, Wenatchee National Forest, Wenatchee, WA.

The Tyee and Hatchery-Complex fires were two of the large fires that burned from late July through August 1994 in the northeastern Washington Cascades. The Tyee burned 140,000 acres of mostly mid- and low-elevation forest. The Tyee fire was intense: 57% of the area burned with moderate to high intensity. The firestorm resulted in direct mortality or injury of deer, black bear, coyote, and cougar, and the likely decimation of smaller vertebrates. About 60,000 acres of mule deer winter range burned, with an 80% reduction in short-term carrying capacity. Nine thousand acres of spotted owl habitat burned, affecting at least four active pairs and two single birds. The Hatchery-Complex fires burned over 43,000 acres of mid- and high-elevation forest. In contrast to the Tyee fire, only 21% of the area burned with moderate to high intensity. The low intensity of the burn resulted in relatively few large impacts on vertebrates. Habitat for eight known pairs of spotted owls burned, but there likely will be no adverse impacts. Impacts of fire rehabilitation efforts on both fires will be discussed. Current rehabilitation and other management efforts aim to create a scientifically based landscape design that meets the needs of ecosystem management first, then the production of forest products where compatible.

AMPHIBIAN AND REPTILE INVENTORY AT McCHORD AIR FORCE BASE, PIERCE COUNTY, WASHINGTON. William P. Leonard, Washington Natural Heritage Program, Department of Natural Resources, P.O. Box 47016, Olympia WA 98504-7016.

Over the past 130 years, many interesting herptiles have been documented in and around McChord Air Force Base. Some of the species once found there (i.e., spotted frog, western pond turtle, sharptail snake, gopher snake, and racer) have not been recorded from the county in over half a century. Beginning in February 1994 a study was begun to determine what herptiles are currently found on the base. McChord Air Force Base and adjacent Fort Lewis include within their boundaries some of the largest remaining tracts of undeveloped lands in the Puget Lowlands. Within the McChord boundaries are remnant prairies, oak woodlands, Douglas-fir woodlands and wetlands. During the 1994 field season, several field methods were used to optimize the chances of encountering all species present. A drift fences array was constructed in an open grassland and monitored through the spring and early summer. Two 6x6 pitfall grids were installed and monitored in a mature Douglas-fir forest. Aquatic funnel-trap transects were rotated through all wetlands on the base. Turtle basking platforms were anchored in several ponds and periodically monitored. Two cover board transects were laid out in a Oregon oak woodland. Thus far, 8 herptiles have been found including: long-toed salamander, northwestern salamander, rough-skinned newt, Pacific treefrog, red-legged frog, common garter snake, northwestern garter snake, and western terrestrial garter snake. Several species are notable by their absence. It was expected that the ensatina, western red-backed salamander, and western toad would be found on the base. The western pond turtle was historically known from two wetlands on McChord Air Force Base, but now appear to be gone. Racers and sharptail snakes collected within 0.5 miles of the base in the late 1930s have not been encountered. The gopher snake, which some question was ever native to western Washington, was not detected.

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THE FEEDING ECOLOGY OF LOGGERHEAD SHRIKES (*LANIUS LUDOVICIANUS*) IN DISTURBED SHRUBSTEPPE HABITAT IN WASHINGTON. Matthias Leu and David A. Manuwal, University of Washington, Seattle.

In the Columbia Basin, remnant shrubsteppe plant communities have changed in species composition and cover characteristics through the introduction of Eurasian grass and forb species. To investigate the feeding ecology of loggerhead shrikes in disturbed habitat, we examined the effects of vegetation cover on foraging attempts and selection of habitat type for foraging during the 1994 breeding season at the U.S. Army Yakima Training Center. Loggerhead shrikes are sit and wait predators, utilizing perches to capture prey. Most (89.3%) foraging occurred on the ground. We compared the effects of vegetation cover (4 classes) and height (3 classes) on foraging attempts. For adults and juveniles, 67.8% and 71.8% of their respective foraging attempts took place in the < 50% vegetation cover classes. We also found that the habitat types chosen by shrikes for foraging were not proportional to occurrence of habitat categories in adults (3 of 3 territories) and juveniles (4 of 4 territories). As predicted, juveniles selected for bare ground and against complete cover in 4 of 4 territories. In 3 of 3 territories, adults selected for the 0-25cm height class but selected against the 26-50cm and > 50cm height classes. Because disturbance increases vegetative cover and decreases the availability of bare ground we hypothesize that the foraging behavior of loggerhead shrikes may be influenced by disturbance in the shrubsteppe habitat.

DISTRIBUTION AND ABUNDANCE OF STREAM-DWELLING AMPHIBIANS IN SOUTHWESTERN WASHINGTON. Patricia A. MacLaren, Douglas E. Runde and Heidi D. Wetmore, Weyerhaeuser Company, Environmental Forestry Department, WTC 1A5, Tacoma, WA 98477.

As part of developing a habitat management plan, Weyerhaeuser Company initiated wildlife and vegetation field surveys on intensively managed second and third growth forest land in southwestern Washington. The study area is 106,000 acres of contiguous Weyerhaeuser Company ownership in western Lewis and eastern Pacific counties spanning three watersheds (Upper Chehalis, Stillman Creek and southern Willapa Headwaters) of the northern Coast Range. Surveys for the presence of stream-dwelling amphibians in 42 small, headwater streams were conducted from July through September 1994. Ten-meter stretches of stream were sampled following methods described by Bury and Corn (1991: Sampling Methods for Amphibians in Streams in the Pacific Northwest, PNW-GTR-275). Eight species of amphibians were documented using streams within this managed forest. The most widespread species was *Rhyacotriton kezeri* which occurred in 76% of sampled streams. Similarly, *Plethodon vehiculum* occurred in 60% of streams; *Dicamptodon tenebrosus* 57%, *D. copei* 50%, *Ascaphus truei* 38%, *P. dunni* 36%, *Rana aurora* 19% and *P. vandykei* 2.4%. Abundances varied from 0 to 181 total individuals captured per 10-meter stretch of stream.

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SURF SCOTERS AND PIGEON GUILLEMOTS AS CONTAMINANT MONITORS. Mary Mahaffy, Camille Bennett, and Wendy Parson, U.S. Fish and Wildlife Service.

As part of the Puget Sound Ambient Monitoring Program, the U.S. Fish and Wildlife Service has been evaluating the potential use of surf scoters and pigeon guillemots for monitoring contaminants. A telemetry study on winter movements of surf scoters was conducted in 1992-93 (Year One) and 1993-1994 (Year Two). The objective was to determine if collection of scoters in fall and spring was appropriate to measure contaminant exposure at sites in Puget Sound. A floating mist net was used to capture scoters. The capture rate was 2.66 and 0.77 birds/capture day in Years One and Two, respectively. Six scoters were monitored via radio telemetry in Year One and 17 in Year Two. Twenty of the 23 scoters were found within 11 km of their capture sites and were present in the study area an average of 91% of the days monitoring was conducted, indicating localized movements. Based on these findings, surf scoters would be an appropriate contaminant monitoring species. Nest boxes for pigeon guillemots were placed at four locations in Puget Sound (Olympia, Seattle, Port Townsend and Protection Island) and at Westport on the outer coast between 1992 and 1994. Nest boxes allow easy access for recording nest productivity, measuring chick growth rates, banding chicks, and potentially for contaminant monitoring. Guillemots nested in boxes at all locations except Seattle. Rock doves used some of the boxes. Contaminant monitoring has not been initiated for either species.

AT-SEA POPULATION SIZE AND DISTRIBUTION OF MARBLED MURRELETS IN BARKLEY SOUND, BRITISH COLUMBIA: 1982 VERSUS 1994. Irene Manley, unaffiliated, and John Kelson, University of British Columbia Fisheries Center.

In June 1994 we repeated extensive at-sea surveys of marbled murrelets (*Brachyramphus marmoratus*) in Barkely Sound, BC, using the same methods as the first survey done in June 1982 by H. Carter. Murrelet distribution was determined by counting birds in 544 contiguous 1km² quadrats in fiord, channel, and inshore habitats. Total population counts for this area, which may be less than the actual total population, was 3,406 birds in 1982 and 1,983 birds in 1994. This is an apparent 42% decrease in the population size. Birds showed clumped distribution in both surveys, with the highest densities in inshore and channel waters. We compare the location, densities, and size of aggregations.

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SAMPLING FOR MARBLED MURRELETS AT FAR INLAND SITES IN CALIFORNIA: HOW ROBUST IS OUR DESIGN? Teresa Matsumoto, Humboldt State University and College of the Redwoods.

The sampling design to determine whether a forest stratum contains marbled murrelets consists of multiple visits to randomly chosen sites, in an attempt to detect the presence of the murrelets. With low density populations, the probability that a murrelet is present at any particular location is extremely small. Furthermore, while the murrelet nesting season lasts from April to September, a given pair may be present only two months during this time. Due to the timing variability, and the bird's reclusive behavior, the conditional probability of detecting murrelet presence is small. The issue under consideration is then: If the murrelets are present in the forest stratum, what are our chances of detecting them? Computer simulations help assess the relationships between the number of sites sampled, the number of visits made to each site, and the power of the sampling design. An understanding of these relationships can help in planning for enough sample sites. Various probabilities of presence at sampled locations were used in the simulations. Also, since the conditional probability of detection is not constant, fixed values *and* random values (with different probabilities for each visit) were used to simulate reality more closely. The focus of this presentation will be on the results of this sensitivity analysis, and its implications for wildlife sampling design and analysis.

PAST DISTRIBUTION AND CURRENT STATUS OF THE NORTHERN LEOPARD FROG (*RANA PIPIENS*) IN EASTERN WASHINGTON. Kelly R. McAllister, Washington Department of Fish and Wildlife, William P. Leonard, Washington Department of Natural Resources--Natural Heritage Program, and Sandy Andelman, the Nature Conservancy.

Prior to the beginning of this century, Northern Leopard Frogs (*Rana pipiens*) were known from two areas of Washington State, the Pend Orielle River and Walla Walla vicinity. Dean Metter's 1958-59 Master's research on the amphibians of eastern Washington provided the first broad inventory in the region. Metter found Northern Leopard Frogs locally abundant in previously recorded areas and added a new locality at Spectacle Lake in Okanogan County. In the 1970's and early 80's biologists noted that Northern Leopard Frogs were abundant around lakes and ponds of the Columbia National Wildlife Refuge and Potholes Wildlife Area. Our work involved reviewing museum specimens to verify species identification and revisiting historic sites to search for Northern Leopard Frogs. We visited historic localities two to three times, walking the margins or rivers, ponds, and lakes looking for frogs, tadpoles or egg masses. We did not find Northern Leopard Frogs in most historic localities, including the well-documented Pend Orielle River and Walla Walla vicinities. We did find Northern Leopard Frogs at the Potholes Wildlife Area. Areas without Northern Leopard Frogs usually have an abundance of bullfrogs while those areas with extant Northern Leopard Frog populations lack bullfrogs.

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THE INFLUENCE OF PROXIMITY TO HUMANS ON POPULATION DENSITY AND HOME RANGE SIZE OF MOUNTAIN BEAVER (*APLODONTIA RUFA*). Karen L. Morris, Christy L. Kimpo, Greg A. Morris, and James C. Ha, Chrysalis School (KLM & GAM); Department of Psychology, University of Washington (CLK & JCH).

Mountain beaver (*Aplodontia rufa*) are found in heavily forested areas from southern British Columbia to Northern California. The purpose of our study was to determine whether there were differences between mountain beaver populations studied on public lands (national park and forest lands) and those studied on a suburban site. Our study examined population density and home range area on a 2 hectare study site in suburban Woodinville, King County, Washington. Fourteen subjects were captured a total of 77 times on 874 trapnights between September 1993 and July 1994. Subjects were weighed, marked with permanent dye for identification, marked with fluorescent dye for determining home range, and released. Home range was calculated by marking the fluorescent dye trails left by each subject and using the minimum convex polygon method. Population density and home range on the suburban site were compared to previously published studies on public lands. Mountain beaver populations in close proximity to human habitation had a higher population density and smaller home ranges than those found on public lands.

HISTORICAL BIOGEOGRAPHY OF INSULAR MAMMAL FAUNAS IN THE PACIFIC NORTHWEST. David W. Nagorsen, Biology Unit, Royal British Columbia Museum, Victoria, BC, Canada V8V 1X5

The coastal area of British Columbia and southeastern Alaska supports a complex series of land-bridge islands. Historical factors such as glacial refugia or late Pleistocene early Holocene ice/land-bridge connections; and recurrent immigration and extinction have presumably shaped these insular mammal faunas. I analyzed faunal affinities, species composition, and species richness in 12 large islands (800-33,800 km²) and seven coastal mainland areas from Washington to Alaska. Faunal elements and similarity coefficients (Jaccard's) demonstrate that the insular faunas are most similar to faunas of the Alaska Panhandle and central British Columbia coast. Faunal similarity is strongly correlated with distance to source area. Multivariate analysis of eight biogeographic parameters revealed that isolation accounts for 59% and area only 20% of the variation in species richness among the islands. These insular mammalian faunas are mainly derived from post-glacial immigration. The prevalence of extinction prone groups such as carnivores, the low incidence of endemism, and the strong association of species richness and species composition with isolation is inconsistent with islands relaxing to equilibrium. The isolated Queen Charlotte Islands support a depauperate mammalian fauna isolated since the early post-glacial. Vancouver Island and islands from the central British Columbia coast and Alexander Archipelago support a mix of relictual species and recent immigrants.

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MARBLED MURRELET NEST SUCCESS AND HABITAT CHARACTERISTICS. S. Kim Nelson, Oregon Cooperative Wildlife Research Unit, Oregon State University.

Information on marbled murrelet (*Brachyramphus marmoratus*) productivity and sources of mortality was compiled from known tree nests in North America. Most (72%, $n = 23$ of 32 with known outcomes) nests were unsuccessful. Known causes of nest failure included predation of eggs and chicks, nest abandonment by adults, chicks falling from nests, and nestlings dying. The major cause (56%) of nest failure was predation. Predators of murrelet nests were Common Ravens (*Corvus corax*) and Steller's Jays (*Cyanocitta stelleri*); predation of a nest by a Great-horned Owl (*Bubo virginianus*) was also suspected. Changes in the forested habitat, such as increased amounts of edge, may be affecting murrelet productivity. Successful nests were further from edges (> 55 m) and were better concealed ($\bar{x} = 87.2\%$ cover above nest) than unsuccessful nests. Because this seabird has a low reproductive rate (1 egg clutch), increases in predation rates could have deleterious effects on population viability. Rigorous studies, including testing the effects of various habitat features on recruitment and demography, should be developed to further investigate the effects of predation on marbled murrelet nesting success.

OVERVIEW OF THE MARINE BIRD AND WATERFOWL TASK WITHIN THE PUGET SOUND AMBIENT MONITORING PROGRAM. David R. Nysewander, Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, WA 98501-1091, (360) 664-9348.

The Washington Department of Fish and Wildlife was given the responsibility in 1991 to design and implement monitoring for marine birds, waterfowl, and marine mammals under the Puget Sound Ambient Monitoring Program. The avian abundance data were intended for use in characterizing and interpreting spatial and temporal trends or patterns. Study design was contracted and aerial surveys began the summer of 1992. Three sets of summer and winter aerial surveys will have been conducted by February 1995 sampling the entire shoreline of greater Puget Sound by two strata: nearshore (< 10 fa) and offshore (> 10 fa). These surveys annually covered 15.1% to 18.3% of the nearshore and 3.7-5.7% of the offshore marine waters found in Puget Sound up to the Canadian border and out to the entrance of the Strait of Juan de Fuca. Comparisons of simultaneous aerial and boat survey data on certain transects, begun in July 1993 and continued 1994-95 have developed correction factors for the aerial survey data. Key species, including four alcid and seven diving duck species as selected by criteria in the project's implementation plan (Nysewander et al. 1993), were examined for monitoring purposes by several different parameters: population estimates and associated confidence limits, densities, and counts. Some of the 1992-94 survey data is compared with data in a synthesized historical database using the 1978-79 MESA studies and some 1980-86 surveys.

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ORGANIZATION OF SHREW ASSEMBLAGES IN THE PACIFIC NORTHWEST. Margaret A. O'Connell, Eastern Washington University; and James G. Hallett, Washington State University.

Recent arguments suggest that shrew assemblages in eastern North America are structured following rules based on relative body size. We are examining the generality of this idea and present results of studies in northeastern Washington. We used pitfall and snap-trapping in 1992 and 1993 to sample shrew populations in riparian and adjacent upland habitats on 18 streams. In 1993, an additional 36 sites, representing three forest types (clearcut, regeneration, and mature) and two stand sizes (≈ 12 and $36+$ ha), were sampled by pitfall trapping. The five shrew species present ranked by decreasing average body mass were *Sorex palustris* (8.6 g), *S. vagrans* (5.8 g), *S. monticolus* (4.7 g), *S. cinereus* (4.1 g), and *S. hoyi* (3.0 g). *S. vagrans* occurred on all 72 sites, although its abundance varied between years and sites. *S. cinereus* was almost as common, occurring on 61 sites. This species was least abundant in large clearcut and regeneration stands. *S. monticolus* was uncommon and occurred at only 30 sites, although there was interyear variation in its presence on a site. This species was found less frequently in regeneration stands. *S. monticolus* usually occurred in association with *S. vagrans* and *S. cinereus*. *Sorex hoyi* was rare everywhere, had high interyear variation in its presence at a site, and showed no habitat associations. *S. palustris* was also rare and occurred only in riparian areas. Our results are consistent with the hypothesis that competition structures this soricid assemblage. Presence/absence data may be generally inadequate for assessing assembly rules.

**AQUATIC VERTEBRATE COMMUNITIES IN WESTERN OREGON FORESTS:
AMPHIBIANS CAN DOMINATE STREAM ECOSYSTEMS. Deanna H. Olson, Pacific
Northwest Research Station, Corvallis, OR**

This study addresses the prediction that amphibians can represent an important component of stream vertebrate assemblages in Pacific Northwest forests. Stream vertebrate assemblages were examined within and among habitat types (pools, glides, and riffles) and stream reaches for three third-to-fifth order streams in northwestern Oregon. Capture and release of stream vertebrates was conducted by electrofishing. Distributional and demographic patterns of stream vertebrates were assessed, and the relative abundance and biomass of amphibians was examined. Aquatic vertebrates found in the study streams included anadromous salmonid fishes (*Oncorhynchus* spp.) and three bottom-dwelling taxa: cottid fishes (*Cottus* spp.), tailed frogs (*Ascaphus truei*), and Pacific giant salamanders (*Dicamptodon tenebrosus*). Assemblages varied among streams, and patterns were apparent with regard to species compositions, abundances, and size-age structures in the different habitat types. Electrofishing results demonstrate that amphibians can be dominant components, numerically and in biomass, of these stream systems. For example, at Schooner Creek in the central Oregon coast, over half the vertebrates collected by electrofishing were larval amphibians and they represented one third of the vertebrate biomass sampled. This is a conservative estimate of the amphibians present because electrofishing does not effectively sample bottom-dwelling species.

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

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*). Our approach is to compare the results of a baseline ecological study (1953-1955) with a similar study (1991-1994) of a frog population in Yellowstone Park at a site where habitat modifications have occurred. We are investigating changes in the population's demographic characteristics, habitat use, and movement patterns. Population size has declined by approximately 80%. There are changes in the proportion of the population using and dispersing among various habitat features within the study area. The most probable causes of these changes are road construction and water developments. In an adjacent area less affected by these disturbances, the abundance of spotted frogs does not appear to have changed significantly over the same 40-year period.

SEABIRD INTERACTIONS WITH NON-TREATY SOCKEYE GILL NET FISHERY IN NORTH PUGET SOUND. D. John Pierce, Pam Erstad, and Steve Jeffries, Washington Department of Fish and Wildlife, 600 Capitol Way N., Olympia, WA 98501.

Several species of seabirds live year round in Puget Sound. Common murre, rhinoceros auklets, and pigeon guillemots are the most abundant seabird species found during Washington Department of Fish and Wildlife surveys. In addition, the marbled murrelet, a species listed as threatened under the Endangered Species Act, occurs in certain areas in Puget Sound. There is also a substantial commercial gill net fishery in the Sound during the summer and fall. Preliminary data collected in 1993 suggested that potential seabird and fishery interactions were greatest in northern Puget Sound (fishing areas 7 and 7A) during the August sockeye fishery. In 1994 a research project was conducted to estimate the level of seabird entanglements with the non-treaty sockeye fishery and estimate the number of seabirds incidentally killed during the commercial gill net sockeye fishery. Observers witnessed a total of 269 individual boat trips, and 1051 sets, during the month-long sockeye fishing season. This effort represented approximately 6% of the total non-treaty sockeye fishing effort. A total of 188 birds were observed entangled (96% mortalities). Most of the birds entangled were common murre (75%) and rhinoceros auklets (22%). Additional species entangled were loon spp. (n = 2) and pigeon guillemot (n = 1). The probability of seabird entanglement was significantly associated with the fishing area (7 or 7A), the number of birds observed within 10 meters of the net during the set, and the set distance to shore. Entanglement rates were estimated to be 0.49 birds/set in fishing area 7 and 0.03 birds/set in fishing area 7A.

CHARACTERISTICS OF ROOST TREES USED BY PILEATED WOODPECKERS ON THE OLYMPIC PENINSULA IN WESTERN WASHINGTON. Catherine M. Raley, Gregory W. Tomb, and Keith B. Aubry, USDA Forest Service, Pacific Northwest Research Station, 3625 93rd Ave. SW, Olympia, WA 98512.

In 1992 we initiated a radio-telemetry study of pileated woodpeckers to determine habitat characteristics of nest and roost sites, home range size, and habitat use within a managed forest landscape. The 8,289-ha study area is within the western hemlock and Pacific silver fir forest zones on the west side of the Olympic Mountains. During 1992 and 1993 we captured and radio-tagged 17 adult pileated woodpeckers at nest and roost cavities. We tracked birds year-round, or until an individual died, and located roost trees every 1 to 2 weeks. We located 120 roost trees: 64 in western hemlock (46 snags, 15 decadent trees with dead tops, and 3 live trees), 47 in western redcedar (17 snags and 30 decadent trees with dead tops), and 9 in Pacific silver fir (8 snags and 1 live tree). The mean dbh and height of roost trees was 112 cm and 34 m for western hemlock, 205 cm and 44 m for western redcedar, and 112 cm and 40 m for Pacific silver fir. Roost sites for adult birds consisted of both excavated cavities and natural hollows in trees.

FOOD LIMITATION AND HABITAT PREFERENCE OF NORTHERN FLYING SQUIRRELS AND RED SQUIRRELS. Douglas B. Ransome and Thomas P. Sullivan, Department of Forest Sciences, Faculty of Forestry, University of British Columbia, Vancouver, British Columbia, Canada V6T 1Z4

Food limitation of northern flying squirrels (*Glaucomys sabrinus*) and red squirrels (*Tamiasciurus hudsonicus*) were examined in the south-central interior of British Columbia. Populations were monitored in 2 second-growth lodgepole pine (*Pinus contorta*) stands (controls) and 2 second-growth stands with food supplementation. Live-trapping was conducted for two summers starting in June 1992. Treatment stands had significantly more flying squirrels than control stands ($P < 0.001$). Average densities of flying squirrels were twice as high in treatment stands (1.38 and 1.50 squirrels/ha) than control stands (0.64 and 0.68 squirrels/ha). In 1992, the abundance of red squirrels was not significantly different between control and treatment stands ($P = 0.74$). In 1993, treatment stands had significantly more red squirrels ($P = 0.008$) than control stands. The average weight of adult males, survival rates, and the proportions of female and male flying squirrels, and male red squirrels in breeding condition were not significantly different in control and treatment stands. The proportion of female red squirrels in breeding condition was significantly higher in control than treatment stands. Consequently, population sizes of flying squirrels and red squirrels were limited by food availability but individual squirrels did not appear to benefit from food supplementation. An intensive survey of cavities, coupled with subsequent cavity checks, indicated that flying squirrels did not use cavities and their population size was not limited by the availability of cavities during this study. These results do not support the hypothesis that flying squirrel abundance is positively related to the abundance of cavities.

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THE CONTRIBUTION OF FEDERAL AND NONFEDERAL HABITAT TO PERSISTENCE OF THE NORTHERN SPOTTED OWL ON THE OLYMPIC PENINSULA, WASHINGTON. Martin G. Raphael, PNW Research Station; Richard S. Holthausen, National Forest System; Kevin S. McKelvey, PSW Research Station; and Eric D. Forsman, PNW Research Station.

As part of a federally sponsored research team, we used a spatially-explicit, single-organism, simulation model to investigate the contributions of differing amounts of nonfederal habitat on persistence of the northern spotted owl (*Strix occidentalis caurina*) on the Olympic peninsula of Washington. We first developed a map of current nesting, roosting, and foraging habitat for all ownerships on the peninsula. We used a simple projection model to estimate growth of new habitat over time on national forest land. We investigated simulated population size and patterns of occupancy by pairs of owls over a 100-yr period. We concluded that it is likely, but not assured, that a stable population of owls could be maintained on portions of the Olympic National Forest and portions of the Olympic National Park in the absence of any nonfederal habitat. However, retention of nonfederal habitat, especially on the western edge of the peninsula, could result in a biologically significant contribution to the maintenance of a stable population of owls. Significant uncertainty remains, due to differing assumptions and inferences from demographic studies, and unknown affects of increasing numbers of barred owls (*Strix varia*).

THE PACIFIC GIANT SALAMANDER IN BRITISH COLUMBIA: HABITAT USE AND DEMOGRAPHY. John S. Richardson and William E. Neill, Department of Zoology, University of British Columbia, Vancouver, BC, Canada, V6T 1Z4.

The Pacific Giant Salamander, *Dicamptodon tenebrosus*, reaches the northward limit of its range just within the Canadian border. Concern over this species derives from the limited range within the country, its apparent scarcity, existing at the north of its range, and potential threats from logging including direct damage to streams and population isolation. As part of a long-term study of the population dynamics of this species we have conducted a quantitative survey of density and habitat characteristics within the Chilliwack River catchment of British Columbia. Within the species' known range we surveyed 70 streams to assess occurrence and density of this species. Of these streams, salamanders were found in 20, but presence and density bore no clear relationship to forest harvest activities. Larvae were found in streams draining through clear cuts, second growth, and unmanaged forests, and from 110 to 1360 m asl. Stream stability may be a more critical habitat element than forest harvest itself. There are at least five hypotheses that might account for this latter result. We have also begun mark-recapture work on selected populations and radiotelemetry studies of transformed adults.

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LATE WINTER FORAGING DYNAMICS OF WOODLAND CARIBOU IN THE SOUTHERN SELKIRK MOUNTAINS. Eric M. Rominger, Dept. of Zoology, Washington State University, Pullman, WA 99164.

To better understand the late winter foraging dynamics of woodland caribou (*Rangifer tarandus caribou*) in the arboreal lichen feeding niche, we used bottle-raised caribou in a field trial in historical woodland caribou habitat in the Selkirk Mountains of northeastern Washington. Caribou consumed a monophagous diet of arboreal lichen with 93% of bites on standing subalpine fir (*Abies lasiocarpa*) and dead trees. Bite size, bite rate, intake rate, tree-resident time, and amount of lichen eaten/tree were included in a General Linear Model with tree species, tree size class, and tree lichen class as the independent variables. All variables, except bite size, increased significantly with an increase in lichen class. A regression model constructed within the framework of the GLM-predicted intake rate of lichen based on available lichen biomass. Caribou foraging on the lowest lichen class trees would have to forage longer than is reported for ungulates to meet predicted daily intake requirements. Tree-resident time and between-tree time varied inversely with tree density. Results from laboratory and field research have substantial implications for forest management in woodland caribou habitat.

HABITAT MANAGEMENT PLANNING FOR PRIVATE TIMBERLANDS: THE WEYERHAEUSER COMPANY'S APPROACH AND PROGRESS. Douglas E. Runde, Weyerhaeuser Company, Environmental Forestry Department, WTC 1A5, Tacoma, WA 98477.

The goal of Habitat Management Planning at Weyerhaeuser is to incorporate non-timber resource values into our forest management. This approach reduces the need for single species management, provides protection for unique areas, maintains biological diversity, and derives desired future conditions for the landscape. It should lead to a more stable regulatory environment. A watershed analysis identifies upslope conditions which could have an adverse impact on aquatic ecosystems which are further protected by maintaining a range riparian conditions similar to those found in unmanaged areas. Surveys locate unique cultural resources, and identify rare biotopes and plant populations. Current habitat features for groups of species with common breeding requirements are mapped, and future occurrences of these features are predicted. Models are developed to relate potential wildlife habitat to these features, and provisional habitat objectives are established for each species group. Potential wildlife habitat, current and future, is predicted by applying the wildlife models to this vegetation information. An economic analysis leads to management plans to produce the desired habitat, and determines the financial impact of achieving each habitat objective. If all objectives cannot be achieved they are ranked with outside stakeholder participation. This process ensures that agreed-upon goals can be met within financial constraints. Monitoring assesses the efficacy of the plan and the underlying science, provides new vegetation data, and determines actual wildlife species occurrence. Models and prescriptions are tested and improved using this new data. Through this adaptive management new desired future conditions and management plans are developed.

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BIRD-HABITAT RELATIONSHIPS IN INDUSTRIAL FORESTED LANDSCAPES OF THE INLAND NORTHWEST. Rex Sallabanks, Conservation Research Foundation, Inc.

The relative abundance of breeding birds was measured in 104 industrial forest stands owned by Boise Cascade Corporation in west-central Idaho and northeastern Oregon. Vegetation was also intensively sampled where bird surveys were conducted. Stands were selected for sampling based upon habitat type, coniferous overstory composition, and crown closure. In Idaho, habitat type was found to influence the distribution of many bird species. Dry, open stands of Douglas Fir appeared to be the least favored of the three habitat types studied. Neotropical migrant songbirds favored wet Grand Fir habitat types. In Oregon, it was crown closure rather than coniferous overstory composition that was found to affect bird species composition. Due primarily to the predominance of permanent resident (i.e., non-migratory) species, open-canopy stands contained more birds compared with closed-canopy stands. When closed-canopy managed and unmanaged (old-growth) stands were compared in Oregon, avian abundance and species richness were found to be greater in managed stands. Only three species were found to prefer old-growth over managed stands of the same habitat type and crown closure. For both study areas, stand types were compared with respect to vegetation (e.g., snag, tree, and shrub density, ground cover attributes, etc.) and significant habitat functions were derived for many bird species. A better understanding of why birds were distributed as they were across different habitat types and stand conditions was then achieved by combining information from stand-vegetation relationships with habitat functions.

SUCCESSION AND THE METAPOPOPULATION DYNAMICS OF AMPHIBIANS: A LONG-TERM STUDY. David K. Skelly, University of Washington, Seattle, WA 98195; Earl E. Werner, University of Michigan, Ann Arbor, MI 48109; and Spencer A. Cortwright, Indiana University Northwest, Gary, IN 46408.

We evaluated distributional dynamics of 14 pond-breeding amphibians in a set of 32 ponds in southeastern Michigan. We assessed presence or absence of each species in each pond between 1988 and 1992 and compared our results with survey data collected 1967-74. Between surveys most species experienced large numbers of invasions and extinctions, but low net changes in numbers of populations. We suggest that succession in the form of increasing forest cover and decreased pond permanence has altered distributions of habitat-specific amphibians. These results have critical implications for understanding the links between land management practices and amphibian distributions.

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AN ANALYSIS OF ELK POACHING LOSSES, AND OTHER MORTALITY SOURCES IN WASHINGTON, USING BIOTELEMETRY. J.L. Smith, W.A. Michaelis, K. Sloan, J. Musser, and D.J. Pierce.

A total of 335 adult elk were captured and successfully monitored from March 1988 through June 1993 in the Colockum, Olympic, and St. Helens study areas of Washington State. Elk were equipped with radio-collars or an internal rumen transmitter. Main objectives of the study were to (1) define poaching, (2) develop a reliable measurement of the numbers of elk lost to poaching each year in Washington, and (3) determine factors associated with poaching activity. Poaching was defined as elk killed during closed season, in a closed area, or in excess of the bag limit, including the taking of an illegal animal in open season, closed season harvest, vandalistic shooting, and persons killing more than the one-elk bag limit. Statewide annual poaching mortality during the study was 21% of the 1988-1972 mean annual legal elk harvest and is equivalent to 2,000 elk lost annually to poaching in Washington. A total of 165 radio-equipped-elk mortalities were documented and classified as Elk taken by hunters (59%), Poaching (15%), Natural (15%), Wounding (7%), and Other (4%). Poaching of elk in Washington appears to be a largely opportunistic activity. There was no difference in the poaching rate between bulls and cows. No difference existed in the poaching levels of either yearling or adult bulls. Only 12% of documented poaching occurred more than 3 weeks outside an elk season. The majority of poaching (56%) occurred during an open elk season. Most elk poaching occurred within 30 miles of urban areas and within 300 yards of a driveable road. The St. Helens area had twice the amount of poaching than the other two study areas.

AN ANALYSIS OF ELK POACHING LOSSES AND OTHER MORTALITY SOURCES IN WASHINGTON USING BIOTELEMETRY. Smith et al.

The Washington Department of Fish and Wildlife is continuing large mammal investigations. During September of 1994 a study to document elk poaching losses and other mortality sources (Smith et al. 1994) was concluded and formally released. Main results addressed factors most important to poaching and achieved a more reliable method to estimate elk lost to poaching annually in the state. Development of an internal rumen transmitter was employed to test visibility bias. Copies of this study can be obtained by contacting the Washington Department of Fish and Wildlife, Wildlife Management Program.

BIRDS AND BOMBS: HANFORD'S ROLE IN CONSERVATION OF UPLAND BREEDING BIRDS IN THE COLUMBIA BASIN. Michael R. Smith, Washington Cooperative Fish and Wildlife Research Unit, University of Washington, WH-10, Seattle, WA 98195.

A geographic analysis of avian nesting habitats in eastern Washington showed that the Hanford site and the Army's Yakima Training Center are the last two large reservoirs for birds dwelling in arid steppe habitats. Models were based on a vegetation map derived from Landsat TM imagery with a 100-ha minimum mapping unit. Predicted distribution maps were created from it using habitat associations and known geographic nesting locations. Maps of regional species richness were created from several combinations of upland breeding bird maps. Habitat analysis shows that shrublands account for only 18% of the region's habitats, while agriculture makes up 50%. Many species dependent on these habitats had <10% of their habitats in eastern Washington protected under wildlife management schemes. Diversity maps show 2 major foci for conservation of arid steppe breeding birds: the region from Yakima to the Columbia River (YTC included) and the Hanford site. The large size of these tracts, combined with pristine condition in some areas and a variety of microhabitats, makes them essential to conservation of birds in the fragmented Columbia Basin.

SAMPLING FOR MARBLED MURRELETS AT FAR INLAND SITES IN CALIFORNIA: ARE THEY THERE? Howard B. Stauffer, Humboldt State University, Department of Mathematics, and USDA Forest Service, Six Rivers National Forest.

The Six Rivers National Forest is designing and implementing a marbled murrelet survey at far inland sites in California, to determine within a certain specified strata, whether the bird is present or not. It is critical in this survey to visit enough sample sites, with sufficient frequency, to ensure that the probability of detecting murrelets in strata where they are present be sufficiently high (i.e., $\geq 95\%$). This probability is the "power" of the survey. The sampling design and analysis for this type of "strata-specific" survey require special features which will be described in this talk.

SHRUB-STEPPE BIRD RESPONSE TO HABITAT VARIABLES IN EASTERN WASHINGTON. Matthew Vander Haegen, Frederick Dobler, and John Pierce, Washington Department of Fish and Wildlife, Olympia, WA.

Conversion of shrub-steppe communities to agriculture has reduced the availability of this habitat type in eastern Washington. We estimate that only 40% of an historic 10.4 million acres of shrub-steppe remain, and significant portions of the extant shrub-steppe have been altered to varying degrees by grazing or past agricultural uses. Several species of birds, and one state-endangered mammal, exist only in shrub-steppe communities. How birds respond to the varying physical characteristics within the shrub-steppe communities is of significant interest to managers but also is poorly understood. From 1991-1993 we used line-intercept methods to estimate the density of birds along 79 transects in shrub-steppe communities in eastern Washington. In this report we examine the relationships between vegetation, soils, and abundance of breeding birds.

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BALD EAGLE RESPONSES TO EXPERIMENTAL HUMAN ACTIVITY. James W. Watson and Brenda L. Cunningham, Washington Department of Fish and Wildlife.

An investigation of responses of nesting bald eagles (*Haliaeetus leucocephalus*) to a moving pedestrian was conducted in northwest Washington in 1993-94. We assessed effects of nest stage, nest screening, and distance from activity on 21 pairs of eagles during 130 experimental influence and control bouts. Eagles exhibited 525 responses during 780 influence episodes (x influence duration = 9.0 min). We found no interactive effects among nest stage (incubation, brood) and screening (low, partial, high), or nest stage and distance (30, 60, 120 m). Individual effects analysis revealed a difference ($P = 0.048$) between nest stages for only one of nine response variables; eagles were disturbed an average of 9 to 11 min more per bout during brooding than incubation. Five response variables were different among levels of screening; high nest screening significantly reduced responses relative to low and partially screened nests. Five response variables were different among distances of experimental activity to the nest tree; eagles tended to be more responsive at 60 m than at 30 m or 120 m. Reduced responses closer to the nest tree likely reflected greater tenacity whereas those farther from the nest tree were due to less disturbance. Nest height explained 41-77% of the variability in these four response variables and the regression model for total disturbance response on nest height predicted a response frequency of 0 at 49 m. Preliminary results suggest maintenance and enhancement of vegetative screening cover is the most manageable and effective technique to reduce temporal human disturbance at eagle nests in western Washington.

A COMPARISON OF TERRESTRIAL SMALL MAMMAL POPULATIONS BETWEEN RIPARIAN ZONES AND ADJACENT UPLANDS IN MANAGED FORESTS OF WESTERN WASHINGTON. Stephen D. West, College of Forest Resources AR-10, University of Washington, Seattle, WA 98195.

As part of a large field experiment looking at the effectiveness of current state guidelines in providing habitat for wildlife, populations of several small mammal species were sampled within the riparian zones of small streams (1-2m wide) and adjacent uplands at 18 western Washington locations. All sites were low elevation (<620m), second growth forests dominated by Douglas-fir, with substantial deciduous tree cover within the riparian zones. Small mammals were sampled simultaneously with two trap lines consisting of pitfall and snap traps on each side of the stream, one within the riparian zone and the other in the uplands 100m away. Trap lines were operated during September 1992 and 1993 for 4 consecutive days and nights; pitfall traps for 28 consecutive days. Altogether, 3,780 individuals of 14 species were caught. All 14 species were caught in the riparian zones (1,834 individuals) and 12 species (1,946 individuals) were caught in the uplands. As expected, the most abundant species (seven species with ≥ 200 captures) were caught in similar numbers on riparian and upland transects. Species of intermediate (≥ 50 captures) and low abundance showed the strongest habitat use patterns. *Sorex vagrans*, *Microtus longicaudus*, *Zapus trinotatus*, and *Microtus townsendii* were caught more frequently on riparian, while only *Clethrionomys gapperi* was caught more frequently in the upland transects.

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BAT DISTRIBUTION AND FORAGING ACTIVITY IN SOUTHWEST WASHINGTON. Heidi D. Wetmore, Douglas E. Runde, and Patricia A. MacLaren. Weyerhaeuser Company. Federal Way, Washington.

Our study was conducted to determine distribution of bats in intensively managed second and third growth forest land in southwestern Washington. The study area is 106,000 acres of contiguous Weyerhaeuser Company ownership in western Lewis and eastern Pacific counties spanning three watersheds (Upper Chehalis, Stillman Creek and southern Willapa Headwaters) of the northern Coast Range. This pilot study is part of a habitat management plan which Weyerhaeuser is using to develop and implement multi-species habitat management guidelines. Anabat II ultrasonic bat detectors equipped with automatic, light-sensitive tape recorders were placed at 38 locations in 10 habitat types. Snags, ponds, wetlands, bridges, railroad trestles, clearcuts, old growth, riparian sites and high elevation (1800-2000 feet) habitats were sampled for 1-2 nights. Taped calls were analyzed using Anabat V software. The species of bat was determined by the sound, shape and minimum frequency of the call as displayed in a frequency-time spectrogram. At least 6 of the 12 bat species expected to occur were detected. *Myotis yumanensis* and other *Myotis* species numerically dominated calls from other taxa throughout the study area. Foraging activity took place in 5 habitat types and in all three watersheds. Peak feeding periods (as indicated by feeding buzzes) occurred shortly after sunset and shortly before sunrise. These findings suggest that bat communities are widely distributed and utilize commercial forest lands successfully in southwestern Washington.

HABITAT ASSOCIATION OF THE WOOD FROG (*RANA SYLVATICA*) AND THE BOREAL TOAD (*BUFO BOREAS*) IN THE MIXED-WOOD BOREAL FOREST OF NORTH-CENTRAL ALBERTA. Elke Wind, Centre for Applied Conservation Biology, University of British Columbia, Vancouver, BC V6T 1Z4.

An understanding of the ecology of a population is essential in order to reduce the impacts many of our resource extraction practices may have on various species. In the mixed-wood boreal forest of north-central Alberta, a large, collaborative study is underway to investigate the effects of forestry on that ecosystem. My study focuses on amphibians in the terrestrial environment, specifically, determining what aspects of habitat of the mixed-wood boreal forest are associated with a higher relative abundance of wood frogs and boreal toads. Historically, the majority of the research on amphibians has taken place at breeding sites and focuses on reproduction, demographics, and early life cycles. Little research effort has gone into fundamental aspects of amphibian ecology in terms of the habitat requirements of these species during the summer months, away from breeding ponds, and especially for hibernation. The habitat attributes they require during these times may be quite different from those surrounding wet areas for breeding. Effective management of forested ecosystems that support healthy amphibian populations requires an understanding of all aspects of amphibian ecology.

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THE EFFECTS OF HABITAT FRAGMENTATION ON THE DEMOGRAPHY AND SOCIAL STRUCTURE OF THE GRAY-TAILED VOLE. Jerry O. Wolff, Eric M. Schaubert, and W. Daniel Edge, Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oregon 97331 USA

We monitored the demographic and behavioral responses of gray-tailed voles, *Microtus canicaudus*, to fragmentation in 12 0.2 ha enclosures planted with alfalfa. A 70% reduction in habitat did not adversely affect reproduction, survival, juvenile recruitment, or population size of voles in one large continuous fragment (625 m²), or a mosaic of 25 small fragments (each 25 m²). Peak density estimates based on the amount of habitat in each enclosure were 545 animals/ha in control, 1,056 in large fragment, and 2,880 in small fragment enclosures. In small fragments 6% of females and 15% of males moved among fragments within a week compared to approximately 50% in large fragment and control enclosures. We conclude that at the time of fragmentation, population sizes were low enough to accommodate a 70% reduction in habitat and still continue to increase in numbers. The social system of gray-tailed voles was sufficiently flexible to accommodate an influx of animals and to withstand densities in excess of 1,000 voles/ha.

**HABITAT UTILIZATION AND HOME RANGE SIZE OF THE BOBCAT IN
MANAGED FORESTS OF WESTERN WASHINGTON.** Levon P. Yengoyan, College
of Forest Resources, University of Washington.

Habitat utilization and home range size of bobcats (*Felis rufus*) in managed forests of western Washington were investigated from May 1993 through September 1994 with the use of radio-telemetry and Geographic Information Systems (GIS). A total of 751 independent locations for 6 male and 4 female bobcats indicated a mean annual home range size of 14.37 km² for males and 8.44 km² for females. Home range size and movements differed between sexes ($P < 0.05$) but not between seasons (winter vs. summer and breeding vs. nonbreeding). A density estimate of 0.22 cats/km² was calculated based on mean home range size and a mean home range overlap of 27.24%. Availability of six habitat types defined by structural differences resulting from timber management was determined from Landsat digital imagery. Differential use of habitat ($P < 0.05$) was detected for seven cats based on availability within the study area and for three cats based on availability within individual home ranges. Young stands (12-25 years old) were the most consistently preferred. Clearcuts (2-5 years old) and harvest-age stands (50-70 years old) were consistently avoided. Preferred habitat appeared to be related to abundant understory vegetative cover and prey availability. Results from this study were consistent with those found by another bobcat study conducted on the same study area in 1978 and suggest little change in bobcat social organization and patterns of habitat use over the past 15 years.

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**ESTIMATING MARBLED MURRELET HABITAT FROM FOREST INVENTORY
DATA.** Leonard S. Young, Charles W. Turley, and Gerald E. Hoyer, Washington
Department of Natural Resources, P.O. Box 47014, Olympia, WA 98504-7014.

We estimated the amount of marbled murrelet (*Brachyramphus marmoratus*) habitat on 1.6 million acres of forest trust lands within the Washington range of the northern spotted owl (*Strix occidentalis caurina*). This estimate was needed to establish a baseline against which to evaluate conservation strategies developed for the Washington Department of Natural Resources' (DNR) Habitat Conservation Plan. Specific data on the amount of murrelet habitat were not available. Therefore, we established relationships among platform abundance, tree size, and stand age that took into account tree species, site index, and stocking level. Using these relationships, we were able to estimate stands that likely contain murrelet habitat from forest inventory data stored in the DNR's Geographic Information System. We estimate that there are between 56,000 and 63,000 acres of potential murrelet habitat on forest trust lands within the northern spotted owl's Washington range (3.4% - 3.8% of these lands). Three quarters of this habitat (71% - 77%) is on the western Olympic Peninsula, within the DNR's Olympic Experimental State Forest. Ongoing field investigations of murrelet habitat relationships will allow us to refine this estimate and enable the development of a long-term conservation strategy for marbled murrelets.

ADDENDUM TO ABSTRACTS

MOVEMENTS AND HABITAT USE OF WESTERN TOADS (*BUFO BOREAS*) IN THE GREATER YELLOWSTONE ECOSYSTEM: EFFECTS OF HABITAT MODIFICATION. Paul E. Bartelt and Charles R. Peterson, Idaho State University, Pocatello, ID 83209-8007.

Many amphibian populations have experienced declines in the Pacific Northwest, including western toads (*Bufo boreas*) in the Greater Yellowstone Ecosystem (GYE). Habitat modification has been an important contributing factor in many cases. Because portions of the GYE have been logged, we are studying the habitat relationships of western toads and how logging affects their movements and habitat use. We radio-tracked six toads during 1993 at a pond site and eight toads during 1994 at a stream site on the Targhee National Forest. To measure toad movements, we located each animal every two to three days and recorded the coordinates for each location by using a GPS. To investigate habitat use, we imported these data into a GIS and mapped toad movements with respect to landscape habitat patterns. During 1993 four toads traveled through a variety of habitats for up to 2.5 km from their breeding pond. During 1994 only two toads briefly left riparian habitat, and none traveled over 500 m from their first capture site. The differences probably reflect contrasts between the two sites and differences in weather conditions between the two years. Toads frequented habitat edges, but seemed to avoid highly exposed areas (e.g., clearcuts). We are developing physical models to test the hypothesis that logging affects the movements and habitat selection of toads by influencing the thermal/hydric gradients under different cover types.

Note: This abstract and title replace the ones in the program.

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AIRBORNE VIDEOGRAPHY: A REMOTE SENSING TOOL FOR OREGON'S NATURAL RESOURCE MANAGERS. Greg Sieglitz, Oregon Department of Fish and Wildlife, 7118 NE Vandenberg Ave., Corvallis, OR 97330.

Airborne videography is a relatively new remote sensing tool. Even newer still is the use of video in natural resource management and research. Projects such as agricultural assessment, wildlife censusing, fish habitat analysis, and change detection of geographic features have been conducted in recent years throughout the nation. In Oregon, airborne videography is being explored as a complement to other available data in the classification of vegetation for the Biodiversity Gap Analysis Project. The objective is to use the 1993 videography as a ground truthing technique to train the 1988-1993 Landsat Thematic Mapper (TM) imagery for the state. Selected portions of the video will be interpreted and classified according to the Manual of Oregon Actual Vegetation (Kagan and Caicco 1992). Those same locations (TM pixels) will be classified accordingly. In addition, other pixels with similar reflectance values will then be classified as the same type. Ancillary data such as U.S. Forest Service timber inventory data, aerial photographs, other agency stand inventory, National Wetlands Inventory data, and actual ground truth data will also be used to facilitate the classification process. Once an initial classification has been conducted, the video will be a means of assessing the accuracy of the preliminary map.

