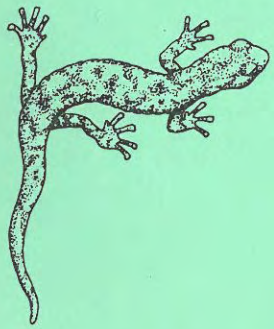
Final Program
and
Abstracts

1998 Annual Meeting

Northwest Scientific Association
Society for Northwestern Vertebrate Biology
(in association with PNARC)
Northwest Lichen Guild



Cosponsored and Hosted by

The Evergreen State College
Olympia, Washington
March 25-28, 1998

FINAL PROGRAM and ABSTRACTS FOR THE 1998 ANNUAL MEETINGS OF THE

Northwest Scientific Association
Society for Northwestern Vertebrate Biology (including PNARC)
The Northwest Lichen Guild

Co-Sponsored and Hosted by
The Evergreen State College, Olympia, Washington

March 25-28, 1998

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ACKNOWLEDGEMENTS

We thank Fish Brewing Co. and Washington Hill Cellars for their contributions to the opening reception and the many student staff and volunteers who contribute to the successful operation of the meeting, especially Dylan Monahan, Katrina Kapantais, and Amber Nielson.

Richard Cellarius, President, Northwest Scientific Association
Larry Jones, President, Society for Northwestern Vertebrate Biology
Gabriel Tucker, Program Chair

FINAL PROGRAM SUMMARY

Northwest Scientific Association
Society for Northwestern Vertebrate Biology (including PNARC)
The Northwest Lichen Guild

Wednesday, March 25

Events take place on The Evergreen State College campus, 2700 Evergreen Parkway NW, Olympia Washington, at the Ramada Inn Governor House Hotel at 621 Capitol Way South in downtown Olympia, and Forestry Sciences Laboratory, 3625 93rd Ave SW, Olympia, as indicated below

7:30 am to 9:00 am, Registration, Lobby of LAB I, The Evergreen State College
8:00 am to 5:00 pm, Field Trip to Fort Lewis Ecosystem Studies; departs from The Evergreen State College McCann Plaza Loop
8:00 am to 4:15 pm, U.S. Forest Service Botany Workshop, The Evergreen State College, Room 1047, LAB I
Revegetation to Prevent the Spread of Noxious Weeds
9:00 am to 5:00 pm, Society for Northwestern Vertebrate Biology Workshops, The Evergreen State College
- Survey and Manage Amphibians — Lecture Hall 3
- Northwest Birds — Lecture Hall 5
- Small Mammals — Room 1050 LAB I

4:00 to 7:00 pm, Northwest Scientific Association Governing Board Meeting, Council Room, Ramada Inn Governor House
4:00 to 7:00 pm, Society for Northwestern Vertebrate Biology Executive Board Meeting, Forestry Sciences Laboratory
5:00 to 7:00 pm, Registration, Legislative Room, Ramada Inn Governor House
7:00 p.m. to 10:00 pm, Reception, Legislative Room, Ramada Inn Governor House

Thursday, March 26 *All events at The Evergreen State College* Registration: 7:30 am to 5:00 pm LAB I Lobby	**Friday, March 27** *All events at The Evergreen State College* Registration: 7:30 am to 12:00 noon LAB I Lobby
Morning/Noon	Morning/Noon
Aquatic Biology (8:00 am) — Lecture Hall 4 Demonstration of Ecosystem Management Options (DEMO) (8:00 am) — Lecture Hall 3 Ecology (8:00 am) — Room 1050, LAB I Rare Plants I (8:15 am) — Lecture Hall 5 Lichen Guild Field Trip (Meet at 8:30 am) — Leaves from McCann Plaza Loop	Botany (8:00 am) — Room 1050, LAB I Watershed Analysis (8:00 am) — Lecture Hall 3 Behavioral Attributes of Northwestern Vertebrates (8:00 am) — Lecture Hall 5 Habitat Use and Ecology of Vertebrates (8:00 am) — Lecture Hall 2 Forest Canopies (8:00 am) — Lecture Hall 4 Northwest Lichen Guild I (10:40 am) — Lecture Hall 4
12:00 - 1:30 pm Business Meeting — CAB 110 Pacific Northwest Amphibian and Reptile Consortium (PNARC)	12:00 -1:30 pm Business Meetings — Longhouse Northwest Scientific Association Society for Northwestern Vertebrate Biology
Afternoon/Evening	Afternoon/Evening
Rare Plants II (1:00 pm) — Lecture Hall 5 The Cedar River Watershed: Four Decades of Ecosystem Research (1:00 pm) — Lecture Hall 2 Ecology and Management of Amphibians and Reptiles (1:40 pm) — Lecture Hall 3	Northwest Lichen Guild II (1:40 pm) — Lecture Hall 4 Forestry (1:40 pm) — Room 1050, LAB I Dynamics of Vertebrate Populations (1:40 pm) — Lecture Hall 3 Rare Plant Working Group (1:00 pm) — Room 1047, LAB I
3:00 - 6:00 pm Posters — Library 4300 5:00 - 6:30 pm No-host Reception — Library 4300 6:30 pm All Society Banquet — Library 4300 Speaker: Steve Amen, Executive Producer and Host, Oregon Field Guide Title: "What a Character"	5:00 - 6:30 pm Open meeting of interested authors for stream amphibian book (Northwest Fauna) — Library 4004 6:30 pm SNVB/PNARC Post-Presentations Soiree — Library 4300

Refreshments will be available in the Lecture Hall Rotunda at morning and afternoon breaks on Thursday and Friday.

Saturday, March 28

All field trips depart from The Evergreen State College McCann Plaza Loop

8:00 am to 5:00 pm, Field Trip to U.S. Forest Service Wind River Canopy Crane
Society for Northwestern Vertebrate Biology Workshops Field Portions:
9:00 am - 1:00 pm Survey and Manage Amphibians
7:00 am - 2:00 pm Northwest Birds
8:00 am - 12:00 noon Small Mammals
NOTE: The field trip to Northwest Trek has been cancelled.

11:20 DISTRIBUTION OF SULFUR AND LEAD IN LICHENS AND TREE CORES IN WESTERN WASHINGTON CASCADES. Jan A. Henderson and Robin D. Lesher, USDA Forest Service, Mountlake Terrace, WA. [A54]

11:40 DEVELOPING AN NSDI CLEARINGHOUSE NODE FOR THE OLYMPIC PENINSULA. Robert A. Norheim and Teresa Z. Alcock, Field Station for Protected Area Research, University of Washington, Seattle; David L. Peterson, USGS-Biological Resources Division, University of Washington, Seattle; Nicholas Chrisman, Dept. of Geography, University of Washington, Seattle. [A91]

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8:00 AM Thursday, March 26 — Lecture Hall 5
RARE PLANTS I [RP1]
Session Chair: Ted Thomas

8:15 INTRODUCTION TO THE SESSION. Ted Thomas, US Fish & Wildlife Service

8:20 A NEW LOOK AT ENDEMISM AND RARITY. A. R. Kruckeberg, University of Washington, Seattle. [A68]

9:00 GENETIC AND ECOLOGICAL STUDIES OF THE MATING SYSTEM IN THE PALE LARKSPUR, *DELPHINIUM LEUCOPHAEUM* (RANUNCULACEAE). Keith Karoly, Reed College, Portland. [A63]

9:30 A REVIEW OF THE STATUS OF *HACKELIA VENUSTA*. Richy J. Harrod, Lauri A. Malmquist, Leavenworth Ranger District, Leavenworth, and Robert L. Carr, Eastern Washington University, Cheney [A51]

10:00 Break — Refreshments available in the Lecture Hall Rotunda

10:20 A PRELIMINARY ASSESSMENT OF RARITY AND DISTRIBUTIONS OF FUNGI IN THE PACIFIC NORTHWEST. T.E. O'Dell, M.A. Castellano and R. Molina. USDA Forest Service. Forestry Sciences Lab. 3200 Jefferson Wy., Corvallis, OR 97331. [A93]

10:50 UPDATE ON THE CONSERVATION STATUS OF RARE PLANTS IN WASHINGTON. John G. Gamon, Natural Heritage Program, Washington Department of Natural Resources, Olympia. [A39]

11:20 THE ROLE OF A SMALL BOTANIC GARDEN IN REGIONAL RARE PLANT RESEARCH AND CONSERVATION. Andrea N. Raven, The Berry Botanic Garden, Portland, OR. [A109]

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1:00 PM Thursday, March 26 — Lecture Hall 5
RARE PLANTS II [RP2]
Session Chair: Ted Thomas

1:00 RARE PLANT MANAGEMENT ON NATIONAL FORESTS IN OREGON AND WASHINGTON: PAST, PRESENT, AND FUTURE. Nancy A. Fredricks, USDA Forest Service, Vancouver, WA. [A36]

1:30 EFFECTS OF TIMBER HARVEST ON *CIMICIFUGA ELATA*, A RARE PLANT OF WESTERN FORESTS. Thomas N. Kaye, Oregon State University, Corvallis. [A64]

2:00 PROMOTING PRAIRIE VEGETATION, RARE PLANTS, AND A RARE BUTTERFLY. Mark V. Wilson, Oregon State University, Corvallis, Deborah L. Clark, Oregon State University, Corvallis, Cheryl B. Schultz, University of Washington, Seattle. [A144]

3:00 Break — Refreshments available in the Lecture Hall Rotunda

3:20 OF *BOS* AND *SISYRINCHIUM*: A MONITORING STUDY EXAMINING THE SUCCESS OF A *BOS* EXCLOSURE ON A RARE WASHINGTON NATIVE. Andrea N. Raven, The Berry Botanic Garden, Portland, OR. [A110]

3:40 PATTERNS OF GENETIC VARIATION IN RARE AND WIDESPREAD PLANT CONGENERS: DO RARE SPECIES HAVE LOWER LEVELS OF GENETIC VARIABILITY? Matthew A. Gitzendanner and Pamela S. Soltis Washington State University, Pullman. [A42]

* The three-letter code after each session title identifies the session as noted in the abstract section of this program; the A number in brackets after each presentation listing identifies the abstract number.

Northwest Science Meetings Technical Program and Schedule*

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1:00 PM Thursday, March 26 — Lecture Hall 2

THE CEDAR RIVER WATERSHED: FOUR DECADES OF ECOSYSTEM RESEARCH [CRW]

Sesson Chair: Thomas M. Hinckley

1:00 OVERVIEW AND INTRODUCTION, T.M. Hinckley, University of Washington, Seattle

1:10 FOREST NUTRIENT DYNAMICS IN THE LOWER CEDAR RIVER WATERSHED: OBSERVATIONS AND EXPERIMENTS. Peter S. Homann, Western Washington University, Bellingham, Dale W. Cole and Rob Harrison, University of Washington, Seattle. [A56]

1:40 FINDLEY LAKE: KEY TO UNDERSTANDING SOIL FORMING PROCESSES IN THE CASCADES. F. C. Ugolini, Suolo e Nutrizione della Planta, Florence, Italy [A138]

2:10 FINDLEY LAKE SPODOSOLS: FRACTIONATION, CHARACTERIZATION, AND ROLE OF ORGANICS IN THEIR GENSIS. R.S. Sletten, F.C. Ugolini, I.G. Choi, D. Zabowski, A.J. Krzyszowska, and R. Jandl, University of Washington, Seattle. [A128]

2:25 WEATHERING AND MINERAL STABILITY OF SPODOSOLS AT FINDLEY LAKE. D. Zabowski, R.S. Sletten, University of Washington, Seattle and F.C. Ugolini, University of Florence, Italy. [A147]

2:40 CARBON ALLOCATION AND MYCORRHIZAL STUDIES IN THE CEDAR RIVER WATERSHED. R. L. Edmonds, A. K. Barg, E. T. Cline, G. S. Sparks and K. A Vogt, University of Washington, Seattle. [A29]

3:10 Break — Refreshments available in the Lecture Hall Rotunda

3:30 STRUCTURE AND MORPHOLOGY IN PACIFIC SILVER FIR STANDS: WHEN YOU'VE SEEN ONE, HAVE YOU SEEN THEM ALL? D.G. Sprugel, T. A. Martin, T. M. Hinckley, K. J. Brown, J. Rombold, University of Washington, Seattle, and B. J. Yoder, Oregon state University, Corvallis. [A129]

4:00 PHYSIOLOGICAL STUDIES AT FINDLEY LAKE: INSIGHTS FROM THE ORGAN TO THE STAND. T.M. Hinckley, R.O.Teskey, J.W. Leverenz, G. Tucker, J.R. Brooks, T.A. Martin, K.J. Brown, J.R. Rombold and D.G. Sprugel, University of Washington, Seattle. [A55]

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1:40 PM Thursday, March 26 — Lecture Hall 3

ECOLOGY AND MANAGEMENT OF AMPHIBIANS AND REPTILES [EAR]

Session Chair: Susan Piper

1:40 ABUNDANCE OF LONG-TOED SALAMANDERS IN RELATION TO VARYING LEVELS OF CANOPY COVER FOLLOWING LOGGING ADJACENT TO BREEDING PONDS. Christine Ferguson, University of British Columbia. [A34]

2:00 RESISTANCE AND RESILIENCE OF AN AMPHIBIAN ASSEMBLAGE TO LARGE-SCALE CATASTROPHIC DISTURBANCE: AN EXAMPLE FROM THE MOUNT ST. HELENS VOLCANO, 1980-1997. Charles M. Crisafulli, Forest Service, PNW Research Station, Olympia, Louise S. Trippe, Utah State University, Logan. [A21]

2:20 LANDSCAPE RELATIONSHIPS OF THE HERPETOFAUNAL ASSEMBLAGE OF A NORTHWESTERN CALIFORNIA WATERSHED: PATTERNS, PROCESSES, AND PROGNOSES. H. H. Welsh, Jr. and G. R. Hodgson, USFS-PSW Redwood Sciences Lab., 1700 Bayview Dr., Arcata, CA 95521. [A143]

2:40 TERRESTRIAL AMPHIBIANS IN MANAGED FORESTS OF SOUTHWESTERN WASHINGTON. D. E. Runde, D.W. Stinson, K. A. Austin, Weyerhaeuser, Tacoma WA, S. Lathrop, Weyerhaeuser, Longview, WA, and S. R. Butts, Oregon State University, Corvallis. [A119]

3:00 Break — Refreshments available in the Lecture Hall Rotunda

3:20 ABUNDANCE PATTERNS AND HABITAT AFFINITIES OF STREAMSIDE AMPHIBIANS IN THE OLYMPIC PENINSULA, WASHINGTON. Lawrence L. C. Jones and Martin G. Raphael, Pacific Northwest Research Station, Olympia, WA. [A61]

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3:40 HEADWATER CHANNELS AND VERTEBRATES IN MANAGED FORESTS IN NORTHWESTERN OREGON. Deanna H. Olson, Bruce Hansen, and Loretta L. Ellenburg, USDA Forest Service, Pacific Northwest Research Station, Corvallis, Oregon. [A95]

4:00 DELAYED RECOVERY OF STREAM AMPHIBIANS IN CLEARCUT FORESTS OF WESTERN OREGON Don J. Major and R. Bruce Bury, Biological Resources Div., U.S.Geological Survey, Corvallis, OR. [A75]

4:20 CHANGING HERPETOFAUNAS ALONG THE STREAM CONTINUUM. R. Bruce Bury and Donald J. Major, FRESC, Biol. Res. Div., U.S. Geological Survey, Corvallis, Oregon. [A11]

4:40 A HIERARCHICAL ANALYSIS OF THE HABITAT ATTRIBUTES OF THE TAILED FROG *(ASCAPHUS TRUEI)* IN A LOW SEDIMENT STREAM SYSTEM. Lisa M. Ollivier, Pacific Southwest Research Station, Arcata, CA. [A94]

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3:00 - 6:00 PM Thursday, March 26 — Library 4300

POSTERS [POS]

DEMONSTRATION OF ECOSYSTEM MANAGEMENT OPTIONS (DEMO): A STUDY OF VARYING LEVELS AND PATTERNS OF GREEN-TREE RETENTION IN WESTERN OREGON AND WASHINGTON Richard Abbott, USFS, Idleyld Park, OR; James D. White, USFS, Trout Lake, WA [A1]

SPOROCARP BIOMASS, SMALL MAMMAL ABUNDANCE AND DIET IN TWO SOUTHERN CASCADE RANGE FOREST STANDS. Efren Cazares, Dan Luoma, and Carol Chambers, Oregon State University, Corvallis, John Lehmkuhl, Pacific Northwest Research Station, Wenatchee [A16]

NORTHWEST FOREST PLAN HARVESTS VERSUS CLEARCUTS: A PRELIMINARY INVESTIGATION OF PUBLIC PERCEPTIONS OF THE ACCEPTABILITY AND AESTHETICS OF HARVEST RETENTION PATTERNS. Robert G. Ribe, University of Oregon, Eugene. [A111]

RESPONSE OF FOREST UNDERSTORY COMMUNITIES TO GREEN-TREE RETENTION HARVEST: THE *DEMO* STUDY. Charles B. Halpern, Shelley A. Evans, Cara R. Nelson, and Donald McKenzie, University of Washington, Seattle. [A48]

INITIAL VEGETATIVE RESPONSE TO ALTERNATIVE THINNING IN SECOND GROWTH DOUGLAS-FIR STANDS IN CENTRAL OREGON. Sean A. Bohac, Michael D. Lattig, & Gabriel Tucker of The Evergreen State College Olympia, WA [A8]

THE INFLUENCE OF COMMERCIAL THINNING ON WILDLIFE POPULATIONS AND STAND STRUCTURE IN A MANAGED FOREST IN THE OREGON COAST RANGE--A LONG TERM STUDY. J. P. Hayes, M. D. Adam, J. M. Weikel, K. Maas-Hebner, D. Gomez, N. Suzuki, W. H. Emmingham, D. Larson, R. G. Anthony, and S. D. Hobbs. Oregon State University, Corvallis. [A52]

A RETROSPECTIVE METHOD TO DETERMINE THE EFFECT OF TIMBER HARVEST ON THE DISTRIBUTION OF CANDY STICK (*ALLOTROPA VIRGATA*). Mark J. Pistrang, Gifford Pinchot NF, Packwood, Tim Max, PNW Research Station, Portland, Jamie Barbour, PNW Research Station, Portland, Jeff Ricklefs, The Evergreen State College. [A101]

HERBARIUM SHEET WALL DISPLAY. Chris O. Loggers and Kirk W. Larson, US Forest Service, Kettle Falls Ranger District, 255 West 11th, Kettle Falls, WA 99141 [A72]

VEGETATION DYNAMICS IN A WETLAND SYSTEM INUNDATED WITH TREATED WASTEWATER. Mary L. Water, Eastern Washington University, Cheney. [A142]

ROLE OF MYCORRHIZA-TYPE IN NITROGEN UPTAKE IN AN OLD-GROWTH-FORESTED WATERSHED, OLYMPIC NATIONAL PARK, WA. Steven A. Trudell and Robert L. Edmonds, College of Forest Resources, University of Washington [A137]

USING NATURAL PATTERNS AS A "MARKING TECHNIQUE" FOR HERPETOFAUNA. Patrick Loafman [A71]

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9:20 INDIVIDUAL AND POPULATION RESPONSES OF THE GRAY-TAILED VOLE, *MICROTUS CANICAUDUS*, TO AN ENDOCRINE DISRUPTOR. Tracie Sanchez-Caslin, Oregon State University, Corvallis. [A121]

9:40 REPRODUCTIVE SUPPRESSION IN *MICROTUS MONTANUS* AT PRE-PEAK DENSITIES: EFFECTS ON POPULATION GROWTH AND DEMOGRAPHY. Todd L. Scarlett, Washington State University, Pullman, WA. [A122]

10:00 Break — Refreshments available in the Lecture Hall Rotunda

10:20 WHY ARE FEMALE MAMMALS PROMISCUOUS? Jerry O. Wolff, Oregon State University, Corvallis. [A146]

10:40 EFFECTS OF FEMALE KIN GROUPS ON REPRODUCTION AND DEMOGRAPHY IN THE GRAY-TAILED VOLE, *MICROTUS CANICAUDUS*. Christine Dalton, Oregon State University, Corvallis [A22]

11:00 SEXUAL STRATEGY OF THE CENTRAL LONG-TOED SALAMANDER, *AMBYSTOMA MACRODACTYLUM COLUMBIANUM*. Paul Verrell, Washington State University, Pullman. [A140]

11:20 BATTLE OF THE SEXES: MATING SUCCESS VARIANCE IN *DESMOGNATHUS OCOEE*. Susan Gershman and Paul Verrell, Washington State University, Pullman. [A40]

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8:00 AM Friday, March 27 — Lecture Hall 2

HABITAT USE AND ECOLOGY OF VERTEBRATES [HBV]

Session Chair: Jeff Lewis

8:00 BIRD COMMUNITIES OF RIPARIAN BUFFER STRIPS. Susan Shirley, University of British Columbia, Vancouver, B.C. [A125]

8:20 SMALL-MAMMAL POPULATIONS IN RIPARIAN AND UPLAND FORESTS OF NORTHWESTERN WASHINGTON. Margaret A. O'Connell, Eastern Washington University, Cheney; James G. Hallett, Washington State University, Pullman. [A92]

8:40 HOME RANGE AND HABITAT USE OF WESTERN RED-BACKED VOLES IN MATURE CONIFEROUS FORESTS IN THE SOUTHERN OREGON CASCADES. Rebecca Thompson, Colville Confederated Tribes, Nespelem, WA. [A136]

9:00 DENSITY, SEX RATIO AND SPACE USE IN MALE AND FEMALE GRAY-TAILED VOLES (*Microtus canicaudus*). Monica Bond, Oregon State University, Corvallis. [A9]

9:20 RADIOTELEMETRIC STUDY OF HABITAT AND MOVEMENT IN AN ALBERTA POPULATION OF THE PRAIRIE RATTLESNAKE. G.L. Powell, University of Calgary, Calgary, A.P. Russell, University of Calgary, Calgary. [A103]

9:40 THE EFFECT OF NONNATIVE FISH ON AMPHIBIAN POPULATIONS IN NORTHEAST WASHINGTON. Liana M. Aker and Steven J. Stein, Eastern Washington University, Cheney, WA. [A2]

10:00 Break — Refreshments available in the Lecture Hall Rotunda

10:20 TEMPORAL AND GEOGRAPHIC VARIATION IN SNAKE POPULATIONS IN THE MID-WILLAMETTE VALLEY OF OREGON. Robert T. Mason, Ignacio T. Moore, and Darren T. Lerner, Oregon State University, Corvallis. [A78] Life history tradeoffs

10:40 TESTS FOR DIVERGENCE IN THE SEAL SALAMANDER, *DESMOGNATHUS MONTICOLA*. Michelle Mabry and Paul Verrell, Washington State University, Pullman. [A74]

11:00 EFFECTS OF HABITAT FRAGMENTATION ON WOOD FROGS. Elke Wind, M.Sc. Thesis, Fred Bunnell and Ann Chan-McLeod, University of British Columbia, Vancouver. [A145] Wet Patches

11:20 NEOTROPICAL MIGRANT LANDBIRD USES OF DISTURBED, FRAGMENTED HABITATS IN THURSTON COUNTY, WASHINGTON. Brian Price, The Evergreen State College. [A104]

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11:40 STATUS OF DECLINING AMPHIBIANS IN CALIFORNIA. Gary M. Fellers, Biological Resources Division, USGS, Point Reyes National Seashore, Point Reyes, CA [A33]

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8:00 AM Friday March 27 — Lecture Hall 4

FOREST CANOPIES [CNP]

Session Chair: David Shaw

8:00 CANOPY INVERTEBRATE COMMUNITIES IN OLD-GROWTH AND MATURE DOUGLAS-FIR ALONG A LATITUDINAL GRADIENT. Robert A. Progar, Timothy D. Schowalter, Brett Scherer, Tim Work, Jlea Welsh, Brannon Forrester, and Christina Carney, Oregon State University. [A106]

8:20 CROWN STRUCTURE AND SPATIAL DISTRIBUTION OF WESTERN HEMLOCK EPIPHYTES. Betsy Lyons, The Evergreen State College, Olympia. [A73]

8:40 RELATIONSHIPS BETWEEN CANOPY STRUCTURE AND THROUGHFALL VARIABILITY IN A PRIMARY AND SECONDARY CONIFEROUS FOREST. Mark M. Sumera and Nalini M. Nadkarni, The Evergreen State College, Olympia. [A134]

9:00 ECOLOGICAL DATA IN A MEANINGFUL CONTEXT: A METADATA DATABASE MANAGEMENT SYSTEM Sylys Knackstedt, Betsy Lyons, Mark Sumera, Nalini Nadkarni, Judy Cushing, The Evergreen State College, Olympia [A67]

9:20 BIOMASS OF THE EPIPHYTIC FERN *Polypodium scouleri* IN OLD-GROWTH COAST REDWOOD FOREST CANOPY AT PRAIRIE CREEK REDWOODS STATE PARK, CALIFORNIA. Mark Bailey, Humboldt State University, Arcata, CA. [A6]

9:40 CANOPY RESEARCH IN NORTHERN BRITISH COLUMBIA; AN EXPLORATION OF LICHEN COMMUNITIES. Jocelyn Campbell, Darwyn S. Coxson. University of Northern British Columbia, Prince George, B.C. Canada V2N 4Z9, and Susan K. Stevenson. Silvifauna Research, Prince George, B.C. Canada. V2M 2G8. [A13]

10:00 Break — Refreshments available in the Lecture Hall Rotunda

10:20 CANOPY MACROLICHENS FROM FOUR FOREST STANDS IN SEQUOIA NATIONAL PARK, CALIFORNIA. David C. Shaw, Wind River Canopy Crane Research Facility, Carson, Washington, Steven A. Acker, Oregon State University, Corvallis. [A123]

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10:40 AM Friday, March 27 — Lecture Hall 4

NORTHWEST LICHEN GUILD I [LG1]

Session Chair: Paul Przybylowicz

10:40 THE LICHEN FLORA OF CHIRICAHUA NATIONAL MONUMENT, SOUTHEAST ARIZONA. Kim T, Anderson and Larry L. St. Clair, Department of Botany & Range Science, Brigham Young University, Provo, Ut. [A4]

11:00 THE LICHEN FLORA OF SNOW CANYON STATE PARK, WASHINGTON COUNTY, UTAH. K.Anderson, L.Cooper, C. Hansen, K. Knight, L. Porter, L.Stewart, L.St .Clair, S. St. Clair, Department of Botany and Range Science Brigham Young University, Provo, Utah. [A3]

11:20 THE LICHEN FLORA OF STONY PASS, AN ALPINE TUNDRA SITE IN SOUTHWESTERN COLORADO. S.B. St. Clair, L.S. Cooper, L.J. Stewart, L.L. St. Clair, Department of Botany & Range Science, Brigham Young University, Provo, Utah 84602, and C.C. Newberry, Department of Integrative Biology, University of California, Berkeley, California 94720. [A130]

11:40 PATTERNS OF METABOLIC ACTIVITY IN INTERMOUNTAIN AREA POPULATIONS OF TERRICOLOUS VAGRANT *XANTHOPARMELIA* SPP. USING MICROCALORIMETRY. L.S Cooper, R.C. Cates, L.L. St. Clair, B.N. Smith, and L.D. Hansen, Brigham Young University. [A20]

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1:40 PM Friday, March 27 — Lecture Hall 4
NORTHWEST LICHEN GUILD II [LG2]
Session Chair: Paul Przybylowicz

1:40 A SURVEY OF THE *SPHAGNUM* MOSS SPECIES FOUND IN BOGS IN KING COUNTY, WASHINGTON. Sarah Spear Cooke, Kate McWiggins, Cooke Scientific Services Inc., Seattle. and Paul Yurkey. [A19]

2:00 ZEN AND THE SEARCH FOR CALICIALES. Eric B. Peterson, Department of Botany and Plant Pathology, Oregon State University, Corvallis. [A98]

2:20 DISTRIBUTION PATTERNS OF CALICIALES IN THE PACIFIC NORTHWEST. Jouko Rikkinen, Department of Botany and Plant Pathology, Oregon State University, Corvallis. [A112]

2:40 MANAGING FOR A RARE LICHEN UNDER THE NORTHWEST FOREST PLAN: AN ONGOING CASE STUDY. Abbey L. Rosso, Tom R. Rambo, Bruce McCune, Oregon State University, Corvallis. [A118]

3:00 Break — Refreshments available in the Lecture Hall Rotunda

3:20 FOREST FLOOR BRYOPHYTES AS INDICATORS OF SUBSTRATE AND STAND AGE. Thomas R. Rambo and Patricia S. Muir, Oregon State University, Corvallis. [A108]

3:40 CERTIFYING FIELD LICHENOLOGISTS TO ASSURE DATA QUALITY. Bruce McCune, Oregon State University, Corvallis [A80]

4:00 EPIPYHTE GUILDS IN TEMPERATE RAINFORESTS: A GLOBAL PERSPECTIVE. Roger Rosentreter, Bureau of Land Management, Boise, ID. [A116]

4:20 CAUSES FOR SLOW ACCUMULATION OF EPIPHYTIC LICHENS IN DOUGLAS-FIR FORESTS. Stephen C. Sillett, Humboldt State University, Arcata, Bruce McCune, Jerilynn E. Peck, Thomas R. Rambo, Andrea Ruchty, Oregon State University, Corvallis. [A126]

4:40 TRANSPLANTING AND MONITORING OF THE AQUATIC LICHEN *HYDROTHYRIA VENOSA*. Chiska C. Derr, Gifford Pinchot National Forest. [A23]

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1:40 PM Friday, March 27 — Room 1050, LAB I
FORESTRY [FOR]
Session Chair: Steven D. Stinson

1:40 GROUND BASED PHOTO MONITORING. Frederick C. Hall, USDA Forest Service, Portland. [A47]

2:00 SUSTAINABLE FOREST MANAGEMENT IN THE SOUTHERN TIP OF THE PUGET TROUGH A CASE STUDY: THE COWLITZ RIDGE TREE FARM. Steven D. Stinson College of Forest Resources Silviculture Laboratory, University of Washington [A132]

2:20 A NEW INDEX TO INVESTIGATE THE STRUCTURAL COMPLEXITY OF FORESTS, Eric K. Zenner, Oregon State University, Corvallis [A148]

2:40 TREE SPECIES MIXTURE ENHANCES THE STRUCTURAL COMPLEXITY OF NATURAL YOUNG TO MATURE CONIFEROUS FORESTS. Eric K. Zenner, Oregon State University, Corvallis. [A149]

3:00 Break — Refreshments available in the Lecture Hall Rotunda

3:20 PLANT DIVERSITY IN MANAGED FORESTS: UNDERSTORY RESPONSES TO THINNING AND FERTILIZATION IN DOUGLAS-FIR PLANTATIONS. Sean C. Thomas and Charles B. Halpern, University of Washington, Seattle, WA. [A135]

3:40 ENHANCING LICHENS AND BRYOPHYTES IN YOUNG FORESTS. Patricia S. Muir and Thomas R. Rambo, Oregon State University, Corvallis. [A88]

* The three-letter code after each session title identifies the session as noted in the abstract section of this program; the A number in brackets after each presentation listing identifies the abstract number.

4:00 AUTECOLOGY OF *OPLOPANAX HORRIDUS*. Ashley Roorbach, Oregon State University, Corvallis; David Hibbs, Oregon State University, Corvallis; Nan Vance, USFS PNW Research Station, Corvallis. [A115]

4:20 LANDSCAPE-SCALE ADAPTIVE MANAGEMENT IN THE OREGON COAST RANGE. Andrew N. Gray, US Forest Service Research Station, Corvallis. [A44]

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1:40 PM Friday, March 27

DYNAMICS OF VERTEBRATE POPULATIONS [DYV]

Session Chair: Charles Peterson

1:40 WHAT DO YOU DO WHEN A TIGER WANTS TO EAT YOU? Julie A. Fronzuto and Paul A. Verrell, Washington State University, Pullman, WA. [A38]

2:00 VULNERABILITY OF POSTMETAMORPHIC OREGON SPOTTED FROGS. Marc P. Hayes, Department of Biology, Portland State University, PO Box 751, Portland, OR 97207, Joseph D. Engler, U.S. Fish and Wildlife Service, PO Box 457, Ridgefield, WA 98642 [A53]

2:20 MOVEMENT PATTERNS OF COLUMBIA SPOTTED FROGS IN A COMPLEX OF HIGH MOUNTAIN LAKES. David S. Pilliod and Charles R. Peterson, Idaho State University, and Peter Ritson, Portland Community College. [A99]

2:40 MONITORING IDAHO AMPHIBIAN AND REPTILE POPULATIONS THROUGH CHANGES IN OCCURRENCE. Charles R. Peterson, Sarah Cooper Doering, and John Cossel, Jr. Idaho State University. Pocatello, Idaho. [A96]

3:00 Break — Refreshments av

3:20 USE OF TRANSMITTER ... HICKS TO MONITOR PREDATION OF ARTIFICIAL MARBLED ... Bradley*, John M. Marzluff, John M. Luginbuhl, and Martin G. Raphael. C ... ity of Washington, Seattle (JEB, JMM, JML), U.S. Forest Service, Pacifi ... ıpia (MGR). [A10]

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3:40 ACCESSIBILITY AND U ... BY RAPTORS: AN EXPERIMENTAL APPROACH. Tiffany Fox ... len, Oregon State University, Corvallis. [A35]

4:00 DEMOGRAPHIC RESPO ... MAMMALS TO RAPTOR PREDATION: AN EXPERIMENTAL APPROACH. Robert S. Skillen, Jerry O. Wolff, Guiming Wang, and Tiffany Fox, Oregon State University, Corvallis. [A127]

4:20 SMALL MAMMAL POPULATION TRENDS ON THE BOARDMAN BOMBING RANGE AS REFLECTED IN THE DIET OF SYMPATRIC OWLS. Gregory A. Green, Parametrix, Kirkland, WA, Kent Livezey, U.S. Navy, Poulsbo, WA, Russell Morgan, Oregon Dept. of Fish and Wildlife, Heppner, OR. [A45]

4:40 NUTRITIONAL ECOLOGY OF LIVING AND EXTINCT BEARS: STABLE ISOTOPE ANALYSIS. Michael E. Jacoby, Charles T. Robbins, Grant V. Hilderbrand, Washington State University, Pullman, Chris Servheen, University of Montana, Missoula, Robert Michener, Boston University [A58]

* The three-letter code after each session title identifies the session as noted in the abstract section of this program; the A number in brackets after each presentation listing identifies the abstract number.

Abstracts

Abstracts are arranged alphabetically by first author*. The session in which the paper is presented is identified by a three-letter code in brackets following the title and author. These codes identify the sessions as follows:

- AQU Aquatic Biology — Thursday am
- BHV Behavioral Attributes of Northwestern Vertebrates — Friday am
- BOT Botany — Friday am
- CNP Forest Canopies — Friday am
- CRW The Cedar River Watershed — Thursday pm
- DEM Demonstration of Ecosystem Management Options (DEMO) — Thursday am
- DYV Dynamics of Vertebrate Populations — Friday pm
- EAR Ecology and Management of Amphibians and Reptiles — Thursday pm
- ECO Ecology — Thursday am
- FOR Forestry — Friday pm
- HBV Habitat Use and Ecology of Vertebrates — Friday am
- LG1 Northwest Lichen Guild I — Friday am
- LG2 Northwest Lichen Guild II — Friday pm
- POS Posters — Thursday pm
- RP1 Rare Plants I — Thursday am
- RP2 Rare Plants II — Thursday pm
- WSA Watershed Analysis — Friday am

* Exception: The abstract of Sisseck and Stein is number A46 as a result of a clerical error discovered too late to rearrange the abstracts.

A1

DEMONSTRATION OF ECOSYSTEM MANAGEMENT OPTIONS (DEMO): A STUDY OF VARYING LEVELS AND PATTERNS OF GREEN-TREE RETENTION IN WESTERN OREGON AND WASHINGTON Richard Abbott, USFS, Idleyld Park, OR; James D. White, USFS, Trout Lake, WA [POS]

The DEMO Study evaluates the biological effects and social perceptions of different levels and patterns of green-tree retention in harvests of mature forests in western Oregon and Washington. Eight blocks (replications) of six treatments each are included in the study. Treatments include 15% dispersed and 15% aggregated retention units, 40% dispersed and 40% aggregated retention units, a 75% retention unit which includes 3 small group harvests, and a 100% retention unit (control). Information from the study will contribute to validation of some of the assumptions in the Northwest Forest Plan dealing with the 15% green-tree retention standard for "matrix" lands. Currently, pre-harvest information has been collected, and study sites are being harvested. The DEMO display will present a brief description of the study, including objectives and major areas of investigation; pictures and descriptions of the treatments being tested; and locations of the eight study sites in Oregon and Washington. Managers and scientists involved in the study will be available during the poster session for discussion and questions.

A2

THE EFFECT OF NONNATIVE FISH ON AMPHIBIAN POPULATIONS IN NORTHEAST WASHINGTON. Liana M. Aker and Steven J. Stein, Eastern Washington University, Cheney, WA. [HBV]

Researchers are currently investigating reasons behind worldwide amphibian declines and extinctions. Problems that are under investigation include environmental disturbances and the introduction of nonnative amphibian and fish species into native amphibian habitat. Our study addresses the introduction of nonnative fish into amphibian habitat in northeast Washington. Amphibian abundance data was collected at eleven no-fish, nine native-fish and twelve nonnative-fish sites using aquatic trapping techniques and shoreline surveys. Results indicate nonnative and native fish species may have an effect on amphibian abundance and diversity within the study area. Average number of individual amphibians per trap among the three treatments was 3.9 individuals/trap in no-fish locations, 1.64 individuals in native fish sites and 0.14 individuals in nonnative fish sites. Average amphibian species diversity was 2.0, 1.67 and 0.54 species/site among no-fish, native fish and nonnative treat- ments, respectively. Results of this study should alert managers to consider the effect of further nonnative fish introductions on native amphibian populations. This study was supported by the W.D.F.W, the Colville National Forest, the BLM and Pend Oreille P.U.D.

A-3

THE LICHEN FLORA OF SNOW CANYON STATE PARK, WASHINGTON COUNTY, UTAH. K.Anderson, L.Cooper, C. Hansen, K. Knight, L. Porter, L.Stewart, L.St .Clair, S. St. Clair, Department of Botany and Range Science Brigham Young University, Provo, Utah. [LG1]

The lichen flora of Snow Canyon State Park is rich and diverse, consisting of 81 species in 41 genera. The composition of the lichen flora appears to have been influenced by three major geographic regions: The Mojave Desert, the Great Basin, and the Colorado Plateau. Eleven species are new records for the state of Utah, and one taxa appears to be a new species from the lobate genus *Lobothallia*. The Snow Canyon lichen flora has an unusually high percentage of foliose species (46%), with only 37% crustose species. Most locations in the Intermountain Area are dominated by crustose species (48-60%). Other Intermountain Area locations with high percentages of foliose species include: southwestern Colorado (43%); west central New Mexico (53%); and southeastern Arizona (47%). This growth form pattern, along with the high number of new state records supports the conclusion that the development of the Snow Canyon lichen flora appears to have been influenced by several biogeographical regions. The single most important substrate for lichens in the park is Navajo Sandstone, which accounts for 56% of all species.

A-4

THE LICHEN FLORA OF CHIRICAHUA NATIONAL MONUMENT, SOUTHEAST ARIZONA. Kim T, Anderson and Larry L. St. Clair, Department of Botany & Range Science, Brigham Young University, Provo, Ut. [LG1]

The lichen flora of Chiricahua National Monument is rich and diverse. From 867 collections made during the course of this study 171 species in 68 genera have been identified. Thirty six species are reported as new records for the state of Arizona. *Acarospora brouardi* B. de Lesd., previously known only from Mexico, is reported as a new species record for the United States. Growth form distribution patterns show an unusually high number of foliose species (47.4%), with almost equal numbers of crustose species(40.3%). Squamulose and fruticose species account for 7.6% and 4.8% of the flora respectively. Growth form patterns dominated by foliose species are unusual for much of the Intermountain area. However, the southern Rocky Mountains (southwestern Colorado, west central New Mexico, and southeastern Arizona) appear to be an exception to this pattern. The abundance of foliose species in this area may in part be influenced by the mild winter temperatures and summer monsoonal rains, typical of this region. Substrate distribution patterns for the lichen flora also depart from typical Rocky Mountain core patterns, with a much higher percentage of bark and lignum species (34.5%) compared to 21% to 29% for several sites in northern Utah and western Wyoming.

A-5

DEMO: A STUDY OF VARYING LEVELS AND PATTERNS OF GREEN-TREE RETENTION IN WESTERN OREGON AND WASHINGTON Keith B. Aubry, USFS, Olympia, WA, Michael P. Amaranthus USFS, Grants Pass, OR, Charles B. Halpern, Univ. of Washington, Seattle, James D. White, USFS, Trout Lake, WA, Brenda L. Woodard, USFS, Roseburg, OR, Charles E. Peterson, USFS, Portland, OR, Cynthia A. Lagoudakis, USFS, Juneau, AK, Alan J. Horton, USFS, Portland, OR. [DEM]

The Northwest Forest Plan requires retaining at least 15% of green trees within harvest units, and recommends placing at least 70% of the retention in moderately sized aggregates. These prescriptions have never been rigorously tested on a broad geographic scale, however. The ecological and social effects of various levels and patterns of green-tree retention (15, 40, and 75%; dispersed vs. aggregated) are being evaluated experimentally in the Demonstration of Ecosystem Management Options (DEMO) study on 8 replicate blocks located on the Gifford Pinchot and Umpqua National Forests, and the Capitol State Forest. We present a brief history of the scientific and management basis for the establishment of the DEMO study and discuss research objectives, experimental design, treatment prescriptions, and major areas of investigation.

A-6

BIOMASS OF THE EPIPHYTIC FERN *Polypodium scouleri* IN OLD-GROWTH COAST REDWOOD FOREST CANOPY AT PRAIRIE CREEK REDWOODS STATE PARK, CALIFORNIA. Mark Bailey, Humboldt State University, Arcata, CA. [CNP]

Virtually no work has been done before now to determine biomass of epiphytic ferns in the temperate low elevation coastal forest canopy. This study at Prairie Creek Redwoods State Park, Humboldt County, California measures total biomass of the epiphytic fern *Polypodium scouleri* in trees of an old-growth coast redwood forest stand. It evaluates the affects on this biomass of architectural differences, branch size and orientation, and crown reiterations, comparing these parameters in coast redwood *(Sequoia sempervirens)* and Sitka spruce *(Picea sitchensis)*. Ten trees were selected and climbed. Distribution of *P. scouleri* within trees was mapped. Height, distance and direction from bole, branch slope, and volume were measured for each fern accumulation. Stratified subsampling for biomass determinations was based upon three size classes. Determinations of total fern biomass per tree are currently in progress and will be available in March but initial indications show striking differences between redwood and spruce. Preliminary findings also indicate poor correlation between numbers of ferns in a mat, height, and branch basal diameters as well as azimuth from bole.

A-7

PREDATOR-INDUCED LIFE HISTORIES OF THREE *Daphnia pulex* CLONES: CHEMICAL-INDUCED RESPONSES TO LARGE SIZE-SELECTIVE PREDATORS. Ross Black and Louise Wold, Department of Biology, Eastern Washington University, Cheney, Washington, 99004, USA. [AQU]

Life table experiments were conducted to determine if predatory larvae of the dragon fly, *Anax* (odonata, aeshnidae), diving beetle, *Graphoderus* (coleoptera, dytiscidae), and damselfly, *Hesperagrion* (odonata, coenagrionidae) induce specific life histories in *Daphnia pulex* (branchiopoda, daphniidae). Individuals of three *D. pulex* clones were exposed to predator-conditioned media or a control medium. When exposed to *Anax*-conditioned medium, two of the three *Daphnia* clones exhibited shorter times to maturity, and all three clones exhibited increased fecundity, when compared to the control individuals. One of the three clones exhibited increased fecundity when exposed to the *Graphoderus*-conditioned medium. There were no apparent differences in the life histories of *Daphnia* in the control and *Hesperagrion* treatments. Within *Graphoderus* and *Anax* treatments, the intrinsic rates of increase of *D. pulex* were either equal or greater than for *Daphnia* in the controls. Our results corroborate previous experimental results with invertebrate and vertebrate large-size-selective predators.

A-8

INITIAL VEGETATIVE RESPONSE TO ALTERNATIVE THINNING IN SECOND GROWTH DOUGLAS-FIR STANDS IN CENTRAL OREGON. Sean A. Bohac, Michael D. Lattig, & Gabriel Tucker of The Evergreen State College Olympia, WA [POS]

The Young Stand Thinning & Diversity Study was initiated to examine ecosystem level effects of alternative silvicultural systems on forest health and productivity. Our objective is to determine immediate vegetative response to three alternative thinning regimes, typical "commercial" thin (318 acres, n=90), Heavy thin (231 acres, n=74) and Light thin with gaps (256 acres, n=121) compared to uncut controls (406 acres, n=90). Differences in each canopy layer were observed: bryophyte cover was strongly affected yielding a nearly linear decline in relation to overstory cover reductions; herb, low shrub and tall shrub cover was highest in control plots with several significant differences between treatments; colonizing weeds were present in thinned sites yielding higher values of species richness. Natural cycles of disturbance and succession produce a diversity of late-successional forests necessary for many plant and animal habitats. Stand thinning is comparable to natural disturbance in many ways. Our long-term goal is to help determine which of, and to what extent these management strategies will resemble natural disturbance and succession, accelerating the return of old growth characteristics in younger managed stands.

A-9

DENSITY, SEX RATIO AND SPACE USE IN MALE AND FEMALE GRAY-TAILED VOLES (*Microtus canicaudus*). Monica Bond, Oregon State University, Corvallis. [HBV]

Use of space influences how an individual gains access to resources such as food, mates and nesting sites and may affect reproductive success. Home range size is usually inversely density-dependent, however, the relative influence of intrasexual competition versus dispersion of the opposite sex on space use has not been addressed. I conducted an experiment in which I manipulated density and sex ratios to test alternative hypotheses for explaining space use by each sex. Sex ratios of four replicate, enclosed populations of gray-tailed voles were skewed towards either males or females to determine which sex had the greatest influence on home range size. Enclosed populations of voles were trapped at 2-week intervals for 10 weeks in the fall of 1997 to calculate home range size. Preliminary results suggest that home ranges of males were density-dependent and male density had a greater influence on male home range size than did female density. Female home range size also decreased with an increase in density, but was not influenced by the distribution of males. The implications of using voles as a behavioral model species for other mammal species will be discussed.

A-10

USE OF TRANSMITTERS IN ARTIFICIAL EGGS AND CHICKS T0 MONITOR PREDATION OF ARTIFICIAL MARBLED MERRELET NESTS. Jeffrey E. Bradley*, John M. Marzluff, John M. Luginbuhl, and Martin G. Raphael. College of Forest Resources, University of Washington, Seattle (JEB, JMM, JML), U.S. Forest Service, Pacific Northwest Research Station, Olympia (MGR). [DYV]

From 1995 to 1997 we placed 512 artificial nests in 49 forested stands on the Olympic Peninsula, Washington. We tested the adequacy of artificial nests, using simulated chicks and eggs, in detecting nest predation and identifying potential predators. Each nest contained a movement-sensitive transmitter within a plastic egg or a mounted chicken chick. We painted eggs to simulate Marbled Murrelet eggs, and dipped transmitters in wax. Transmitters served two purposes: they allowed remote sensing of predation-date (pulse-rate changed after disturbance), and allowed tracking of eggs and chicks that were carried by predators. Wax coating allowed identification of predators at 261 (64%) of 410 preyed-upon nests. The use of both eggs and chicks allowed detection of a wide range of visual- and scent-oriented predators. We outline a research approach for studying nest predation. This approach involves: 1) focus on the predators themselves, including identification of all potential predators at artificial nests; and 2) further study of these predators using more natural stimuli in artificial nests and captive trials which focus on factors which influence the impact of predators.

A-11

CHANGING HERPETOFAUNAS ALONG THE STREAM CONTINUUM. R. Bruce Bury and Donald J. Major, FRESC, Biol. Res. Div., U.S. Geological Survey, Corvallis, Oregon. [EAR]

We tested sampling protocols at 35 headwaters and 30 large waters in three watersheds in southern Oregon. We compared the occurrence and abundance of herpetofaunas by two techniques. We sampled headwaters (stream order 1-3) with three 5-m belts/100 m and larger waters with visual searches along 500-m sections. Area- and time-constrained searches in large waters proved to be unproductive. Of no surprise, we found "cold-adapted" species (e.g., tailed frogs) in the headwaters and "warm-adapted" species (e.g., yellow-legged frogs, garter snakes) in larger waters. However, twice we found overlap in the occurrence of Cascade, red-legged, and yellow-legged frogs. Stream width was a better predicator of species presence than did of stream order. Further effort is needed to better estimate the density of stream herpetofaunas, and to define the habitat requirements of these diverse species. Studies were supported by the Umpqua National Forest, BLM - Roseburg Dist., and Oregon Dept. Fish & Wildlife.

A-12

PELLETIZED CYANOBACTERIAL SOIL AMENDMENTS: LABORATORY TESTING FOR SURVIVAL, ESCAPABILITY, AND NITROGEN FIXATION. S.M. Buttars, L.L. St. Clair, Brigham Young University, Provo, UT, J.R. Johansen, J.C. Sray, M.C. Payne, John Carroll University, Cleveland, OH, B.L. Webb, R.E. Terry, Brigham Young University, Provo, UT, B.K. Pendleton, U.S. Forest Service, Provo, UT, and S.D. Warren, USACERL, Champaign, IL. [BOT]

The escape and growth of *Microcoleus vaginatus* from alginate pellets onto soil crusts under controlled laboratory conditions were studied. Soil crust samples were collected and placed in petri dishes. Selected samples were sterilized, and three treatments were established: 75 g m^{-2} *Microcoleus* pellets added to sterilized soil, 75 g m^{-2} blank pellets added to sterilized soil, and unsterilized soil with no additions. Chlorophyll *a* readings were significantly higher in unsterilized soils. *Microcoleus* biovolumes were highest in sterilized inoculated soils and significantly higher than sterilized untreated soils. *Microcoleus* filament density was significantly higher in *Microcoleus*-inoculated soils than in the other two treatments. Nitrogen fixation activity was recorded in unsterilized soils after only 1 month, and rates increased as the experiment progressed. *Microcoleus*-inoculated soils had significant nitrogen fixation activity during the last sampling period.

A-13

CANOPY RESEARCH IN NORTHERN BRITISH COLUMBIA; AN EXPLORATION OF LICHEN COMMUNITIES. Jocelyn Campbell, Darwyn S. Coxson. University of Northern British Columbia, Prince George, B.C. Canada V2N 4Z9, and Susan K. Stevenson. Silvifauna Research, Prince George, B.C. Canada. V2M 2G8. [CNP]

Wet temperate spruce-fir (*Picea engelmannii/Abies lasiocarpa*) rainforest communities at high elevations in north central British Columbia are host to an abundance of epiphytic lichens. The distribution and diversity of these appears to be strongly influenced by stand structure and canopy architectural attributes. We have characterized arboreal lichen community distribution patterns against canopy structural attributes by combining cover estimates and biomass subsampling, using single rope access techniques. Results indicate that lichens respond significantly to vertical gradients separating functional groups into distinct strata within the canopy. We are now exploring how canopy structural characteristics, as integrated by epiphyte communities, can be incorporated into the design of alternative silvicultural systems. This research is also providing insights into the assemblage of canopy lichen communities along elevational gradients in northern "wet-belt" forests.

A-14

A NEW SPECIES OF *ELYMUS* (POACEAE: TRITICEAE) FROM SOUTHEASTERN WASHINGTON. Jack R. Carlson, Natural Resources Conservation Service, Fort Collins, Colorado, and Mary E. Barkworth*, Utah State University, Logan, Utah. [BOT]

In the early 1980s, D.R. Dewey noted that some plants *of Pseudoroegneria. spicata* from southeastern Washington differed from most plants in the species in their overall aspect, heat tolerance, and lack if compatibility with typical plants. Carlson examined the variation within and between typical and atypical populations of P. *spicata.* The atypical plants can be distinguished from typical plants by their narrow, 1-veined glumes, more compact inflorescences, and pubescent seedlings. They are allotetraploids that combine the **St** genome of *Pseudoroegneria* with the **H** genome of wild barley. Crosses with *E. lanceolatus* indicate that the awn character is controlled by a single major gene, with the unawned condition being dominant. The species is being distributed by the USDA as Snake River Wheatgrass 'Secar'. They are being named *Elymus wawawajensis. Pseudoroegneria spicata* consists of diploids and, along the Washington-Idaho border and adjacent Canada, of autotetraploids. Diploids and tetraploids cannot be distinguished morphologically. Most species in the genus are unawned. Although the awn is a recessive character, awned plants of P. *spicata* are now more widespread than unawned plants in North America.

A-15

COLONIZATION OF MAPLE AND NYLON LEAF PACKS BY MACROINVERTEBRATES IN KAMM CREEK. Michael C. Cawrse, Robin A. Matthews, Western Washington University, Bellingham. [AQU]

The input of leaves into a stream is an important factor in determining the distribution of benthic macroinvertebrates in that system. Leaves are a major source of nutrients in forested headwater streams and can act as habitat for benthic invertebrates. To study the different roles of leaves, leaf packs containing maple leaves or nylon cloth were placed in the headwaters of Kamm Creek, a tributary of the Nooksack River in northwestern Whatcom County, Washington. Leaf packs were collected at one-month intervals for three months. Macroinvertebrates were removed from the leaf packs and identified. Preliminary results indicate that the maple leaves had higher total numbers of macroinvertebrates and a higher diversity of organisms. Shredders, scrapers, and predators showed preferences for the maple leaf packs, with collector-filterers preferring the nylon leaf packs. Differences in leaf pack colonization suggest that leaves are an important part of the nutrient cycle in streams.

A-16

SPOROCARP BIOMASS, SMALL MAMMAL ABUNDANCE AND DIET IN TWO SOUTHERN CASCADE RANGE FOREST STANDS. Efren Cazares, Dan Luoma, and Carol Chambers, Oregon State University, Corvallis, John Lehmkuhl, Pacific Northwest Research Station, Wenatchee [POS]

We compared between two areas in the southern Cascades: (1) the abundance of ectomycorrhizal (EM) fruiting bodies; (2) the EM fungus consumption among three small mammal species: northern flying squirrel, western red-backed vole, and Siskiyou chipmunk; (3) correlation of EM sporocarp biomass with the frequency of EM taxa in small mammal diets; and (4) correlation of small mammal abundance with truffle sporocarp biomass. Over 85% percent of the total EM sporocarp biomass production was truffles. Sporocarp biomass differed for some EM species groups between the two areas. Diet analysis showed that spore frequency of the EM truffle genera *Gautieria* and *Hysterangium* was different between the two areas. Small mammal abundance also differed between the two areas. Truffle biomass and dietary frequency were correlated. There was no correlation of small mammal abundance with total truffle sporocarp biomass.

A-17

THE USE OF MACROINVERTEBRATE SUBSAMPLES TO ASSESS ENVIRONMENTAL IMPACTS ON STREAMS. Beth Chase, Bruce Z. Lang, Eastern Washington University, Cheney. [POS]

The species richness and diversity of pollution tolerant and intolerant macroinvertebrates provide an important tool to assess environmental impacts on streams. This study determined the efficacy of subsampling in assessing water quality and the biological health of the system. Two hundred fifty replicates of 100-, 300-, 500- and 800-organism subsamples were modeled using computer simulations based on actual Hess samples containing 1247 organisms. Subsamples were compared using Hilsenhoff's species Biotic Index (HBI) and Family Biotic Index (FBI), feeding guild and taxa composition, Ephemeroptera, Plecoptera, Trichoptera (EPT) to Chironomidae ratio and percentage tolerant or intolerant species or families. Both HBI and FBI rated water quality as fair with values of 2.68 and 5.3; 3% of all species were tolerant and 13% were intolerant, 2% of all families were tolerant and 12% were intolerant for all subsamples. Some taxa were over-represented in the 100- and 300-organism subsamples, but not at greater than 500-organism subsamples. The ratio of EPT to Chironomidae remained constant (32% Chironomidae and 50% EPT) for all subsamples. Preliminary modeling results indicate that subsampling might provide enough data to reliably assess stream health.

A-18

EVALUATING THE PERFORMANCE OF IN-CHANNEL WOOD IN SMALL STREAM OF EASTERN WASHINGTON. charles j. chesney, DNR Forest Practices Division. [WSA]

The purpose of the Wood In Small Streams Project and the Channel Reference Site Network is to make an initial investment in information infrastructure, and to evaluate the performance of in-channel wood for maintaining channel form and function in certain small, steep streams of the Ahtanum watershed analysis area. Methods followed TFW Monitoring Program protocols, except for measurement of small woody debris and sediment obstructions. From initial work on a two year project establishing long-term measurement sites in managed and unmanaged streams of eastern Washington, channels with high proportions of wood in contact with or near the channel's wetted perimeter had higher amounts of sediment stored behind obstructions. Functional wood is important in certain small, steep, alluvial streams identified as being sensitive to the presence of wood in the Ahtanum watershed analysis area. Special thanks go to Larry Dominguez (DNR), Mark Teske (DFW), Susan Hattrup (Yakima County Watershed Stewards), Richard Visser (YIN), Jack Powell (DNR), and Tara Hicks and Scott Hoefer (Wenatchee National Forest) for their tangible contributions to project success.

A-19

A SURVEY OF THE *SPHAGNUM* MOSS SPECIES FOUND IN BOGS IN KING COUNTY, WASHINGTON. Sarah Spear Cooke, Kate McWiggins, Cooke Scientific Services Inc., Seattle. and Paul Yurkey. [LG2]

Sphagnum moss bogs are uncommon but present across the Puget Basin of Western Washington. The vascular plants of these communities have been described, but little work has been done on identifying the *Sphagnum* moss species. It is known that different *Sphagnum* species are associated with environmental gradients elsewhere in the world. This is also the case in the bogs of King County in the Puget Basin. Fifteen species of *Sphagnum* were found during an inventory of bogs across the County. Data on species presence in bogs in King County appears to be related to their location in hummocks or hollows, wet versus dry, nutrient (cation) rich versus nutrient poor, and sunny versus shady environments.

A-20

PATTERNS OF METABOLIC ACTIVITY IN INTERMOUNTAIN AREA POPULATIONS OF TERRICOLOUS VAGRANT *XANTHOPARMELIA* SPP. USING MICROCALORIMETRY. L.S Cooper, R.C. Cates, L.L. St. Clair, B.N. Smith, and L.D. Hansen, Brigham Young University. [LG1]

The objectives for this study include: 1) determine whether or not microcalorimetry techniques can be used with lichens; and 2) if possible use microcalorimetry to evaluate ecologically induced metabolic patterns in Intermountain Area populations of terricolous vagrant *Xanthoparmelia* spp. Microcalorimetry measures metabolic heat and CO_2 evolution which can then be used to calculate growth rates. In our study metabolic patterns for 17 populations in the Intermountain Area were measured at 3 temperatures (10°, 20°, and 30° Celsius). Five replicate samples from each population were analyzed. Our data clearly demonstrate the applicability of microcalorimetry to lichens. For most populations (12/17) optimal growth rates occurred at 10° C, with some growth at 20° C, but no growth at 30° C. Three populations showed optimal growth at 20° C with some growth at 30° C; and two populations showed growth across all temperature regimes. These patterns demonstrate that optimal growth for most populations occurs during cooler, wetter periods; while some populations are metabolically active at higher temperatures.

A-21

RESISTANCE AND RESILIENCE OF AN AMPHIBIAN ASSEMBLAGE TO LARGE-SCALE CATASTROPHIC DISTURBANCE: AN EXAMPLE FROM THE MOUNT ST. HELENS VOLCANO, 1980-1997. Charles M. Crisafulli, Forest Service, PNW Research Station, Olympia, Louise S. Trippe, Utah State University, Logan. [EAR]

Vulcanism is a primary agent of disturbance in the Pacific Northwest, yet few studies have assessed what role it plays in shaping biological assemblages. The 1980 eruption of Mount St. Helens provided an unprecedented opportunity to study the initial responses and subsequent recovery processes of amphibians to large-scale disturbance. From 1980 through 1997 a variety of habitats (terrestrial, seep, stream and lake) were surveyed for amphibians to assess patterns of recovery in areas undergoing both primary and secondary succession. In the severely impacted pyroclastic and debris flow zones no species survived from a hypothetical list of 15 species assumed to be in the area prior to disturbance. Lentic-breeding species have been the most successful group to colonize these sites, with 6 of the 7 possible species present. Seventeen years after the eruption, terrestrial, seep and stream-breeding species have not colonized these primary successional sites. Twelve species survived in isolated refugia throughout the less impacted blowdown zone. These were species associated with aquatic habitats: seep (2), stream (3) and lake (7). All terrestrial species (3) appear to have been extirpated and remain absent from the entire volcanic impact area.

A-22

EFFECTS OF FEMALE KIN GROUPS ON REPRODUCTION AND DEMOGRAPHY IN THE GRAY-TAILED VOLE, *MICROTUS CANICAUDUS*. Christine Dalton, Oregon State University, Corvallis [BHV]

I conducted an experiment with gray-tailed voles in 0.2 ha enclosures to test the Charnov & Finerty (1980) hypothesis that vole populations comprised of female kin groups would grow at a more rapid rate and reach higher densities faster than would populations in which female kin groups were disrupted. In four enclosures, females were left unmanipulated (control) and in four enclosures all newly caught females were removed from their natal enclosures and replaced with females of comparable age from another enclosure so that juvenile females did not settle near their siblings or parents (treatment). The experiment was conducted for 4 months and over several generations. Population growth rates, population size, juvenile recruitment, pregnancy and lactation rates, and survival rates did not differ significantly between control and treatment populations. The only significant difference was the time to sexual maturation for control females which was 3.1 weeks compared to 4.2 weeks in treatment enclosures. I found no support for the hypothesis that kin-structuring contributes significantly to population cycles.

A-31

EFFECTS OF GREEN-TREE RETENTION ON GROUND-LAYER CRYPTOGAMS IN NORTH-WESTERN FORESTS. Shelley A. Evans and Charles B. Halpern, University of Washington, Seattle. [DEM]

Ecological studies that consider mosses and lichens are relatively rare. Among those of us who frequent Northwestern forests, many may have passing familiarity with a small set of ubiquitous species. Unlike vascular plants, however, we lack basic information about the patterns of diversity, distribution, and abundance of the nonvascular flora. We know even less about the sensitivities of these organisms to forest management practices. Within the DEMO study, a green tree retention experiment, systematic sampling of permanent plots prior to harvest will provide basic information on the composition and distribution of ground-layer cryptogams within mature, unmanaged forests. Post-treatment sampling will allow us to assess their short- and long-term responses to varying levels and patterns of canopy retention. We discuss some of our findings from three experimental blocks on the Gifford Pinchot National Forest, Washington. We speculate about the factors that will shape patterns of survival through harvest and that will mediate species re-establishment under the varying canopy conditions imposed.

A-32

WINTER DEN SITES OF NORTHERN FLYING SQUIRRELS IN THE OREGON CASCADES. Jeffrey S. Feen, Oregon State University, Corvallis. [DEM]

I studied winter den sites of northern flying squirrels (*Glaucomys sabrinus*) in forests of the south-central Oregon Cascades. Fifty-six squirrels were trapped and radio-collared in three managed, 80- to 130-year old Douglas-fir stands on the Umpqua National Forest during the winters of 1994-95 and 1995-96. I compared 134 winter den sites with 174 randomly selected sites. Mean d.b.h. was greater for den trees than random trees, as was mean percent lean of the tree. Basal area of snags was greater and canopy closure was lower around den trees than around randomly selected trees. Squirrels used snags in much greater proportion than they were available. A logistic regression model to predict the probability of a tree containing a den correctly classified 71% of the den trees and 88% of the random trees. The probability that a tree contained a den site increased with increasing d.b.h. and increasing lean of a tree, and if a tree was dead. Managers should consider the creation/retention of dead, large d.b.h. and leaning trees as sites for flying squirrel winter den sites.

A-33

STATUS OF DECLINING AMPHIBIANS IN CALIFORNIA. Gary M. Fellers, Biological Resources Division, USGS, Point Reyes National Seashore, Point Reyes, CA [HBV]

Field surveys have been conducted throughout much of the non-desert areas of California in order to evaluate the status of California amphibians. Since 1991, more than 4,000 field sites have been visited. These surveys have demonstrated significant declines in the distribution of anurans, especially in the southern Cascade and Sierra Nevada mountains of the western United States. *Rana cascadae*, *R. boylii*, *R. muscosa* have declined most significantly while *Hyla regilla* and *Bufo canorus* have declined in at least some portions of their range. Factors which appear to be involved include 1) non-native trout which feed on eggs, larvae, and adult anurans, and 2) a variety of pesticides and herbicides which are abundantly applied in the agricultural areas of the Central Valley of California, upwind from the most severely impacted areas. Preliminary data from pesticide studies indicate that contaminants are found in measurable and biologically significant concentrations at even at elevations of 3,000 m in the Sierra Nevada where populations of *R. muscosa* were once present. An experimental reintroduction of R. muscosa in this same area has been largely unsuccessful.

A-34

ABUNDANCE OF LONG-TOED SALAMANDERS IN RELATION TO VARYING LEVELS OF CANOPY COVER FOLLOWING LOGGING ADJACENT TO BREEDING PONDS. Christine Ferguson, University of British Columbia. [EAR]

This study was conducted at the Opax Mountain Silvicultural Systems Research Area near Kamloops, British Columbia, as part of a multidisciplinary study of the effects of different silvicultural systems on several factors, including seedling regeneration, windthrow, plant ecology, microclimate, soils and wildlife. I examined the relationship between degree of canopy removal following logging adjacent to breeding ponds and the abundance of adult and juvenile long-toed salamanders (*Ambystoma macrodactylum*). Breeding salamanders were surveyed at 28 ponds at the two sites in the research area. Emerging juvenile salamanders were surveyed at 21 ponds. There was a weak trend toward higher capture rates of breeding adult salamanders at higher canopy covers for both sites. Pond permanence influenced capture rates as well. Trends in juvenile emergence with canopy cover were different at the two sites, with a strong negative relationship between emergence rate and canopy cover at one of the two sites. Capture rates of breeding salamanders differed between sites by a factor of 2, while juvenile emergence rates differed by a factor of 12. Differences in observed relationships and overall abundance between sites are attributed in part to differences in elevation.

A-35

ACCESSIBILITY AND USE OF GRASSLAND HABITATS BY RAPTORS: AN EXPERIMENTAL APPROACH. Tiffany Fox, Jerry O. Wolff, and Robert S. Skillen, Oregon State University, Corvallis. [DYV]

Raptors are major predators on small mammals in the Willamette Valley or Oregon during winter. Predator access to small mammal habitat is in part a function of available perch sites. In that perch sites are not available in much of grassland habitat, predator access to these areas may be limited. We experimentally constructed perch sites in treeless vole habitat and monitored raptor use of the area before and after addition of perches. Use of the area did not differ before and after treatment for northern harriers, which do not use perches, however use of the area increased over 2-fold for American kestrels following addition of perches. Foraging efficiency for harriers was <10% compared to ~20-35% for kestrels. Mean perch time/site for kestrels ranged from 5 to 20 minutes and correlated positively with perch height. We conclude that adding perch sites can significantly increase raptor use of an area which in turn may have demographic consequences for small mammals (Skillen et al. this symposium).

A-36

RARE PLANT MANAGEMENT ON NATIONAL FORESTS IN OREGON AND WASHINGTON: PAST, PRESENT, AND FUTURE. Nancy A. Fredricks, USDA Forest Service, Vancouver, WA. [RP2]

In 1990, four permanent botanists were employed by the 19 National Forests of Region 6 (Oregon and Washington) of the USDA Forest Service. In 1998, 58 permanent full-time botanists represent issues including threatened and endangered plants, noxious weeds, special forest products, research natural areas, and environmental education. The recently updated Regional Forester's Sensitive Species list includes fungi, lichens, bryophytes, and vascular plants which are managed under the National Forest Management Act to avoid downward population trends. Conservation Strategies and Assessments promote management of rare species to avoid federal listing under the Endangered Species Act. Effective management of the botanical diversity of National Forests requires strong commitment from state and other federal agencies, native plant societies, botanical gardens, academics, and private individuals in partnership with Forest Service botanists.

A-37

WHEN DOES SOLAR ENERGY APPLY? VIABILITY OF SOLAR TECHNOLOGIES IN OLYMPIA'S CLIMATE. Cathy French, Andrew Oberg, The Evergreen State College. [POS]

In this case study we explore the viability of solar technologies in Olympia's climate, where we interpret climate in both a physical and political sense. We limit our scope to solar technologies that can be applied to meet the energy needs of buildings. The study includes an analysis of solar technologies, integrative building design, policy issues, and economic and environmental costs. It is important to understand each of these topics in order to create a context in which to view Olympia's solar potential. What we find is that passive and active solar technologies have the most immediate potential in our cloudy climate. Also, grid intertie technology in combination with net metering policy would make photovoltaic energy much more attractive in this area. This is because the building could receive electricity from the on site photovoltaic system during sunny conditions and the utility grid during cloudy conditions. It also became clear during the course of this study that, prior to employing any of these solar technologies, it is important to apply energy conservation strategies to buildings in order to obtain the greatest benefit from them. Finally, an increased public interest in solar techniques in combination with a guarantee of solar access and other policy incentives appear to be key components in making solar energy more prevalent in Olympia.

A-38

WHAT DO YOU DO WHEN A TIGER WANTS TO EAT YOU? Julie A. Fronzuto and Paul A. Verrell, Washington State University, Pullman, WA. [DYV]

Predation and competition are important determinants of community structure of amphibians, although almost all attention has focused on interactions among larval populations. Two species of ambystomatid salamanders frequently breed in the same ponds in southeast WA, *A. tigrinum* (*AT*) and *A. macrodactylum (AM)*. The former is a voracious predator, and is anecdotally reported to prey on the latter. We are collecting phenological data for a syntopic breeding site in Pullman, WA, and find considerable temporal overlap for adults, eggs and larvae of both species, suggesting that interspecific predation is ecologically likely. We have documented the occurrence of both partial and complete predation by *AT* on its congener, for both aquatic and terrestrial-phase salamanders. Theory predicts that *AM* should exhibit tactics for either predator avoidance and/or predator defense. Laboratory work demonstrates that *AM* uses cover significantly more often ($p=0.006$) in the potentially lethal presence of *AT* than when *AT* is absent. Work is in progress to examine, in detail, the behavior patterns that comprise the antipredator tactics of *A. macrodactylum*.

A-39

UPDATE ON THE CONSERVATION STATUS OF RARE PLANTS IN WASHINGTON. John G. Gamon, Natural Heritage Program, Washington Department of Natural Resources, Olympia. [RP1]

A revision to the state's list of rare plants (*Endangered, Threatened and Sensitive Vascular Plants of Washington*) was completed in August, 1997. The list now contains a total of 451 vascular taxa: 20 Endangered, 49 Threatened, 192 Sensitive, 57 Review, and 133 Watch. Working lists of non-vascular species have also been included for the first time, with 80 mosses, 111 lichens, 57 fungi, and 32 marine algae. There have also been recent changes in the federal status of several taxa. There are currently six plant taxa in Washington listed as endangered or threatened under the federal Endangered Species Act, two taxa have been formally proposed for listing, and one taxon is a candidate for listing. There are also 53 "species of concern." The USFWS is reviewing the status of several species for possible inclusion in the next revision to the list of candidates. Conservation activities have either taken place or are underway for several of these high priority rare plant taxa. Activities include additional inventory, monitoring, research, preparation of management plans, designation of natural areas, and on-the-ground habitat management, including the use of tools such as mechanical vegetation control and prescribed fire.

A-40

BATTLE OF THE SEXES: MATING SUCCESS VARIANCE IN *DESMOGNATHUS OCOEE*. Susan Gershman and Paul Verrell, Washington State University, Pullman. [BHV]

Darwin's theory of sexual selection posits that certain male characteristics have evolved because they allow some males differential access to females. In the salamander *Desmognathus ocoee*, matings can only occur after elaborate "persuasive" male courtship. In our captive population of *D. ocoee*, we measured the ability of individual males and females to mate successfully, classifying them as "studs," with high mating success rates, and "duds" with low mating success rates. We crossed male and female studs and duds to determine whether disparities exist in the likelihood of successful mating encounters between male studs with female duds versus male duds with female studs. We predicted that if male persuasiveness is more influential to the success of mating encounters than female responsiveness, the male studs with female duds should be more successful; if not, the alternate cross should be as or more successful. Our results indicate that male studs with female duds had significantly more successful encounters than male duds with female studs, confirming the prediction that male persuasiveness has a greater effect on the success of a mating encounter than female responsiveness.

A-41

SMALL MAMMAL RESPONSES TO EXPERIMENTAL FOREST GAPS IN THE SOUTHERN WASHINGTON CASCADES. Robert Gitzen and Stephen D. West, University of Washington, Seattle. [DEM]

Responses of Pacific Northwest small mammals to stand replacement disturbances are generally understood; however the effects of smaller-scale disturbances are less clear. We compared small mammal abundance and species occurrence between experimental gap patches and forested control patches in the southern Washington Cascades. Abundance of *Peromyscus* was not significantly different between patch type in the summer, but was significantly higher in gap patches during the fall. Contingency table analysis of sex and age-class data did not support the hypothesis that gap patches were functioning as sinks for *Peromyscus keeni*. One pre-canopy species (*Microtus oregoni*) was present in most gaps but not most forested sites. Closed-canopy species (*Clethrionomys gapperi*, *P. keeni*, *Sorex trowbridgii*) occurred as frequently in gaps as in forested patches, indicating that the gap size studied (50 m diameter) is below the threshold disturbance size at which these species decline in numbers or disappear. Determining threshold disturbance sizes across the Pacific Northwest will help managers to evaluate the effects of alternative forestry practices on small mammals.

A-42

PATTERNS OF GENETIC VARIATION IN RARE AND WIDESPREAD PLANT CONGENERS: DO RARE SPECIES HAVE LOWER LEVELS OF GENETIC VARIABILITY? Matthew A. Gitzendanner and Pamela S. Soltis Washington State University, Pullman. [RP2]

Rare species have been viewed as having low levels of genetic variation. This view has been supported by several reviews of isozyme studies. However, such reviews have neglected phylogenetic information and compared unrelated taxa. Recently, more researchers have also studied a widespread congener when investigating the genetic diversity of a rare species. We summarize the available data from such studies, comparing the levels of genetic variability at the population and species levels and measures of population substructuring for rare and widespread congeners. At the population level, we gathered data for percent polymorphic loci, mean number of alleles per polymorphic locus, and observed heterozygosity. Species-level measures used were percent polymorphic loci, total genetic diversity, and indices of population subdivision. Using paired t-tests, we found no significant differences between rare and widespread species for any of the three population-level measures of genetic variability examined. At the species level, values of $\%P_{spp}$ between rare species and their widespread congeners were significantly different, while values of H_T were not . Finally, there does not appear to be a difference between rare and widespread congeners in terms of how they partition their genetic variation within and among populations.

A-43

SPARTINA ALTERNIFLORA: CLIMATIC FACTORS INVOLVED IN SEEDSET Nicole Goodwin, Mollie Caka, Sophia Dadi, Olga Meydbray, Amy Burns, Chelsea Ruben, Chad Herring, The Evergreen State College, Olympia. [ECO]

Since its accidental introduction into Willapa Bay in the late 1880's, *Spartina alterniflora* has spread over more than 5000 acres of tidal flats as of 1997. Attempts at stopping the spread of *S. alterniflora* have included physical, mechanical, and chemical methods. None have proved effective enough to reverse the course of the infestation. Although it has not yet been thoroughly studied, controlling seed set could be an effective way of slackening population growth. Our study at Bay Center, Washington, was conducted to seek correlations between temperature and precipitation data for the area and heavy seed set years. Annual radial growth was estimated and used to bactrack clones to the years in which they sprouted. Climate data compiled at Raymond, Washington were analyzed for climate trends. A tentative relationship was found between years of high temperatures and low precipitation, and heavy seed set. If it is possible to predict heavy seed set by climatic or other factors, attempts at control should be concentrated in these years. Many thanks to Dave Milne and The Environmental Analysis Program, Fall 1997.

A-44

LANDSCAPE-SCALE ADAPTIVE MANAGEMENT IN THE OREGON COAST RANGE. Andrew N. Gray, US Forest Service Research Station, Corvallis. [FOR]

The effects of forest management must be evaluated at the landscape scale in order to determine success at meeting the various ecosystem and social objectives placed upon our forests. Yet little work has tackled interdisciplinary landscape questions in a systematic manner. Federal land managers and researchers associated with the Northern Coast Range Adaptive Management Area (Oregon) are beginning a collaborative process with citizens to develop a landscape-scale study that will compare different management "strategies" over large landscapes and long time periods. Strategies consist of alternative approaches to forest, riparian, roads, and recreation management to meet objectives of restoring old-growth-dependent wildlife and salmon and providing social and economic value to local residents at the same time. The overall study will incorporate principles of experimental design to the greatest extent possible, including addressing questions with well-defined treatments, initial similarity of experimental units, replication, and randomization. The social and ecological rationale behind alternative strategies, the methodology of defining unit similarity and selecting replicates, and preliminary landscape monitoring plans are discussed. Despite a variety of barriers that will need to be overcome, this kind of study may be the only way to answer vital social questions concerning the role of humans in native ecosystems.

A-45

SMALL MAMMAL POPULATION TRENDS ON THE BOARDMAN BOMBING RANGE AS REFLECTED IN THE DIET OF SYMPATRIC OWLS. Gregory A. Green, Parametrix, Kirkland, WA, Kent Livezey, U.S. Navy, Poulsbo, WA, Russell Morgan, Oregon Dept. of Fish and Wildlife, Heppner, OR. [DYV]

A barn owl/long-eared owl diet study was conducted on the U.S. Navy's Boardman Bombing Range in 1980, and 1994 to 1997. Study objectives were to search in the owl diets for the presence of small mammal species previously unrecorded on the range, compare diets of the sympatrically-occurring owls, and relate inter-annual variation in diets to environmental factors. Owl pellet analysis resulted in the first record for sagebrush voles on the range, and revealed a much greater than expected population of western harvest mice. Diets of the owls were largely similar. Great Basin pocket mice and deer mice were the principal prey of both owls, although barn owls also preyed heavily on northern pocket gophers. Both species showed the same pattern of inter-annual variation in the percentage of heteromyid rodents in their diet compared to cricetine rodents. The percentage of heteromyids in the combined diet of both owl species was highly correlated with the number of days greater than 90°F the previous summer. We relate this correlation to the greater hot weather survivability of the deep-burrowing heteromyids compared to the shallow-burrowing and/or surface-nesting cricetines.

A-46

THE EFFECT OF FIRE ON SURVIVAL OF MULLEIN (*VERBASCUM THAPSUS*) FIRST-YEAR ROSETTES. Diana L. Sisseck and Steven J. Stein, Eastern Washington University, Cheney. [POS]

This research is part of a larger study on the effect of fire on mullein growth and reproduction at Turnbull National Wildlife Refuge. Here we investigated the relationship between rosette diameter and amount of post-fire surviving plant. One hundred pre-fire mullein rosettes were marked and their diameters measured. A 120 hectare prescribed burn was conducted on September 22, 1997. Eighteen days after the burning we determined the amount of each rosette that survived. There was a significant positive linear relationship between rosette diameter and amount of plant remaining after fire ($R^2 = 0.96$, $p = 0.0005$). The largest two rosette diameter size groups together had a mean damage of only 18%, while the combined mean damage of the two smallest diameter size groups was 43%. It appears that fire may not have much of an effect on mullein population dynamics because it only has a major detrimental impact on smaller individuals, which would probably not reach sexual maturity anyway.

A-55

PHYSIOLOGICAL STUDIES AT FINDLEY LAKE: INSIGHTS FROM THE ORGAN TO THE STAND.

T.M. Hinckley, R.O.Teskey, J.W. Leverenz, G. Tucker, J.R. Brooks, T.A. Martin, K.J. Brown, J.R. Rombold and D.G. Sprugel, University of Washington, Seattle. [CRW]

Our studies on the physiological ecology of Pacific silver fir have focused on three issues. First, how does Pacific silver fir function in an environment of low soil temperatures and a relatively short growing season? Second, how does the foliage of Pacific silver fir, a shade tolerant species, respond to its light environment including the environment during foliage development, the environment over the life of a given unit of foliage and a new environment resulting from gaps or clearcut. Third, what regulates water loss from needles, trees and stands? As a result of almost two decades of studies, we have a solid insight into the physiological ecology of these species.

A-56

FOREST NUTRIENT DYNAMICS IN THE LOWER CEDAR RIVER WATERSHED: OBSERVATIONS AND EXPERIMENTS.

Peter S. Homann, Western Washington University, Bellingham, Dale W. Cole and Rob Harrison, University of Washington, Seattle. [CRW]

The movement of nutrients within and through forest ecosystems is integral to plant productivity, nutrient losses in water percolating through soils, soil development, and influences of atmospheric deposition and management practices. For more than 30 years, observational and experimental studies have been carried out to examine nutrient dynamics in the forests of the Cedar River Watershed. Studies of nitrogen fertilization yielded a better understanding of the importance of soil processes in controlling nitrogen availability. Additions of anions to soil showed responses of cation mobility within soil profiles and cation losses from the soil. Comparison between Douglas-fir and red alder stands indicated substantial effects of vegetation on nutrient uptake, nitrogen fixation, weathering rates, cation leaching, and sulfur dynamics. Manipulation of vegetation demonstrated rapid responses of soil processes and the influence of former vegetation on current productivity. Comparison of this relatively unpolluted area with other forests throughout North America affirmed the diversity and complexity of nutrient cycling patterns and controls.

A-57

THE WARNER CREEK FIRE DISTURBANCE PROCESS RESEARCH NATURAL AREA PROPOSAL.

Timothy Ingalsbee, Ph.D., Western Fire Ecology Center, Fall Creek, OR [ECO]

The 1991 Warner Creek fire burned across 8,973 acres of a Habitat Conservation Area for the northern spotted owl (*stix occidentalis caurina*). Nine owl pairs had their habitat activity centers within the fire perimeter, and 2,060 acres of suitable habitat experienced high fire mortality. A spring 1992 survey discovered that eight of the owl pairs still occupied their nest sites, seven pairs exhibited reproductive behavior, and six of these pairs successfully fledged young. Six years after the wildfire, spotted owls and their prey base continue to flourish in one of the rarest forest landscapes in the Cascadia bioregion: a roadless, mid-elevation, naturally recovering, recently burned forest containing both young natural stands and high-mortality old-growth stands. A unique coalition of citizen-scientists, environmental organizations, and the Forest Service have all proposed the Warner Creek Burn as a Research Natural Area. This would be the first RNA devoted to post-fire disturbance ecological processes, including natural recovery of spotted owl habitat. Future prospects for developing an inter-regional network of similar fire disturbance process RNAs throughout the Northwest will be discussed.

A-58

NUTRITIONAL ECOLOGY OF LIVING AND EXTINCT BEARS: STABLE ISOTOPE ANALYSIS.

Michael E. Jacoby, Charles T. Robbins, Grant V. Hilderbrand, Washington State University, Pullman, Chris Servheen, University of Montana, Missoula, Robert Michener, Boston University [DYV]

We used stable isotope analyses to investigate the nutritional ecology of black (*Ursus americanus*), grizzly (*U. arctos*) and extinct North American short-faced (*Arctodus simus*) bears. This technique has shown a greater utility over traditional nutrition study techniques in which the differential digestibility of diet components may skew the findings. It also allows significance to be attached to individuals, thereby addressing issues below the subpopulation level. These analyses may be done on living, dead and extinct organisms, and on any available tissue. 11 collections were sampled for bone and hair, and hair samples collected from extant populations in the Greater Yellowstone (GYE) and Northern Continental Divide (NCDE) ecosystems. Grizzly populations in Glacier National Park, North Fork and South Fork of the Flathead River were found to have significantly lower meat intake than those in the GYE ($p < 0.0001$). Males in the GYE were found to have significantly higher meat intake than females in the same area ($p = 0.0095$). Stable isotopes show promise as a management tool given that responses by the bears to their nutritional environment can be detected in time frames varying from days to lifetimes.

A-59

DEPOSITION, RETENTION AND UTILIZATION OF WILD CHUM SALMON (*ONCORHYNCHUS KETA*) CARCASSES IN KENNEDY CREEK. Joseph Jauquet, The Evergreen State College, Olympia. [AQU]

Understanding of mechanisms for salmon carcass deposition and retention in small streams is important because juvenile fish, insects, riparian plants and terrestrial animals use carcass nutrients. Wild chum salmon (*O. keta*) carcass distribution in Kennedy Creek was compared with an experiment that released coho salmon (*Oncorhynchus kisutch*) carcasses in Olympic Peninsula streams. Two 100m sections of Kennedy Creek were observed from November 1997 to February 1998, to count carcass deposition and retention, and photographs of chronological utilization by terrestrial animals were taken. Carcass deposition occurred most frequently in eddies, riffles and on gravel bars with differences between sections based on stream sinuosity and complexity. Greatest frequency of carcass retention was by woody debris and live wood. Specific in-channel wood complexes permanently retained up to 50% of the identical carcasses until they were buried or no tissue remained through four high flows. This is consistent with previous research emphasizing the importance of stream channel complexity based on woody debris and live wood. Channel complexity thus contributes to efficient carcass utilization in small streams.

A-60

ENDEMIC FAUNA OF THE OWYHEEAN ISLANDS OFF THE COAST OF IDAHO: INDUCED EXTINCTION BY POOR MANAGEMENT PRACTICES. Lawrence L.L.L.C. Jones, Janet L. L. Jones, Uncle Nardly, J. Jay, Barnabas Zokvnov, and Commander Salamander. Insituto de Bunko Historico Naturale, 666 Snorkybork Lane, Wallawallawa University for the Conceptually Challenged. [POS]

Our team of trained biologians have been growing weary of the stupid animals inhabiting the Owyheean Islands, so we decided to conduct an experiment. Our null hypothesis was: the introduction of starlings, poop-doves, rats, mices, goats, breakfast cereals, elephantoids, house kats, bully frogs, and DDT would have no effect on the completely unique, endemic fauna of the islands. Our findings rejected the null hypothesis, as all species of vertebrates are now extinct, except for the dead frog that thrived under the new regime. Therefore it brings us great pleasure to re-display our decaying poster as a paleontological treatise, rather than a biotic one. Now the Tooth-cow, Dear Mouse (*Promiscuous manipulatus*), Potatoe Frog (Quayle) , and their neighbors can be admired in museums around the world.

A-61

ABUNDANCE PATTERNS AND HABITAT AFFINITIES OF STREAMSIDE AMPHIBIANS IN THE OLYMPIC PENINSULA, WASHINGTON. Lawrence L. C. Jones and Martin G. Raphael, Pacific Northwest Research Station, Olympia, WA. [EAR]

From spring 1996 to fall 1997 we conducted hand-search transects for streamside amphibians in the Olympic Peninsula. We captured 1,328 specimens of 11 species. Only 3 species were abundant enough for analysis: western red-backed salamander *(Plethodon vehiculum*, 69%), Olympic torrent salamander (*Rhyacotriton olympicus*, 13%), and Van Dyke's salamander (*P. vandykei*, 11%). Across age classes, streams in old stands had the highest density of amphibians ($6.8/100m^2$). The stream valley had higher densities ($6.8/100m^2$) than near-stream ($2.0/100m^2$) or upslope ($2.7/100m^2$) transects. *P. vehiculum* was well-distributed across habitat types. *R. olympicus* was found near the stream and seeps, and *P. vandykei* was usually found within 20 m of the stream (= 6.9 m). Salamanders tended to cluster at certain habitat features. Four nests of *P. vandykei* were found in large, rotting logs near the streams. One of the nests was monitored with temperature loggers. The clutch incubated for > 150 days (female was present) and the log buffered the eggs from outside temperatures, particularly from daily thermal maxima.

A-62

GROWTH FACTORS OF COMMON ARID-LAND MOSSES. Robin Jones, Boise State University, Boise, Idaho [POS]

The restoration of degraded rangeland normally involves the reintroduction of native vascular plant species and non-native forage and browse species by drill and aerial seeding after wildfire. However, land managers have yet to consider the reintroduction of nonvascular microphytes, such as arid-land mosses. Many moss species have the ability to reproduce a clonal individual from a single cell. Moss species typically found as a common component of the microbiotic crust of relatively undisturbed steppe vegetation were used for experimentation, including *Tortula ruralis*, *Bryum argenteum*, and *Ceratodon purpureus*. Gametophytic moss thalli were prepared using a protocol of washing and surface sterilization, tissue drying, and fragmentation of thalli. Thalli fragments were inoculated to a variety of substrata, e. g., vermiculite, perlite, sand, and soil from three field sites. Fragments were allowed to grow under a constant light and moisture regime in covered petri plates until scoring. Moss fragments grown on artificial substrata (i. e. vermiculite, perlite, and sand) showed more consistent growth than fragments inoculated to the field soils. The results of these experiments give insight to the possible success of inoculating mosses to the soil at field locations.

A-63

GENETIC AND ECOLOGICAL STUDIES OF THE MATING SYSTEM IN THE PALE LARKSPUR, *DELPHINIUM LEUCOPHAEUM* (RANUNCULACEAE).

Keith Karoly, Reed College, Portland. [RP1]

Reproductive biology plays a profound role for flowering plants in determining their distribution and abundance. A full understanding of the mating system can therefore provide critical information when developing management plans for rare species. Both genetic and ecological features of reproduction were studied for *Delphinium leucophaeum*, a narrow endemic that is a state-listed Endangered Species in Oregon. The dependency on pollinators and adequacy of natural levels of pollinator visitation were experimentally investigated in a natural population. The outcrossing rate was estimated using allozyme markers and a controlled pollination study was used to investigate the effects of crossing-distance on inbreeding and outbreeding depression. Genetic markers were also used to characterize the genetic structure of Willamette Valley populations. The pale larkspur was found to rely on pollinators for seed production. Augmentation of natural pollen loads did not increase seed set, indicating that pollinators were not a factor limiting seed set in this population. The population outcrossing rate estimate was t=0.83, indicating little selfing in this natural population. The genetic marker data and crossing-distance results both indicate genetic differentiation exists, even at local scales.

A-64

EFFECTS OF TIMBER HARVEST ON *CIMICIFUGA ELATA*, A RARE PLANT OF WESTERN FORESTS.

Thomas N. Kaye, Oregon State University, Corvallis. [RP2]

Cimicifuga elata is a rare plant of northwestern North America. Conservation of the species in forests of western Washington and Oregon creates the potential for conflict with timber harvest objectives. Previous reports indicate the species may be old-growth dependent, and that populations near clearcuts have low vigor. The objectives of this study were to compare populations in sites with differing timber-management histories to evaluate the effects of timber harvest. In contrast to previous reports, we found that *C. elata* in uncut old-growth forest was smaller and less reproductive than in clearcuts, probably because the plants respond well to additional light in cut-over areas. Plants in areas with other management histories, such as second growth and thinned stands (both >70 years old), had an intermediate size. No populations have been reported in clearcuts of moderate age (15-30 years), and it is possible that competing vegetation excludes *C. elata* from clearcuts after a few years. We recommend protection of selected populations, improvement of other sites through strategies such as forest thinning, and creation of gaps in forests to provide additional habitat for the species, as well as additional targeted research.

A-65

MAPPING THE POTENTIAL VEGETATION OF THE NORTH FORK JOHN DAY WILDERNESS, OREGON: INTEGRATING GIS AND CLASSIFICATION TREE MODELING.

Alison M. Kelly, Utah State University, Logan. [BOT]

Knowledge of the distribution of potential natural vegetation over a landscape can be important in many management decisions. In this study, the potential vegetation of a wilderness area in northeastern Oregon was predicted using a combination of field data, GIS, and a predictive model. Collected during the summers of 1996 and 1997, data points with known locations and plant associations were combined with data from GIS layers. The layers utilized were slope, aspect, elevation, precipitation, geology, and soils. The known points, with their associated information, were then input into a classification tree model, which utilized both continuous and categorical data. The model output, a binary decision tree, was then used to predict the plant associations over the entire study area. Examination of the tree and of the model cross-validation provided insight into the relative importance of the abiotic factors used by the classification model and of the error associated with the prediction of each plant association.

A-66

A NEW SPECIES OF BUD GALLING MIDGE (DIPTERA: CECIDOMYIIDAE) AND ITS IMPACT ON GROWTH PATTERNS OF SNOWBERRY (Symphoricarpus albus).

David J. Kinateder, and Steven J. Stein, Eastern Washington University, Cheney. [BOT]

The purpose of this study was to describe the life history of a new gall midge species found in Eastern Washington and determine the impact it has on its host plant. Galls and buds were periodically dissected to monitor the progress of this galler through one full life cycle. Seventy-seven snowberry ramets were randomly chosen to determine the impact of this galler on its host plant. This galler is tightly synchronized with its environment limiting the majority of its developmental stages to the short time in spring when conditions are both warm enough and wet enough to support larval growth. The number of shoots were 42% lower and the number of latent buds 14% greater on galled branches than on ungalled branches ($P = 0.0001$). Shoots growing on galled branches were significantly shorter (mean = 2.0) than shoots growing on ungalled branches (mean = 3.1, $P = 0.0001$). We have shown that this galler not only manipulates plant tissue in the formation of a gall but also changes plant physiology by suppressing growth throughout the plant and diverting resources to the gall for the benefit of the parasite.

A-67

ECOLOGICAL DATA IN A MEANINGFUL CONTEXT: A METADATA DATABASE MANAGEMENT SYSTEM Sylys Knackstedt, Betsy Lyons, Mark Sumera, Nalini Nadkarni, Judy Cushing, The Evergreen State College, Olympia [CNP]

As the amount of data generated from ecological studies increases, long-term archival sites face the problem of documenting and integrating data so that future scientists are able to understand and use it. Our interdisciplinary team of database scientists and ecologists explored solutions to this problem. Our assumption was that scientific data can best be organized as formal data structures implemented in a database management system (DBMS) if they reflect the scientists conceptual understanding of the data. To better understand the process of data generation and documentation, we participated in an ecological research project. The ecologist's original data structures are presented and compared to structures designed by database scientists. These designs guided the development of a metadata database system that gives context to a researcher's conceptual model by explicitly documenting the methods employed in gathering the data. We show how data and metadata from two case studies, both of which relate to aspects of forest canopies, can be queried within the DBMS.

A-68

A NEW LOOK AT ENDEMISM AND RARITY. A. R. Kruckeberg, University of Washington, Seattle. [RP1]

The terms endemism, rarity, and endangerment are closely linked. Rare taxa are usually narrow to local endemics and may become endangered for a variety of causes. Further, several kinds of rarity have been noted: narrow endemics (restricted species), sparse species, relictual versus newly evolved species, outlier populations, and unusual populations in common species. The Endangered Species Act has done much to foster study of rare plant and animal species. At first their study focused on inventory: population size and extent, locality, habitat attributes, and endangerment. More recently, rare taxa are being studied for their intrinsic biological attributes: population biology (demography, breeding system, etc.), genetic structure (polymorphism, heterozygosity, inbreeding depression), their spatial and ecological distribution (biogeography), and their evolutionary origins and relationships (speciation and phylogeny). The focus here will be on the biological attributes of rare plant species, drawing upon case studies in the recent literature. In some cases, endangerment, conservation status, and measures for protecting rare taxa will be discussed.

A-69

CONSPECIFIC TRAILING BEHAVIOR OF GARTER SNAKES UNDER NATURAL CONDITIONS. Michael P. LeMaster, Oregon State University, Corvallis, Robert T. Mason, Oregon State University, Corvallis. [BHV]

The ability of many animals to successfully migrate between distant locations plays a critical role in their reproductive success and survival. One navigational mechanism utilized by many organisms, particularly reptiles, is the trailing of conspecifics. Previous studies have demonstrated that snakes will trail conspecifics in the laboratory but it has yet to be shown that snakes will trail conspecifics in the field under natural conditions. To test whether garter snakes will trail conspecifics under natural conditions, male and female red-sided garter snakes (*Thamnophis sirtalis parietalis*) were captured in the field near Narcisse, Manitoba, during the spring and tested on mazes set up on the natural substrate. Trials were repeated in the fall to ascertain whether conspecific trailing behavior is utilized as a mechanism for den location. Trailing was observed to occur under natural conditions and exhibited both sexual and seasonal differences. Males garter snakes were found to trail females in the spring while neither sex exhibited trailing behavior in the fall suggesting that garter snakes rely primarily on conspecific trailing behavior for locating potential mates and may utilize other mechanisms for navigation to winter hibernacula.

A-70

CAN PAIRING SUCCESS BE INFERRED FROM RELATIVE ABUNDANCE ESTIMATES OBTAINED FROM POINT COUNTS? Matthias Leu and David A. Manuwal, University of Washington, Seattle. [DEM]

Point-count methods are frequently employed to census forest birds. Abundance estimates from these censuses are then used to infer number of territorial males in breeding habitat. However, the ability of point counts to estimate male pairing success has rarely been validated in forests of the Pacific Northwest. We used spot mapping and behavioral observations to test whether point-counts accurately sample the number of paired males. The data for this study were collected on Washington DEMO (Demonstration of Wildlife Options, USFS) sites on 11 passerine species. First, we compared relative abundance between the two census methods, predicting a positive correlation. We found significant positive correlations for eight species. Second, we compared pairing success with relative abundance derived from point counts. Here we predicted either a positive or negative correlation between relative abundance and percent of paired males, depending on species-specific territorial and reproductive behaviors. We found significant positive correlations for two species only. Although both methods agreed on relative abundance for most species, we suggest that spot mapping may be superior to point counts, because pairing success can be collected in addition with census data.

A-71

USING NATURAL PATTERNS AS A "MARKING TECHNIQUE" FOR HERPETOFAUNA. Patrick Loafman [POS]

Toe-clipping has been the primary marking technique for amphibians since its introduction fifty years ago, though many basic questions remain unanswered about its validity. Recently there has been growing concern among herpetologists as to the effects of toe-clipping on amphibians, especially frogs. Results from initial studies have given varied results as to how detrimental clipping toes is to the survival and well-being of an amphibian. It seems that responses to toe-clipping is variable from species to species, as well as within species and may depend on the number of toes clipped. I have been experimenting with using natural patterns to identify individual amphibians and reptiles within populations and present my successes, failures, and problems. The use of drawings, photographs, and "spot counts" in identifying individuals is discussed. Get hands on experience with "Find Spot" the new "Where's Waldo" game for herpetologists.

A-72

HERBARIUM SHEET WALL DISPLAY. Chris O. Loggers and Kirk W. Larson, US Forest Service, Kettle Falls Ranger District, 255 West 11th, Kettle Falls, WA 99141 [POS]

We designed a low-cost, wood-and-Plexiglas wall mount to display 10 herbarium sheets. The display consists of 3 wooden, grooved slats mounted horizontally, parallel each other. Slats are separated by 15 3/4 inches. Each slat is backed by 3/16-inch hardboard to prevent the wall from marring the Plexiglas sheets. On each level 5 herbarium-sheet holders made of folded Plexiglas slide into grooves in the slats. The display's overall dimensions are 60 inches by 37 1/2 inches. Slats measure 2 inches by 1 inch by 60 inches. Folded-Plexiglas sheets measure 11 1/2 inches by 16 1/2 inches. We will display a 2-sheet model.

A-73

CROWN STRUCTURE AND SPATIAL DISTRIBUTION OF WESTERN HEMLOCK EPIPHYTES. Betsy Lyons, The Evergreen State College, Olympia. [CNP]

Epiphytes are an important component of Pacific Northwest forests providing food and nesting material for arboreal animals and are a source of nitrogen input. Stand conditions favorable to epiphyte abundance have not been examined for western hemlock, a shade tolerant species dominating canopy volume in old-growth forests. Thirty western hemlock at the Wind River Canopy Crane site were sampled to: 1) quantify patterns of epiphyte distribution at distinct spatial scales, 2) compare epiphyte abundance between trees differing in size, and 3) identify structural elements that may influence epiphyte abundance. Epiphyte cover varied with branch height, height class, and relative crown position. Within trees, epiphyte cover was greatest in the lower crown and inner branch plots. Epiphyte functional groups were stratified vertically within the stand and horizontally within branches. At the stand level, canopy height is the main influence on epiphytes. Within trees, relative position may play a role in structuring epiphyte communities. Branch height and tree size appear to be the most important structural variables. In old-growth forests, epiphyte succession on understory trees may operate in reverse of that observed in young stands.

A-74

TESTS FOR DIVERGENCE IN THE SEAL SALAMANDER, *DESMOGNATHUS MONTICOLA*. Michelle Mabry and Paul Verrell, Washington State University, Pullman. [HBV]

The seal salamander, *D. monticola,* is distributed as allopatric populations in the Appalachian Mountains. Given this distribution and the biology of plethodontid salamanders (lunglessness and susceptibility to desiccation), we would predict limited dispersal and limited gene flow among populations. Reduction in gene flow may facilitate divergence among populations, manifest as variation in mate-recognition systems. A result of divergence in mate-recognition systems is sexual incompatibility among populations. We determined levels of sexual incompatibility among three populations of *D. monticola*, and among *D. monticola* and *D. welteri* where they occur in sympatry. Complete sexual incompatibility was found between *D. monticola* and *D. welteri*, but no significant sexual incompatibility was detected among populations of *D. monticola*. The first result is intuitive and in accord with results of other studies. The second result is unusual, given the significant levels of sexual incompatibility found among a complex of congeners (*D. ochrophaeus*) across a comparable geographic range. Additional behavioral research is underway to expand our samples to include the extremes of the range of *D. monticola*, and to determine patterns of geographic variation for molecular markers.

A-75

DELAYED RECOVERY OF STREAM AMPHIBIANS IN CLEARCUT FORESTS OF WESTERN OREGON

Don J. Major and R. Bruce Bury, Biological Resources Div., U.S.Geological Survey, Corvallis, OR. [EAR]

Recovery of stream amphibians in managed stands is assumed to occur after logging. We surveyed 29 streams in the Umpqua River Drainage (OR) to determine reinvasion of stream amphibians in harvested stands. Although logged 25-52 years ago, streams in harvested stands had fewer species and abundances than paired unlogged streams in mature or old-growth forests. Stream substrate appears to be recovering (e.g., increased cobble), but amphibians remain unable to recolonize or the habitat is still unsuitable.

A-76

TRAUMATIC STRESS DISORDER OBSERVED IN AN ADULT WILD CAPTIVE WOLF (*CANIS LUPUS*).

Jay S. Mallonée, Wolf & Wildlife Studies, Olympia. [BHV]

Tenino, an adult wolf born in the wild, was placed into captivity at 1 year of age because of her participation in livestock depredation. Her method of capture has been well documented and involved being darted twice by helicopter and translocated twice. This method of capture would have exposed her to the two factors that are important in the etiology of post-traumatic stress disorder in humans: uncontrollability and unpredictability (as perceived by the victim). In captivity, she has shown symptoms that are similar to those of humans with post-traumatic stress disorder. These symptoms include hypervigilance, exaggerated startles, generalized fear, avoidance, and arousal. She has also displayed looking up behaviors that occur during the presence of perceived threats, such as a neighboring rancher's gunshots, the keeper truck, some keeper activity, and occasionally aircraft. When compared to 3 other wolves, including her enclosure mate, these behaviors are exclusive to Tenino. Although individual animals vary greatly in their behavior, it is suggested that the trauma of her capture may have contributed to her symptoms of post-traumatic stress disorder and that her exposure to stressors continues.

A-77

1997 HOWLING SURVEY FOR WOLVES IN THE KANIKSU AND KOOTENAI NATIONAL FORESTS OF IDAHO AND MONTANA.

Jay S. Mallonée, San Francisco State University, San Francisco. [BHV]

The author has conducted 18 howling wolf surveys since 1992 in Montana, Idaho and Wyoming. The surveys were based on the need of agencies (i.e., USFWS and USFS) to document the presence of wolves in regards to natural wolf recovery, prior to and after wolf reintroduction and timber sales. In the summer of 1997, surveys conducted in the Cabinet/Yaak area of northwest Montana found evidence of a new wolf pack. Although adjacent wilderness areas have had wolf packs since 1992, nine surveys in the Cabinet/Yaak area beginning in 1993 indicated no wolf packs were present, until now. The past absence of a wolf pack in this area has some agency biologists concerned that the wolves have been shot, trapped or otherwise discouraged from establishing themselves in the Cabinet/Yaak area. Specific to the Yaak area, four factors help substantiate the biologists' concerns: 1) A review of wolf sightings by the public since 1968 (provided by the USFS) which includes indirect evidence of intermittent wolf pack activity; 2) Our survey data which has documented the presence of a wolf pack; 3) The experience of agency biologists dealing with negative public attitudes toward predators; and 4) The shooting of a wolf in the Yaak area.

A-78

TEMPORAL AND GEOGRAPHIC VARIATION IN SNAKE POPULATIONS IN THE MID-WILLAMETTE VALLEY OF OREGON.

Robert T. Mason, Ignacio T. Moore, and Darren T. Lerner, Oregon State University, Corvallis. [HBV]

For the past three years we have been conducting population surveys of six snake species in the mid-Willamette valley of Western Oregon. Three different habitats were chosen for the comparisons: 1) riparian zones in mid-valley where standing water was present, 2)mixed-hardwoods in the foothills of the Coast range adjacent to permanent running water, 3)mixed-woodland with both seasonal ponds and permanent running water. We permanently marked over 2,000 individuals at these sites. We have found significant variation in how these six snake species are spatially and temporally arranged among these habitats. In addition, initial analyses indicated that significant differences in body size occur in red-spotted garter snakes (*Thamnophis sirtalis concinnus*) living syntopically, versus allotopically with the Northwestern garter snake, *Thamnophis ordinoides*.

A-79

1996 FLOOD EFFECTS ON STREAMS IN THE BREITENBUSH RIVER BASIN OF THE OREGON CASCADES. Kim Mattson, Ecosystems Northwest, Corvallis, Oregon; John Runyon, BioSystems, Corvallis, Oregon. [WSA]

Surveys were performed on tributaries to the Breitenbush River to assess the impacts of the 1996 floods on channel condition and fish habitat. Surveys had just been completed on eleven streams in 1995. The February 1996 flood occurred over most of western Oregon and provided the opportunity to examine flood effects. These streams were resurveyed in 1996 to assess effects of the flood. The surveys used two approaches. In 1995 and in 1996, stream reaches were surveyed using Level II survey protocols which are a modified Hankin and Reeves technique adopted by Region 6 U.S. Forest Service. The Level II involves numerous objective measures of stream condition. Also in 1996, a synoptic approach was performed that involves a subjective evaluation of channel change and an examination of photos taken in both years. A number of significant changes to the stream channel occurred. While changes at specific points in the stream could be dramatic, the over all effects to the stream were often minor. Because the Level II surveys often rely more on mean values for the entire reach, it was often difficult to discern the localized channel effects of the floods. In contrast, the synoptic approach described flood effects rather well.

A-80

CERTIFYING FIELD LICHENOLOGISTS TO ASSURE DATA QUALITY. Bruce McCune, Oregon State University, Corvallis [LG2]

It is commonly observed that field botanical work performed under contract is highly variable in quality. Because these contracts are increasing in importance in deciding the fate of our resources, the OSU lichen research group has proposed a certification program under the auspices of the American Bryological and Lichenological Association (ABLS). The purposes of the program would be to promote and encourage professional development; to enhance the visibility of the profession; and to maintain and promote high standards of performance by all members of the profession. Certification would be for competency with a group of organisms in a particular region (in this case macrolichens in the Pacific Northwest). Competency would be demonstrated by a combination field and laboratory practical exam with emphasis on identification skills, including recognition of rare or listed species. The examiner for a given taxonomic group and region would be nominated by any ABLS member and appointed by the oversight committee. A certification program could serve a valuable function in helping to assure data quality for activities under the Endangered Species Act, the Northwest Forest Plan (survey-and-manage), the Clean Air Act (biomonitoring air quality in Class I areas), and the Forest Health Monitoring Program. Certification would be welcomed as a clarifying step by contractors, contracting agencies, consulting firms, and students of lichenology.

A-81

MIOCENE PALEOSOLS, WESTERN MARGIN OF THE NORTHERN ROCKY MOUNTAINS. Paul A. McDaniel, Soil Science Division, Kurt L. Othberg, and Roy M. Breckenridge, Idaho Geological Survey, University of Idaho, Moscow. [WSA]

The northern Rocky Mountains are juxtaposed with the Columbia Plateau along an irregular boundary comprised of several embayments of Columbia River Basalt. The eruptions of flood basalt disrupted stream drainages and generally resulted in deposition of lake and stream sediments along the plateau-mountain margin. A regionally extensive paleosol appears to have formed in these Miocene sediments and today is mantled by Pleistocene and Holocene deposits. The paleosol exhibits properties that are consistent with a stable, soil-forming environment. Clay fractions of the paleosol account for as much 60% of the soil mass and are dominated by kaolinitic mineralogy. Secondly, we have observed a discontinuous plinthite phase associated with these soils. Plinthite is a sesquioxide-rich, humus-poor material that changes irreversibly to an ironstone hardpan upon exposure to repeated wetting and drying. It forms in stable, hydromorphic soil environments of tropical and sub-tropical regions. In the U.S., plinthite is found primarily in the upper coastal plain of the southeast region.

A-82

THE SOURCE AND ACTIVITY OF CELLULASE IN THE FRESHWATER AMPHIPOD *GAMMARUS LACUSTRIS*. Claire C. McGrath and Robin .A. Matthews, Western Washington University, Bellingham. [AQU]

Deciduous leaves provide a major allochthonous source of energy to stream food webs, particularly in small, shaded headwater streams. In order to digest cellulose, the major structural carbohydrate in leaves, invertebrates must utilize cellulase enzymes. We investigated the activity of cellulases in the common freshwater detritivore, *Gammarus lacustris*. We determined that *G. lacustris* possesses all three enzymes necessary to hydrolyze cellulose to glucose: endoglucanase, cellobiohydrolase, and b-glucosidase. These enzymes may originate from three potential sources: (1) tissue-level production of cellulase by *G. lacustris*; (2) cellulase activity by gut endosymbionts living in *G. lacustris*; and (3) ingestion of fungal cellulase exoenzymes that remain active in the gut of *G. lacustris*. Laboratory feeding experiments are currently being used to determine which sources provide the enzymes that degrade cellulose. This research is funded by a grant from Huxley College of Environmental Studies and by the Institute for Watershed Studies at Western Washington University.

A-83

SPATIAL MODELS OF FIRE FREQUENCY FOR THE COLUMBIA RIVER BASIN. Donald McKenzie, David L. Peterson, Ernesto Alvarado, James K. Agee, and Robert A. Norheim, College of Forest Resources and Field Station for Protected Area Research, University of Washington, Seattle. [ECO]

Quantitative data on fire regimes are not generally available at coarse scales. Reconstructions of fire history are localized, providing detailed information at fine scales, but are limited geographically. We used a coarse-scale approach to estimate mean fire return intervals (FRIs) for forested lands in the Interior Columbia River Basin. We developed two types of model to predict fire frequency as a function of elevation, latitude, and vegetation type: 1) multiple regression, and 2) a regression tree model. Both models reproduce known latitudinal gradients, but the paucity of sites in the model database that supported high-severity/low-frequency fire regimes makes predictions questionable for these forest types. The tree-based model explains a larger proportion of the variation, but should not be extrapolated beyond the range of environmental predictor variables. Output grids (estimated FRIs) can be used to parameterize fire-effects models in geographic areas for which no local fire history data exist.

A-84

USING GENETIC DATA TO ASSESS THE EFFECTS OF HABITAT FRAGMENTATION: AN EVALUATION. Stephen G. Mech and James G. Hallett, Washington State University, Pullman. [ECO]

We critically examined some methods and statistics used in population genetics as possible tools to assess the effects of habitat fragmenation on natural populations. We collected red-backed voles (*Clethrionomys gapperi*) from 3 populations in northeaster Washington in 1994 and 1995. These populations were located in unfragmented riparian and upland forest habitat. Because the populations were 16 to 50 km apart there should be low levels of migration and gene flow between them. We analyzed these samples for genetic variation at 4 microsatellite loci. There was an average of 9 alleles per locus for each population and average heterozygosity ranged from 0.58 to 0.78. Wright's F_{st}, a measure of population subdivision, was significantly different from zero, but predicted an unreasonably high migration rate between populations. As an alternative, we used a phylogenetic approach that successfully grouped sites into temporal and geographic clades. Our results suggest that statistics from population genetic theory may not be as useful as phylogenetic analysis when comparing populations over small temporal and spatial scale.

A-85

EROSION AND SEDIMENT YIELDS FROM FOREST ROADS IN GRANITIC MATERIALS: A TEST OF THE "R1-R4" SEDIMENT PREDICTION MODELS. Walter F. Megahan, NCASI, Port Townsend, WA, Gary Ketcheson, U.S. Forest Service, Mountlake Terrace, WA. [WSA]

Erosion and sedimentation data from study watersheds in the Silver Creek Study Area in central Idaho were used to test logging road erosion and sediment delivery predicted using the 'R1-R4' and 'BOISED' sediment yield prediction models. Three small watersheds were instrumented and monitored to measure erosion from newly constructed roads and sediment delivery to the mouths of the watersheds over 4 years following road construction. The two models were used to predict road erosion and sediment delivery. Road surface erosion predictions were accurate (+- 25%) and unbaised and the factors which adjust erosion rates for varying road erosion control features were reasonable. Mass erosion predictions from BOISED appear to predict volume well (within 35%) over 15 to 20 years, however mass wasting is more episodic then the model predicts. Sediment yields predicted by BOISED were consistently greater (average of 2.5 times) than measured sediment yields. Hillslope sediment delivery coefficients in BOISED appear to be overly conservative to account for average site conditions and road locations and thus over-predict sediment delivery.

A-86

SOIL AND ROOT NEMATODES IN WILLAMETTE VALLEY, OREGON NATIVE WET PRAIRIE. Kathy Merrifield, Oregon State University. [ECO]

In September 1997, to determine soil and root nematode community composition and to detect crop parasites, nematodes were extracted from 70 g soil (Baermann funnels, 5 days) and from accompanying plant material (mist chamber, 7 days) from each of 7 plots of native wet prairie in Finley National Wildlife Refuge, Benton County, Oregon. Dominant plants were *Carex unilateralis*, *Deschampsia caespitosa*, *Beckmannia syzigachne*, *Hordeum* sp., and *Rosa eglanteria*. Nematodes recovered from soil included 24.7 *Pratylenchus crenatus*, 53.6 *Dorylaimus* sp., 5.0 *Labronema* sp., 1.0 *Hirschmaniella gracilis*, 3.0 *Ditylenchus* sp., and 9.3 *Plectus* sp./100 g soil. Nematodes recovered from roots included 11.2 *P. crenatus*, 2.0 *Filenchus* sp., 13.0 *Ditylenchus* sp., and 0.3 *H. gracilis*/g plant material. Several *Pratylenchus* spp., including *P. crenatus*, are economically important temperate upland crop root migratory endoparasites. *Hirschmaniella* spp., also migratory endoparasites, occur in moist, usually warm habitats, but 6 spp. parasitize northern temperate plants. Some *Ditylenchus* spp. are obligate crop endoparasites, but most live in soil feeding on mycelia or are facultative plant parasites. *Dorylaimus* and *Labronema* are omnivorous or predaceous. *Filenchus* feeds on root epidermal cells, *Aphelenchoides* on mycelia, and *Plectus*, *Monhystera*, and rhabditidae on bacteria. Five basic nematode feeding strategies were represented. *H. gracilis* has not been reported previously in Oregon.

A-87

SNAKES, SEX AND STRESS: ENDOCRINE AND BEHAVIORAL RESPONSES TO CAPTURE AND HANDLING IN THE RED-SIDED GARTER SNAKE, *THAMNOPHIS SIRTALIS PARIETALIS*. Ignacio T. Moore, Oregon State University, Corvallis, Robert T. Mason, Oregon State University, Corvallis. [BHV]

Environmental stressors invoke both behavioral and physiological responses. One physiological response to a stressor is an increase in glucocorticoid stress hormones which serve to mobilize energy stores, suppress unnecessary behaviors, and generally prepare the individual to face the challenge. The red-sided garter snake, (*Thamnophis sirtalis parietalis*), is the most northerly living reptile in North America. In Manitoba, Canada these snakes are constrained to hibernate for 8 month of the year. Upon emergence they mate during a brief period in which they may be exposed to environmental challenges such as floods and blizzards. Snakes exposed to such natural stressors display no obvious behavioral changes with courtship and mating occurring immediately after the stressor has passed. Blood samples were obtained from individuals subjected to a capture and handling stress paradigm. Plasma corticosterone concentration increased and testosterone decreased in males subjected to four hours of restraint, however it had no effect on mating behavior. Exogenous administration of corticosterone suppressed mating behavior in a dose-dependent manner.

A-88

ENHANCING LICHENS AND BRYOPHYTES IN YOUNG FORESTS. Patricia S. Muir and Thomas R. Rambo, Oregon State University, Corvallis. [FOR]

Several recent studies have assessed lichen and bryophyte diversity, abundances, and community composition in relationship to structural and compositional features of forests in western Oregon. Study sites ranged from relatively homogeneous young stands (ca. 50 years) to old-growth (> 500 years). Study objectives were to improve understanding of how stand age, within-stand structural and compositional features, and environmental factors influenced lichen and bryophyte communities. Certain structural and compositional features appear to be particularly important in fostering diversity and abundance of lichens and bryophytes. These features include old remnant trees, "wolf" trees, hardwood trees and shrubs, coarse woody debris, and landscape-level features such as rock outcrops and riparian areas. Results have been published in technical papers, which often do not reach land managers to whom such information may be of particular value. To facilitate transfer of this information to land managers, we made a video that summarizes study results in a relatively nontechnical format. This video is the basis of our presentation.

A-89

FOREST HARVESTING EFFECTS ON STREAM CHEMISTRY, TEMPERATURE AND TURBIDITY IN SMALL WATERSHEDS IN THE HOH RIVER VALLEY. Georgia Murray, Robert Edmonds, and James Marra University of Washington, Seattle. [WSA]

We investigated the effects of forest harvesting on stream nutrient chemistry, turbidity and temperature, parameters significant to water quality issues. West Twin Creek (WTC), a control site, is located in an old growth forest in the Hoh River Valley, Olympic National Park. Rock and Tower creeks, located on DNR land adjacent to the park, were harvested 10-20 years ago. Stream water samples were taken monthly since May 1996 for chemical analysis and since May 1997 for turbidity determination. Stream temperatures were monitored since June 1996. There were no differences in nutrient chemistry between the creeks, although a large nitrate pulse occurred in August 1996 in the cut watershed streams. Turbidity was higher in Rock and Tower creeks than in WTC during some months, but not consistently. Stream temperatures in WTC were seasonally more stable than harvested watershed streams, which differed by ±2.5 °C. Cutting of these watersheds has long-term effects on stream temperature, likely due to narrow riparian vegetation zones. Turbidity may be higher on cut watersheds on an annual basis, however, more data during higher flows are needed.

A-90

THE CONSEQUENCES OF AGGREGATED RETENTION FOR UNDERSTORY PLANTS: AN EXPLORATION OF HYPOTHESES. Cara R. Nelson and Charles B. Halpern, University of Washington, Seattle. [DEM]

Aggregated retention of trees is now a standard component of harvest prescriptions for federal "matrix" lands in the range of the northern spotted owl. However, there has been little systematic study of the consequences of aggregated retention for most components of forest ecosystems. Although there is some evidence that patches of retained trees facilitate the maintenance of biological diversity in harvest units, the extent to which they retain components of the original understory vegetation and/or ameliorate conditions in the surrounding matrix is largely untested. We have initiated a study to investigate floristic changes in and adjacent to 1-ha sized retention patches within replicate treatment units of the DEMO green-tree retention study. We will test the hypotheses that 1) species associated with forest-interior environments will decrease in abundance and diversity with proximity to the aggregate edge, 2) invasive species will decline in abundance and diversity with distance into the forest aggregate, 3) dominant forest species will show positive responses to the creation of edges, and 4) edge effects will be greater where environmental conditions are more stressful.

A-91

DEVELOPING AN NSDI CLEARINGHOUSE NODE FOR THE OLYMPIC PENINSULA. Robert A. Norheim and Teresa Z. Alcock, Field Station for Protected Area Research, University of Washington, Seattle; David L. Peterson, USGS-Biological Resources Division, University of Washington, Seattle; Nicholas Chrisman, Dept. of Geography, University of Washington, Seattle. [ECO]

We are currently developing a National Spatial Data Infrastructure (NSDI) Clearinghouse Node for the Olympic Natural Resources Center, Forks, Wash. This Clearinghouse Node will contain metadata for geospatial (GIS) datasets that cover the Olympic Peninsula. We have contacted dozens of organizations, from federal and state agencies to tribes, NGOs, and timber companies to enlist their participation in the Clearinghouse. Response has been enthusiastic, and we are now working with these organizations to develop metadata to place on the Clearinghouse Node. We have developed a web page that describes the development of the Node and which will include images of the datasets that we include on the Node. We are currently working with the Washington State Geographic Information Council and the Olympic Coast National Marine Sanctuary to obtain further funding for development of the Node. All researchers developing datasets that include the Peninsula are encouraged to develop metadata for their datasets for inclusion on the Clearinghouse Node.

A-92

SMALL-MAMMAL POPULATIONS IN RIPARIAN AND UPLAND FORESTS OF NORTHWESTERN WASHINGTON. Margaret A. O'Connell, Eastern Washington University, Cheney; James G. Hallett, Washington State University, Pullman. [HBV]

To evaluate the effectiveness of state-mandated riparian management zones for wildlife, we sampled populations of small-mammals from 1992 to 1996 within riparian and adjacent upland habitats on 18 sites associated with lower order streams in northeastern Washington. Each year, pitfall trapping and snap trapping was conducted for 2 weeks and 4 days, respectively. Eleven sites were selectively harvested in 1993-1994 under two harvest prescriptions and seven sites served as controls. We had >13,000 captures of 19 small-mammal species. Four species, *Clethrionomys gapperi*, *Peromyscus maniculatus*, *Sorex cinereus*, and *S. vagrans*, were common in both habitats at almost all sites, although *S. vagrans* was more abundant in riparian habitat. Four less abundant species, *Tamias amoenus*, *Glaucomys sabrinus*, *Phenacomys intermedius*, and *S. monticolus*, also were found in both habitats. *Zapus princeps* and *S. palustris* were associated with riparian habitats. Many species showed increases in distribution in 1994 when populations were at their highest levels. Changes in distributions following forest harvest were associated with alteration of microhabitats, indicating that management activities can alter species diversity.

A-93

A PRELIMINARY ASSESSMENT OF RARITY AND DISTRIBUTIONS OF FUNGI IN THE PACIFIC NORTHWEST. T.E. O'Dell, M.A. Castellano and R. Molina. USDA Forest Service. Forestry Sciences Lab. 3200 Jefferson Wy., Corvallis, OR 97331. [RP1]

Two hundred forty-seven species of macrofungi are listed for survey and management in President Clinton's Northwest Forest Plan. One hundred thirty-four species require some level of protection of known sites (Strategy 1), all require extensive regional survey. We have completed an assessment of the rarity and distribution of the Strategy 1 species. Several herbaria were visited by taxa experts to confirm the identification of specimens and record label data. About 1784 collections of the Strategy 1 taxa were examined, 1456 of these were judged to be accurately identified. Most collection localities could be determined to within 1.5 miles or closer, our criterion for a "known site". One hundred seven collections could be located to within 500 m. Distribution categories included: restricted to type locality (e.g. *Gastroboletus imbellus; Chroogomphus loculatus),* locally endemic (*Hebeloma olympianum*), broadly disjunct (*Otidea smithii*), and widespread in the region (*Tylopilus pseudoscaber*). Results of this assessment will be presented, including proposed taxonomic revisions and changed status for several listed taxa.

A-94

A HIERARCHICAL ANALYSIS OF THE HABITAT ATTRIBUTES OF THE TAILED FROG *(ASCAPHUS TRUEI)* IN A LOW SEDIMENT STREAM SYSTEM. Lisa M. Ollivier, Pacific Southwest Research Station, Arcata, CA. [EAR]

I employed a habitat-based systematic sampling design to analyze the habitat attributes of the tailed frog in the Smith River drainage of extreme northern California. This aquatic system flows through serpentine lined channels and is naturally low in sediment production. Variables representing two spatial scales and seven ecological components were examined for association with the presence and abundance of tailed frogs. This multivariate analysis revealed relationships with aquatic conditions, instream cover, and coarse and fine substrate variables.

A-95

HEADWATER CHANNELS AND VERTEBRATES IN MANAGED FORESTS IN NORTHWESTERN OREGON. Deanna H. Olson, Bruce Hansen, and Loretta L. Ellenburg, USDA Forest Service, Pacific Northwest Research Station, Corvallis, Oregon. [EAR]

To aid in our understanding of headwater systems, we are developing a headwater characterization based on physical habitats and vertebrates assemblages. This work is part of a larger experimental study of alternative riparian buffer widths with upslope forest density management; headwater characterizations stem from surveys conducted prior to upslope thinning at 9 sites in forests of 30-50 yrs and 3 sites in 70-80 yr-old forest. During wet and dry season surveys, 139 reaches (min. length 180 m) and >4000 animals of 15 species were sampled during in-stream and near-bank sampling. Seven channel types were identified based on flow occurrence and continuity, spatially and seasonally. Stream reaches with spatially discontinuous flow (intermittent) were the most frequent. Variability in species occurrences among reaches were largely explained by hydrological type. Reaches with discontinuous flow had the greatest species richness, 11 taxa overall, whereas reaches with perennial flow typically were dominated by two taxa, trout and Pacific giant salamanders. These patterns of species-occurrences should be integrated into forest management designs at site-to-landscape scales to maintain unique assemblages in discontinuous channels.

A-96

MONITORING IDAHO AMPHIBIAN AND REPTILE POPULATIONS THROUGH CHANGES IN OCCURRENCE. Charles R. Peterson, Sarah Cooper Doering, and John Cossel, Jr. Idaho State University. Pocatello, Idaho. [DYV]

Declines in populations of some formerly common, wide-spread amphibians and reptiles indicate the need for a statewide monitoring program. The mark-recapture studies needed to document changes in numbers of animals are too expensive to conduct on a statewide basis. The best evidence we have for population declines comes from studies documenting changes in species occurrence over wide areas. This suggests that an alternative approach is to periodically survey selected areas for changes in the number of sites occupied by each species. Such a program could involve selecting 20 areas around the state so that all species would be represented at least twice. Every year, 2-3 study areas (with 20-30 sites each) could be surveyed using standard techniques so that all would be sampled once per decade. If a considerable decrease in the number of occupied sites for a species is detected, further studies could be conducted to determine the extent and nature of the declines. We are testing this approach by repeating surveys conducted during the 1970's at two areas in southern Idaho.

A-97

CLIMATIC CHANGE AND LIMITING FACTORS IN HIGH-ALTITUDE FORESTS. David L. Peterson, USGS-Biological Resources Division, University of Washington, Seattle. [ECO]

Relationships between forest dynamics and climate are predictable for high-altitude forest ecosystems in the Pacific Northwest and other mountainous regions. Duration of snowpack and spring temperature combine to determine when there are a snowfree soil surface and sufficiently high soil temperatures for physiological activity. Regeneration of tree seedlings varies spatially and temporally as mediated by duration of snowpack, which affects length of growing season on high-precipitation sites and soil moisture supply on low-precipitation sites; regeneration is favored by climatic conditions that produce a mesic soil moisture regime rather than extremes. Relatively short-term climatic trends can have major impacts on regeneration patterns, particularly after disturbances. Tree growth in these systems generally is limited more by precipitation than by temperature, with growth negatively correlated with snowpack depth. Growth response varies between species and within species, depending on subregional climate, altitude, aspect and genotype. The potential effects of climatic change on high-altitude forests are distinct, and models based on low-altitude ecosystems are not necessarily applicable to high-altitude systems.

A-98

ZEN AND THE SEARCH FOR CALICIALES. Eric B. Peterson, Department of Botany and Plant Pathology, Oregon State University, Corvallis. [LG2]

Caliciales (pin-lichens) are a group of crustose lichens in which most species require old-growth forest structures. For lack of information on Caliciales in the Pacific Northwest, 16 species were listed in the Northwest Forest Plan under survey strategy 4, "conduct general regional surveys." Given the experience required to accurately survey and identify Caliciales, it is likely that the surveys will actually be minimal. Keys appropriate for identifying species in most of North America are not yet available. We are still learning which species occur in North America and the PNW. Complicating this, many Caliciales are difficult to see in the field. Fortunately most species are found in certain identifiable substrate and habitat types. Most old-growth associated species grow on bark and wood where they will be sheltered from rain water. Some are specific to certain habitats on trunks and logs (e.g. *Chaenotheca furfuracea* is limited to very sheltered sites often found under the bole of a tree). Many members of the Mycocaliciaceae are not associated with old-growth, but are restricted to twigs of a narrow range of phorophytes. Understanding which substrates and habitats are used by various species of Caliciales greatly increases success with surveying species that occur in stands.

A-99

MOVEMENT PATTERNS OF COLUMBIA SPOTTED FROGS IN A COMPLEX OF HIGH MOUNTAIN LAKES. David S. Pilliod and Charles R. Peterson, Idaho State University, and Peter Ritson, Portland Community College. [DYV]

Effective conservation and management of amphibian populations requires detailed information about migration and dispersal. Unfortunately, the complexity of amphibian habitat use patterns is often underestimated, leading to inadequate habitat protection. To better understand the movement patterns of frogs in alpine environments, we studied the Columbia Spotted Frog (*Rana luteiventris*) in a wilderness area in central Idaho. Between 1995 and 1997, we examined frog movement patterns associated with sex, age, lake location, and fish stocking history by marking over 5300 frogs in 71 lakes. To investigate seasonal migration patterns and potential travel corridors, we telemetered a total of 114 frogs. We found that frogs moved between lakes up to 2000 m apart, using riparian areas as stepping stones in otherwise dry, terrestrial routes. Females typically traveled further than males and made longer migrations to summer foraging areas. We observed fall migrations to specific lakes for overwintering. Apparently, frogs use their habitat selectively, often migrating to specific lakes for breeding, to wet meadows and different lakes for summer foraging, and yet other lakes for hibernating.

A-100

THE EFFECTS OF FOREST STRUCTURE AND FOREST AGE ON EPIPHYTIC LICHEN BIOMASS AND DIVERSITY. Andrea K. Pipp and Ray M. Callaway, University of Montana, Missoula. [DEM]

To maintain biodiversity in mature forests, we must first understand what processes determine plant and animal species abundances. We compared forest age and forest structure as indicators of lichen biomass, richness, and community composition. Epiphytic lichens were sampled in 1995 and 1996 on 21, 32 acre forested units (75 to160 years old) on the Gifford Pinchot National Forest, WA. Canopy lichen litterfall was sampled in 15, two meter radius plots per unit. Mean lichen litterfall differed significantly between years, but species composition did not. Multiple regression tested the relationship of age and eight structure variables against dependent variables (lichen biomass, richness, and community composition), returning r^2 values between 0.46 and 0.97. Forest structure variables were refined using principle component analysis resulting in axis 1 and 2 with a 77.5% combined eigenvalue. These axes, and forest age, were then correlated with the dependant variables. In both years, and in both analyses, forest structure explained more variance in lichen biomass and richness, whereas, age explained more variance in community composition. The structural variables important for predicting lichen biomass differed from those predicting lichen richness. In mature forests, forest structure was a better indicator of lichen biomass and richness than forest age.

A-101

A RETROSPECTIVE METHOD TO DETERMINE THE EFFECT OF TIMBER HARVEST ON THE DISTRIBUTION OF CANDY STICK (*ALLOTROPA VIRGATA*). Mark J. Pistrang, Gifford Pinchot NF, Packwood, Tim Max, PNW Research Station, Portland, Jamie Barbour, PNW Research Station, Portland, Jeff Ricklefs, The Evergreen State College. [POS]

Maintaining the viability of candy stick (*Allotropa virgata*) throughout its range is a requirement under the Northwest Forest Plan. In order to learn more about the distribution of *Allotropa virgata* on the Gifford Pinchot National Forest and its response to timber harvesting activities, a retrospective study was conducted on the Cispus Adaptive Management Area. This poster reports on the development of statistical sampling procedures devised to estimate the frequency of occurrence of *Allotropa virgata* or other species with irregular distributions. In an initial field trial, forty ten-acre plots were randomly placed within two habitat/management types selected to represent management extremes. These plots were surveyed for presence of *Allotropa virgata*. Initial results indicate presence of *Allotropa virgata* in 5 of 20 natural stands and 0 of 20 previously managed stands. The methods used appear to be a viable approach to sampling for this, or similar species on a landscape level.

A-102

WATER QUALITY MONITORING IN THE DRAYTON HARBOR WATERSHED. Amy E. Pomada and Robin A. Matthews, Institute for Watershed Studies, Huxley College, Western Washington University, Bellingham, WA. [WSA]

Located in the northwest corner of Whatcom County, the Drayton Harbor watershed is of ecological concern because of high fecal coliform counts in the harbor. The objective of this one year monitoring project was to characterize the water quality of two major tributaries, California and Dakota Creeks. From January to December 1997 water samples were collected once a month from eight sites and analyzed for basic physical, chemical, and biological water quality parameters. A bog located at the headwaters of California Creek influenced water quality by contributing to high nutrient concentrations and low dissolved oxygen, while downstream this trend was reversed. A more typical pattern was found on Dakota Creek. The south fork of Dakota Creek drains land with a high concentration of dairy farms, and nutrient concentrations and fecal coliform counts were large. The north fork had relatively good water quality, and sites downstream of the north and south fork merger had intermediate water quality. In conclusion, poor water quality in the tributaries potentially contributes to poor water quality in the harbor.

A-103

RADIOTELEMETRIC STUDY OF HABITAT AND MOVEMENT IN AN ALBERTA POPULATION OF THE PRAIRIE RATTLESNAKE. G.L. Powell, University of Calgary, Calgary, A.P. Russell, University of Calgary, Calgary. [HBV]

Eight adult Prairie rattlesnakes (*Crotalus v. viridis*) were tracked at a range-marginal locality in southeastern Alberta. Emergence from riverside hibernacula in early May was followed by movement away from the hibernaculum area in late May by adult males and non-gravid females, as far as 12 km into upland mixed-grass prairie, where summer ranges were established and mating took place. Densities were low, and movements in the summer ranges appeared to be associated with shelter and pocket gopher (*Thomomys*) burrow complexes. Upland-range snakes began returning to the hibernaculum area in late August.

A-104

NEOTROPICAL MIGRANT LANDBIRD USES OF DISTURBED, FRAGMENTED HABITATS IN THURSTON COUNTY, WASHINGTON. Brian Price, The Evergreen State College. [HBV]

Most studies of Pacific Northwest Neotropical migrant landbird habitat uses have taken place at large-scale sites in National Forests. Small-scale sites have not received much attention. My objective was to discover those habitats in small (less than 200 acre) disturbed, fragmented sties most used by Neotropical migrants, so as to inform land conservation choices by local city and county land managers. I censused Neotropical migrants eight times at each of seven sites between May 1 and July 7, marking their locations on habitat maps, then creating spreadsheets summarizing numbers observed per habitat type for each species, for all species, and for territorial males, for each individual site and for all sites combined. The data demonstrated that those habitats most used are shrubby and deciduous wetland, and riparian and non-riparian oak woodland. Most studies of large-scale sites argue for the conservation of single, large mature coniferous forested habitats maximizing interior and minimizing edge. My findings suggest that where such sites are absent, small wetland and oak woodland fragments may have an important subsidiary conservation role to play, encouraging Neotropical migrant conservation at the local, city, and county level.

A-105

RIPARIAN ARTHROPOD COMMUNITIES FROM PERENNIAL AND DISCONTINUOUS PRIMARY STREAMS IN FORESTED AND CLEARCUT UPLAND. Robert Progar and Andy Moldenke, Oregon State University. [ECO]

Riparian reserves are a primary concern and are a detailed component of the Northwest Forest Plan. Minimal investigation has been performed detailing silvicultural impacts on the arthropod community in primary perennial and discontinuous streams. Three even-aged 60-70-year-old stands in the Salem BLM District were selected in the Oregon Cascade Mountains and Oregon Coast Range. Each site contains a perennial and discontinuous stream flowing through a forest and adjacent clearcut. Spring and late summer pitfall trapping, and emergence trapping was done from January through November 1997 at each site. Preliminary data analysis indicates unique communities among perennial and discontinuous streams and an increased abundance of Diptera in streams flowing through clearcut forest.

A-106

CANOPY INVERTEBRATE COMMUNITIES IN OLD-GROWTH AND MATURE DOUGLAS-FIR ALONG A LATITUDINAL GRADIENT. Robert A. Progar, Timothy D. Schowalter, Brett Scherer, Tim Work, Jlea Welsh, Brannon Forrester, and Christina Carney, Oregon State University. [CNP]

This poster describes differences in canopy arthropod community structure between old-growth and mature Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) forests along a latitudinal gradient. Canopy arthropods were sampled by foliage pruning from old-growth and mature Douglas-fir stands. Paired stands were sampled from the Thorton T. Munger Research Natural Area and the Gifford Pinchot National Forest in Washington, and from the Andrews Experimental Forest and the Umpqua National Forest in southern Oregon. The abundance of juice feeding insects, Psocoptera and spiders increased with latitude and were more predominant in old-growth trees. Distribution of these arthropods may be attributed to increasing rainfall and higher humidity along a northerly gradient.

A-107

ARBOREAL INVERTEBRATE RESPONSES TO VARYING LEVELS AND PATTERNS OF GREEN TREE RETENTION IN NORTHWESTERN FORESTS.

Robert A. Progar, Timothy D. Schowalter, and Tim Work, Oregon State University, Corvallis. [DEM]

Canopy arthropods play an important role in forest ecosystems and are sensitive to anthropogenic disturbances. The DEMO (Demonstration of Ecosystem Management Options) experiment investigates the influence of varying levels and patterns of green tree retention on diverse elements of northwestern forest ecosystems. We describe research in progress on the response of arboreal arthropod communities to retention harvests in the Pacific Northwest. Pretreatment foliage was pruned and canopy arthropods collected from dominant overstory and understory vegetation within six treatment units in eight experimental blocks in western Oregon and Washington. Significant pretreatment differences in abundance were found among blocks and treatments for several taxa in the overstory. Block-level differences reflect natural variation in the geographic distribution of arthropod taxa. Differences among treatment units may reflect local scale variation. We expect to see changes in arthropod richness, abundance and functional group organization indicating the degree to which the level and pattern of retention alter arthropod communities in the overstory and understory canopies.

A-108

FOREST FLOOR BRYOPHYTES AS INDICATORS OF SUBSTRATE AND STAND AGE.

Thomas R. Rambo and Patricia S. Muir, Oregon State University, Corvallis. [LG2]

We quantified the relationships of 93 forest floor bryophytes, including epiphytes from incorporated litterfall, to substrate and stand age in *Pseudotsuga menziesii-Tsuga heterophylla* stands at two sites in western Oregon. We used the method of Dufrêne and Legendre, which combines a species' relative abundance and relative frequency, to calculate each species' importance in relation to environmental variables. The resulting "indicator value" describes a species' reliability for indicating the given environmental parameter. Thirty-nine species indicated humus, a decay class of coarse woody debris (CWD), or stand age. Bryophyte community composition changed along the continuum of CWD decomposition from recently fallen trees to forest floor humus. Diversity of forest floor bryophytes is enhanced when a full range of CWD decay classes is present. A suite of bryophytes, mainly epiphytes associated with older conifers and liverworts associated with CWD, indicated old-growth forest. Hardwood-associated epiphytes mainly indicated young stands. Mature conifers, hardwoods, and CWD are biological legacies that can be protected when thinning stands to foster habitat complexity and biodiversity, consistent with an ecosystem approach to forest management.

A-109

THE ROLE OF A SMALL BOTANIC GARDEN IN REGIONAL RARE PLANT RESEARCH AND CONSERVATION.

Andrea N. Raven, The Berry Botanic Garden, Portland, OR. [RP1]

The Berry Botanic Garden is a six-acre estate garden created by Rae Selling Berry and located in Portland, OR. Currently, it is a private, non-profit organization with six full-time and four part-time employees. Despite our small size, we run extensive programs in horticulture, public education and plant conservation, working cooperatively with many other organizations. The Garden maintains special collections of native plants, alpines, primroses, and rhododendrons. The conservation program specializes in *ex situ* (off-site) efforts and houses the Seed Bank for Rare and Endangered Plants of the Pacific Northwest, which currently contains roughly 300 taxa from Oregon, Washington, Idaho, California and Nevada. Our role is not only to develop the seed bank as a regional resource but also to perform basic rare plant research, such as germination testing, tissue culture, common garden experiments, reintroductions and diverse field research on rare plant populations. All efforts are intended to support and complement on-site conservation.

A-110

OF *BOS* AND *SISYRINCHIUM*: A MONITORING STUDY EXAMINING THE SUCCESS OF A *BOS* EXCLOSURE ON A RARE WASHINGTON NATIVE.

Andrea N. Raven, The Berry Botanic Garden, Portland, OR. [RP2]

One of the largest populations of pale blue-eyed grass, *Sisyrinchium sarmentosum*, is located on the Gifford Pinchot National Forest in Washington. Concerns over cattle grazing prompted the Forest Service to build a fence to exclude cows from a portion of the area. The Berry Botanic Garden is performing a multiple-year study on this population as part of a challenge cost-share contract with the Forest Service. We are examining the effects of cattle on *S. sarmentosum* and are attempting to determine whether the exclosure is successful in maintaining a stable *S. sarmentosum* population. Monitoring objectives include obtaining estimates of population size, reproductive characteristics and herbivory. We sampled quadrats before and after cattle arrived. We found that there were similar densities of plants inside (no cattle) and outside (cattle present) of the exclosure. We found more flowering plants inside the exclosure in 1996 but similar proportions in 1997. Outside of the exclosure, we found that dramatically more plants with greater portions were removed roughly ten days after cattle arrived at the site in 1997. Fruit production outside of the exclosure is very low. The results of this limited study suggest that the presence of cattle has serious implications for the genetic diversity and long-term health of this population.

A-111

NORTHWEST FOREST PLAN HARVESTS VERSUS CLEARCUTS: A PRELIMINARY INVESTIGATION OF PUBLIC PERCEPTIONS OF THE ACCEPTABILITY AND AESTHETICS OF HARVEST RETENTION PATTERNS. Robert G. Ribe, University of Oregon, Eugene. [POS]

The Northwest Forest Plan, "new forestry" and the "regeneration harvests" they prescribe offer some potential resolution to long standing conflicts between silvicultural clearcutting and adverse public perceptions of such harvests. This study sought to investigate the nature and extent of this possible resolution as an aid to management decisions awaiting more robust findings to come from the full DEMO social perceptions study. Ratings of acceptability and scenic beauty for aggregated and dispersed green tree retention patterns in scenes were acquired from a survey sampling a diversity of adults in western Oregon and Washington. These respondents rated photographs and simulated photographs showing these different retention patterns as well as clearcuts and uncut forests shown in other versions of the same scenes. They rated the regeneration harvest scenes with and without information about their "new forestry" attributes and intentions. The pattern of differences among the average ratings across these harvest pattern and information dimensions were analyzed. Findings indicate that public education should be critical to the perception of acceptability and that aggregated retention harvest patterns should produce more favorable perceptions of scenic beauty than dispersed retention.

A-112

DISTRIBUTION PATTERNS OF CALICIALES IN THE PACIFIC NORTHWEST. Jouko Rikkinen, Department of Botany and Plant Pathology, Oregon State University, Corvallis. [LG2]

The Pacific Northwest is rich in Caliciales, with over 70 species identified so far. Most species have wide circumpolar, antitropical or azonal distributions, but the flora also includes some narrow endemics. At least one species (*Chaenotheca olivaceorufa*) has a circum-Pacific distribution. Many lichenized Caliciales prefer habitats without much direct sunlight, but with plenty of diffuse light. High species diversity can be found in montane old-growth forests, forested swamps, riparian habitats and around mountain meadows. Also mature *Quercus-Pseudotsuga* stands in the Willamette valley are quite rich in species. Conversely, the coastal *Picea sitchensis* and *Sequoia sempervirens* forests seem to represent poor environments for most Caliciales.

A-113

GEOMORPHOLOGICAL SURVEY OF EASTERN CASCADE STREAMS BEFORE AND AFTER 1995-96 FLOODS. Thomas A. Robison, Wenatchee National Forest, Wenatchee, Jeffrey Barry, Forest Service, Intermountain Region, Boise. [AQU]

A series of monumented cross section surveys were made on streams across the Wenatchee National Forest prior to a flood event of record during the winter of 1995-96. Resurveys were completed on 18 stream reaches. The objective was to quantify stream channel response across a range of stream types and landsystem units. Changes in bankfull cross sectional area, width and depth were measured. Lateral migration of outer bends was measured. Aggradation and degradation of thalweg depth was surveyed. Five of 18 reaches had statistically significant increases in average bankfull depth ranging up to 0.4ft. Cross section area increased on one reach. Average lateral migration ranged from 1-14 ft. Thalweg degradation occurred on 13 sites, aggradation on 5. There is a high correlation between geomorphological channel characteristics and channel response. Degree of entrenchment and channel slope are highly correlated with increases in channel depth and with channel degradation. Slightly entrenched channels had higher lateral migration rates. Area mapping using landform stratification offers geomorphic explanation for channel features that correlate with channel response to extreme flood events.

A-114

THE EFFECT OF FIRE ON THE DENSITY AND HEIGHT OF FLOWERING PLANTS AT TURNBULL NATIONAL WILDLIFE REFUGE. Nicole R. Rodgers, Steven J. Stein, and Lisa D. Holmes, Eastern Washington University, Cheney. [ECO]

After nearly a century of fire suppression in the western United States, fire is now being reintroduced as a management tool in many areas. This study examined the effect of fire on several flowering plant species found in ponderosa pine communities of Eastern Washington. During the fall of 1996 a 173 hectare prescribed burn was conducted at Turnbull National Wildlife Refuge. The following summer we randomly placed 60 one by two meter plots within the burned area and an adjacent unburned area. The number of individual plants and their heights were recorded for eighteen flowering plant species within all plots. Eight species were significantly more abundant in the fire plots while six species were significantly more abundant in the non-fire plots. However, only three species had significantly greater average heights in the fire plots and only two species had significantly greater average heights in the non-fire plots. Our results suggest that fire suppression has probably dramatically changed plant community structure in areas that have experienced frequent fires in the past.

A-115

AUTECOLOGY OF *OPLOPANAX HORRIDUS*. Ashley Roorbach, Oregon State University, Corvallis; David Hibbs, Oregon State University, Corvallis; Nan Vance, USFS PNW Research Station, Corvallis. [FOR]

Devil's club (*Oplopanax horridus*) is an understory shrub that is gaining attention as a potentially important medicinal plant. In the Pacific Northwest, devil's club ranges from southern Oregon to south, central Alaska. Researchers have documented the plant's traditional uses and modern medicinal potential, but have conducted little ecological research on it. In both the central Oregon Cascades and central Oregon Coast Range we observed the microhabitat conditions in which devil's club grows, including soil moisture and diffuse radiation levels, as well as associated plant community characteristics. At other sites, discrete populations of devil's club were measured for stem density, flowering potential and stem heights, with the age, growth rates and branching patterns of randomly selected individual stems also measured. We drew detailed stem 'patch' maps at three selected sites. Initial results suggest that though devil's club in western Oregon can grow in a wide range of light conditions, it's internodal stem growth is longest in very low light conditions, with its presence limited to moister soils. Devil's club can persist for decades in an area. Reproduction in a patch is primarily vegetative, with large areas occupied by only a few individuals.

A-116

EPIPYHTE GUILDS IN TEMPERATE RAINFORESTS: A GLOBAL PERSPECTIVE. Roger Rosentreter, Bureau of Land Management, Boise, ID. [LG2]

Temperate rainforests occur in Tasmania, New Zealand, Chile, and the Pacific Northwest of North America. The epiphytic flora of these forests is composed primarily of lichens and bryophytes. These epiphytes occur as groups of associated species forming similar ecological guilds among the continents. Epiphyte guilds in temperate rainforests include seven types: alectoroid, cyanolichen, leafy arboreal, crust, fruticose trunk, tree base, and soil-dwelling guilds. Species differ across geographic regions but they are morphologically similar and often in the same or related genus. The ecological role for each morphological guild appears to be similar among geographic regions.

A-117

VAGRANT LICHEN DISPERSAL PATTERNS. Roger Rosentreter. Bureau of Land Management, Boise, ID. [BOT]

In west-central Idaho there are high elevation shrub-steppe communities that contain large areas occupied by vagrant lichens. These valleys are mosaics of *Artemisia*-grasslands and more open, windswept grasslands. The vagrant lichens are dispersed throughout this region by vegetative fragmentation. I measured the distance and direction of vegetative dispersal over three years at four experimental sites. Three vagrant *Rhizoplaca* and one *Xanthoparmelia* taxa were observed in the study. The vagrant lichens moved predominantly in a northeasterly direction, with significant differences among taxa. The mean dispersal differences appear to be related to thallus morphologies. *Rhizoplaca haydenii* had a dispersal distance of twice the other two *Rhizoplaca* taxa.

A-118

MANAGING FOR A RARE LICHEN UNDER THE NORTHWEST FOREST PLAN: AN ONGOING CASE STUDY. Abbey L. Rosso, Tom R. Rambo, Bruce McCune, Oregon State University, Corvallis. [LG2]

Nephroma occultum is a rare, nitrogen-fixing lichen associated with old-growth forests of the Pacific Northwest. Under the Survey and Manage guidelines of the Northwest Forest Plan, it is listed as a strategy 1 & 3 species ("manage known sites" and "conduct extensive surveys and manage sites"). Discovery of this lichen in a proposed timber sale prompted a survey to determine the distribution and abundance of the species in the sale area and surrounding watershed. Within the study region, *N. occultum* grows almost exclusively in the canopy. Thus, we used direct canopy access in combination with litter searches to address the questions of how rare is this species and what affect would the sale have on its distribution. We also compared the effectiveness of the two survey methods, and described the habitat of *N. occultum* within the study area. We concluded that, if the goal of management was to maintain *N. occultum* populations throughout the watershed over the long term, then the stand in question should be left intact. Management should emphasize protection of populations and habitat, as it is impractical and inappropriate to manage for individuals of this species. Plans for the sale area remain undetermined at this time.

A-119

TERRESTRIAL AMPHIBIANS IN MANAGED FORESTS OF SOUTHWESTERN WASHINGTON. D. E. Runde, D.W. Stinson, K. A. Austin, Weyerhaeuser, Tacoma WA , S. Lathrop, Weyerhaeuser, Longview, WA, and S. R. Butts, Oregon State University, Corvallis. [EAR]

We studied amphibian habitat associations using pitfall traps in managed forest stands in the Coast and Cascade Ranges of southwestern Washington. *Ensatina eschscholtzii* and *Plethodon vehiculum* accounted for >60% of captures in the Coast Range. *Ambystoma gracile*, abundant near Silver Lake, accounted for 46% of the catch in the Cascades. Fall captures of *E. eschscholtzii* and *Taricha granulosa* were higher in the oldest than in the youngest age class, but *P. vehiculum* appeared more abundant in the oldest and youngest compared to the middle age class. *E. eschscholtzii* capture rates in the Silver Lake watershed differed by site preparation method; capture rates were higher in four scarified stands than in 3 broadcast-burned stands. *E. eschscholtzii* was negatively associated with stand density and positively related to shrub cover; *Ascaphus* exhibited the opposite relationships. There were few significant correlations with coarse woody debris. Abundance and diversity of amphibians, except *T. granulosa*, appeared similar to that reported for unmanaged Cascade stands. Abundance appears related to both physiographic factors that affect temperature and moisture, as well as to stand age and structure.

A-120

CLASSIFICATION OF PINYON-JUNIPER PLANT ASSOCIATIONS OF SOUTHEASTERN IDAHO. Steven K. Rust, Conservation Data Center, Idaho Department of Fish and Game, Boise, ID. [BOT]

Pinyon-juniper woodland occurs at the northern extent of its range in southeastern Idaho. These woodland communities are recognized as both most rare and most poorly understood. Pinyon-juniper vegetation observed at 12 ecological reference areas and associated sites within southeastern Idaho was sampled to provide basic descriptive information and assist in the assessment of conservation status. The vegetation is classified within 23 plant associations on the basis of species perceived natural potential for dominance and relative tolerance of environmental stress. Plant community composition, distribution and environmental relations are summarized. Basic classification revisions are described for four of five Idaho-endemic plant associations considered globally rare. Over one-half of the plant associations described appear similar to associations described elsewhere. Regional comparisons, however, are difficult due to a relatively low region-wide sampling effort; a preponderance of data for stands in poor, early-seral condition; and/or methods of reporting. Summaries of stand composition and structure derived through the study will promote the utility of designated natural areas in providing reference ecological information needed for work related to woodland conservation and management.

A-121

INDIVIDUAL AND POPULATION RESPONSES OF THE GRAY-TAILED VOLE, *MICROTUS CANICAUDUS*, TO AN ENDOCRINE DISRUPTOR. Tracie Sanchez-Caslin, Oregon State University, Corvallis. [BHV]

I conducted a field experiment to determine if a nominal application rate of commercial formulation of vinclozolin, a fungicide which is a purported anti-androgenic endocrine disruptor, adversely affected reproductive development and demography of gray-tailed voles. I monitored demography of voles in four control (water applied) and four treatment (vinclozolin applied) populations of voles in 0.2 ha enclosures. The experiment was conducted twice, once in tall grass and once in short grass. Preliminary evidence suggested a slight reduction in testes and seminal vesicle size in treatment voles, but I found no significant differences in growth rate or reproductive competence between control and treatment males in either experiment. Similarly, I found no differences in population size, growth rate, or juvenile recruitment in control and treatment populations. I conclude that a standard application rate of vinclozolin in grassland habitat does not adversely affect reproductive development or demography of gray-tailed voles.

A-122

REPRODUCTIVE SUPPRESSION IN *MICROTUS MONTANUS* AT PRE-PEAK DENSITIES: EFFECTS ON POPULATION GROWTH AND DEMOGRAPHY. Todd L. Scarlett, Washington State University, Pullman, WA. [BHV]

Maturation of juvenile females has been shown to be inhibited by breeding females in high density microtine rodent populations; however, the degree to which juveniles are suppressed at lower densities is unknown. To determine the extent that adult female microtines suppress maturation of juvenile females in pre-peak populations, I removed 25% of adult female *Microtus montanus* weekly from two pre-peak populations for 8 weeks. Population matrix models were developed to determine the effect of juvenile reproductive suppression on population growth. Maturation rate significantly increased in response to adult female removal. Adult female survivorship had the greatest influence on population growth rate and maturation rate had an intermediate influence. My findings show that adult female *M. montanus* suppress maturation of juvenile females long before the population becomes saturated with breeding females. Reproductive suppression of juveniles in medium density populations probably does not have a great effect on population growth initially, but the effect will increase as suppression continues and a greater proportion of the population becomes non-reproductive.

A-123

CANOPY MACROLICHENS FROM FOUR FOREST STANDS IN SEQUOIA NATIONAL PARK, CALIFORNIA. David C. Shaw, Wind River Canopy Crane Research Facility, Carson, Washington, Steven A. Acker, Oregon State University, Corvallis. [CNP]

Canopy macrolichens were sampled using the "litter pickup" technique in four forest stands of Sequoia National Park, each dominated by a different conifer: Sugar Pine, White Fir, Giant Sequoia and Jeffrey Pine, with standing crop of lichen litterfall of 70.5 kg/ha, 29.4 kg/ha, 15.9 kg/ha, and 15.1 kg/ha respectively. Five macrolichens were present in the litterfall: *Letharia vulpina* (LEVU), *L. columbiana* (LECO), *Hypogymnia imshaugii* (HYIM), *Bryoria* spp. (BRYO) and *Melanelia* spp. (MELA). The Sugar Pine stand was dominated by HYIM (31.3 kg/ha) with LEVU (30.5 kg/ha), LECO (8.6 kg/ha) and BRYO (0.02 kg/ha), White Fir by HYIM (14.6 kg/ha) with LEVU (13.0 kg/ha), and LECO (1.9 kg/ha), Giant Sequoia by LEVU (10.4 kg/ha) with HYIM (4.2 kg/ha), LECO (0.8kg/ha), BRYO (0.3 kg/ha) and MELA (0.3 kg/ha), and Jeffrey Pine by LEVU (14.7kg/ha) with LECO (0.3 kg/ha), HYIM (0.2 kg/ha), and BRYO (0.02 kg/ha). Lichen abundance increased with increasing tree species diversity, with the exception of the Giant Sequoia stand.

A-124

A NEW TECHNIQUE FOR ESTIMATING PLANKTIVOROUS SECONDARY PRODUCTIVITY: A FIELD TEST CONDUCTED IN LAKE ROOSEVELT, WASHINGTON. John P. Shields, and A. Ross Black, Eastern Washington University, Cheney. [AQU]

Zooplankton form an important facet in the food chain of Lake Roosevelt, creating a critical link between phytoplankton and secondary consumers. Historic zooplankton studies on this reservoir have produced data on speciation, density and biomass, but have been unable to estimate secondary production because of no way to sample a "closed" population of organisms over time. Fortunately, new methods for calculating production rate in terms of birth, mortality and change in biomass by species have been developed utilizing *in-situ* enclosure techniques. By "corralling" ambient populations of zooplankton, enclosures enable production rates to be estimated by season, location or changing environmental condition. Enclosures also allow for zooplankton productivity in the absence of vertebrate predation to be calculated. Within-enclosure production can then be compared to the surrounding lake providing insight into the impact of vertebrate predators on the zooplankton community. It is hoped that this technique will provide a way to identify the factors potentially regulating secondary production in Lake Roosevelt.

A-125

BIRD COMMUNITIES OF RIPARIAN BUFFER STRIPS. Susan Shirley, University of British Columbia, Vancouver, B.C. [HBV]

Riparian habitats support rich communities of terrestrial organisms including songbirds, but are under pressure from agriculture, forestry, recreation and urban development. I am investigating riparian bird habitat requirements by evaluating 1) use of existing buffers and 2) response to fragmentation. From 1995-1997, I studied the distribution of birds by comparing riparian communities across 19 sites with varying buffer width and undisturbed forest to determine bird abundance, species diversity and density. To study harvesting impacts, certain sites are being surveyed before and after harvesting. In 1998, I will conduct studies on bird movement patterns in buffers and across habitat boundaries. Associations between riparian birds and habitat attributes such as vegetation and forest insects were sampled using measurements of vegetation variables, sweepnets, malaise traps and emergence traps. Forty bird species were detected in buffers and undisturbed sites while 25 bird species were detected in clearcuts. Over 103 families of insects and spiders have been identified. Data analysis is ongoing, but preliminary results before statistical analysis suggest a trend towards increasing bird species richness with increasing buffer width while bird density does not differ across buffer width except in very narrow buffers.

A-126

CAUSES FOR SLOW ACCUMULATION OF EPIPHYTIC LICHENS IN DOUGLAS-FIR FORESTS. Stephen C. Sillett, Humboldt State University, Arcata, Bruce McCune, Jerilynn E. Peck, Thomas R. Rambo, Andrea Ruchty, Oregon State University, Corvallis. [LG2]

Many epiphytic lichens are strongly associated with old-growth forests. The causes for their slow accumulation in young forests are poorly understood. We tested whether forest age, dispersal rate, and/or bark roughness limit the distribution of the old-growth associated lichen *Lobaria oregana*. We inoculated rough-barked and smooth-barked branches in clearcuts, young forests, and old growth with lichen propagules each season for one year. Rates of establishment were compared one year later. Dispersal significantly affected the rate of lichen establishment; inoculated branches had 26 times more established thalli than controls. Forest age and bark roughness did not significantly affect establishment rate. We also compared growth rates of transplanted *L. oregana, L. pulmonaria,* and *Hypogymnia inactiva* thalli. There were no significant differences in lichen growth between young forests and old growth, but *L. oregana* grew significantly less in clearcuts. Our results indicate that dispersal rate is the major factor limiting the abundance of old-growth associated lichens in Douglas-fir forests. Silvicultural treatments that facilitate lichen dispersal from populations on older trees into regenerating forests have great potential to promote these lichens in managed forests.

A-127

DEMOGRAPHIC RESPONSE OF SMALL MAMMALS TO RAPTOR PREDATION: AN EXPERIMENTAL APPROACH. Robert S. Skillen, Jerry O. Wolff, Guiming Wang, and Tiffany Fox, Oregon State University, Corvallis. [DYV]

Raptors are major predators on small mammals, however whether they can effectively control rodent numbers is not known. Predation efficiency may, in part, be a function of access in the form of perch sites. We conducted an experiment to determine if adding perch sites for raptors would affect vole demography in the surrounding area. Demography of voles was monitored in three control and three treatment (perches added) 0.2 ha enclosures prior to after erection of perch sites. After perches were erected, we observed a two- to three-fold increase in use of treatment enclosures by American kestrels (Fox et al., this symposium), however, population size, growth rate, and juvenile recruitment of voles did not differ between treatment and control enclosures. A large initial population size, adequate cover, and easier access to voles in the surrounding area may have precluded raptors from decimating treatment populations. We conclude that perch sites can increase raptor use of an area, however demographic responses of prey to aerial predators may be confounded by local habitat and environmental conditions.

A-128

FINDLEY LAKE SPODOSOLS: FRACTIONATION, CHARACTERIZATION, AND ROLE OF ORGANICS IN THEIR GENSIS. R.S. Sletten, F.C. Ugolini, I.G. Choi, D. Zabowski A.J. Krzyszowska, and R. Jandl, University of Washington, Seattle. [CRW]

Soils of the Findley Lake basin have been used as models for understanding soil-forming processes. A key characteristic of these soils is translocation of metals from the upper E horizon to the Bhs (spodic horizon). Soil organics complex metals and reduce iron, thereby mobilizing metals from the upper horizons. The organo-metal complexes are arrested in the Bhs horizon and the interface of the Bhs/Bs horizon due to increasing metal complexation and adsorption on oxide surfaces. The adsorption also leads to an increase in soil solution pH that in turn promotes oxidation of Fe-II and its precipitation in the Bs horizon. Soil pH in the upper horizons is buffering primarily by organic acids and below by carbonic acid. For all horizons the dominant organic fractions are hydrophobic and hydrophilic acids, which include fulvic and low molecular weight organic acids. In addition, hydrophobic neutrals were a significant fraction of organic in the upper horizons and mineralize more quickly. As the solutions percolate down the horizons, the hydrophobic acids decrease the greatest amount. These key processes occur primarily in the upper one-half meter of these soils and transform organically-colored, acidic soil water into clear, near-neutral water that is characteristic of the subalpine lakes.

A-129

STRUCTURE AND MORPHOLOGY IN PACIFIC SILVER FIR STANDS: WHEN YOU'VE SEEN ONE, HAVE YOU SEEN THEM ALL? D.G. Sprugel, T. A. Martin, T. M. Hinckley, K. J. Brown, J. Rombold, University of Washington, Seattle, and B. J. Yoder, Oregon state University, Corvallis. [CRW]

We compared stand structure and shoot and foliage morphology in three Abies amabilis stands in the Cedar River watershed: a 5 m tall, 37-year-old stand on a relatively poor site, and a 22 m tall, ca. 45-year-old stand on a much richer site, and a 40-45 m tall old-growth stand on another relatively poor site. Our goal has been to learn if there are any general structural characteristics of Pacific silver fir trees or stands that hold across a wide range of stands regardless of age or site quality. Although not all of the data have been analyzed, some patterns have emerged. For example, foliage distribution on individual trees is not constant between stands: even after normalizing for differences in tree height and total foliage area, the vertical distribution of foliage on young trees on a poor site is substantially different from that on trees of similar age on a richer site. However, even though the foliage distribution on individual trees is different, the overall foliage distribution for the stand as a whole is similar once it is normalized for the much deeper canopy of the taller site. The vertical distribution of new foliage production closely matches light interception. Finally, shoot structure and leaf morphology vary in the same way with light availability regardless of tree height or age.

A-130

THE LICHEN FLORA OF STONY PASS, AN ALPINE TUNDRA SITE IN SOUTHWESTERN COLORADO. S.B. St. Clair, L.S. Cooper, L.J. Stewart, L.L. St. Clair, Department of Botany & Range Science, Brigham Young University, Provo, Utah 84602, and C.C. Newberry, Department of Integrative Biology, University of California, Berkeley, California 94720. [LG1]

Sixty-eight species in 41 genera are reported for Stony Pass, a high elevation alpine tundra site in the San Juan Mountains of southwestern Colorado. *Candelariella reflexa, Collema ceraniscum,* and *Dermatocarpon lorenzianum* are reported as new species records for the state of Colorado. The lichen flora at Stony pass is dominated by species from the Arctic floristic element. The overall percentage of Arctic Element species at Stony Pass (78%) is most similar to the alpine lichen floras at Lake Peak (84%) and Sierra Blanca Peak (76%) in north central and south central New Mexico respectively. However, Stony Pass shares more total species in common with Mt. Audubon in north central Colorado (40/68 species). This pattern suggest that the contribution of the Temperate Element to alpine tundra sites differs significantly from site to site; while the Arctic Element, in general, tends to be more homogenous from site to site.

A-131

THE RELATIVE IMPACT OF FLORAL VISITORS: A CONTINUUM FROM VERY HARMFUL PARASITES TO VERY BENEFICIAL MUTUALISTS. Steven J. Stein and Donna L. Hensley, Eastern Washington University, Cheney, WA. [ECO]

The relative impact of different species of floral visitors on the reproductive success of plants is determined by the abundance of floral visitations and many behavioral and morphological characteristics of the visitors. We investigated the relative impact of 23 species of floral visitors on the reproductive success of *Asclepias curassavica* in northern Costa Rica. We quantified the abundance of each visiting species, as well as their efficiency in both removing and depositing pollen. Wasps visited flowers 2 times more often than bees and 5 times more often than both butterflies and flies. Wasps also removed and deposited significantly more pollen than any other group of pollinators. Individual species showed great variation in both number of visits and influence on plant reproductive success. The most valuable pollinator to the plant was 6 times less abundant than the most common pollinator but deposited 14 times more pollen per visit. Our results suggest that data on floral visitation is just the beginning in understanding the relative importance of pollinators to plant reproductive success.

A-132

SUSTAINABLE FOREST MANAGEMENT IN THE SOUTHERN TIP OF THE PUGET TROUGH A CASE STUDY: THE COWLITZ RIDGE TREE FARM. Steven D. Stinson College of Forest Resources Silviculture Laboratory, University of Washington [FOR]

This case study analyzes the silvicultural regime of the Cowlitz Ridge Tree Farm (CRTF) a Non-industrial Private Forest for its ability to incorporate ecologically based principles into scientifically and economically sound land stewardship practices. Uneven-age management practices offer the opportunity to mimic, and where possible, restore natural disturbance regimes in geographically specific, forested landscapes. Landscape and stand-level characteristics of the historical fire regime are documented. A silvicultural regime designed to blend high quality timber production with late successional structural characteristics is analyzed for its ability to mimic the spatial and temporal aspects of the historic disturbance regime, within the economic and operational constraints of a non-industrial private forest. The silvicultural activities practiced on the CRTF have been tailored to resemble specific natural disturbances inherent to forests in this region. The spatial and temporal aspects of the fire disturbance regime in the southern Puget Trough are two quantifiable aspects that have been successfully incorporated into an economically feasible and ecologically sound silvicultural regime.

A-133

MEASUREMENT OF DIFFERENCES IN SNOW ACCUMULATION, MELT AND MICROMETEOROLOGY DUE TO FOREST HARVESTING Pascal Storck, Travis Kern, Susan Bolton, University of Washington, Seattle, WA [DEM]

To better quantify the hydrologic response of forest harvesting over a wide variety of harvest prescriptions, measurements of snow accumulation, melt, and micrometeorology are being taken in existing mature forested units and shelterwood units in the transient snow zone of the western Cascades of southwestern Oregon as part of the DEMO project. Snow accumulation and melt at the unit scale are measured by weekly twenty point snow courses. Snowpack water equivalence (SWE) and outflow are measured with large (>13 m^2) weighing lysimeters. Canopy snow interception is directly measured via continuous weighing of cut trees. Maximum differences in SWE between mature and harvested sites approached 250 mm. Canopy snow interception often exceeded 35 mm SWE. Daily runoff during rain on snow events in the shelterwoods were up to 60% greater than under the mature canopy. Increases of 50% were seen during spring melt events.

A-134

RELATIONSHIPS BETWEEN CANOPY STRUCTURE AND THROUGHFALL VARIABILITY IN A PRIMARY AND SECONDARY CONIFEROUS FOREST. Mark M. Sumera and Nalini M. Nadkarni, The Evergreen State College, Olympia. [CNP]

Forest canopies modify rainfall spatial patterns which affects environmental and biological heterogeneity. To better understand this process, we conducted detailed throughfall and canopy structure measurements in a primary and secondary coniferous forest. Range in throughfall quantities was over two times larger in the primary forest than the secondary forest. Collector-specific percent throughfall was consistent between rain events which suggests a strong canopy structure influence. Mean percent throughfall per sample site was not correlated to the one-dimensional stem location, weakly correlated to the two-dimensional crown projection area, weakly correlated to canopy openness as measured with hemispherical photographs, and strongly correlated to the three-dimensional quantity and composition of canopy material above a sample point as measured with 'canopy cylinder transects'. Our results indicate, due to their structural complexity, primary forest canopies may have a greater influence on the spatial aspects of the forest hydrological cycle than secondary forest canopies.

A-135

PLANT DIVERSITY IN MANAGED FORESTS: UNDERSTORY RESPONSES TO THINNING AND FERTILIZATION IN DOUGLAS-FIR PLANTATIONS.

Sean C. Thomas and Charles B. Halpern, University of Washington, Seattle, WA. [FOR]

We investigated responses of understory plant communities to a combination of silvicultural thinning and nutrient addition treatments maintained for 21-27 years in six replicated Douglas-fir plantations. Vegetation cover and diversity increased with the level of thinning, but declined dramatically in response to fertilization, with up to a 10-fold drop in herb-layer cover observed. Tree canopy cover, assessed by means of hemispherical photographs, increased with fertilization but showed no response to thinning. Treatment effects on understory cover and species richness were not simply a function of canopy cover or estimated light availability. Rather, there was a weak positive relationship between estimated understory light flux and herb-layer cover and diversity in non-fertilized plots, and no such relationship in fertilized plots. This lack of correspondence between treatment effects on canopy cover and understory vegetation is possibly due to large time-lags in understory response to changes in canopy cover, and/or to treatment effects not mediated by light availability, such as toxicity responses following fertilization. Our results indicate that silvicultural thinning and fertilization have large impacts on understory plant diversity and community composition, but further work is needed to understand mechanisms responsible for these effects.

A-136

HOME RANGE AND HABITAT USE OF WESTERN RED-BACKED VOLES IN MATURE CONIFEROUS FORESTS IN THE SOUTHERN OREGON CASCADES.

Rebecca Thompson, Colville Confederated Tribes, Nespelem, WA. [HBV]

Home ranges and movements of western red-backed voles (*Clethrionomys californicus*) were estimated in three mature Douglas-fir stands in the southern Oregon Cascades. Twelve voles were radio-collared and tracked between August and September 1994 and 11 between July and August 1995. Average home range size was estimated with the adaptive kernel method and averaged 0.13 ha for females (range 0.06-0.27 ha) and 0.67 ha for males (range 0.58-0.85 ha). Movements between successive telemetry locations averaged 12 meters for females and 30 meters for males. Habitat was characterized at core and random areas within home ranges. Red-backed voles selected for decayed logs and deep organic litter within home range core areas.

A-137

ROLE OF MYCORRHIZA-TYPE IN NITROGEN UPTAKE IN AN OLD-GROWTH-FORESTED WATERSHED, OLYMPIC NATIONAL PARK, WA.

Steven A. Trudell and Robert L. Edmonds, College of Forest Resources, University of Washington [POS]

Studies of nitrogen (N) dynamics in Pacific Northwest (PNW) forests have assumed that plants obtain N from the soil only in mineral forms (ammonium and nitrate). However, the slow decomposition rate in the PNW caused by the cool to cold climate with dry summers leads to a high proportion of soil N occurring in organic form and this suggests that there may be insufficient mineral N to meet plant requirements. Ectomycorrhizal and ericoid mycorrhizal fungi have been shown capable of accessing soil N in organic form. Most PNW forest canopies are dominated by ectomycorrhizal trees, and ericoid mycorrhizal shrubs comprise the understory in many areas. Thus, it is possible that a significant portion of plant N may be taken up in organic form. We are investigating this possibility by using stable isotope analysis and other techniques to assess the relationship between mycorrhiza type and N uptake in an old-growth-forested watershed in the Hoh Valley, Olympic National Park. Significant uptake of organic N would have important implications for global change models that incorporate links between C and N cycling based on assumed rates of mineralization.

A-138

FINDLEY LAKE : KEY TO UNDERSTANDING SOIL FORMING PROCESSES IN THE CASCADES.

F. C. Ugolini, Suolo e Nutrizione della Planta, Florence, Italy [CRW]

Soil studies in the Findley Lake basin were initiated in the summer of 1971 as part of the IBP. Spodosols (Podzols) occupy 74% of the basin. Soil processes were studied by analyzing soil solutions, collected by lysimeters, and a theory of podzolization was postulated. Precipitation is acidified passing through the canopy, further acidification occurs due to organic acids as solution penetrates the forest floor. Fulvic acid is the major organic acid driving weathering in the upper profile (O, E, and Bhs). The organic acids cause congruent weathering in the E by complexing Al and Fe. The complexed Al cannot react with Si and, hence, cannot form allophane or imogolite. These organo-metal complexes migrate until they are arrested at the Bhs/Bs boundary. Below this boundary, in the Bs, BC, and C horizons, is second geochemical zone where pH increases and carbonic acid is the major proton donor. In this zone, incongruent dissolution leads to leaching of bases while Al reacts with Si to form allophane and imogolite, and Fe forms iron-oxides. Substantial unreacted Si is leached. Allophane and imogolite were found to be thermodynamically unstable in the E and Bhs and stable in the Bs, BC, and C. After Mt. St. Helens erupted in 1980, a field experiment was performed to better understand this recurring event on Cascades soils by adding tephra from this eruption to study plots at Findley Lake. The experimental studies conducted at Findley Lake had great influence on our understanding of podzolization in the Arctic, SE Alaska and Japan.

A-139

CHANGES IN WATER QUALITY OF KAMM CREEK WITH CHANGES IN AGRICULTURAL MANAGEMENT PRACTICES. Joan P. Vandersypen and Robin A. Matthews, Institute for Watershed Studies, Huxley College, Western Washington University, Bellingham, WA. [WSA]

During this decade, agricultural best management practices (BMPs) have been implemented in the Kamm Creek Watershed, in Whatcom County, WA, to prevent nonpoint source pollution as a result of dairy farming. The purpose of this 5-year surface water quality study was to determine whether water quality improved with the addition of BMPs. Biweekly samples were collected from February 1993 to February 1998 and analyzed for basic chemical, biological, and physical water quality parameters. Current data was compared to past data from 1988 and 1989. In addition to the implementation of BMPs, another potentially important land use change included crop conversions from pasture to corn. Land use is being mapped to show conditions before and after the 5-year sampling project and trends will be identified. Final data analysis is still in progress, however trends through 1996 indicate that ammonia concentrations were higher in 1988/1989 than in 1993 at all sites studied and that concentrations have generally not changed or have increased from 1993 to 1996. Nitrate + nitrite concentrations were higher in 1993 than 1988/1989 and have remained higher through 1996. The data suggest that the combination of land use changes and BMPs have not been associated with long-term improvement in water quality.

A-140

SEXUAL STRATEGY OF THE CENTRAL LONG-TOED SALAMANDER, *AMBYSTOMA MACRODACTYLUM COLUMBIANUM*. Paul Verrell, Washington State University, Pullman. [BHV]

Field data and laboratory observations were collected in order to describe the sexual strategy of the central long-toed salamander in Pullman, WA. The overall adult sex ratio was approximately equal during the short breeding season of spring 1994. However, males arrived at the water earlier and stayed longer than females; at any one time, the number of sexually-active males likely exceeded the number of receptive females. Courtship consists of multiple periods of clasping of the female by the male (amplexus), between which he dismounts to deposit spermatophores. Unpaired males wrestle with amplectant males in an effort to displace them (as in many frogs), and are sometimes successful. Males also interfere in one another's attempts to deposit spermatophores (as in many other salamander taxa), probably in an effort to 'steal' inseminations. I tentatively classify the mating system of *A. m. columbianum* as a scramble in which a male's mating success is determined more by intense intrasexual competition than intersexual mate choice. Comparative data suggest that this may be the typical mating system for ambystomatid salamanders.

A-141

A UNIFIED THEORY FOR PLANTS. Orvin E. Wagner, Wagner Research Laboratory, Rogue River, Oregon [BOT]

I spent the last 10 years experimentally developing a wave theory for plants (W-waves). The results together with genetics provide explanations for plant structure, a plant's response to gravity and light, plant evolution, sap flow, and others. The experiments also provide extensive proof for the wave theory. For example standing waves seem to implement plant structure. A plant's response to gravity is a wave guide effect due to differing wave velocities vertically and horizontally. Angles at which a plant grows with respect to the vertical seem to come in discrete values if one measures the angles on long straight portions of branches while growing. A plant's response to light apparently is due to excitation of the proper wavelengths of W-waves by light which determine the form of cells. Sap flow seems to result from moving standing waves. Nature seems to provide a template for general plant development and genetics fits its requirements into these rules to determine the exact form of a particular plant. W-waves can be directly detected in a plant using electronics. See the Wagner Research Laboratory web page for further details and references.

A-142

VEGETATION DYNAMICS IN A WETLAND SYSTEM INUNDATED WITH TREATED WASTEWATER. Mary L. Water, Eastern Washington University, Cheney. [POS]

Wetlands are defined by their soils, vegetation, and hydrology, with hydrology the most important factor in determining the type of wetland that is established. In 1995, the City of Cheney inundated a meadow, formerly maintained in reed canarygrass, with treated wastewater. This meadow had been divided into ponds by dikes. Changes in species composition were expected with the extended flooding. Subsequent vegetation development was affected by drawdowns in 1996 and 1997. The diversity of the wetlands was explored in field and greenhouse studies. In the field study, species richness and Shannon diversity indices were compared for plots in areas impacted by the placing of inlets for wastewater distribution, to plots in undisturbed areas. Greater diversity was found in disturbed than undisturbed areas. In the greenhouse, a seed bank study was done to determine what species were present in the soil. Two ponds were evaluated using moisture level and stratification as variables. Both ponds had more species emerge under moist rather than inundated conditions; stratification had little effect. Vegetation observed in the field in 1997 exhibited at least a temporary increase in diversity; future conditions will be influenced by the levels of water maintained.

A-143

LANDSCAPE RELATIONSHIPS OF THE HERPETOFAUNAL ASSEMBLAGE OF A NORTHWESTERN CALIFORNIA WATERSHED: PATTERNS, PROCESSES, AND PROGNOSES. H. H. Welsh, Jr.[1] and G. R. Hodgson, USFS-PSW Redwood Sciences Lab., 1700 Bayview Dr., Arcata, CA 95521. [EAR]

We sampled the herpetofauna of forty-nine, 300 m reaches along 31 tributary streams throughout the Mattole River watershed. We employed a four-tiered sampling strategy, over three years (1994-1996), to sample species in aquatic, riparian, and upland environments. We measured vegetation composition and structure, microclimatic parameters, and physical landscape attributes. This data enabled us to model the distributional patterns of this herpetofauna relative to hydrologic and vegetation patterns. Analysis revealed the existence of several unique assemblages of reptile and amphibian species on this landscape. Species diversity, richness, and evenness varied significantly among vegetation cover types and stream hydrologic types. Comparing past (1947) landscape vegetation patterns with present, we propose hypotheses on the nature and direction of major landscape-scale processes in the watershed and their role in the creation of these species assemblages. From analysis of microclimatic requirements of assemblage members relative to current conditions, we speculate on their future status. Our conclusions may have implications for other sensitive native fish and wildlife species in the Mattole watershed.

A-144

PROMOTING PRAIRIE VEGETATION, RARE PLANTS, AND A RARE BUTTERFLY. Mark V. Wilson, Oregon State University, Corvallis, Deborah L. Clark, Oregon State University, Corvallis, Cheryl B. Schultz, University of Washington, Seattle. [RP2]

Willamette Valley prairies, home to remnant populations of the threatened Fender's blue and several listed plant species, are one of the most endangered ecosystems in the United States. Species recovery efforts emphasize habitat restoration. We report results from a field experiment evaluating the effectiveness of three promising restoration tools: burning, mowing, and mowing followed by herbicide application. The goals were to develop a better understanding of prairie dynamics and to identify techniques that controlled woody pest plants without harming native species or promoting nonnative herbaceous species. Three years after the initial manipulations, all treatments significantly reduced woody plant cover. Mowing promoted native grasses without promoting nonnative plant species, but burning had mixed effects on common herbaceous species. Treatments stimulated lupine species, the larval host plants for the Fender's blue butterfly. Treatments also caused local increases in numbers of butterfly eggs, probably because invigorated lupines attracted ovipositing females. Although burning killed butterfly larvae, egg densities were still higher the following year. These results show that both mowing and burning should be considered in planning prairie restorations.

A-145

EFFECTS OF HABITAT FRAGMENTATION ON WOOD FROGS. Elke Wind , M.Sc. Thesis, Fred Bunnell and Ann Chan-McLeod , University of British Columbia, Vancouver. [HBV]

Habitat destruction and loss are blamed for amphibian declines worldwide, and development and forestry operations fragment amphibian habitat. Populations in fragments may become isolated if the matrix environment, namely clearcuts, limit dispersal, movement, and migration patterns. Small forest fragments may also have an increased ratio of edge to interior habitat, changing temperature and moisture regimes. We pitfall trapped Wood Frogs (*Rana sylvatica*) in 10 sites in Alberta from 1993 to 1995, to study the effects of habitat fragmentation on capture rates. The 10 sites were in continuous forest in 1993, but through forest harvesting, six of these sites were made isolated forest fragments surrounded by 200-m wide clearcuts in 1994 (three 10-ha and three 100-ha). The abundance of wood frogs decreased and average body length increased within 10-ha fragments two years post-harvesting compared to 100-ha and control sites. Forest fragmentation reduces the number of wood frogs, especially impacting small individuals, but the presence of wet patches within a site may mitigate the effects. We would like to thank Alberta Pacific Forest Industries for their support.

A-146

WHY ARE FEMALE MAMMALS PROMISCUOUS? Jerry O. Wolff, Oregon State University, Corvallis. [BHV]

Sexual selection theory proposes that males should attempt to copulate with as many females as possible and that females should be "choosey" and mate with the "best" male. Yet in many species of mammals, females are promiscuous and mate with several males during an estrous period. Hypotheses to explain multi-male mating (MMM) have focused on quality of offspring (such as increasing genetic diversity or sperm competition). I propose that MMM did not evolve to improve offspring quality, but has two primary functions, to create paternity uncertainty to prevent infanticide and to avoid sexual harassment. MMM occurs primarily among species that have altricial young, in which infanticide has been reported, and in which loss of young results in a mating opportunity for the male. In these species females solicit multiple mates to confuse paternity. MMM also occurs in a small group of species that have precocial young, in which infanticide does not occur, loss of young does not result in remating, and post-copulation mate guarding does not occur. MMM in these species reduces harassment during foraging, maternal care, and predator vigilance. In both cases, selection has operated directly on the act of multiple mating and not on offspring quality.

A-147

WEATHERING AND MINERAL STABILITY OF SPODOSOLS AT FINDLEY LAKE. D. Zabowski, R.S. Sletten, University of Washington, Seattle and F.C. Ugolini, University of Florence, Italy. [CRW]

Mineral stability can affect biogeochemical cycling by altering weathering inputs. Mineral stability also varies in response to environmental factors and can change throughout the year in response to seasonal variations. We examined the ability of seasonal changes in soil temperature and soil solution composition of the Findley Lake Spodosol to alter the stability of clay minerals using soil solutions and equilibrium relationships. Seasonality did alter the stability of minerals throughout an annual cycle. Soil solution data was also used in conjunction with previous biomass and nutrient data to approximate leaching losses and weathering inputs to the biogeochemical cycle at Findley Lake.

A-148

A NEW INDEX TO INVESTIGATE THE STRUCTURAL COMPLEXITY OF FORESTS, Eric K. Zenner, Oregon State University, Corvallis [FOR]

The 3-dimensional nature of forest structure has long been elusive to comprehensive structural comparisons among forests. Traditionally, 0-dimensional (e.g., graphical methods), 1-d (e.g., tree density, mean tree size, coeff. of variation of tree size), and, more recently, 2-d (e.g., nearest neighbor analyses, Ripley's k) summary variables have all been advanced to compare the structural heterogeneity among forests. Based on the spatial position of tree stems and size differences of neighboring trees, I have developed a structural complexity index (SCI) that is sensitive to the 3-d nature of forest structure. By tessellation, a triangulated irregular network of mapped or simulated stem positions with x,y,z (e.g., tree size) coordinates created a surface whose area was summed and divided by the sum of the projected 2-d triangle area to give the SCI. The SCI can be used to test the observed structural heterogeneity against simulated structures to evaluate the effects of spatial patterns and size differences between neighbors. The index can be used to test, for example, whether (1) natural forests tend to maximize their structural complexity at some scales, (2) the structure of natural and managed forests is different, and (3) which type of management may produce the most heterogeneous stand.

A-149

TREE SPECIES MIXTURE ENHANCES THE STRUCTURAL COMPLEXITY OF NATURAL YOUNG TO MATURE CONIFEROUS FORESTS. Eric K. Zenner, Oregon State University, Corvallis. [FOR]

The restoration, creation, and maintainence of structural complexity in managed forests has become a focal point of forest management in PNW forests. Green-tree retention and longer rotations have been emphasized in achieving greater structural complexity, and variations in thinning intensities have been proposed to hasten the development of old forest characteristics such as large trees and high variation in tree sizes. The effects of species composition, however, have been largely ignored. I compared the structure of young-to-mature stands with and without residual trees on the basis of a newly developed structural complexity index (SCI) that is sensitive to the 3-d nature of forest structure. Intermediate levels of residual trees were found to be positively associated with structural complexity by increasing both the tree species mixture of the understory and variation in tree sizes. Tree species mixture was strongly related to the SCI and was maximized at about 50 % (based on density) Douglas-fir in the understory. Monospecific Douglas-fir and western hemlock stands had the lowest SCI values.

A-150

A COMPARISON OF THE INITIAL STRUCTURAL HETEROGENEITY AND GENERAL PREDICTIONS FOR THE TREATMENT EFFECTS ON THE STRUCTURAL DEVELOPMENT OF SOME DEMO-SITES. Eric K. Zenner, David E. Hibbs, Oregon State University, Corvallis. [DEM]

To eludidate the effects of various levels and patterns of green-tree retention on forest structure and to provide information on temporal structural changes, are some of the fundamental objectives of the Demonstration of ecosystem Management Options (DEMO) experiment. We compared the initial structural heterogeneity of some of the Demo-sites with a newly developed structural complexity index and developed some general predictins for the treatment effects on the structural development. The following treatments were applied to the 13 ha stands: (1) 100 % retention (control), (2) 75 % aggregated retention (3 circular 1ha gaps harvested), (3) 40 % dispersed retention, (4) 40 % aggregated retention (5 circular 1 ha patches), (5) 15 % dispersed retention, and (5) 15 % aggregated retention (2 circular 1 ha patches). In all but the control treatments we assumed that 200 tpa were planted, 200 tpa regenerated naturally, and trees < 8'' diameter were retained. Stands were grown for 20 years in Organon and the surviving trees at the end of the growth period were randomly put on the treatment units to compare the structural heterogeneity.

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