BIOLOGY AND CONSERVATION OF MARTENS, SABLES, AND FISHERS: A NEW SYNTHESIS

Abstracts for Oral Presentations

Attachment A.

DIFFERENCES BETWEEN FISHER AND MARTEN DISTRIBUTIONS IN NORTH IDAHO

Albrecht, N.M.[1], C.L. Heusser[1], and M.K. Schwartz[2]

[1]Wildlife Program, Coeur d'Alene Tribe, 401 Anne Antelope Road, Plummer, Idaho 83851 USA, nalbrecht@cdatribe-nsn.gov; [2]USDA Forest Service, Rocky Mountain Research Station, 800 East Beckwith, Missoula, Montana 59801 USA.

Recent studies have suggested that deep snow may limit fisher (*Martes pennanti*) distribution, and that large fisher populations may in turn limit marten (*Martes americana*) distribution. We tested these hypotheses in northern Idaho, a region in which very little was known about the distributions of either species, except through trapping records which are likely biased by effort. A group of researchers from multiple agencies and interests deployed non-invasive hair-snaring devices to ultimately obtain DNA for species identifications of several mid-sized carnivores. We compared habitat attributes such as canopy closure, tree size class, and vegetative cover type in locations where fisher (n = 123) and marten (n = 173) were detected, and compared these data to each other and to random sites within the region. In addition, mean winter snow depth from 2002-2007 was analyzed at each detection site based on data from the National Oceanic and Atmospheric Administration's National Operational Hydrologic Remote Sensing Center. Our habitat analysis showed that canopy closure was significantly higher where martens were detected and the distribution of vegetative cover types used was significantly different for the 2 *Martes* species, with marten being found in higher elevation habitat types (i.e., sub-alpine fir), and fisher sites being associated with lower-elevation forests (Douglas-fir, western redcedar). Our environmental analysis showed that mean winter snow depth was significantly deeper at sites that detected martens than sites that detected fishers. These results suggest that martens and fishers on average are distributed differently in Idaho, despite the fact that they are often found in overlapping habitats, and that climatic and structural factors are important in explaining this variation.

SELECTION OF REST STRUCTURES BY FISHERS IN THE CASCADE RANGE OF SOUTHERN OREGON

Aubry, K.B. and C.M. Raley

USDA Forest Service, Pacific Northwest Research Station, 3625 93rd Ave. SW, Olympia, Washington 98512 USA, kaubry@fs.fed.us.

Overtrapping and habitat loss from timber harvesting resulted in the extirpation of fishers (*Martes pennanti*) from most of their historical range in the Pacific states. However, conservation efforts in this region have been severely constrained by a lack of information on

their ecological relations, especially in Oregon and Washington. To fill these and other information gaps, we conducted a radio-telemetry study of fishers on the west slope of the Cascade Range in southern Oregon to investigate their habitat relations at various spatial scales. From 1995 to 2001, we radio-collared 12 females and 5 males and monitored them year-round to locate structures used for resting. Fishers primarily rested in live trees (62%; 230/371), frequently used logs (20%; 73/371) and dead trees (14%; 51/371), and rarely used other structures (e.g., woody debris piles or rocks) (4%; 17/371). We compared the proportion of key micro-sites (e.g., mistletoe brooms, cavities, etc.) used by fishers in 354 trees, snags, and logs to their prevalence in 1,051 structures sampled randomly at 373 points distributed throughout a 1,036-km^2 area. Although in live trees, fishers primarily (60%; 137/230) used mistletoe brooms, very few (7%; 27/368) randomly sampled live trees contained this type of micro-site. Similarly, fishers primarily (78%; 40/51) used cavities when resting in dead trees, but only 15% (48/322) of available snags had cavities or hollows large enough for a female fisher to access. When resting in logs, fishers almost exclusively (89%; 65/73) used hollows, but hollows were present in only 18% (65/361) of available logs. Fishers choose rest structures and micro-sites that provide protection from potential predators, thermal advantages, and a safe location to consume recently captured prey. Our results indicate that suitable resting structures are relatively rare in forested landscapes on the west slope of the Cascade Range, and may represent an important limiting factor.

COMPARATIVE ECOLOGY OF FISHERS IN EASTERN AND WESTERN NORTH AMERICA

Bowman, J.[1] and E. Lofroth[2]

[1]Ontario Ministry of Natural Resources and Trent University, 2140 East Bank Drive Peterborough, Ontario K9J 7B8 Canada, jeff.bowman@ontario.ca; [2]British Columbia Ministry of Environment, 2975 Jutland Road, Victoria, British Columbia V8W 9M1 Canada.

Fishers (*Martes pennanti*) are endemic to North America, and have been considered by some to exist as 3 subspecies: *M. p. pacifica* and *M. p. columbiana* in western North America, and *M. p. pennanti* in the East. Fishers have undergone declines across their range since European settlement, leading to widespread efforts to conserve the species. Conservation appears to have been most successful in eastern North America, within the range of *M. p. pennanti*. For example, contemporary genetic analyses show that although fisher populations have been fragmented across their range, there appears to be greater homogenization of lineages occurring in the East, suggesting a recovery of functional connectivity there. We reviewed published studies to compare fisher ecology in eastern and western North America to better understand potential reasons for the species' different conservation histories in these regions. We have defined East and West to coincide with the subspecies boundary between *M. p. pennanti* and *M. p. columbiana.* Our review suggests few ecological differences between fishers in these regions. There was no consistent difference in home range size or density, although the highest densities occured in the East, suggesting the potential for higher food production there. Indices of diet diversity however, were not different between the regions. There was some evidence of lower reproductive capacity in the West (e.g., 2.3 vs 3.3 corpora lutea per adult female in British

Columbia and Ontario, respectively). An important difference between the regions may be annual snowfall which was much higher in western North America. This difference may be reflected in the larger body size of *M. p. columbiana* that formed the original basis of fisher subspecies delineation. We propose that deep snow may reduce fisher habitat quality in the West, which would explain the relatively slower recovery rates of fishers in this region.

MATRIX DEMOGRAPHIC MODELING OF THE FISHER AND AMERICAN MARTEN

Buskirk, S.W.[1], J. Bowman[2], and J.H. Gilbert[3]

[1]Department of Zoology and Physiology, University of Wyoming, Laramie, Wyoming 82071 USA, marten@uwyo.edu; [2]Ontario Ministry of Natural Resources, Wildlife Research and Development Section, 2140 East Bank Drive, Peterborough, Ontario K9J 7B8 Canada; [3]Great Lakes Indian Fish and Wildlife Commission, P.O. Box 9, Odanah, Wisconsin 54806 USA.

Matrix modeling is a means of characterizing age- or stage-structured population processes. Specifically, matrix models can identify key transitions between stages in life cycles that influence λ. For *Martes*, only North American taxa appear to provide sufficient data to parameterize matrix models, and fewer data are available for martens, particularly in untrapped settings, than for fishers. We reviewed literature and unpublished accounts on vital rates for martens and fishers, and constructed Lefkovitch matrix models with 4 life stages for untrapped and trapped populations of each species. We found a non-significant trend toward higher stage-specific survival in females of both species. Trapping tended to reduce the proportion of the population that was juveniles. Parameterizing a model for the marten in an untrapped setting was particularly problematic, because of a dearth of estimates of stage-specific survival rates. Elasticities reveal that λ for both species in untrapped and untrapped settings is most sensitive to survival from year 1 to year 2, and adult survival (years 4 and above). Adult fecundity, the probability of a female surviving to year 4 of life and reproducing, is the single most important determinant of λ for both species in all scenarios, but is especially important in untrapped fisher populations. As the importance of fur trapping as a population influence declines, we have greater need for information about demographic factors, especially vital rates, which affect population growth in untrapped populations of conservation concern.

LOCAL ADAPTATION IN AN INSULAR MARTEN: FORAGING ECOLOGY OF EURASIAN PINE MARTEN IN SCOTLAND

Caryl, F.M.[1], C. Quine[2], and K. Park[1]

[1]School of Biological & Environmental Sciences, University of Stirling, Stirling, Scotland FK9 4LA United Kingdom, fcaryl@unimelb.edu.au; [2]Ecology Division, Forest Research, Northern Research Station, Midlothian, Scotland EH25 9SY United Kingdom.

Habitat use by animals is influenced by a need to fulfill basic life requirements such as obtaining food whilst avoiding predation and reducing energetic costs. The life requirements of marten are not uniform or ubiquitous, however, and wildlife managers must recognize how local marten populations may have adapted to local conditions, and modify their management plans accordingly. As an island, Britain supports a reduced fauna to mainland Europe; thus, British marten benefit from a reduction in potential competitors and predators. The range of British marten is predominantly restricted to northern Scotland, where small relict populations were able to survive prolonged and extensive historical deforestation, which has resulted in highly fragmented and depleted forest cover. Despite being at northerly latitudes of 55-59°N, Scottish marten benefit from a maritime climate of short, mild winters and reduced snow cover in comparison to their mainland counterparts. To better understand how these unique conditions may have affected the ecological niche of Scottish marten, we examined marten diet in relation to prey availability, and investigated habitat use by female marten at multiple scales within a plantation forest in NE Scotland (58°N). During 1 year, 2,450 scats were collected, 86 % of which were genetically confirmed as marten in origin. Scat contents showed that small mammals, berries and small birds were the principal foods consumed. Comparison of small mammal species in the diet with that in the environment revealed an unequivocal preference for *Microtus* voles. This preference was reflected in habitats used by 7 foraging female marten; whilst they selected to make their home ranges in areas of late successional coniferous forest, they heavily utilised areas of low canopy cover for foraging, in which graminoid vegetation supported *Microtus* populations. These results suggest that Scottish marten display a niche divergence from mainland populations in which they have become dependent upon *Microtus* voles. Forests should be managed to ensure heterogeneity in canopy coverage that allows the persistence of *Microtus* populations. There is little evidence to suggest marten will utilize forest rodents even where present in high densities, which may have implications for the habitat management of the endangered Newfoundland marten, an insular marten which also demonstrates a considerable preference for *Microtus* voles.

MARTEN RESPONSE TO FRAGMENTATION DUE TO FOREST HARVESTING IN EASTERN BOREAL FORESTS OF CANADA

Cheveau, M.[1], L. Imbeau[1], P. Drapeau[2], and L. Bélanger[3]

[1]Center for Forest Research & Chair in Sustainable Forest Management, Department of Applied Sciences, University of Quebec in Abitibi-Temiscamingue, 445 University Boulevard, Rouyn-Noranda, Quebec J9X 5E4 Canada, marianne.cheveau@uqat.ca; [2]Department of Biological Sciences, University of Quebec in Montreal, P.O. Box 8888, Centre-ville Station, Montreal, Quebec H3C 3P8 Canada; [3]Faculty of Forestry and Geomatics, Abitibi-Price Building, Laval University, Quebec City, Quebec G1K 7P4 Canada.

The American marten is considered to be sensitive to human disturbances. Marten prefer forests with a complex structure and avoid recent clear-cuts and open areas. We investigated marten response to forest management in eastern boreal forests of Canada in agglomerated and dispersed cutting landscapes. According to site occupancy analyses based on 470 sites, martens used all residual forests along a gradient of habitat loss (0 to 78%), showing no local extinction even when clear-cut levels exceeded 70% within a 1-km radius around the trapping sites. Despite that marten was more tolerant than expected to habitat loss, abundance and body condition

(especially among males) were lower in highly fragmented landscapes. At a smaller scale, female home range size (n = 21) was the same in the 2 landscape types and was not influenced by the amount of clear-cuts. Resource selection functions revealed that the least-used habitats were recent clear-cuts and forested bogs and the most used was mixed-wood forests, which therefore appear to be critical habitats in these largely coniferous landscapes. Finally, at a finer scale, marten movements obtained by snow tracking were influenced by forest/clear-cut edges as martens moved in a more parallel direction to edge when they progressively approached the edge. This effect was recorded as far as 100 m from the edge. In agglomerated cutting landscapes, martens used small residual forest strips (60-100m wide) as movement corridors, but they were always under the influence of an edge creating a channelling effect. In conclusion, we suggest that marten populations in the eastern boreal forest of Canada seem to be more tolerant to forest fragmentation than in other regions. However, at the individual level we have shown that clear-cutting patterns affected local-scale movements and body condition, which could lead to a delayed negative response to cumulative effects of forest harvesting.

POPULATION ECOLOGY OF FISHERS IN NORTHCENTRAL BRITISH COLUMBIA

Corbould, F.B.[1], and R.D. Weir[2]

[1]Peace/Williston Fish and Wildlife Compensation Program, Suite 325, 1011 Fourth Avenue, Prince George, British Columbia V2L 3H9 Canada, Fraser.Corbould@gov.bc.ca; [2]Artemis Wildlife Consultants, 4515 Hullcar Road, Armstrong, British Columbia V0E 1B4 Canada.

Fisher (*Martes pennanti*) populations have been a management concern in British Columbia since the late 1980s. However, our understanding of the demographics of fisher populations in the province is limited and is based on data that may not reflect actual population dynamics in British Columbia. We examined survivorship and reproduction of free-ranging radio-tagged fishers in an industrial forest landscape within the Williston region of north-central British Columbia to provide better population information. We captured 21 fishers (6 M, 15 F) during 4 trapping seasons between November 1996 and March 2000 and determined the fates of 16 fishers. Nine fishers died while being monitored, with 7 deaths occurring in winter. We observed limited population growth (lambda = 1.02, SD = 0.32, n = 3), low recruitment ($\bar{x}$ = 0.58 juveniles per adult female, SD = 0.55, n = 4 years), moderate adult survival (0.71-0.88), little change in the late-winter density over the 4-year term (≤1.5 fishers/1,000 km^2), and several population-level behaviours (protracted transiency of young, quick assumption of open territories, no notable change to home range sizes, and no change in geographic areas used) that suggested our study population was stable and at or near its carrying capacity, albeit at exceptionally low densities (11.2 fishers/1,000 km^2). Fur harvesting at the time (9% of average annual fall population density) and fluctuating prey availability did not appear to notably affect the number of fishers present during the study. The low population density exhibited by fishers in the Williston region make them less resilient to stochastic and human-induced perturbations to their population and habitat. Options to reduce potential fur-harvesting impacts are suggested.

HEIRARCHICAL, MULTI-SCALE ANALYSES OF *MARTES* HABITAT RELATIONS

Cushman, S.A.[1], T.N. Wasserman[2], M.G. Raphael[3], L.F. Ruggiero[1], and A.J. Shirk[4]

[1]USDA Forest Service, Rocky Mountain Research Station, 800 East Beckwith, Missoula, Montana 59801 USA, scushman@fs.fed.us; [2]Huxley College of the Environment, Western Washington University, 516 High St., Bellingham, Washington 98225 USA; [3]USDA Forest Service, Pacific Northwest Research Station, 3625 93rd Ave. SW, Olympia, Washington 98512 USA; [4]University of Washington, Center for Science in the Earth System, 3737 Brooklyn Ave. NE, Seattle, Washington 98105 USA.

Ecological processes are often driven by the simultaneous action of multiple causal factors. These drivers may each act at unique scales in space and time. It is critically important to correctly match the scale of each driving variable to the response process. Mismatches in scale may lead to errors of inference and attribution. Incorrect scale of measurement of driving variables may result in failure to observe a relationship between pattern and process when one exists, the observation of spurious or distorted relationship, or error in evaluation of the significance or effects size of a pattern-process relationship. Wildlife habitat relations are particularly sensitive to the scale of analysis. Several studies have shown that incorrect choice of the scale of measurement for a variable frequently may lead to incorrect inference regarding a variable's relationship with a species. There appears to be particularly high scale dependency in the strength and nature of observed relationships between environmental variables and patterns of species occurrence. In a recent evaluation of multi-scale habitat selection by American martens, researchers found sensitive dependence of observed species-environment relationships on the extent and thematic resolution of environmental variables. Importantly, they observed dramatic differences in the scale at which different environmental variables were associated with marten occupancy, and frequent examples of cases where incorrect scale of analysis for an environmental variable would lead to error in judging the importance or the nature of a species-environment relationship. The goal of the analysis to be presented in this chapter would be to use several occurrence data sets for American marten to demonstrate the importance of multi-scale modeling of habitat relationships for this species, and provide guidance on concepts, terminology and methods for effective multi-scale habitat modeling for *Martes*.

FISHER (*MARTES PENNANTI*) REPRODUCTIVE DENNING ECOLOGY IN THE CHILCOTIN AREA OF BRITISH COLUMBIA

Davis, L.R.[1] and A.S. Harestad[2]

[1]Davis Environmental Ltd, 202 Fetters Drive, Williams Lake, British Columbia V2G 5G2 Canada, rldavis@shaw.ca; [2]Department of Biological Sciences, Simon Fraser University, Burnaby, British Columbia V5A 4T1 Canada.

Fourteen radio-tagged fisher (2005 – 2008) in the Chilcotin region of British Columbia used reproductive (natal and maternal) dens in cavities of 20 trees: lodgepole pine (n = 9, 39.0 cm dbh, SE = 1.7); trembling aspen (n = 7, 45.8 cm dbh, SE = 1.4), and Douglas-fir (n = 4, 68.4 cm

dbh, SE = 5.1). The pine and aspen den trees were smaller in diameter than those reported elsewhere in western North America. However, these den trees were larger diameter compared to non-den trees within the same forest patch and den tree plots had greater numbers of trees >27.5cm dbh compared to random plots in each fisher's home range. Fisher used live declining trees preferentially for natal dens, but also trees in more advanced stages of decay. Most den trees were in older stands on south aspects. All natal dens in aspen were in the toe position next to riparian zones where moisture likely produced larger aspen. Most conifer den trees were in mid and upper mesoslope positions, generally in open, older stands resulting from infrequent mixed severity fires. Mean age of trees at den sites were: lodgepole pine 177 years; Douglas-fir, 372 years; and trembling aspen, 96 years. Coniferous den trees were older than coniferous trees in random plots. Old, large diameter trees are critical habitat for fisher and should be avoided during forest harvesting. Management for fisher habitat should include: retaining stands with trees >30 cm dbh and evidence of heart rot to provide potential dens in upland areas and conserving riparian aspen and mixed aspen–conifer stands. Most fishers used >1 den/year and so providing a supply of suitable trees in a variety of landscape positions is required to sustain fisher in managed forests.

PHYLOGEOGRAPHY OF TWO MARTENS (*MARTES AMERICANA* AND *MARTES CAURINA*) IN NORTH AMERICA: TRACKING DIVERSIFICATION IN FOREST-ASSOCIATED MUSTELIDS

Dawson, N. and J.A. Cook

Biology Department, University of New Mexico, Albuquerque, New Mexico 87131 USA, natstracks@gmail.com.

Two species of marten (*Martes americana* and *Martes caurina*) were originally described for North America based on morphological analyses conducted by C. Hart Merriam in 1890. Sixty years later, researchers discovered introgression in western Montana, and concluded that these 2 species were conspecific. Subsequently, a single species (*M. americana*) has been recognized. Nonetheless, a primary dichotomy (*americana* and *caurina*) in North American marten has continued to be acknowledged, and a preliminary view of genetic differentiation suggested 2 discrete species. We review subsequent molecular studies and develop a more detailed view of genetic differentiation across the range of North American marten. We address the question of how many species of marten are extant in North America. Mitochondrial DNA studies identified 2 monophyletic groups within North American *Martes* that correspond to the 2 morphologically distinct species. Investigations using nuclear loci are consistent with species-level differences in North American *Martes*. Based on a series of studies, we confirm the presence of 2 species in North America, paralleling the original descriptions, although limited hybridization has been discovered. Phylogeographic analyses indicate independent histories of expansion following the deglaciation of northern North America. *Martes caurina* was limited to western North America predominantly along the west coast and in the south-central Rocky Mountains. The northern extent of this species is defined by 2 islands in southeast Alaska. *Martes caurina* is the only species of marten on Vancouver Island and Haida Gwaii. In contrast, *M. americana* ranges from eastern Canada westward to Idaho and into northern Canada and central and southeast Alaska.

Both species form a contact zone that extends from Montana into British Columbia, although the dynamics of this overlap are poorly understood.

WEST COAST FISHER CONSERVATION ASSESSMENT AND STRATEGY

Finley, L.L.[1] and R.H. Naney[2]

[1]U.S. Fish and Wildlife Service, Yreka, California 96097 USA, laura_finley@fws.gov; [2]USDA Forest Service, Pacific Northwest Region, Winthrop, Washington 98862 USA.

We developed a comprehensive Conservation Assessment and Strategy for the West Coast population of fishers, from southern British Columbia to the southern Sierra Nevada. An interagency approach, including 3 states, British Columbia, 4 federal agencies and the Hoopa Tribe, was chosen because of the differing responsibilities each organization has regarding land and species management. Three organizational levels were established: Steering Committee, Biology Team, and Science Team. The Conservation Assessment provides a comprehensive summary of fisher ecology and biology and summarizes all fisher habitat studies from the West (including eastern British Columbia, Idaho, and Montana). A modified Delphi approach was then used to identify and help rank threats to fishers and fisher habitat in each geographic area to better provide an effective targeted conservation strategy. The Conservation Strategy outlines a process to protect existing fisher populations and restore habitat and populations in the West Coast assessment area.

SPATIAL RESPONSES TO HABITAT LOSS IN TWO POPULATIONS OF FOREST MARTENS

Fuller, A.K.[1], D.J. Harrison[1], B.J. Hearn[2], and J.A. Hepinstall[3]

[1]University of Maine, Department of Wildlife Ecology, 5755 Nutting Hall, Orono, Maine 04469 USA, angela_fuller@umit.maine.edu; [2]Natural Resources Canada, Canadian Forest Service – Atlantic, P.O. Box 960, Corner Brook, Newfoundland A2H 6J3 Canada, [3]University of Georgia, Warnell School of Forestry and Natural Resources, Athens, Georgia 31705 USA.

We compared responses to habitat loss for 2 populations of forest martens that evolved in landscapes with vastly different composition and configuration of habitats in Maine, USA (*Martes americana*) and on the island of Newfoundland, Canada (*M. a. atrata*). Home range occupancy of martens in both Maine (n = 150) and Newfoundland (n = 84) declined in a non-linear fashion with habitat loss, but the shape and steepness of decline curves differed. Responses of both populations were inconsistent with predictions from classical threshold theory. Martens in Maine exhibited steeper declines in occupancy and responded to habitat loss at a finer grain than Newfoundland martens. We suggest that different responses to habitat loss between these populations of martens can be explained by differences in landscape composition and configuration, and from lower prey and community diversity within insular Newfoundland. We caution against the assumption that a particular response curve associated with habitat loss is

an inherent trait at the species level, and argue that responses to changes in extent of suitable habitat result from morphological and behavioral adaptations of martens to local conditions of habitat and ecological community. Further, our results indicate that organisms may exhibit different threshold responses to habitat loss and fragmentation that may be expressed at the level of the population. Finally, ongoing changes in habitat and ecological community in Maine and Newfoundland are profoundly altering broad-scale patterns of habitat occupancy within these populations.

PATHOGENS AND PARASITES OF THE GENUS *MARTES*

Gabriel, M.W.[1,2], G.M. Wengert[1,2], and R.N. Brown[2,3]

[1]Canid Diversity and Conservation Unit, Veterinary Genetics Laboratory, University of California, One Shields Avenue, Davis, California 95616 USA, mwgabriel@ucdavis.edu; [2]Integral Ecology Research Center, 102 Larson Heights Road, McKinleyville, California 95519 USA; [3]Humboldt State University, Wildlife Department, 1 Harpst Street, Arcata, California 95521 USA.

This presentation describes associations of pathogens and parasites with the genus *Martes*. However, little is directly known about the pathology caused by most of these agents in this genus. We briefly review the epidemiology and maintenance of selected pathogens thought to be most important to *Martes*, and report our ongoing disease-related research on ecology and population health. When appropriate, we discuss the potential fitness effects that selected pathogens and parasites might have on individuals or populations. Sampling protocols for the collection, transportation and storage of biological samples, including blood, other tissues, endoparasites and ectoparasites relevant to the determination of the health status of individuals and populations are described. We discuss potential implications of disease as well as management options related to prevention of pathogen spread, translocations and vaccinations. Lastly, we provide thoughts on potential directions for future disease-related research in *Martes*. The overall goal of this review is to inform wildlife biologists, wildlife veterinarians, and others concerned about the biology, management and conservation of species within the genus *Martes*.

RESOURCE SELECTION OF A RECOLONIZING FISHER POPULATION IN DECIDUOUS FORESTS OF SOUTHCENTRAL PENNSYLVANIA

Gess, S.G.[1], E.H. Ellington[1], J. Duchamp[1], M.J. Lovallo[2], and J.L. Larkin[1]

[1]Department of Biology, Indiana University of Pennsylvania, 126 Weyandt Hall, Indiana, Pennsylvania 15705 USA, S.W.Gess@iup.edu; [2]Bureau of Wildlife Management, Pennsylvania Game Commission, 2001 Elmerton Avenue, Harrisburg, Pennsylvania 17110 USA.

Limited information exists regarding fisher (*Martes pennanti*) resource selection in deciduous forests of the northeastern United States. We examined multiple scales of resource selection in a recolonizing fisher population in a landscape dominated by deciduous forest in southcentral

Pennsylvania. We captured and radio-collared 23 individual fisher (10M, 13F) from July 2006 through January 2007. We collected sufficient radio-telemetry locations (≥30 locations per individual) to create fall/winter (15 October - 15 March) and spring/summer (16 March - 31 July) home ranges for 7 and 6 female fishers, respectively. We quantified resource selection at home range and landscape scales using the Euclidean distance approach. At the landscape scale, fisher resource selection did not differ between the 2 seasons, and fisher radiolocations were closer to deciduous forest than random points ($P = 0.001$). At the home range scale, fisher habitat selection differed between fall/winter and spring/summer ($P = 0.03$). During fall/winter fisher radiolocations were closer to open habitat than random locations ($P = 0.03$). We also characterized 79 rest sites used by 15 fishers (4M 11F). Stand-level habitat data were collected at all 79 rest sites and compared with 80 random sites using multiple logistic regression (MLR). Fishers used a variety of structures as rest sites including live trees containing cavities or broken tops (69%), standing dead trees with broken tops or cavities (17%), and fossorial sites including burrows, rock piles, or root-balls (14%). Results from the MLR revealed at the stand-level, standard deviation of tree DBH ($P = 0.005$), diversity of tree structural classes ($P = 0.007$), and amount of course woody debris ($P = 0.03$) influenced fisher rest site selection. While all 3 of these are characteristic of mature stands, they can be managed for in areas where timber harvest and fisher conservation are desired. Our results support the assertion that structurally diverse deciduous forests are important for fisher conservation in Pennsylvania.

ECOLOGICAL COMPARISONS OF HOME-RANGE CHARACTERISTICS OF AMERICAN MARTENS IN NEWFOUNDLAND AND MAINE: WHY ARE HOME RANGES OF THREATENED NEWFOUNDLAND MARTENS SO LARGE?

Hearn, B.J.[1], and D.J. Harrison[2]

[1]Natural Resources Canada, Canadian Forest Service – Atlantic, P.O. Box 960, Corner Brook, Newfoundland A2H 6J3 Canada; [2]Department of Wildlife Ecology, The University of Maine, 5755 Nutting Hall, Orono, Maine 04469 USA, lynxdan@gmail.com.

The American marten (*Martes americana*) is a broadly distributed forest carnivore with highly variable spatial requirements. Previous work has suggested that the genetically distinct and threatened population of martens endemic to the island of Newfoundland, Canada (*M. a. atrata*) is larger bodied and may have greater spatial requirements than adjacent mainland populations of martens in eastern North America. We evaluated the hypothesis that martens in Newfoundland occupy disproportionately larger home ranges than predicted from allometry and that those differences may be explained by uniquely different prey abundances and landscape configuration in Newfoundland. We documented and compared body mass and home-range characteristics for a radiocollared sample of 92 resident, adult (>1 year of age) Newfoundland martens and for 226 martens from Maine, USA and compared the sex-specific relationship between home range and body weight among larger bodied Newfoundland martens and smaller bodied martens from Maine. We also compared availability of environmental resources among these 2 marten populations using 2 indices of small mammal prey abundance and 2 site-specific measures of habitat patchiness. Median annual home-range areas of adult resident martens in Newfoundland averaged 27.6 km^2 for males and 10.6 km^2 for females, and were disproportionately larger than

median home-range areas reported for martens in Maine (males = 3.3 km^2; females = 2.4 km^2). Home range area (HR) of martens from Maine scaled approximately linearly (slope = 0.914) with body weight (BW) as $HR = 0.73BW^{0.914}$. By comparison, the home range–body mass relationship for martens in Newfoundland was nonlinear (slope = 1.545; $HR = 0.04BW^{1.545}$). Home-range areas of martens in Maine and Newfoundland were approximately 2.5 times, and 8-12 times larger, respectively, than predicted for terrestrial carnivores. Indices of small mammal prey abundance were 3-5 times higher in Maine relative to Newfoundland and home range areas in Newfoundland were more fragmented. Our results suggest that relationships between spatial requirements and body mass may vary at the level of the population, and that the threatened population of martens in Newfoundland may occur at relatively lower densities because of the unique combination of community-level and landscape characteristics where they evolved. Finally, recent human alterations to the prey community in Newfoundland could compromise the future integrity of the island's uniquely adapted and threatened population of martens.

DEMOGRAPHIC RATES OF FISHERS *(MARTES PENNANTI)* IN THE MANAGED FORESTS OF THE HOOPA VALLEY RESERVATION, CALIFORNIA

Higley, J.M.[1], S.M. Matthews[2], and P.C. Carlson[3]

[1]Hoopa Tribal Forestry, P.O. Box 368, Hoopa, California 95546 USA, mhigley@hoopa-nsn.gov; [2]Wildlife Conservation Society, P.O. Box 368, Hoopa, California 95546 USA; [3]Colorado Cooperative Fish and Wildlife Research Unit, Colorado State University, 1484 Campus Delivery, Fort Collins, Colorado 80523 USA.

We analyzed fisher (*Martes pennanti*) demographic data using both known-fate and mark-recapture techniques to assess the feasibility of establishing a long term demographic monitoring program using mark-recapture methods. The distinct population segment of fisher in the Pacific states is listed as a candidate for federal and California state endangered species protection. The fisher is also culturally significant to the Hupa people and has a relatively large population on the Hoopa Valley Indian Reservation, California. The Hoopa Tribe's economy is almost entirely timber based. Cutting of old growth forest using regeneration silvicultural practices has occurred since the mid 1950's and continues today. The heterogeneous landscape created through this management provides an opportunity to investigate habitat fitness potential within the study area by modeling demographic data with individual habitat covariates. The focus of this study was to determine the feasibility of using mark-recapture techniques to monitor demographic rates of fishers and to compare the results with those obtained from known-fate modeling. Fifty-four fishers (11 male, 43 female) were radio collared between 2004 and 2009; 52 were included in the known fate analysis. The top known-fate survival model indicated that fisher survival varied by year (0.547 - 0.961). Mean annual survival calculated from the known-fate method was 0.775 (95% CI 0.672-0.853). The mark-recapture estimate of mean annual apparent survival was 0.722 (95% CI 0.627-0.801). The most appropriate comparison between the 2 techniques was the comparison of mean annual female survival (known-fate) of 0.754 (95% CI 0.635-0.843) to female mean annual apparent survival (mark-recapture) 0.764 (95% CI 0.627-0.862). From the mark-recapture data we estimated lambda as 1.03 (95% CI 0.93-1.14). Given the similar

estimates from the 2 methods, using mark-recapture methods for monitoring the relatively dense fisher population at Hoopa shows great promise.

EXPLORING COMPLEX HOST-PARASITE SYSTEMS IN *MARTES*: HISTORICAL BIOGEOGRAPHY AND COEVOLUTIONARY PROCESSES

Hoberg, E.P.[1], A.V.A. Koehler[2,3], and J.A. Cook[2]

[1]U.S. National Parasite Collection, Animal Parasitic Disease Laboratory, USDA, ARS, BARC East 1180, 10300 Baltimore Avenue, Beltsville, Maryland 20705 USA, eric.hoberg@ars.usda.gov; [2]Department of Biology and Museum of Southwestern Biology, University of New Mexico, Albuquerque, New Mexico 87131 USA; [3]Department of Zoology, University of Otago, P.O. Box 56, Dunedin 9054 New Zealand.

Complex assemblages of hosts and parasites reveal insights about biogeography and ecology, and can inform us about processes which serve to structure faunal diversity on varying temporal and spatial scales. A discussion of coevolution (association of lineages by descent) will serve as a brief preamble for addressing specific aspects of the parasite faunas associated with *Martes* spp. and other mustelids across the Holarctic and specifically within Beringia and the Nearctic. We will briefly outline what is coevolution and how this phenomenon has contributed to explanations about biodiversity in complex host-parasite associations. We will further examine the historical interplay of coevolutionary and ecological phenomena that structure assemblages of parasites across evolutionary and ecological time. Conceptually, this addresses the growing understanding of the importance of historical ecological and biogeographical drivers for the origin and maintenance of diversity. Our discussion will emphasize some tapeworms (*Taenia* spp.) and nematodes (*Soboliphyme baturini* and *Trichinella* spp.). This parasite fauna in martens will be assessed in the context of a more general understanding of historical biogeography which is emerging for the northern fauna. Of particular importance here are issues related to episodic climate variation, biotic expansion, geographic colonization, and host-switching as factors which determine the distribution of parasites. Further, we will address the following generalities: (1) Why are parasites important? (2) How do coevolutionary, ecological and biogeographic processes interact and serve as determinants of the structure of complex host-parasite faunas in space and time? (3) What signals do parasites reveal which contribute to elucidation of host history, ecology and biogeography? (4) Why are these issues of importance in conservation biology, and in a regime of accelerating climate change? (5) Why should mammalogists and parasitologists collaborate in building a comprehensive framework to understand the biosphere? We suggest and identify pathways in which mammalogists and parasitologists might develop and benefit from such synergy in research programs.

EVOLUTIONARY HISTORY AND BIOGEOGRAPHY OF THE GENUS *MARTES* REVISITED

Hughes, S.S.

P.O. Box 11284, Bainbridge Island, Washington 98110 USA, susansh54@msn.com.

Since Anderson reviewed *Martes* evolution, biogeography, and systematics for the 1st International *Martes* Symposium in 1991, much new information has come to light. Today, biomolecular data and new research on *Martes* behavior and physiology have contributed greatly to understanding the evolutionary history of the genus. A more nuanced understanding of climate change and biogeographic barriers also offers mechanisms to interpret evolutionary trends. Picking up where Anderson left off, I present a synthesis of *Martes* evolution, adaptation, and biogeography drawing on 3 lines of evidence: the fossil record, DNA evidence, and expanded understanding of *Martes* adaptations. I also review the role of climate change in *Martes* evolutionary history. Biomolecular research suggests that *Martes* diversification is a function of a number of radiations beginning in the Miocene linked with climate change. The evolutionary history of *Martes* is reviewed here chronologically from the Miocene, focusing on these radiations, possible climatic and biogeographic causes, and *Martes* adaptations. The DNA results broadly correspond to the fossil record. General evolutionary trends include: (1) the genus *Martes* evolved in Eurasia in the Miocene and colonized North America in 2 radiations, dated at 1.8 and 1.0 ma (*Gulo gul*o represents a third colonization), (2) diversification is strongly influenced by glacial events in the Pliocene and Pleistocene creating barriers to gene flow, and (3) members of the genus have evolved adaptations to different environments including open habitats. While new research has refined our knowledge of the evolutionary history of the genus, gaps remain. Recent study has focused on the subgenuses, *Pekania* and *Martes,* while *Charonnia* has received little attention. Also, relationships between subspecies remain unstudied in most regions. Since many subspecies are endangered, this information may soon be lost. A relatively complete fossil record is necessary to support the interpretation of DNA data, especially for time estimates of dispersal and climatic events. Unfortunately the *Martes* fossil record is incomplete and needs revision. Because new fossil finds are slow in coming, it may be time for the revision that Anderson recommended in 1991.

HARVEST DYNAMICS OF AMERICAN MARTENS AND FISHERS RELATIVE TO FOREST-TREE SEED CROPS AND PREY ABUNDANCE

Jensen, P.G.[1,2], C. Demers[3], S. McNulty[3], W. Jakubas[4], and M.M. Humphries[1]

[1]Department of Natural Resource Sciences, McGill University, Ste.-Anne-de-Bellevue, Québec H9X 3V9 Canada; [2]New York State Department of Environmental Conservation, Division of Fish, Wildlife and Marine Resources, Warrensburg, New York 12885 USA, pgjensen@gw.dec.state.ny.us; [3]Adirondack Ecological Center, State University of New York, College of Environmental Science and Forestry, Newcomb, New York 12852, USA; [4]Maine Department of Inland Fisheries and Wildlife, Bangor, Maine 04401 USA.

Many forest tree species produce seed crops that are consumed by a variety of wildlife species and these pulsed resources may mediate interactions among predator and prey populations. We examined trends in small mammal abundance in relation to tree seed crops in the transitional boreal-deciduous forest of northern New York. Furthermore, we described variation in American marten (*Martes americana*) and fisher (*Martes pennanti*) harvest rates (1988-2008) and differences in the sex/age structure of harvested martens relative to American beech (*Fagus grandifolia*) mast production and small mammal abundance. Beech mast production was cyclical from 1993-2008 (first order autocorrelation = –0.59); mast failures occurred during odd years and mast crops were produced during even years. Additionally, a significant autocorrelation at a 4-year lag was evident (0.65). Small mammals responded synchronously to these mast cycles. Short-tailed shrew (*Blarina brevicauda*), southern red-backed vole (*Myodes gapperi*), *Peromyscus* spp., and red squirrel (*Tamiasciurus hudsonicus*) abundance during the summer was correlated positively with seed production from the previous autumn and winter. Harvest rates were positively related to small mammal abundance and inversely related to beech mast production. Mast production accounted for 87% ($P < 0.0001$) and 41% ($P < 0.01$) of the annual variation in marten and fisher harvest rates, respectively. The highest marten harvest rates (mean = 2.15 marten/marten trapper; $SE = 0.12$) were associated with mast failures that followed summers with high prey abundance; harvest rates decreased dramatically (mean = 0.33; $SE = 0.04$) during the largest beech masting events. The age structure of harvested martens ($n = 933$) differed between these combinations of prey and mast ($P < 0.05$) and cohort effects were apparent. A better understanding of how environmental variability influences demographic responses and trapping vulnerability of martens and fishers would improve our ability to manage harvests of these species on a sustainable basis.

STUDY DESIGN CONSIDERATIONS FOR ESTIMATING ABUNDANCE AND SURVIVAL OF FISHERS BY MEANS OF CAMERA TRAPS

Jordan, M.J.[1], R.H. Barrett[2], and K.L. Purcell[3]

[1]Division of Sciences and Outdoor Leadership, Green Mountain College, One Brennan Circle, Poultney, Vermont 05764 USA, jordanm@greenmtn.edu; [2]Department of Environmental Science, Policy, and Management, University of California, Berkeley, 137 Mulford Hall, #3114, Berkeley, California 94720 USA; [3]USDA Forest Service, Pacific Southwest Research Station, 2081 E. Sierra Avenue, Fresno, California 93710 USA.

Developing efficient monitoring strategies for species of conservation concern is critical to ensuring their persistence. We have developed a method using camera traps to estimate abundance and survival in mesocarnivores and tested it on a population of fishers (*Martes pennanti*) in an approximately 300 km^2 area of the southern Sierra Nevada mountains in California. This species' conservation status in this region is poorly understood, making management decisions difficult. We live-trapped and ear-tagged fishers, and resighted them with camera traps to estimate density and survival from 2000 to 2004 (although abundance was only estimated from 2002 to 2004). We also measured latency to first detection (LTD), probability of detection (POD), and detection rate (DR) to compare our results to previous camera trapping studies of fishers. To explore a variety of study design considerations, we also conducted

simulations of both the abundance and survival estimation processes. Our comparison metrics (LTD, POD, and DR) were similar to those obtained by previous studies. We determined that fishers in this region occur at low densities (~10 animals/100 km^2), while their annual adult survival rates (0.88) were comparable to those found in other studies. However there were wide confidence intervals around both of these estimates. Our simulation results combined with data from the field suggested that increasing the probability of marking individual animals and extending the duration of the study would be the most feasible means for increasing the precision of both of these estimates. These results demonstrate a method for obtaining estimates of density and survival for mesocarnivores, and although imprecise, they still provide timely information to managers about fishers at the local population level in the southern Sierra Nevada mountains.

DEVELOPING AND TESTING A LANDSCAPE HABITAT SUITABILITY MODEL FOR THE AMERICAN MARTEN (*MARTES AMERICANA*) IN THE CASCADE MOUNTAINS OF CALIFORNIA, U.S.A.

Kirk, T.A.[1] and W.J. Zielinski[2]

[1]USDA Forest Service, Lassen National Forest, 2550 Riverside Drive, Susanville, California 96130 USA, tkirk@fs.fed.us; [2]USDA Forest Service, Pacific Southwest Research Station, 1700 Bayview Drive, Arcata, California 95521 USA.

Field surveys and Geographic Information System (GIS) data were used to identify landscape-scale habitat associations of American martens (*Martes americana*) and to develop a model to predict their occurrence in northeastern California. Systematic surveys using primarily enclosed track plates were conducted by USDA Forest Service personnel across a 27,700 km^2 area of largely forested, mountain terrain. Martens were detected at 20/184 (10.8%) of the sample units, aggregated in 3 distinct regions. We investigated habitat selection at multiple scales using circular assessment areas of 3, 20, and 80 km^2. Predictor variables included elevation, stream density, land ownership, road density, nearby marten detections, and landscape metrics of forest vegetation. An information-theoretic method was used to rank 89 *a priori* candidate models. Multivariate models were constructed using combinations of environmental variables hypothesized to be important to marten ecology and management. The model for the largest assessment area best fit the data and included the following predictors: amount of reproductive habitat, number of habitat patches, and land ownership category. These results support the hypothesis that martens select habitat based upon broad-scale landscape conditions and that these conditions vary with ownership. We tested the model using an independent set of data, collected primarily during the winter. Poor fit of the test data in some locations raised concerns that our model, which was developed using data collected during the snow-free season, may not predict winter distribution well. We are investigating possible causes for the seasonal variation in occurrence and until they can be incorporated our model represents a conservative view of marten habitat suitability based on summer occupancy. During the summer months, which is the reproductive season, martens are predicted to occur largely in relatively undisturbed landscapes where high-elevation, late-successional forests are common.

EVOLUTIONARY RELATIONSHIPS OF THE GENUS *MARTES* BASED ON A MULTIGENIC DATA SET

Koepfli, K.-P.

Department of Ecology and Evolutionary Biology, University of California, Los Angeles, California 90095 USA; klausk@lifesci.ucla.edu.

Our understanding of the phylogenetic position of the genus *Martes* within the Mustelidae and of the relationships among the extant species that comprise *Martes* have been greatly improved through the analysis of DNA sequence data. During the last decade, studies initially based on 1 or a few mitochondrial loci have evolved into data sets comprised of multiple gene segments from both the mitochondrial and nuclear genomes. I will discuss a number of issues related to the evolutionary relationships of *Martes* based on a molecular supermatrix of nearly 12kb of mitochondrial and nuclear DNA sequences. First, *Eira*, *Gulo* and *Martes* form a well-supported clade (Martinae) that is placed deep within Mustelidae and sister to a clade that contains otters, weasels and their allies. Second, *Martes* appears to be paraphyletic with respect to *Gulo*: the wolverine is consistently placed as sister to all species of *Martes* (subgenera *Charronia* and *Martes*) expect *M. pennanti* (subgenus *Pekania*). The fisher, together with the tayra (*Eira barbara*), either comprise a clade or form successive lineages sister to a clade containing the wolverine and the remaining species of *Martes*, but these alternatives (and perhaps others) are difficult to resolve given the current data set. Third, the yellow-throated marten (*M. flavigula*, subgenus *Charronia*) is sister to the true martens (subgenus *Martes*). Fourth, among the true martens, *M. foina* is sister to a clade comprised of *M. americana*, *M. martes*, *M. melampus* and *M. zibellina*, and for the latter species, *M. martes* and *M. zibellina* are joined as sister species, while the positions of *M. americana* and *M. melampus* remain unresolved. The weak statistical support for several branches within the Martinae likely reflects rapid and/or recent speciation events, and suggests that newly developed approaches based on the multispecies coalescent for estimating species trees may be required to resolve these outstanding phylogenetic issues. I will also discuss the tempo of diversification of the Martinae based on results of molecular dating analyses of the molecular supermatrix. Relaxed molecular-clock analyses suggests that the Martinae originated sometime during the Middle to Late Miocene, 9.2–12.9 Mya. The divergence of *Eira*, *M. pennanti*, and *Gulo* may have occurred during the Late Miocene/Early Pliocene, while the true martens diversified during the Pleistocene (<1.8 Mya). Finally, I will discuss how well these divergence time estimates correspond with the fossil record of the Martinae and suggest ways of combining these different types of data to yield a more robust estimate of the evolutionary history of the group.

DISTRIBUTIONAL DYNAMICS OF *MARTES* IN EASTERN NORTH AMERICA: SPACIOTEMPORAL ANALYSES OF HISTORICAL PATTERNS, 1699-2001

Krohn, W.B.

U.S. Geological Survey, Maine Cooperative Fish and Wildlife Research Unit, 240 Nutting Hall, University of Maine, Orono, Maine 04469 USA, wkrohn@umenfa.maine.edu.

Changes in the distributions of American martens (*Martes americana*) and fishers (*M. pennanti*) in eastern North America between colonial times until the fisher's recent (1930-present) expansion are well documented, but causative factors underlying these range declines have only been superficially studied. Traditional explanations for the long-term historic range contractions of these 2 species are forest clearing and unregulated hunting/trapping, with essentially no consideration given to alternative explanations. It has been hypothesized that at the geographic-scale deep snow limits the northern distribution of fishers, and that high fisher populations limit the southern distribution of martens. Because deeper snows occurred further south approximately 200 years before the end of the Little Ice Age than today, 5 explicit predictions based on these hypotheses could be made about the historical distributions of these 2 *Martes* species. Using published data on the distribution of fishers and martens in eastern North America, including early and contemporary fur harvest records (n = 11,608), changes in the long-term distributional dynamics of *Martes* in eastern North America were found to be consistent with the predictions. Retrospective analyses, however, are inadequate to partition out the relative importance of land clearing, unregulated harvests, and climate change. Nevertheless, 300 years of broad-scale changes in the distributions of fishers and martens in eastern North American south of the St. Lawrence River, when viewed in the context of long-term climate warming and the results from related studies, suggest that traditional explanations of the geographical declines of *Martes* are only partial explanations. At a minimum, past climate warming should be considered as a factor contributing to the historical range contractions of both fishers and martens. These results further suggest that continued climate warming will result in an expansion of fishers northward, and a retreat in American marten populations along the southern edge of their current geographical range.

MARTENS AND FISHERS IN A CHANGING CLIMATE

Lawler, J.J.[1], H.D. Safford[2,3], and E.H. Girvetz[1]

[1]School of Forest Resources, University of Washington, Box 352100, Seattle, Washington 98195 USA, jlawler@u.washington.edu; [2]USDA Forest Service, Pacific Southwest Region, 1323 Cub Drive, Vallejo, California 94592 USA; [3]Department of Environmental Science and Policy, University of California, Davis, California 95616 USA.

Average global temperatures are projected to rise between 1.1 and 6.4 °C by the end of the century. Coupled with changes in precipitation and increasing atmospheric carbon dioxide, these increases in temperature will alter species distributions and phenology with cascading effects on ecological communities and ecosystem functions. Here, we investigate how projected changes in climate will likely affect 4 species of the genus *Martes*—the American marten (*M. americana*), fisher (*M. pennanti*), European pine marten (*M. martes*), and the beech marten (*M. foina*). We begin with an overview of the factors that determine the inherent sensitivity (or resilience) of the species to climate change. We then go on to review projected climatic changes across the geographic ranges of the species and project shifts in their distributions under different climate-change scenarios. To provide insights at a finer spatial scale, we describe analyses that have explored the potential effects of climate-driven changes in habitat on the American marten and

the fisher. We conclude by highlighting the key areas in which additional research is needed and provide recommendations for developing climate-adaptation strategies for the species.

REINTRODUCING FISHERS (*MARTES PENNANTI*) TO OLYMPIC NATIONAL PARK: PROGRESS FOR YEARS 1 AND 2

Lewis, J.C.[1], P.J. Happe[2], K.J. Jenkins[3], and D. Manson[2]

[1]Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, Washington 98501 USA, lewisjcl@dfw.wa.gov; [2]Olympic National Park, 600 E. Park Ave., Port Angeles, Washington 98362 USA; [3]U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, Olympic Field Station, 600 E. Park Ave., Port Angeles, Washington 98362 USA.

A 3-year reintroduction project was initiated in 2007 to release 100 fishers (*Martes pennanti*) from British Columbia to Olympic National Park. The fisher had been extirpated in Washington as the result of historical over-trapping and loss of suitable habitat. Eighteen fishers were released in January and March of 2008 (year 1), and 31 were released in December 2008, and January and February of 2009 (year 2). Fishers were released at 6 areas: Elwha Valley, Hurricane Ridge, Sol Duc Valley, Hoh Valley, Queets Valley, and Staircase. Each fisher was equipped with a radio-transmitter and relocated via aerial and ground telemetry. Measures of fisher movements, survival, home range establishment and reproduction were used to evaluate reintroduction success and guide future releases. Preliminary results indicate that fishers made extensive movements after being released, however, the movements of many individuals localized shortly after the breeding season (i.e., May). Fishers crossed rivers, and traversed rugged, unforested terrain, and managed and unmanaged forest landscapes. Four of the 18 fishers released in year 1 died (3F, 1M), and 8 (6F, 2M) of the 31 released in year 2 died. Preliminary monitoring efforts revealed no successful reproduction in year 1, however, we have located 2 den sites so far in year 2. Survival is higher than we expected. We also report on the timing, prevalence, and location of home range establishment. We will release 45 additional fishers in year 3, which is expected to increase successful reproduction and the likelihood of establishing a self-sustaining population.

NONINVASIVE METHODS FOR SURVEYING AND MONITORING MARTENS, FISHERS, AND SABLES

Long, R.A., and P. MacKay

Road Ecology Program, Western Transportation Institute, Montana State University, 222 East 4th Avenue, Suite 104, Ellensburg, Washington 98926 USA, robert.long@coe.montana.edu.

The study of secretive, low-density, and wide-ranging carnivores is inherently challenging. Although tracking and scat surveys have long been used by carnivore researchers, these noninvasive methods have been limited in their ability to provide data useful for estimating population parameters, or for assessing genetic aspects of populations. Over the last decade, however, advances in both remote camera technology and DNA laboratory techniques have opened the door for researchers to collect valuable information about occupancy, population size, relatedness, genetic structuring, hybridization, recolonization, and behavior with increased resolution and efficiency. Such advances have, in turn, provided the impetus to further develop methods for collecting DNA and photographic data, and for analyzing these data. We provide an overview and review of the methods currently available for the noninvasive study and monitoring of martens, fishers, and sables. In addition to summarizing the major classes of noninvasive methods (i.e., track and scat surveys, remote photography and videography, hair collection, scat detection dogs), we discuss techniques for attracting animals to survey stations as well as the general types of objectives that can be met with noninvasive surveys. Finally, we touch upon challenges and nuances pertinent to noninvasive *Martes* surveys, including heterogeneity in detection rates, study design issues, and method selection based on overall objectives and target species.

A REVIEW OF *MARTES* CONSERVATION STRATEGIES IN BIOREGIONAL ASSESSMENTS

Marcot, B.G.[1] and M.G. Raphael[2]

[1]USDA Forest Service, Pacific Northwest Research Station, 620 SW Main St., Suite 400, Portland Oregon 97205 USA, bmarcot@fs.fed.us; [2]USDA Forest Service, Pacific Northwest Research Station, 3625 93rd Avenue S.W., Olympia Washington 98502 USA.

We provide a synthesis and review of *Martes* conservation strategies and guidelines from bioregional assessments throughout the U.S. and other countries. The purpose is to recount how *Martes* conservation is addressed at broad landscape and regional scales, including specification of habitat conditions and patterns (including forest structural and age classes, forest patch sizes, connectivity, and provision of key habitat elements such as large hollow logs for denning) and integration with other regional-scale guidelines for ecosystem management (including management for disturbance regimes and general biodiversity). We summarize the intent, content, and efficacy, where known, of *Martes* bioregional conservation strategies. We note geographic areas and ecological contexts where such strategies are not available or have not been developed in the U.S. and elsewhere. For areas in which strategies have not been developed, we suggest topics that might be covered if strategies were to be developed for these areas, drawing upon our summary of existing strategies. We provide examples from the United States, including the Northwest Forest Plan, Sierra Nevada Framework, Interior Columbia Basin Ecosystem Management Project, and Tongass Land Management Plan.

REPRODUCTIVE RATES OF FISHERS *(MARTES PENNANTI)* IN THE MANAGED FORESTS OF THE HOOPA VALLEY RESERVATION, CALIFORNIA

Matthews, S.M.[1], J.M. Higley[2], R.E. Green[3], K.M. Rennie[2], and C.A. Goddard[2]

[1]Wildlife Conservation Society, P.O. Box 368, Hoopa, California 95546 USA, smatthews@wcs.org; [2]Hoopa Tribal Forestry, P.O. Box 368, Hoopa, California 95546 USA; [3] USDA Forest Service, Pacific Southwest Research Station, 2081 E Sierra Ave, Fresno, California 93710 USA.

A field-based estimate of reproductive output is an essential vital rate in determining population dynamics and developing conservation strategies. The distinct population segment of fisher (*Martes pennanti*) in the Pacific states is listed as a candidate for federal and California state endangered species protection. The fisher is also culturally significant to the Hupa people and occurs in relatively large numbers on the Hoopa Valley Indian Reservation, California. Female fishers were radio collared and located using triangulation and homing during the 2005-2008 den seasons. Denning behavior was observed on average between 23 March and 24 May. Twenty-seven breeding age (≥ 2 years old) females denned on 41 of 47 (87%) denning opportunities. Twelve (29%) of these denning attempts failed prior to kits being weaned. Three of the failures were the result of the denning female being predated. Thus, 29 of 47 (62%) denning opportunities were successful in weaning at least 1 kit. Female fishers which weaned at least 1 kit used a mean of 3.1 dens per den season (range 2-6 dens). Successive dens were located an average of 426 m apart (SD=315 m). Twenty-one male and 22 female kits comprised the 29 successful litters. Denning rates and litter sizes for 2 year-old females were 67% and 1.3, 3-5 year-olds were 89% and 1.5, and ≥6 year-olds were 100% and 1.1. The failure rate of 2 year-olds was 33%, 3-5 year-olds was 32.0%, and ≥6 year-olds was 20.0%. These estimates of reproductive output will inform future population modeling, monitoring and conservation efforts on the Reservation and across the range.

SURVIVAL OF ADULT AMERICAN MARTENS IN NORTHERN WISCONSIN

McCann, N.P.[1], P.A. Zollner[1], and J.H. Gilbert[2]

[1]Department of Forestry and Natural Resources, Purdue University, West Lafayette, Indiana 47907 USA, nmccann@purdue.edu; [2]Great Lakes Indian Fish and Wildlife Commission, P.O. Box 9, Odanah, Wisconsin 54806 USA.

In Wisconsin, USA, American martens (*Martes americana*) remain rare >30 years following initial reintroductions and low survival has been hypothesized as a cause of low or negative population growth. We monitored adult marten survival in northern Wisconsin between 1993 and 2007. We then estimated annual and seasonal adult marten survival and the influence of fisher- (*Martes pennanti*) and raptor-caused mortality on adult marten survival using a Kaplan-Meier estimator. Annual adult survival (0.79) was similar to studies where martens are more numerous, suggesting low adult survival fails to explain why marten populations have not increased in Wisconsin. Winter survival (0.87) was lower than summer/fall survival (0.98).

Winter survival was most sensitive to fisher-caused mortality, which may have been a consequence of interference competition. Fishers and martens have similar diets and greater numbers of fisher-caused mortalities during winter may be due to increased interaction while hunting increasingly rare prey. Raptors influenced adult survival most during kit-rearing. Raptor-caused mortalities may be more numerous during the kit-rearing period due to increased raptor territoriality while nesting. The marten kit-rearing period overlaps great horned owl (*Bubo virginianus*) and barred owl (*Strix varia*) nesting. Relative to other studies, we captured small numbers of juveniles, suggesting a need for studies focusing on reproduction and juvenile survival. Results from this study and other studies will be used to parameterize simulations of marten dispersal in Wisconsin. Simulations will be conducted using a spatially explicit population model entitled SEARCH. Within SEARCH, virtual animals disperse across dynamic vector-based maps with points representing animals' response to habitat characteristics. We will use SEARCH simulations to measure effects of potential forest management on marten distributions over multiple years to evaluate scenarios encompassing the range of survival values observed in this study.

RESPONSES OF EUROPEAN PINE MARTEN POPULATIONS TO HABITAT FRAGMENTATION

Mergey, M.[1], E. Petit[2], J.-J. Roeder[3], and R. Helder[1]

[1]2C2A-CERFE, 5 rue de la héronnière, 08240 Boult-aux-Bois, France, marina.mergey@cerfe.com; [2]INRA/Agrocampus Rennes/Univ. Rennes 1, UMR1099 BiO3P, Domaine de la Motte, F-35653 Le Rheu and CNRS France; [3]Institut Pluridisciplinaire Hubert Curien (UMR 7178), Département Ecologie Physiologie et Ethologie, 23 rue Becquerel, F-67087 Strasbourg Cedex 2 France.

Habitat fragmentation is 1 of the main causes of biodiversity loss. By disrupting population functioning, this process can have serious effects especially on habitat specialists. We studied the response of populations of the European pine marten (*Martes martes*), a forest specialist, to forest landscape fragmentation. Radiotracking individuals in northeastern France, we compared space-use patterns in continuous and fragmented forests and then analysed habitat-selection patterns of pine martens in hedged farmlands. We concluded that pine martens are present in highly fragmented forests, but their movements are reduced and home ranges smaller, than in continuous forests. The results of habitat-selection analysis showed that this pattern results from martens confining their movements to forest patches. We also searched for a genetic effect of habitat fragmentation on pine marten populations by comparing the genetic variability of 3 populations sampled in sites with different levels of fragmentation. We contrasted this result with the variability of other European pine marten populations and populations of other mustelid species. Finally, we analysed the influence of forest structure on gene flow in these populations. Additional sampling will increase our statistical power, but early results suggest that forest structure affects the pattern of dispersal, perhaps as a function of sex.

AMERICAN MARTEN DISTRIBUTIONS OVER A 30-YEAR PERIOD: THE EFFECT OF LANDSCAPE CHANGE WITHIN SAGEHEN CREEK EXPERIMENTAL FOREST, CALIFORNIA, USA

Moriarty, K.M.[1], W.J. Zielinski[2], and E.D. Forsman[3]

[1]Department of Fisheries and Wildlife, Oregon State University, 104 Nash Hall, Corvallis, Oregon 97331 USA, ktmoriarty22@gmail.com; [2]USDA Forest Service, Pacific Southwest Research Station, 1700 Bayview Drive, Arcata, California 95521 USA; [3]USDA Forest Service, Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, Oregon 97331 USA.

The distribution of American martens (*Martes americana*) within Sagehen Creek Experimental Forest (SCEF) and vicinity has been documented periodically from 1979 to 1993. Sagehen Creek Experimental Forest has been the location of 9 marten studies, each involving a systematic (detection/nondetection) survey on the same grid. These data are an unprecedented time series of information on the distribution of martens that can be related to habitat changes in the study area. Our objectives included (1) resurveying SCEF using similar methodolgy to assess current distributions, (2) evaluating marten distributions over the last 30 years, (3) creating maps to depict predicted high-reproductive habitat at 2 time steps (1978, 2007), and lastly, (4) correlating marten occurance in relation to spatio-temporal habitat metrics. Marten surveys were conducted in the summer of 2007 using enclosed track plate stations (n = 104) and the winter of 2008 with alternating remote-sensor cameras and snow-tracking bait stations (n = 94). Although there was a dramatic decline in marten occurance since they were first studied in this area, there appears to be a residual and isolated population. Habitat was characterized both in 1978 and 2007 by interpreting remotely sensed vegetation information according to the California Wildlife Habitat Relationships system. Using FRAGSTATs, landscape and patch metrics were quantified for the 2 time steps. There has been a decrease in predicted habitat, patch size, and core area, and an increase in distance between the patches. Possible explanations for the change in habitat abundance and configuration over the 30-year period were evaluated in relation to marten distributions.

CURRENT RANGE AND DISTRIBUTION OF PINE MARTENS IN IRELAND: CONSERVATION SUCCESS OR FAILURE?

O'Mahony, D.

Ecological Management Group, Ormeau Business Park, 8 Cromac Avenue, Belfast BT7 2JA Northern Ireland, declan.omahony@ecomgt.com.

Pine marten (*Martes martes*) are considered a rare and elusive mammal in Ireland. The population has suffered from the historical destruction of native forests and persecution as a fur-bearer and pest of livestock and game. Due to concerns over its population status, it became a protected species in the late 20th century. Since then there has been little research into pine marten distribution, range, conservation status or general ecology. The National Pine Marten Survey of Ireland was initiated in 2005 to address these knowledge gaps and conducted the first

large-scale distribution survey of pine marten across the island of Ireland (including Republic of Ireland and Northern Ireland). The principal objectives were to determine the current distribution and range of pine marten, assess any change using historical datasets, and investigate factors that are influencing the population in Ireland. An occupancy survey technique was used in 258 10-km national grid squares. Three 1.5-km transects were delineated within forested or scrub habitat in each 10-km square and surveyed during June to September 2005-07. Pine marten detections were recorded only from direct sightings or from scats that were collected and subject to DNA testing using micro-satellite analysis to confirm species identity. During the survey, over 760 transects were surveyed, total transect distance completed was >1,200 km, and over 500 hundred scats were collected. Pine marten were detected in 59% of 10-km squares surveyed across the island of Ireland. Core population range was estimated to occupy nearly half of the land area. A significant range expansion of pine marten has occurred in Ireland over the last 30 years due to several factors including large-scale afforestation policy, legal protection, and deliberate re-introduction events. The population, however, still exists at low density and is vulnerable to land management practices.

MAXIMIZING SUCCESS OF *MARTES* REINTRODUCTIONS: MODELS, DATA, AND A NEW HYPOTHESIS FOR MATING PATTERNS

Powell, R.A.[1], J.C. Lewis[2], B. Slough[3], S.M. Brainerd[4,5], N. Jordan[6], A. Abramov[7], V. Monakhov[8], P. Zollner[9], and T. Murakami[10]

[1]Department of Biology, North Carolina State University, Raleigh, North Carolina 27695 USA, rpowell@ncsu.edu; [2]Washington Department of Fish and Wildlife, Olympia, Washington 98501 USA; [3]35 Cronkhite Road, Whitehorse, Yukon Territory Y1A 5S9 Canada; [4]Alaska Department of Fish and Game, 1300 College Road, Fairbanks, Alaska 99701 USA; [5]Norwegian Institute for Nature Research, Tungasletta 2, Trondheim, NO-7485 Norway; [6]Vincent Wildlife Trust, Waterside, Lowick Bridge, Ulverston, Cumbria, LA12 8EF United Kingdom; [7]Laboratory of Mammalogy, Zoological Institute, Russian Academy of Sciences, Universitetskaya nab., 1, Saint-Petersburg, 199034 Russia; [8]Institute of Plant and Animal Ecology of RAS, 202 8th Marta str., Ekaterinburg 620144 Russia; [9]Department of Forestry and Natural Resources, Purdue University, West Lafayette, Indiana 47907 USA; [10]Shiretoko Museum, Hokkaido 0994113 Japan.

Historically, over-trapping for fur, loss and fragmentation of forest habitats, and predator control caused decreases and local extirpations of *Martes* populations. Protection allowed population recovery in some places but not everywhere. Because these predators are important components of ecological communities and can be valuable furbearers, they have been reintroduced to re-establish populations. Animals have also been released to augment low populations and to establish populations at new sites. Not all such translocations have been successful. We modelled reintroductions to predict criteria for success and tested model predictions using data from real reintroductions. The model predicted that more adult females released across several sites increases the probability of re-establishing a population. The number of males released should not affect success beyond a minimum number. American martens (*M. americana*) have been translocated >50 times with >50% success. Fishers (*M. pennanti*) have been translocated

>30 times with >80% success. Pine martens (*M. martes*) and house martens (*M. foina*) have each been translocated 6 times, the former with at least 67% success and the latter with no confirmed successes. Japanese martens (*M. melampus*) were accidentally released once, successfully. Nearly 20,000 sables (*M. zibellina*) were translocated in the former Soviet Union, re-establishing many populations. For actual reintroductions, the 2 variables most strongly linked to success were the total number of animals released and the number of release sites. Sex-specific analyses for fishers, American martens and sables linked number of females released, number of release sites, *and* number of males released strongly with success. The contradiction between model and data regarding males may relate to the assumption in the model that all males are equal. We hypothesize many males must be released so that sufficient numbers of good breeders are released, possibly big males.

MARTES IN CHANGING TIMES

Proulx, G.

Alpha Wildlife Research & Management Ltd., 229 Lilac Terrace, Sherwood Park, Alberta T8H 1W3 Canada, gproulx@alphawildlife.ca.

In the last 100 years, priorities relative to the management of *Martes* species have evolved from consumption to conservation, and caused a change in the objectives of research on martens (*Martes* spp.) and fishers (*M. pennanti*). For most of the 20th Century, in North America and northern Eurasia, *Martes* species have been managed for the value of their pelt, and extensive research was conducted on reproductive ecology, harvest management, and capture technology (efficacy and humaneness). Since the 1970s, however, the value of *Martes* as a forest product raised scientific concerns about species distributions and population status, and sparked several years of research on habitats and home ranges, food habits, and reintroduction programs. The effects of timber harvest and other disturbances on *Martes* populations and habitats were the subject of major investigations in the later part of the 20th Century, and are still being studied today. Since the late 1990s, with a decrease in importance of the fur industry and a surge of popular interest in biodiversity conservation, American marten (*M. americana*), pine marten (*M. martes*), and fishers have been recognized as forest specialists associated with late-successional forests, but also as species at risk endangered by habitat loss. The new socio-economic status of *Martes* gave rise to an array of habitat research and management programs at landscape and stand levels, and a reassessment of the systematics and evolutionary genetics of martens, fishers and other mustelids. In Europe, increased efforts in the last 20 years to conserve pine marten populations and habitats resulted in an increase of research on the species distribution, food habits and habitat requirements. Extensive work has also been conducted on the role of pine marten and stone marten (*M. foina*) in predator communities, particularly in rural and sub-urban contexts where they may be considered as pests. The socio-economic value of yellow-throated (*Martes flavigula*; including the Nilgiri marten, *M. gwatkinsi*) and Japanese (*Martes melampus*) martens is limited, and conservation is based on relatively little scientific information. *Martes* research has adapted to changing times and produced a wealth of information on *Martes* taxonomy, ecology, techniques and conservation. Unfortunately, while issues relative to animal welfare, species conservation, and habitat management still need to be addressed, *Martes* research and conservation may be negatively affected by current, difficult economic times. The future of *Martes* research and conservation may ultimately depend on public education, lobbying for political support, and the maintenance of an active group of *Martes* researchers.

MULTI-SCALE MANAGEMENT OF *MARTES* HABITAT ACROSS GEOGRAPHIC REGIONS

Proulx, G.

Alpha Wildlife Research & Management Ltd., 229 Lilac Terrace, Sherwood Park, Alberta T8H 1W3 Canada, gproulx@alphawildlife.ca

Habitats used by *Martes* species have been the subject of extensive investigations over the last 20 years, but although much has been learned, the implementation of this information as management guidelines that reflect such knowledge is lacking. In this paper, we demonstrate that, even if *Martes* habitats vary in composition across their geographic distribution, and forests differ, broad habitat management guidelines based on several key components may be implemented from one region to another. *Martes* select their living quarters at landscape, stand, patch and element scales. At the landscape scale, all *Martes* species establish their home ranges in interconnected areas with <30% fragmentation. At the stand scale, *Martes* prefer mesic, late-successional forests of various composition depending on the region, with >25% canopy closure, ≥20m^2/ha in trees that are >6 m high and >20 cm dbh, variable shrub closure, and structured ground cover with coarse woody debris. Martens and fishers select patches with canopy or shrub closure, basal areas, tree dbh, and densities of coarse woody debris that are greater than the average stand composition. Within these patches, they use structures that are atypical on the basis of their abundance or size. Habitat management must reflect the fact that *Martes* habitat selection is the result of an integration of choices made at different scales, and it must be based on spatially-explicit information. Knowing that *Martes* are sensitive to fragmentation, habitat conservation of at least 50% of landscapes should correspond to large, contiguous forested areas that are well interconnected by ≥250 m-wide upland corridors and riparian zones. Ground surveys should be carried out to identify stands with valuable habitat patches and elements that should be protected from harvesting. We propose a series of guidelines to minimize the impact of industrial (primarily logging) activities on *Martes* habitat. We suggest that sustainable populations of *Martes* can best be maintained in forested landscapes that are managed over a 240-year rotation, and monitored through an adaptive management program evaluating the efficacy of objective-based *Martes* management strategies. Finally, *Martes* management implies people management, i.e., the training of managers and the use of experienced wildlife biologists.

HABITAT SELECTION BY THE FISHER ACROSS THE WEST COASTAL PART OF ITS GEOGRAPHIC RANGE: A META-ANALYTIC APPROACH

Raley, C.M.[1], S.W. Buskirk[2], K.B. Aubry[1], W.J. Zielinski[3], M.K. Schwartz[4], R.T. Golightly[5], K.L. Purcell[6], R.D. Weir[7], and J.S. Yaeger[8]

[1]USDA Forest Service, Pacific Northwest Research Station, 3625 93rd Ave. SW, Olympia, Washington 98512 USA, craley@fs.fed.us; [2]Department of Zoology and Physiology, University of Wyoming, Laramie, Wyoming 82071 USA; [3]USDA Forest Service, Pacific Southwest Research Station, 1700 Bayview Drive, Arcata, California 95521 USA; [4]USDA Forest Service, Rocky Mountain Research Station, 800 E. Beckwith Ave, Missoula, Montana 59801 USA; [5]Humboldt State University, Department of Wildlife, Arcata, California 95521 USA; [6]USDA Forest Service, Pacific Southwest Research Station, 2081 E. Sierra Avenue, Fresno, California 93710 USA; [7]Artemis Wildlife Consultants, 4515 Hullcar Road, Armstrong, British Columbia V0E 1B4 Canada; [8]U.S. Fish and Wildlife Service, 1829 S. Oregon Street, Yreka, California 96097 USA.

To provide habitat for species of conservation concern, natural resource managers need information about the structures and site-specific environmental conditions animals require, yet such information for a particular site often is lacking. For the fisher, a presumed habitat specialist in western North America, a general model of habitat selection applicable across broad geographic areas would be useful in planning management actions in areas where intensive studies have not been conducted. To develop such a model, we conducted a formal meta-analysis of habitat selection by the fisher in 8 geographic locations from north-central British Columbia to the southern Sierra Nevada in California. Each study included in the meta-analysis measured attributes of sites used by fishers for resting (i.e., the immediate vicinity of resting structures; typically <1 ha) and random sites representing availability in each study area. We reviewed published and unpublished habitat models generated for specific locales, and identified 9 habitat attributes that appeared to be mostly independent, commonly measured, and plausibly important to fishers across a broad geographic area: slope, aspect, canopy cover, log volume, basal area of large conifers (51-100 cm in diameter), basal area of large hardwoods, basal area of large snags, diameter of live conifers, and diameter of live hardwoods. Seven of the 9 attributes we analyzed were measured in all 8 studies, 1 in 7 studies (basal area of large snags), and 1 in 4 studies (log volume). Our analyses revealed significant positive effect sizes for each of the 9 variables we analyzed, demonstrating geographically broad positive selection for habitat attributes related to physical structure, for relatively steep slopes and for aspects facing farther from southwest than those available in the study areas.

HARVEST MANAGEMENT OF *MARTES* SPECIES: AN UPDATE

Robitaille, J.-F.

Department of Biology, Laurentian University, 935 Ramsey Lake Road, Sudbury, Ontario Canada P3E 2C6, jfrobitaille@laurentian.ca.

Since the publication of the first *Martes* monograph, there have been no formal updates on the development of new techniques, approaches, and results obtained through the study of harvested *Martes* populations, and possibly converted into applied management methods by harvest jurisdictions. The intent of this chapter is to provide such an update, with a particular focus on the development and the application of new techniques. To achieve a more comprehensive review, and to revisit previous issues, the review will not be spatially confined. Rather, I will briefly review the world-wide distribution of *Martes* species, identify areas where harvest is monitored and where formal management protocol is being implemented. The review will provide an overview of management approaches currently used, with an obvious bias towards more documented species or areas. Documentation will include the peer-reviewed literature, and due to the strongly applied aspect of this scientific discipline, a review of web-based postings and a selection of personal communications with wildlife management agencies. Some of the techniques used in Ontario will also be presented, including original data on diet, phenotypic attributes and physical condition, based on direct observations from 1998-2002 harvest years. This review will highlight progress made in the last decade, as well as unresolved issues in the management of *Martes* species. In the context of decreasing demand in fur trade and public perception of fur harvest, the conclusion will bear (a) on the current and future harvest pressure exerted on, and (b) welfare and sustainability of harvested *Martes* populations with respect to management approaches.

PHYLOGEOGRAPHY OF THE EUROPEAN PINE MARTEN (*MARTES MARTES*)

Ruiz-González, A.[1,2], M.J. Madeira[1], E. Randi[2], A. Abramov[3], and B.J. Gómez Moliner[1]

[1]Department of Zoology and Animal Cell Biology, Zoology Laboratory, Facultad de Farmacia, Universidad del País Vasco(UPV-EHU), C/ Paseo de la Universidad 7, 01006 Vitoria, Spain, arg.salinas@gmail.com; [2]Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA), Sede Amministrativa ex_INFS, Via Cà Fornacetta, 9 40064 Ozzano dell'Emilia (BO) Italy; [3]Laboratory of Mammalogy, Zoological Institute, Russian Academy of Sciences, Universitetskaya nab. 1, Saint-Petersburg, 199034 Russia.

This study details the phylogeographic pattern of the European pine marten (*Martes martes*) a carnivore species strongly associated with forest habitat. We used sequences of 1,500 base pairs of the mitochondrial DNA (which includes the final part of the cytochrome b gene, tRNAPro, tRNAThr, the control region and the initial part of rRNA12S) from 215 pine martens collected from 21 countries distributed throughout its distribution area. This study enlarges the range of distribution of previous phylogeographic works, getting to Scandinavia in the North, Russia in the East, and the Iberian Peninsula in the South-West. Sable (*Martes zibellina*) samples were

also included to better understand the relationships between *M. martes* and *M. zibellina* in Fennoscandia. Our results reveal the presence of 74 different haplotypes grouped within 2 major clades. The first includes all *Martes martes* samples collected throughout all European countries. It is further subdivided into 2 different groups distributed along the Central-northern Europe and Mediterranean region. The Mediterranean lineage did not contribute to the postglacial recolonization of much of the Palaearctic range of species. Moreover, our phylogeographic analyses also reveals differentiated populations of pine marten in Fennoscandia, which are introgressed by mitochondrial DNA of *Martes zibellina*. In conclusion, this study demonstrates a complex phylogeographic history for a forest species in Europe which is sufficiently adaptable that, facing climate change, survives in relict southern and northern habitats. The high level of genetic diversity characterizing pine marten populations from parts of central Europe also highlights the importance of such regions as a source of intraspecific genetic biodiversity.

ARGOS SATELLITE TELEMETRY AND THE FISHER (*MARTES PENNANTI*): ISSUES OF ACCURACY, BIAS, AND BEHAVIOR

Sauder, J.D.[1,2] and J.L. Rachlow[2]

[1]Idaho Fish and Game, 3316 16th St, Lewiston, Idaho 83501 USA, joel.sauder@idfg.idaho.gov; [2]University of Idaho, Department of Fish and Wildlife Resources. PO Box 441136, Moscow, Idaho 83844 USA.

Technological improvements in Argos telemetry satellites and transmitters potentially expand application of this technology to studies of resource selection by mid-sized mammals. We evaluated the influence of canopy cover and terrain on performance of Argos platform terminal transmitters (weighing about 120 g) configured for fishers (*Martes pennanti*). We modeled the effects of both habitat features on location errors and acquisition rates. Overall, 44% of recorded locations were in the highest accuracy class assigned by Argos (i.e., class 3) and had a median error of <162 m. Although performance declined between control sites on mountain tops and test sites in forested areas, neither location errors nor acquisition rates were significantly influenced by either canopy cover or topography. We deployed 23 Argos collars on fishers in north-central Idaho to study resource selection at landscape and home range spatial scales. Performance of collars on fishers declined substantially from test collars (7.8 ± 3.8 high accuracy points (i.e., classes 3 and 2) per day of operation versus 3.2 ± 1.6), presumably due to fisher behavior. However, over the 1-year lifespan of the transmitters, collars averaged 149.1 ± 31.0 high accuracy points, sufficient for many habitat modeling techniques. We applied probabilistic estimates of location errors derived from our field trials to evaluate the effect of location errors on estimates of home range and core area. Our results suggest that Argos telemetry is a potentially viable alternative to GPS telemetry, particularly when acquisition biases due to canopy cover and topography are of concern.

MARTES CONSERVATION GENETICS: USING MOLECULAR GENETICS TO ASSESS WITHIN-SPECIES MOVEMENTS, BARRIERS, AND CORRIDORS

Schwartz, M.K.[1], A. Ruiz-González[2], R. Masuda[3], and C. Pertoldi[4]

[1]USDA Forest Service, Rocky Mountain Research Station, 800 E. Beckwith, Missoula, Montana 59801 USA, mkschwartz@fs.fed.us; [2]Departamento de Zoología y Biología Celular Animal Laboratorio de Zoología, Universidad del Pais Vasco-Euskal Herriko Unibertsitatea. UPV-EHU, Paseo de la Universidad, 7, 01006 Vitoria-Gasteiz, Spain; [3]Department of Natural History Sciences, Faculty of Science, Hokkaido University, Sapporo 060-0810 Japan; [4]Bygning 1540, Ny Munkegade 114, DK - 8000 Århus C, Denmark.

Understanding both the physical and associated temporal factors that structure *Martes* populations is essential to the conservation and management of the 8 recognized *Martes* species. Recently, advances in 3 distinct subdisciplines in molecular ecology have provided insight into historical and contemporary environmental factors that have created population substructure and influenced movement patterns of several of the *Martes* species. The field of intraspecific phylogenetics has allowed us to understand the role of large-scale historical events, such as the last glacial maxima and associated refugia, on *Martes* populations in Europe, Asia and North America in at least 5 different species (*M. americana*, *M. martes*, *M. melapus*, *M. pennanti*, *M. zibellina*). In addition, the field of population genetics has examined how connected *Martes* populations are within species across space and, in some cases, how this level of connectivity has changed over recent time by examining historical samples in multiple populations. These population genetic studies often examine environmental variables that likely cause substructure or promote connectivity among populations within species, but do so post-hoc. More recently, several landscape genetic analyses, including graph theoretic and least-cost-path approaches, have been used to evaluate the correlation between landscape features (including habitat variables) and genetic relatedness among individuals (within a species). These new approaches are showing promising results in empirically evaluating multiple habitat features at multiple scales that foster connectivity, and those recent features on the landscape that hinder connectivity. This approach has been applied on at least 2 species (*M. americana* and *M. pennanti*). Once these landscape genetic models are derived, least-cost-path or circuit-theory approaches have also been used to derive corridor maps for the species of interest. This paper reviews the intraspecific phylogenetic, population-genetic, and landscape-genetic studies conducted on *Martes* populations; discusses commonalities found among species in terms of habitats deemed important for connectivity; and identifies knowledge gaps for understanding movement and substructure of the 8 *Martes* species.

OCCUPANCY MODELING FOR *MARTES* USING DATA OBTAINED FROM NON-INVASIVE SURVEYS

Slauson, K.M.[1], J.A. Baldwin[2], and W.J. Zielinski[1]

[1]USDA Forest Service, Pacific Southwest Research Station, 1700 Bayview Drive, Arcata, California 95521 USA, kslauson@fs.fed.us; [2]USDA Forest Service, Pacific Southwest Research Station, 800 Buchanan Street, West Annex Building, Albany, California 94710 USA.

Recently, occupancy modeling has been developed to quantitatively deal with some of the shortcomings inherent with non-invasive survey data (e.g., partitioning true absences from false absences). These methods involve estimating 2 parameters (P and ψ) from the collection of detection histories, the sequences of 0's and 1's representing detection or non-detection of a *Martes* sp., over the duration of a survey at each site. P refers directly to the ability of the survey protocol to detect a *Martes* sp. given its presence in the sample unit, which directly refers to the characteristics (e.g., number of stations, survey duration) of the survey protocol. ψ refers to the probability that ≥1 *Martes* sp. occupies the site, which is directly related to the ecological characteristics of the sites surveyed (e.g., habitat structure, carnivore community). We analyzed data from 5 case studies involving fishers (*M. pennanti*) and American martens (*M. americana*) to illustrate some key issues for occupancy modeling for *Martes* research, management, and monitoring. For each case study we used data from standardized survey protocols for fishers and martens to estimate detection probabilities and investigate factors causing detection heterogeneity. We found 5 significant sources of detection heterogeneity: within sample unit visit-dependency, visit-specific detection probabilities, survey season, gender-specific detection probabilities, and bait status. Incorporating covariates to account for sources of detection heterogeneity significantly increased accuracy of parameter estimates. Probability of detection varied by station check interval, with probability of detection generally increasing throughout the survey duration. Fishers had a lower probability of detection during the summer season (July-September), compared to all other seasons; American martens can also show a similar drop in detection probability during the summer, but this was not consistent in all locations. In all cases, custom models created to estimate P far outperformed standard models available in software packages.

A REVIEW OF THE USE OF TELEMETRY IN *MARTES* RESEARCH: TECHNIQUES AND TECHNOLOGIES

Thompson, C.M.[1], R.E. Green[1], R.A. Sweitzer[2], and K.L. Purcell[1]

[1]USDA Forest Service, Pacific Southwest Research Station, 2081 E. Sierra Av., Fresno, California 93710 USA, cthompson@fs.fed.us; [2]University of California, Sierra Nevada Adaptive Management Program, P.O. Box 350, Bass Lake, California 93604 USA.

Over the past 4 decades, telemetry has been an integral part of *Martes* research. Its use varies widely, ranging from investigating the ecological energetics of fishers in the United States to the impacts of forest management on sables in China. While the vast majority of telemetry studies have been associated with the American marten and fisher, recent work has expanded to include European pine and stone martens. Less well represented are the Asian species such as the sable, yellow-throated marten, and Japanese marten. We explored the use and efficiency of different attachment techniques, methodologies, and monitoring technologies, and summarized how recent technological advances are being applied to *Martes* research. Telemetry has been used for a variety of objectives including territory delineation, identifying habitat preferences, quantifying population vital rates, evaluating reintroductions, and assessing the impacts of disturbances. Researchers have begun experimenting with collar expansion and/or breakaway devices, designed to either stretch or tear free, should an animal grow or become entangled. Implant transmitters, either subcutaneous or intraperitoneal, have been used with mixed results. Early work with American martens suggested an increased risk of mortality associated with subcutaneous transmitters; however intraperitoneal transmitters have been used successfully on fishers in British Columbia. Most studies have employed VHF transmitters and ground monitoring. Though expensive, aerial surveys have become more prevalent in the past decade, providing more consistent locations in rugged terrain. The use of satellite-based and GPS collars is relatively new and, to the best of our knowledge, limited to 4 fisher projects in the United States. We compare methods and technologies in terms of the type and accuracy of data generated, efficiency, cost, influence of terrain, and other potential obstacles. We will present case studies showing how different techniques can be employed in different landscapes as well as what pitfalls can be avoided.

A REVIEW OF MARTEN HABITAT REQUIREMENTS IN NORTH AMERICA

Thompson, I.D.[1] and J. Fryxell[2]

[1]Canadian Forest Service 1219 Queen St. East, Sault Ste. Marie, Ontario P6A 2E5 Canada, ian.thompson@nrcan.gc.ca; [2]Department of Integrative Biology, University of Guelph, Guelph, Ontario N1G 2W1 Canada .

This paper reviews habitat selection by marten across North America. Contemporary theory on habitat selection relates this to patterns of habitat use by American marten (*Martes americana*) across North America, suggesting hypotheses for mechanisms of habitat selection based on limiting features or factors. Marten habitat use is variable across the continent with populations occupying a range of forest ages and types. Most models indicate habitat selection is dependent on variables at 3 spatial scales: landscape, home range, and individual structures. Habitat selection may be a function of the availability of preferred habitats but observed patterns of habitat selection may also be influenced by density dependence, owing to mortality in many populations from commercial trapping, the capacity for dispersal, and the availability of untrapped reserves as source populations. Further, since most dispersing animals are juveniles, observed patterns of habitat selection may represent novel habitat choices by inexperienced animals. Hence, we argue that more useful measures of habitat requirement be based on fitness of individuals and not to broadly observed patterns.

FISHER POPULATION MONITORING IN THE SOUTHERN SIERRA NEVADA, 2002–2008.

Truex, R.L.[1], W.J. Zielinski[2], J.S. Bolis[3], and J.M. Tucker[4]

[1]USDA Forest Service, Pacific Southwest Region, 2480 Carson Rd., Placerville, California 95667 USA, rtruex@fs.fed.us; [2]USDA Forest Service, Pacific Southwest Research Station, 1700 Bayview Drive, Arcata, California 95521 USA; [3]USDA Forest Service, 57003 Road 225, North Fork, California 93643 USA; [4]USDA Forest Service, Rocky Mountain Research Station, 800 E. Beckwith Ave., Missoula, Montana 59801 USA.

The fisher (*Martes pennanti*) population in the southern Sierra Nevada, CA, USA is isolated from the northern California fisher population by >350 km and is currently considered a candidate for protection under both the US and California Endangered Species Acts. During 2002, the U.S. Forest Service initiated a regional fisher monitoring program to track population trends throughout the southern Sierra Nevada. The primary objective of the program is to use presence/absence sampling to detect a 20% decline in relative abundance of the population with 80% statistical power. The proportion of sites occupied is estimated annually by deploying sample units comprised of 6 track-plate stations at 5 km intervals from 800 to 3200 m in elevation throughout the region. Sample units encompass ~1.2 km^2 and are surveyed for 10 consecutive days, checked every 2 days. The same locations are resampled annually or bi-annually and sampling occurs from June through October. During the first 7 years of the monitoring program, annual sampling effort has varied from 110 to 190 sample units, requiring the efforts of >23 field employees and approximately $550,000 in funding per year. Occupancy modeling techniques are being used to assess the effects of various survey and ecological characteristics on detection probabilities and occupancy rates. These covariates include seasonal and geographic influences, persistence factors within survey periods (visit dependence) and among years (site extinction and colonization rates), and various factors influencing sample unit operability (e.g., disturbance by black bear [*Ursus americanus*]). Fishers have been detected at 23-27% of sites annually, with the majority of detections occurring in mid-elevation forested habitats. Preliminary analysis suggests no decline in the index of abundance across the population during the monitoring period, though occupancy rates appear to vary among geographic regions within the population.

ECOLOGICAL COMPARISON BETWEEN PINE (*MARTES MARTES*) AND STONE (*MARTES FOINA*) MARTENS IN ITALY

Vercillo, F. and B. Ragni

University of Perugia, Department of Cellular and Environmental Biology, Via Elce di Sotto, Perugia 06123 Italy, francesca.vercillo@unipg.it.

Pine and stone martens are sympatric in the Italian peninsula. Few morphological characters distinguish them, making species identification difficult. According to European studies, the 2 species seem to share the same trophic niche, but to use different habitats, suggesting ecological

competition. This study is focused on examining evidence for such competition. Fifty-seven *ingesta* (20 of pine and 37 of stone marten) and 111 faeces (63 of pine and 48 of stone marten) were collected, screened genetically and analyzed since 2000. Fifty-four items for pine and 69 for stone martens have been identified and divided into 6 food categories. The results show that for both species the most important food category was fruits, followed by invertebrates. However, while there is continuity in the stone marten among food categories, the pine marten shows a strong separation between the fruits and other dietary items that are clearly secondary in importance. The trophic niche overlap between these 2 mustelids is almost complete and their overall diet seem very similar (the most-used categories are harvested with the same intensity). We investigated habitat selection using a sub-sample of 76 observations of pine and 46 of stone marten. Based on X^2 analysis, both species favor "woody vegetation" and avoid "woody and herbaceous cultivations" ($P = 0.8 \times 10^{-8}$ for pine and $P = 0.003$ for stone marten). Within the "woody" categories, the pine marten actively selects "forests of evergreen Mediterranean sclerophylls" ($P = 0.1 \times 10^{-9}$), whereas the stone marten uses categories in proportion to availability. Pine martens appear to be more selective than stone martens in their diet and choice of habitat; the stone marten is more of a "generalist", and therefore more adaptable. There is potential competition that makes the stone marten "dominant" relative to pine marten.

DISTRIBUTION AND GENETICS OF FISHERS (*MARTES PENNANTI*) IN THE NORTHERN ROCKY MOUNTAINS.

Vinkey, R.S.[1], M.K. Schwartz[2], N.M. Albrecht[3], J.J. Claar[4], B.J. Giddings[5], T.M. Bertram[4], K.L. Pilgrim[2], and J. Sauder[6]

[1]Montana Fish, Wildlife & Parks, P.O. Box 1066, Philipsburg, Montana 59858 USA, rvinkey@mt.gov; [2]USDA Forest Service, Rocky Mountain Research Station, 800 East Beckwith, Missoula, Montana 59807 USA; [3]Coeur D'Alene Tribe, 850 A Street, Plummer, Idaho 83851 USA; [4]USDA Forest Service, Northern Region, 200 East Broadway, Missoula, Montana 59807 USA; [5]Montana Fish,Wildlife & Parks, 1420 East Sixth Ave, Helena, Montana 59620 USA; [6]Idaho Fish and Game, 3316 16th Street Lewiston, Idaho 83501 USA.

In contrast to fisher (*Martes pennanti*) populations of the midwestern and northeastern United States, fisher in the Intermountain West are found at lower densities with a patchy distribution. Data is being collected on the status of fisher in the Northern Rockies of Idaho and Montana. We review new and existing data on the distribution and genetics of fisher that indicate that these populations are discrete and have multiple origins. Information on fisher distribution in Idaho was derived from ad-hoc and systematic hair-snare surveys conducted by the U.S. Forest Service (USFS), Coeur d'Alene Tribe, Idaho Fish & Game, and Potlach Corporation across a variety of ownerships including 5 National Forests. Records in Montana come from hair-snare surveys coordinated by USFS on 2 National Forests and from harvested animals collected by Montana Fish, Wildlife & Parks. This first comprehensive examination of fisher distribution in the region has particular relevance, given the February 2009 petition submitted to the U.S. Fish and Wildlife Service to list "Northern Rocky Mountain fisher" as a Distinct Population Segment and Threatened or Endangered under the Endangered Species Act. Comparison of habitat-based models for fisher with verified fisher records, along with genetic evidence, suggests that fisher

range is occupied, but may be limited in extent and discontinuous. Until recently, fisher populations in the Northern Rockies were thought to be descended solely from translocations from British Columbia and the midwestern United States. However, our analysis of 2 regions of the mitochondrial DNA genome reveals that native fisher, possessing 2 unique haplotypes, *Cytb-B* and CR-12, persist within west-central Montana and north-central Idaho. The distribution of native and introduced haplotypes in Idaho and Montana proves that fisher populations have multiple origins. These findings reflect a history of translocations, as well as the influence of native populations.

LANDSCAPE GENETIC PATTERNS OF *MARTES AMERICANA* IN NORTHERN IDAHO

Wasserman, T.N.[1] and S.A. Cushman[2]

[1]Western Washington University, Huxley College of the Environment, 516 High St., Bellingham, Washington 98225 USA, moonhowlin@yahoo.com; [2]USDA Forest Service, Rocky Mountain Research Station, 800 East Beckwith, Missoula, Montana 59801 USA.

In order to understand the effects of landscape and environmental features on the genetic structure of American marten (*Martes americana*) in the Idaho Panhandle National Forest (IPNF) in northern Idaho, genetic information was used to model genetic relationships of this marten population with respect to environmental and spatial variables across the landscape. Over 3 field seasons from 2004 to 2006, 70 individual marten were detected across the study area. Their genetic similarities were based on the pair-wise percentage dissimilarity among all individuals based on 7 microsatellite loci. We compared their genetic similarities with several landscape-resistance hypotheses describing a range of potential relationships between movement cost and landcover, elevation, roads, Euclidean distance, and barriers. The degree of support for each model was tested with causal modeling on resemblance matrices using partial Mantel tests. Over 160 models were tested to effectively describe the genetic structure of this marten population. Hypotheses of isolation-by-distance and isolation-by-barrier were not supported. Isolation-by-landscape resistance proved to be the best model describing genetic patterns of *Martes americana* in the IPNF. Elevation 1600 m with a standard deviation of 600 m was the most highly supported landscape resistance model correlated to genetic structure of American marten in this landscape. In our case, elevation is a proxy for snowpack and the forest composition at this specific elevation. Correlating genetic similarity of individuals across large landscapes with hypothetical movement cost models can give reliable inferences about population connectivity. By linking cost modeling to the actual patterns of genetic similarity among individuals, it is possible to obtain rigorous empirical models describing the relationship between landscape structure and gene flow, and to produce species-specific maps of landscape connectivity, which can provide managers with critical information to better administer our forests for meso-carnivores and other species of concern.

USE OF REPRODUCTIVE DENS BY FISHERS IN NORTHCENTRAL BRITISH COLUMBIA

Weir, R.D.[1] and F.B. Corbould[2]

[1]Artemis Wildlife Consultants, 4515 Hullcar Road, Armstrong, British Columbia V0E 1B4 Canada, rweir@artemiswildlife.com; [2]Peace/Williston Fish and Wildlife Compensation Program, Suite 325, 1011 Fourth Avenue, Prince George, British Columbia V2L 3H9 Canada.

In fishers (*Martes pennanti*), females invest considerable time and resources raising young, expending approximately 1/3 of their annual energy budget during the 2 months that they rear and care for their young. Despite this apparent high investment, the factors that affect use of reproductive dens by female fishers are poorly understood. By following a sample of radio-tagged female fishers in the Williston region of north-central British Columbia, we described the patterns of attendance by fishers at reproductive dens and assessed the influence of several factors on the likelihood of a female being present at her den. Breeding-age females did not exhibit whelping behaviour each year, however, the use of reproductive dens was initiated during a brief time period each spring ($\bar{x}$ = 4 April, SD = 4 d, n = 12). Females used between 1 and 3 trees as reproductive dens during the rearing period, which generally lasted between early April and late May. Natal dens (i.e., whelping sites) were used between 30 and 49 d ($\bar{x}$= 41 d, SD = 7, n = 9). We observed females switching to maternal dens (i.e., secondary reproductive dens) on 5 occasions. Two parturient fishers spent, on average, 11 h each day (range: 3.9-24 h, n = 50 monitoring-days) at their reproductive dens during 2 reproductive seasons each. The total time spent at the den each day generally diminished as the denning period progressed. Our data supported the hypothesis that females timed the start of excursions away from their reproductive dens to coincide with peak daily temperatures. These results helped to identify factors that affect the survivorship of young, which ultimately affect recruitment into the population.

CONFIRMING THE IDENTITY OF SUSPECTED PREDATORS OF FISHERS (*MARTES PENNANTI*) THROUGH MOLECULAR TECHNIQUES

Wengert, G.M.[1,2], M.W. Gabriel[1,2], J.M. Higley[3], S.M. Matthews[4,5], C.M. Thompson[6], K.L. Purcell[6], R. Green[6], R.A. Sweitzer[7], R.H. Barrett[7], J.C. Lewis[8], P.J. Happe[9], K.J. Jenkins[10], J.E. Foley[11], and B.N. Sacks[1,12]

[1]Canid Diversity and Conservation Unit, Veterinary Genetics Laboratory, University of California, One Shields Avenue, Davis, California 95616 USA, gmwengert@ucdavis.edu; [2]Integral Ecology Research Center, 102 Larson Heights Road, McKinleyville, California 95519 USA; [3]Hoopa Tribal Forestry, P.O. Box 368, Hoopa, California 95546 USA; [4]Wildlife Conservation Society, 2300 Southern Boulevard, Bronx, New York 10460 USA; [5]Department of Natural Resources Conservation, University of Massachusetts, 160 Holdsworth Way, Amherst, Massachusetts 01003 USA; [6]USDA Forest Service, Pacific Southwest Research Station, 2081 E. Sierra Avenue, Fresno, California 93710 USA; [7]Department of Environmental Science, Policy, and Management, University of California, Berkeley, California 94720 USA; [8]Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, Washington 98501 USA;

[9]Olympic National Park, 600 E. Park Avenue, Port Angeles, Washington 98362 USA; [10]USGS-FRESC, 600 E. Park Avenue, Port Angeles, Washington 98362 USA; [11]Department of Veterinary Medicine and Epidemiology, University of California, One Shields Avenue, Davis, California 95616 USA; [12]Department of Biological Sciences, California State University, 6000 J Street, Sacramento, California 95819 USA.

The fisher (*Martes pennanti*) is a candidate for listing under the Endangered Species Act in the Pacific United States. Recovery of their populations requires an understanding of mortality factors, including predation. In most accounts of predation on fishers, observers have suspected potential predators based on puncture wounds and visual clues at the scene. Taken alone, these clues can be misleading in determining the predator species. Furthermore, DNA evidence of predation in any wildlife community is scarce in the literature. We generated a field protocol for documenting and collecting DNA evidence of predation on fishers for several research projects in California and Washington. In addition to physical evidence, such as bite wound measurements and carcass condition, we collected biological samples from which we extracted predator DNA. We have been able to identify predators of fishers through 3 types of samples: predator fur left at the carcass, predator saliva from matted fisher fur, and predator saliva collected by swabbing the interior of bite wounds. In conjunction with necropsies performed, we were able to confirm in most cases that bite wounds from which we collected DNA were inflicted ante-mortem, verifying that injuries from the predator led to the fisher's death and were not due to scavenging. To date, we have documented bobcats (*Lynx rufus*) and mountain lions (*Puma concolor*) as frequent predators of fishers, while only 1 fisher was killed by a coyote (*Canis latrans*). Currently, we are working on identifying the sex of the predator through its DNA, as well as the individual identity of each predator, to search for patterns in predation. This information coupled with knowledge of the trends in fisher predation, such as whether fishers of one sex sustain greater predation rates, will allow for a more thorough assessment of the impact that predation may have on fisher populations.

PATTERNS OF GEOGRAPHIC VARIATION IN FOOD HABITS OF BOREAL MARTENS

Zalewski, A.

Mammal Research Institute, Polish Academy of Sciences, 17-230 Bialowieza, Poland, zalewski@zbs.bialowieza.pl.

Interactions between resource availability (mainly food) and physiological tolerances to abiotic conditions are often key factors that determine a species' geographical range. Sibling or other closely related species are expected to have similar physiological adaptations to environmental conditions, but their geographic ranges often are characterized by different climates. Given similar physiological characteristics, adaptation by sibling species to contrasting climates is expected to be largely behavioral, particularly in terms of foraging behavior. The genus *Martes* includes 8 species and 4 of them (pine marten, American and Japanese marten and sable) are "boreal forest martens" and exhibit very close taxonomic and ecological similarities. The boreal forest martens are distributed across the temperate, boreal and taiga zones where climatic conditions differ dramatically. In response to harsher environmental conditions, pine martens

decreased their body size but increased their food niche breath (hunting larger prey) and moved longer distances per day. Do other boreal martens exhibit feeding ecologies and behaviour convergent to those of the pine marten? To test this, I compare geographic variation in food composition of the pine marten and sable in relation to climatic conditions and habitat productivity.

DESIGNED FOR APPLICATION: BUILDING HABITAT MODELS USING INSTITUTIONAL VEGETATION INVENTORY DATA TO MONITOR FISHER RESTING HABITAT AND TO SIMULATE THE EFFECTS OF MANAGEMENT

Zielinski, W.J.[1], A.N. Gray[2], J.R. Dunk[3], J.W. Sherlock[4], and G.E. Dixon[5]

[1]USDA Forest Service, Pacific Southwest Research Station, Arcata, California 95521 USA, bzielinski@fs.fed.us; [2]USDA Forest Service, Pacific Northwest Research Station, Corvallis, Oregon 97330 USA; [3]Department of Environment and Natural Resource Sciences, Humboldt State University, Arcata, California 95521 USA; [4]USDA Forest Service, Pacific Southwest Region, Vallejo, California 94592 USA; [5]USDA Forest Service, Forest Management Service Center, Fort Collins, Colorado 80521 USA.

Researchers have revealed much about the habitat of fishers (*Martes pennanti*) in California, yet this work has not been translated into practical tools that managers can use to monitor fisher habitat, or evaluate or mitigate the effects of proposed forest management on fisher habitat. This frustration—that many of the research findings have not directly applied to management decisions—led us to create new habitat models that are intimately linked to programs and tools used by managers to plan timber harvests and vegetation management. Instead of expecting managers to apply our new science in the format it was originally developed, we created habitat models that were integrated with institutional programs that forest managers use for 2 purposes: (1) to inventory timber resources (i.e., Forest Inventory and Analysis [FIA] plots) and (2) to simulate the response of forest stands to silvicultural prescriptions (i.e., Forest Vegetation Simulator [FVS]). We assess the status of fisher resting habitat conditions via models developed using the FIA vegetation protocol, and explore their use for monitoring habitat change over time. We also provide an example of how the FIA-based model is integrated into FVS—software that simulates the effect of alternative silvicultural treatments on plot data. Using these tools we produce quantitative measures of the effect of treatments on predicted fisher resting habitat which, in turn, can be used to understand, reduce, or mitigate the effects of treatments on habitat. The fisher provides an example of how habitat assessments for other wildlife species could be advanced if they were developed with implementation success as a primary goal.

STONE MARTEN (*MARTES FOINA*) IN TURKMENISTAN

Abramov, A.V.

Laboratory of Mammalogy, Zoological Institute, Russian Academy of Sciences, Universitetskaya nab., 1, Saint-Petersburg, 199034 Russia, a.abramov@mail.ru.

The stone marten (*Martes foina*) is widely distributed in Palearctic regions from Spain to Mongolia and China. In Turkmenistan, the stone marten inhabits the mountains along the boundaries with Iran and Afghanistan (Kopetdag, Balkhan, and Kugitang Mountains). We collected data on the ecology and distribution of *M. foina* in the Kopetdag Mountains from 1985 to 1990. The Kopetdag is the northernmost range of the Turkmeno-Khorassan Mountains. This region is comprised of mountainous shrub-like Mediterranean xeric woodlands. In Kopetdag, the stone marten usually inhabits areas with a sparse growth of *Juniperus* trees, which form open woodlands in the middle and upper mountain belts at elevations of ca. 1,000-2,000 m. In Central Kopetdag (Firuza and Germab Valleys), *M. foina* is abundant along forested valleys of small rivers, which support xeric, shrublike woodlands with high numbers of fruit trees, Turkmen maples, and shrubs. Sometimes, the animals were recorded near border-guard stations or small settlements. During the summer-autumn period, small mammals (hamsters, gerbils and others) and small birds were staple foods for stone martens. Vegetable matter (juniper berries, different wild fruit) represented almost 1/3 of the diet. Insects and other invertebrates were also frequently eaten. We compared the skulls and skins of stone martens from Caucasus and Central Asia (Kirgizia, Kazakhstan) with Turkmen martens to determinate the taxonomic position of *M. foina* from Turkmenistan. Multivariate analyses were performed to estimate the geographic variability of 26 cranial characters. The Turkmen marten differed from the Caucasian marten *M. foina nehringi* and *M. foina intermedia* from Tien-Shan in the size and proportion of the skull, and in pelage coloration.

MODELING SPATIAL CONSTRAINTS LIMITING RESOURCE ACQUISITION: A CASE STUDY WITH THE NEWFOUNDLAND MARTEN

Adair, W.A.[1] and J.A. Bissonette[2]

[1]Wildland Resources Department, Utah State University, 5230 Old Main Hill, Logan, Utah 84321 USA, badair66@hotmail.com; [2]Utah Cooperative Fish and Wildlife Research Unit, Utah State University, 5290 Old Main Hill, Logan, Utah 84322 USA.

Wildlife ecologists have long recognized that habitat quality depends on the quantity and quality of available resources. In contrast, constraints on resource acquisition, such as movement barriers and perceived predation risk, have proven more difficult to conceptualize and quantify.

We created a set of spatially explicit models for the Newfoundland marten (*Martes americana atrata*) that use optimal decision-making principles to examine the relationships between critical resources (den sites and foraging opportunities) and constraints (thermal conditions and exposure to predation). As should be expected, these models are quite complicated and depend on a complex array of interacting assumptions. Nevertheless, these models have proven to have heuristic value. For example, varying prey population parameters to mimic natural fluctuations confounds the relationship between landscape configuration and fitness. This result challenges conventional definitions of marten habitat, which are usually based on vegetation alone. Likewise, the models' sensitivity to spatial circumstances argues against the concept of an "optimal landscape configuration," a traditional objective for wildlife habitat analyses. Although our analyses do not refute the conventional wisdom that marten are strongly associated with (and may depend on) large contiguous blocks of senescing forests, they do suggest that the Newfoundland marten may be an opening-sensitive, rather than core-sensitive, species. The models also suggest avenues for research addressing marten den site selection, predator avoidance behavior, foraging efficiency, and space use strategies, as well as techniques for assessing the trade-offs that govern marten habitat-selection behavior. Finally, the models also suggest guidelines for promoting marten population recovery, including recommendations for placing artificial resting structures; creating favorable (if not optimal) landscape mosaics; managing ephemeral resources such as transition old-growth forests, defoliation, and coarse woody debris; and developing alternative, competing management scenarios that address both forest and prey conditions simultaneously.

AN INTERACTIVE INTERNET WEBSITE FOR ARCHIVING AND RETRIEVING DATA ON FOREST CARNIVORE SURVEYS IN THE PACIFIC STATES

Aubry, K.B.[1], C.M. Raley[1], and F.V. Schlexer[2]

[1]USDA Forest Service, Pacific Northwest Research Station, 3625 93rd Avenue Southwest, Olympia, Washington 98512 USA, kaubry@fs.fed.us; [2]USDA Forest Service, Pacific Southwest Research Station, 1700 Bayview Avenue, Arcata, California 95521 USA.

We recently developed an interactive internet website that provides current and future biologists with a permanent archive and retrieval system for data obtained from standardized forest carnivore surveys conducted anywhere in Washington, Oregon, and California. This tool is now available for professional use. Data on all survey efforts are included, regardless of their success or failure to detect target species, because both positive and negative results provide useful information for the conservation of fishers and American martens. The website is also designed to provide a permanent archive and retrieval system for all verifiable records of the 5 forest carnivores of greatest conservation concern in the Pacific states: Canada lynx, wolverine, fisher, coastal marten (west of Interstate Highway 5), and mountain red fox (>3,000 ft. elev.). Thus, interested users will be able to generate reliable and up-to-date distribution maps at any spatial scale for these 5 taxa that are based solely on physical evidence of their occurrence. Due to their inherent unreliability, no anecdotal records of any kind are included in the website database. The poster will introduce potential users to the website, and explain its layout and design, the content of its database, and its functionality.

AN EXPERIMENTAL HARVEST OF FISHERS IN ONTARIO, CANADA

Bowman, J.[1] and S. Smithers[2]

[1]Ontario Ministry of Natural Resources and Trent University, 2140 East Bank Drive Peterborough, Ontario K9J 7B8 Canada, jeff.bowman@ontario.ca; [2]Ontario Ministry of Natural Resources, 10 Campus Drive, Kemptville, Ontario K0J 1J0 Canada.

Ontario, Canada has a system of trapping furbearers that imposes limits on harvest in 3 ways: spatially through registered traplines, by imposing quotas or bag limits, and with limited seasons. For fishers (*Martes pennanti*), quotas are typically determined through trial and error, and by retrospectively assessing age ratios of the previous year's harvest. This retrospective evaluation may cause overharvest however, because of an inherent negative autocorrelation in exogenous factors affecting fisher population growth (e.g., acorn crops mast every other year). This was evident in our study area because the finite rate of increase (N_t/N_{t-1}) of fisher populations was negatively correlated with annual harvest. Thus, making decisions about a quota based on the previous year's harvest, has inherent flaws. We hypothesized that with suitable education on field-aging techniques, trappers could make appropriate in-year decisions about sustainable levels of fisher harvest in the absence of a quota. We tested this hypothesis beginning in 2005 by removing the bag limit on fishers in 3 of Ontario's fur management units. We predicted that the juvenile to adult female ratios in the harvest would not be negatively related to overall harvest, but would instead be associated with exogenous factors such as acorn production. Following removal of the quota, annual harvest was variable and fluctuated in association with pelt price and winter weather (i.e., good trapping conditions). There was, however, a 12% increase in mean annual harvest (5-year mean annual harvest pre-quota = 1,093, mean annual harvest post quota = 1,228). There was no relationship between overall harvest and age ratios in the harvest. Instead, age ratios varied with exogenous sources. Our findings suggest that age ratios are more indicative of fisher population growth than of harvest pressure.

EFFECTS OF FOREST/CLEAR-CUT EDGES ON AMERICAN MARTEN MOVEMENTS IN THE BOREAL FOREST

Cheveau, M.[1], L. Imbeau[1], P. Drapeau[2], A. Desrochers[3], and L. Bélanger[3]

[1]Center for Forest Research & Chair in Sustainable Forest Management, Department of Applied Sciences, University of Quebec in Abitibi-Temiscamingue, 445 University boulevard, Rouyn-Noranda, Quebec J9X 5E4 Canada, marianne.cheveau@uqat.ca; [2]Department of Biological Sciences, University of Quebec in Montreal, P.O. Box 8888, Centre-ville Station, Montreal, Quebec H3C 3P8 Canada; [3]Faculty of Forestry and Geomatics, Abitibi-Price Building, Laval University, Ville de Quebec, Quebec G1K 7P4 Canada.

Abrupt forest/clear-cut edges potentially represent movement barriers for American martens, which are known to avoid open areas like recent clear-cuts. In the last twenty years, extensive forest harvesting in the eastern boreal forest of Canada has created numerous edges. Depending on shape of residual forests, habitat may be under the effect of a simple edge in large blocks

along forest/clear-cut patch boundaries or at close proximity of 2 edges in narrow linear forest strips. We sampled marten snow tracks along 100 transects perpendicular to edges, during 2 winters, in 2 different landscapes: agglomerated cutting landscapes which corresponded to clear-cuts separated by narrow (60-100 m wide) forest corridors and dispersed (mosaic) cutting landscapes, which were composed of clear-cuts with nearby forest patches similar in size and dispersed evenly within the landscape. Martens did not use edges more than expected by chance, moreover tracks were distributed randomly along transects, notwithstanding the distance from the edge. We also followed 38 marten tracks to investigate if edges represented a constraint for movements. We found that martens moved in a more parallel direction to edge when they progressively approached the edge. This behaviour was recorded as far as 100 m from the edge, and was significant whatever the resolution scale (10, 20 or 40 m) in dispersed cutting landscapes, but only at the largest scale in agglomerated cutting landscapes, where marten were always under the influence of an edge. Finally, movement sinuosity was lower in forest strips than in forest patches suggesting that linear corridors canalized marten movements.

FISHER (*MARTES PENNANTI*) REST-SITE SELECTION IN THE CHILCOTIN AREA OF BRITISH COLUMBIA

Davis, L.R.[1] and A.S. Harestad[2]

[1]Davis Environmental Ltd, 202 Fetters Drive, Williams Lake, British Columbia V2G 5G2 Canada, rldavis@shaw.ca; [2]Department of Biological Sciences, Simon Fraser University, Burnaby, British Columbia V5A 4T1 Canada.

Rest sites provide fisher (*Martes pennanti*) with shelter from inclement weather and protection from predators. We used radiotelemetry to identify 100 rest sites of 17 fishers in the Chilcotin area between 2005 - 2008. More terrestrial rest sites were used than arboreal rest sites during winter, which may be due to the cold climate. Fisher did not use terrestrial rest sites preferentially during cold periods, but did use terrestrial sites more than expected when snow was deep. Temperatures <-20°C commonly occur and, hence, terrestrial sites may not provide suitable microclimates unless snow is deep. Spruce and aspen stands and number of large logs (>27.5 cm diameter) were important predictors of terrestrial rest sites. Trees used by fisher for resting were among the largest in the rest plot. White spruce (*Picea glauca*) was used more than expected, but, other species were also used. Rust brooms (*Chrysomyxa arctostaphyli*) were the most often used structure when fisher rested in spruce trees. Large branches, cavities, and squirrel nests were used on other tree species. Spruce, trembling aspen, Douglas-fir, and mixed forest stands were more likely to contain arboreal rest sites. Rest sites were rarely in lodgepole pine stands. Structures used for resting are often in older forests and generally less abundant in forests managed for timber production, especially where there are mountain pine beetle infestations and salvage harvesting. Management for fisher rest sites in pine-dominated landscapes should focus on spruce, aspen, Douglas-fir and mixed forest types. Retaining patches containing greater basal area in spruce >30 cm diameter at breast height (DBH), Douglas-fir >50 cm DBH, and trembling aspen >40 cm DBH will provide opportunities for arboreal rest sites. Trees with brooms, large limbs, and cavities are especially valuable but in recent cut blocks, fishers will use cull piles within 50 m of forest stands.

SPACING PATTERNS AND HABITAT USE OF STONE MARTEN (*MARTES FOINA*) IN URBANIZED AREA OF WROCLAW IN SOUTH-WESTERN POLAND

Dudus, L.[1], A. Zalewski[2], and Z. Jakubiec[1]

[1]Institute of Nature Conservation, Polish Academy of Science, Low Silesia Field Station, Podwale 75, 50-449 Wroclaw, Poland, leszek.dudus@gmail.com; [2]Mammal Research Institute, Polish Academy of Science, ul. Waszkiewicza 1c, 17-230 Bialowieza.

Urbanized areas have become a substantial part of the environment, and some species adapt to these new conditions very well. One group of such animals are mesocarnivores. Stone martens (*Martes foina*) have a widespread distribution in Europe, from Mediterranean environment to the southern shore of the Baltic Sea. This species occurs in many types of habitats including urban areas. In Wroclaw, these have been known for over 150 years. Urban environments are a mosaic of different habitats which differ in food abundance and availability, as well as density of population or traffic. The survey was conducted in an area of 94 km² inclusive of the most urbanized part of the city (center and south), which is the 6th biggest city in Poland (632,000 citizens). I trapped, radio-collared and tracked martens at night, 2-4 times per month in 6-hour continuous monitoring sessions. I will present the spatial behavior of stone martens based on their home ranges and activity in 3 different types of urban environment: green areas, housing estates, and congested housing. I studied daily movement distance (DMD, sum of straight-line distances between consecutive locations) and daily ranges in relation to food abundance and type of environment. I analyzed the habitat selection of stone martens in Wroclaw based on a detailed habitat map of the city. This research could help understand how the wild animals adapt to the urban conditions.

PREDICTING FISHER OCCUPANCY IN DECIDUOUS FORESTS OF PENNSYLVANIA

Ellington, E.H.[1], S.G. Gess[1], J.E. Duchamp[1], M.J. Lovallo[2], M. Dzialak[3], and J.L. Larkin[1]

[1] Department of Biology, Indiana University of Pennsylvania, 126 Weyandt Hall, Indiana, Pennsylvania 15705 USA, osuhance@gmail.com; [2]Bureau of Wildlife Management, Pennsylvania Game Commission, 2001 Elmerton Avenue, Harrisburg, Pennsylvania 17110 USA; [3]Hayden-Wing Associates, LLC, 2308 S. 8th St., Laramie, Wyoming 82070 USA.

Fishers (*Martes pennanti*) were extirpated from Pennsylvania by the early-1900s. Regeneration of forests, prolonged absence of a trapping season, and a reintroduction effort in the 1990s has resulted in increased fisher sightings throughout a large portion of the Commonwealth. Nonetheless, no formal post-reintroduction studies on fishers in Pennsylvania have been conducted. We developed occupancy models to better understand factors that influence fisher distribution in northern and southern Pennsylvania. Fisher presence/absence data were collected using hair snares placed in 4-km^2 grid cells during Jul–Sep 2007, Jan–Mar 2008, & May–Sep 2008. A total of 548 hair samples were collected, 79 were fisher (14%), 424 were non-target species (77%) and the remaining 55 samples (10%) were of poor DNA quality. Probability of detection varied among study areas and with the use of bait. These data were modeled with

occupancy variables (n=17) derived from landcover, canopy cover, elevation, road density, and land ownership data. Three *a priori* model variable sets were used: forest, disturbance, and rest site. The important ($P < 0.10$) variables from the top models were then incorporated into a best model variable set. In both study areas, PCA-Landuse and PCA-Forest type were important in determining probability of fisher occupancy ($P < 0.10$); whereby fisher were detected in cells that had more forest and these forests were deciduous. Additionally the variable PCA-Conifer was important in determining probability of fisher occupancy in our northern study area ($P < 0.10$); whereby in the northern study area, fishers were detected in cells that had more coniferous than mixed forests. As reputed elsewhere, forest extent was an important factor that influenced fisher occupancy in Pennsylvania. A more novel finding was that forests dominated by deciduous stands (>75%) appear to be suitable as fisher habitat in Pennsylvania.

REVIEW OF *MARTES* RESEARCH IN THE UPPER GREAT LAKES STATES

Gilbert, J.H.

Great Lakes Indian Fish and Wildlife Commission. P.O. Box 9, Odanah, Wisconsin 54806 USA, jgilbert@glifwc.org.

In the 20th century, *Martes* populations in the upper Great Lakes states were greatly reduced to remnant populations or extirpated. Starting in the 1950's, reintroduction and/or population augmentations took place in Michigan and Wisconsin. Minnesota remnant populations were allowed to recover with no augmentation work. *Martes* research efforts were first reported in published literature in 1964. Since then, 60 papers/theses have been published (41 fisher, 19 marten). Most work has come from Michigan (30) followed by Wisconsin (20) and Minnesota (10). Fisher research began in the 1960's and increased steadily to the 1990's when it peaked and has declined since. Marten research produced a couple of papers per decade from 1970 to the 1990's. Most marten work was published in the 2000's. Most (17) fisher papers were reports of natural history and these were distributed throughout the 4 decades. Models (e.g. energetics, predatory-prey, habitat), abundance estimates, and evaluations of reintroduction efforts were next most common with 5–6 papers each, also distributed throughout the 4 decades. In the 2000's, work on fisher genetics, disease, and physiology has been conducted. Marten research has focused on habitat selection at various scales and population distribution estimates (11). Introduction evaluations (3) and natural history (3) appeared in fewer papers for martens than for fishers. Similar to fisher studies in recent times, researchers have examined genetics, disease, and physiology. Five of the 6 papers in this area have come since 2005. Research is needed in several areas. There continues to be questions about inter-specific interactions among predators, most notably between the 2 *Martes* species. Somewhat related is the work on relationships between *Martes* fitness and snow, especially as it relates to climate change. Emerging fields such as geographic genetics hold promise for elucidating new *Martes* information. Finally, disease issues (e.g. canine parvovirus and distemper) in martens are surfacing with unknown consequences.

DENNING ECOLOGY OF THE FISHER IN THE SOUTHERN SIERRA NEVADA

Green, R.E., K.L. Purcell, C.M. Thompson, and J.D. Garner

USDA Forest Service, Pacific Southwest Research Station, 2081 E Sierra Ave, Fresno, California 93710 USA, rebeccagreen@fs.fed.us.

Characterization of suitable habitat for fisher (*Martes pennanti*) in the western United States has become increasingly important as concern for the conservation of this species has grown over the last decade. Identification of the habitat and structures used by female fishers during the reproductive period is particularly needed in the southern Sierra Nevada to assist in the creation of land management plans that conserve fisher habitat while mitigating the risk of large fires. To learn more about fisher reproductive ecology and associated habitat needs, we used radio-telemetry to find natal and maternal dens during the spring of 2008 and 2009 in the Sierra National Forest, California. To date, we have located 47 structures used by reproductive female fishers (n = 14), including 18 natal dens, 28 maternal dens, and 1 unknown. Counts of kits per female were conducted when feasible using remotely triggered cameras, video cameras on extendable poles, or by climbing the tree and inserting a video camera into the den cavity. Litter counts using these techniques on 18 occasions yielded a mean of 1.5 kits per female. Nineteen (40%) of the 47 dens were found in cavities of California black oaks (*Quercus kelloggii*). The remaining dens were found in a variety of conifer species including white fir (*Abies concolor*), incense cedar (*Calocedrus decurrens*), ponderosa pine (*Pinus ponderosa*), and sugar pine (*Pinus lambertiana*). Mean diameter at breast height of den trees from 2008 (n = 14) was 99.3 cm, with a range of 57.9–162.8 cm. Mean structure height for 2008 dens was 24.0 m, with a range of 5.6 (a broken snag)–48.6 m, and mean height of the cavity opening was 9.8 m (range of 1.8–33.5 m). Canopy cover was 72.7% across 2008 den sites, with a range of 56–93%.

PREDICTING SPATIAL DISTRIBUTION OF *MARTES AMERICANA* AT THE LANDSCAPE SCALE ACROSS THE WESTERN US

Guy, R.K. and K.G. Boykin

New Mexico Cooperative Fish and Wildlife Research Unit, Department of Fish, Wildlife and Conservation Ecology, New Mexico State University, P.O. Box 30003, MSC 4901, Las Cruces, New Mexico 88003 USA, guy@nmsu.edu.

Modeling species habitat distribution at the landscape scale has been recognized for its importance in predicting dispersal patterns, anticipating potential dispersal barriers, and identifying new pockets of habitat not previously documented. Traditionally, modeling at large extents has been done deductively or inductively at a coarse grain, using habitat relationships with environmental factors such as vegetation communities, elevation, and climatic variables. Variables such as percent of forested landscape have not been used over large extents for species such as American marten (*Martes americana*). It is also uncertain if the influence of these variables can be extrapolated to the entire range of a species. The objectives of this study were to: (1) create a novel spatial dataset of percent forest cover measured at 9 km^2; (2) deductively

model using the novel percent forest cover dataset in conjunction with a canopy cover dataset, a seral stage dataset, and a landcover dataset at a 30-m grain size; (3) combine the deductive model with an inductively derived elevation-climatic envelope; and (4) determine the marten's differential response to the variables across disparate sites in the western United States. Omission rates were determined for each model using Natural Heritage datasets and museum records from the 1990's to present day. The results from the percent forest cover dataset when compared to marten occurrences is in agreement with the literature throughout the sites, with the majority of occurrence points coinciding with areas greater than 25-30% forest cover. Omission rates for the models were also highest for seral-stage models in all study sites, whereas they were lowest for models using canopy cover and percent forest cover datasets. These results indicate that percent forest cover and canopy cover may prove useful datasets for modeling the American marten's distribution over large extents.

NOBLE MARTEN (*MARTES AMERICANA NOBILIS*) REVISITED: ITS ADAPTATION AND EXTINCTION

Hughes, S.S.

11194 Killdeer Lane NE, Bainbridge Island, Washington 98110 USA, susansh54@msn.com.

The cause of extinction of the noble marten (*Martes americana nobilis*), as well as its taxonomic position, has been the subject of debate in recent years. This extinct marten, a close relative of the extant American marten (*Martes americana*), is known from 18 sites in western North America, most dating to the late Pleistocene. Because boreal fauna were associated with the late-Pleistocene noble marten, researchers generally believed that it inhabited boreal forests like the American marten, and competition between the 2 may have caused its extinction. Recent discoveries of noble martens associated with xeric fauna from Holocene contexts have called these assumptions into question. I explore the adaptation and habitat of the noble marten with an analysis of its faunal associations and find-site locations. The analysis suggests that the noble marten was adapted to open, mesic grasslands in montane foothills, and was likely not sympatric with the American marten. I also introduce a new Holocene noble marten specimen, a right mandible dating to 6,400 years ago, from Mummy Cave, an archaeological site in northwestern Wyoming.

MODELING FUNCTIONAL CONNECTIVITY OF THE AMERICAN MARTEN (*MARTES AMERICANA*) IN NORTHEASTERN CALIFORNIA, U.S.A.

Kirk, T.A[1]. and W.J. Zielinski[2]

[1]USDA Forest Service, Lassen National Forest, 2550 Riverside Drive, Susanville, California 96130 USA, tkirk@fs.fed.us; [2]USDA Forest Service, Pacific Southwest Research Station, 1700 Bayview Drive, Arcata, California 95521 USA.

Landscape connectivity is important for maintaining species persistence and presents a long-term challenge to land-use managers. Species with specialized habitat preferences, large home

ranges, and small populations with limited distributions may be particularly vulnerable to habitat conversion and fragmentation. We used least-cost path/corridor analysis in a Geographic Information System (GIS) to model likely movement corridors for the American marten (*Martes americana*) in northeastern California. Functional connectivity measures the 'effective distance' of marten movements across the landscape by modeling behavioral responses to the physical structure of different 'matrix' vegetation types as a 'friction' or cost/risk surface, weighting unsuitable habitats with greater 'costs'. Least-cost corridors were calculated for 6 landscape linkages between known marten populations across a study area encompassing 75,352 km^2, from the Oregon border to Lake Tahoe. We developed the cost/risk surface by re-scaling the suitability values for the 'feeding' category from California Wildlife Habitat Relationships system, supplemented with regional knowledge of habitat preferences for martens. Additional resistant landscape features such as roads, rivers, topography (cliffs), low elevation, and recently burned areas were also included. Sensitivity analyses were used to evaluate 8 cost/risk surfaces based on different assumptions of marten responses to matrix vegetation. We provide an example of how land managers can model potential effects of a timber harvest on marten movement corridors and evaluate the corridor using specialty software within 1 of the linkages. The top 25% of connectivity corridors are displayed across all 6 linkages, and 'bottlenecks' (areas of minimal connectivity) are identified in northeastern California. We anticipate assessing modeled corridors in the future using 'indirect' genetic analyses and/or telemetric data.

TOOLS TO ASSIST THE INCORPORATION OF FISHER HABITAT NEEDS INTO FORESTRY PRACTICE IN BRITISH COLUMBIA

Lara Almuedo, P.[1], F.B. Corbould[2], R.L. Davis[3], E.C. Lofroth[4], E.M. Phinney[5], K. Sutherland[1], K. Swift[1], and R.D. Weir[6]

[1]FORREX Forum for Research and Extension in Natural Resources, Suite 702, 235 1st Avenue, Kamloops, British Columbia V2C 3J4 Canada, pedro.laraalmuedo@forrex.org; [2]Peace/Williston Fish and Wildlife Compensation Program, Suite 325, 1011 Fourth Avenue, Prince George, British Columbia V2L 3H9 Canada; [3]Davis Environmental Ltd., 202 Fetters Drive, Williams Lake, British Columbia V2G 5G2 Canada; [4]British Columbia Ministry of Environment, P.O. Box 9338 Stn Prov Gov, 2975 Jutland Road, Victoria, British Columbia V8W 9M1 Canada; [5]Louisiana-Pacific Canada Ltd., 116-116th Avenue, Dawson Creek, British Columbia V1G 3C8 Canada; [6]Artemis Wildlife Consultants, 4515 Hullcar Road, Armstrong, British Columbia V0E 1B4 Canada.

In an effort to encourage improved integration of fisher (*Martes pennanti*) habitat needs into forest management decisions in British Columbia, we are developing and implementing an extension program to support decision-makers with relevant information and tools. This program is an important means of achieving our long-term habitat goal of ensuring that "sufficient habitat is conserved, recruited and enhanced at different spatial scales—element, patch, stand and landscape—to sustain populations of fishers distributed throughout their historical range in British Columbia". Specific consideration will be given to the habitat needs of fishers for rearing, resting, foraging, and traveling. Our extension program uses a collaborative approach that engages researchers, regulatory agencies, forest licensees, logging

and silvicultural contractors, and trappers. Specific, results-based extension products will be developed for each practitioner audience. We will identify desired changes in action, practice, decisions, and policy specific to each audience to promote long-term supply of fisher habitat. The primary outputs of the extension program include: (1) Fisher Habitat Workshops where practitioners provide input on effective means of achieving desired habitat conditions; (2) a Fisher Wildlife Habitat Decision Aid published in the peer-reviewed BC Journal of Ecosystems and Management, integrating best available scientific and expert knowledge on fisher habitat into a user-friendly decision-support product; (3) and a Fisher Habitat Field Guide that facilitates identification , conservation and recruitment of fisher habitat at operational levels. Increased awareness and outreach of these various products will be achieved through a PowerPoint training tool presented and distributed to forestry practitioners throughout the province, along with the delivery of extension articles in newsletters (i.e., LINK) and e-mail distribution lists (i.e., FORREX Conservation Biology Listserv).

DIET AND DISEASE CHARACTERISTICS OF PENNSYLVANIA FISHER

Larkin, J.L.[1], J.C. Wester[1], M. Gabriel[2], R. Gerhold[3], M.J. Yabsley[4], J. Humphreys[1], and J.P. Dubey[5]

[1]Department of Biology, Indiana University of Pennsylvania, 126 Weyandt Hall, Indiana, Pennsylvania 15705 USA, larkin@iup.edu; [2]University of California Davis, Department of Veterinary Genetics, Canid Diversity and Conservation Laboratory, Davis, California 95616 USA; [3]Southeastern Cooperative Wildlife Disease Study, College of Veterinary Medicine, The University of Georgia, Athens, Georgia 30602 USA; [4]Warnell School of Forestry and Natural Resources, The University of Georgia, Athens, Georgia 30602 USA; [5]USDA Animal Parasitic Disease Lab, BARC-East Bldg 1001, 10300 Baltimore Avenue, Beltsville, Maryland 20705 USA.

We examined diet composition and overlap in Pennsylvania fisher. Forty-one accidentally and road-killed fisher carcasses were collected throughout Pennsylvania between 2001 and 2008. Additionally, we also tested carcasses for prevalence of *Toxoplasma gondii*, *Sarcocystis* spp., and rabies. Of 37 stomachs examined, evidence of mammalian and avian prey was found in twenty-nine (78.4%) and 4 (10.8%), respectively. Three (8.1%) contained berries, 1 contained corn (2.7%) and 1 contained eggshell (2.7%). Diet overlap was high ($C_\lambda = 0.87$) between the sexes. Diet diversity, evenness, and niche breadth were all higher for females ($H'_{standard} = 16.9$, $J = 0.89$, $B_{standard} = 0.66$) than males ($H' = 12.5_{standard}$, $J = 0.78$, $B_{standard} = 0.41$). Of the fishers tested for *T. gondii* and *Sarcocystis* spp. (n = 30), 100% and 90% tested positive, respectively. One out of 41 fishers tested positive for rabies. It is likely that these sarcocysts represent a previously undescribed *Sarcocystis* spp. The high prevalence of fishers infected with coccidian parasites may be due to their opportunistic feeding habits.

RESPONSE OF FISHER (*MARTES PENNANTI*) TO ANTHROPOGENIC DISTURBANCE IN THE KISKATINAW PLATEAU ECOSECTION OF THE BC PEACE RIVER REGION.

Mattson, I.K.[1], C.J. Johnson[1], R.D. Weir[2], E.C. Lofroth[3], and E.M. Phinney[4]

[1]Ecosystem Science and Management Program, University of Northern British Columbia, 3333 University Way, Prince George, British Columbia V2N 4Z9 Canada, hanseni@unbc.ca; [2]Artemis Wildlife Consultants, 4515 Hullcar Road, Armstrong, British Columbia V0E 1B4 Canada; [3]British Columbia Ministry of Environment, P.O. Box 9338 Stn Prov Gov, 2975 Jutland Road, Victoria, British Columbia V8W 9M1 Canada; [4]Louisiana-Pacific Canada Ltd., 116-116th Avenue, Dawson Creek, British Columbia V1G 3C8 Canada.

Currently in British Columbia, fishers are recognised as a Blue List species (i.e., vulnerable), meaning their populations are sensitive to human activities and/or natural events. In the Peace River Region of British Columbia, we have a poor understanding of the ecology and habitat use of fishers, despite this being an area where fishers are relatively common. This is problematic as the rapid expansion of the oil and gas industry, as well as continued forestry and agricultural development, are fragmenting landscapes that have historically supported sustainable fisher populations. Responses of fishers to human-created disturbances have rarely been explicitly studied, although altered habitats may impact the ecology and sustainability of fisher populations. For example, increased removal of forest for industrial activity may reduce the availability of suitable den trees, which have the potential to be rare in the Peace Region landscape. We are investigating whether fishers avoid anthropogenic disturbance, which we define as human activities that physically alter the quality or availability of habitats or stimuli that affect how fisher use habitats. We are currently measuring the multi-season response of radio-telemetry monitored fishers to anthropogenic disturbance within their home ranges. Using a resource selection function (RSF), we are assessing fisher movements in relation to habitat and disturbance variables and, if a response is observed, we will quantify potential associated habitat changes by modeling the effects of disturbance on space use by fishers. Data analysis is ongoing so major findings cannot be reported at this date. We have no doubt that in this heavily fragmented landscape, any of the possible outcomes will be of interest to the *Martes* research community.

EXPRESSION OF HOMOLOGIC CRANIAL PHENE IN SIX *MARTES* SPECIES

Monakhov, V.G. and M.N. Ranyuk

Institute of Plant and Animal Ecology of RAS, 202 8th Marta str., Ekaterinburg 620144 Russia; mon@ipae.uran.ru.

We studied the variability of cranial phene (FFCI; *foramen in fossa condyloidei inferior*) in 6 species of *Martes*: *M. americana* (n = 88), *M. flavigula* (n = 78), *M. foina* (n = 80), *M. martes* (n = 2036), *M. pennanti* (n = 12) and *M. zibellina* (n = 9,586) from Russian museums. This work is sponsored by RFBR (projects 07-04-96105, 07-05-00298). This phene has not been detected previously in *M. pennanti*, and there is a very low expression of the trait in *M. flavigula* (1.28%), an average expression in *M. martes* (27.8%; 25.4% for Germany) and *M. zibellina* (45.1%), a

higher expression in *M. americana* (61.4%), and the greatest expression in *M. foina* (72.5%). Geographic variation in this trait in *M. martes and M. zibellina* can be described as clinal (or polyclinal). For example, in *M. zibellina*, the highest average frequency is in the East (70% in Sikhote-Alin Mountains), and the minimum in the West (13% in SW Altai, 20-30% in the Ural Mountains). In central regions (Kuznetsky Alatau, W. Sayan, Yenisei Basin) the phene frequency is 20-35% in males and 40-50% in females. We also found sex-based differences in the expression of this trait—the frequency was higher in females. Thus, the frequency of FFCI (male %/female %) in *M. martes* was 23.9/32.7; in *M. americana*, 54.2/70.0; in *M. zibellina*, 36.5/54.6, and in *M. foina*, 58.5/87.2. We also found that after mass translocations of Baikal sables (phene frequency 50-65%) in portions of the Ob Basin (25-32% for aboriginals), the expression of this trait in allochthonous populations was 45-48%. Thus, there are significant differences among species and populations in this phenetic trait, which suggest their different genetic status. This feature is reported to be ancestral (plesiomorphic), and may indicate proximity to ancestral *Martes* lineages. We suggest using the FFCI as a new population characteristic, together with size, color, etc., as studies show that this trait is chronologically stable in aboriginal populations. Phenetic tests may therefore provide a promising new tool for population, taxonomic, and phylogeographic studies.

SPATIAL ECOLOGY OF PINE MARTEN IN COMMERCIAL FOREST PLANTATIONS IN IRELAND

O'Mahony, D.

Ecological Management Group, Ormeau Business Park, 8 Cromac Avenue, Belfast BT7 2JA, Northern Ireland, declan.omahony@ecomgt.com.

Throughout their Palearctic range, pine marten (*Martes martes*) are dependent on forested and scrub habitat. The most extensive habitat resource available to the pine marten in Ireland is managed commercial forestry plantations, which are dominated by a few conifer species including Sitka spruce (*Picea sitchensis*) and lodgepole pine (*Pinus contorta*). Semi-natural forests are not common and, in some regions, pine marten are capable of occupying relatively open habitats that lack forest cover. As part of the National Pine Marten Survey of Ireland, I undertook the first investigation of pine marten socio-spatial ecology and habitat selection in Ireland. The study area was a 2,800-ha upland commercial forestry plantation actively managed for timber production, that was dominated by conifers (80% of area) but also contained open moorland habitat (15% of area). From March 2008 to March 2009, 7 pine marten (5 male and 2 female) were radio-tracked for between 4 and 10 months. Minimum convex polygons and fixed-kernel estimates were used to investigate home range ecology. Mean home-range estimates for males (171 ha) were larger than those of females (94 ha) and were not correlated with body weight or the proportion of forest habitat within home ranges. There was considerable inter-seasonal overlap in home ranges (approx. 90%) although relatively little inter-sexual (12%) or intra-sexual (17%) overlap. Pine marten home ranges were stable from season to season. Core-ranges were small, ranging in size from 5.6 to 66.9 ha, and as a percentage of home range area, were smaller for males than females (mean = 11.7 and 20.6%, respectively). Core-ranges were occupied exclusively by pine marten throughout the year with no overlap. Direct interactions between pine martens were rare, suggesting that pine marten generally avoided each other. The implications of these results are discussed in relation to potential impacts of forestry management practices on pine marten populations.

THE KINGS RIVER FISHER PROJECT: LINKS BETWEEN FISHER POPULATION VIABILITY AND HABITAT AT MULTIPLE SCALES

Purcell, K.L., C.M. Thompson, J.D. Garner, and R.E. Green

USDA Forest Service, Pacific Southwest Research Station, 2081 E. Sierra Avenue, Fresno California 93710 USA, kpurcell@fs.fed.us.

The Kings River Fisher project was initiated in 2007 to fill gaps in our current understanding of fisher ecology and habitat requirements and address the uncertainty surrounding the impacts of fuels treatments on this small, isolated fisher population in the southern Sierra Nevada in California. We report on results based on 2½ years of data collection in this planned 7-year research effort. The research design employs multiple overlapping techniques that will result in improved demographic estimates and a more sensitive evaluation of the impacts of habitat change. The techniques employed include live trapping, telemetry, and scat-detector dog surveys, as well as monitoring of dens and genetic analysis. Since February 2007, 47 fishers (plus 6 kits) have been captured in the Kings River area. Currently, 27 fishers (20 females and 7 males) are being monitored. Survival has been high and appears to be female-biased. Recaptures from a previous study (2000-2004) included 9 females and only 1 male, and 10 of 14 mortalities documented to date have been males. Reproduction has been high, with 60, 91, and 66% of adult females reproducing in 2007, 2008, and 2009, respectively. Analysis of blood and fecal samples revealed exposure to canine distemper virus, canine parvovirus, canine adenovirus, and *Toxoplasma gondii*. Scat-dog surveys conducted in 2007 and 2008 yielded 1,409 collected scats, of which approximately 42% were genetically confirmed as fisher. Using a combination of genetic analysis and field data, we have been able to assign maternity to all 13 juveniles captured in fall 2008. Recent research directions include testing of prototype GPS collars, analysis of female home range composition to inform forest management efforts, and developing capture/recapture models that incorporate multiple datasets to increase the precision of density estimates from capture/recapture models.

FOOD HABITS OF THE FISHER IN THE CASCADE RANGE OF SOUTHERN OREGON

Raley, C.M. and K.B.Aubry

USDA Forest Service, Pacific Northwest Research Station, 3625 93rd Avenue Southwest, Olympia, Washington 98512 USA, craley@fs.fed.us.

The food habits of fishers are a key component of their habitat ecology that may provide important insights for conservation. From 1995 to 2001, we conducted a radio-telemetry study of fisher habitat relations on the west slope of the Cascade Range in southern Oregon. Prey remains found at den, rest, and kill sites represented a wide variety of birds, mammals, and carrion, including the Stellar's jay, pileated woodpecker, hairy woodpecker, common flicker,

ruffed grouse, turkey, snowshoe hare, brush rabbit, California ground squirrel, Douglas' squirrel, northern flying squirrel, dusky-footed woodrat, Virginia opossum, striped skunk, porcupine, bobcat, black-tailed deer, and elk. However, determining food habits from prey remains alone may over emphasize the importance of larger prey items in fisher diets. Consequently, we also identified prey remains in 387 scats (303 from 11 females, and 84 from 8 males) collected at trap, den, and rest sites. Mammals were the most frequent food item in fisher scats (83% of scats). Birds and insects were common food items (28 and 26% of scats, respectively), berries and mast were found in 14% of scats, and reptiles in 7% of scats. Our results indicate that male and female fishers in Oregon have divergent foraging strategies, whereby males often forage on larger prey species than females. This may simply reflect the larger size of males, or it could be related to the need for denning females to kill prey that can easily be carried back to the den site and consumed by young kits. There also appear to be regional differences in prey selection; fishers in California generally foraged on smaller prey items than those in Oregon, and California fishers commonly foraged on reptiles, whereas Oregon fishers rarely did. These findings may also be related to differences in body size, since California fishers are smaller than the reintroduced fishers we studied in Oregon.

CRANIOLOGIC VARIABILITY OF THE SABLE AND PINE MARTEN

Ranyuk, M.N. and V.G. Monakhov

Institute of Plant and Animal Ecology, 202 8 Marta Str., Yekaterinburg, 620144 Russia, ranyuk@ipae.uran.ru.

The sable (*Martes zibellina*) and pine marten (*M. martes*) are closely related species that may have evolved from a common ancestor in the mid-Pleistocene. Currently, the pine marten occupies all of Europe from the British Isles in the West to the Ural Crest in the East. The sable occurs from the Ural Mountains in the West to the Kamchatka Peninsula and Japan Islands in the East. In areas where these 2 species overlap in the Ural region, they may be hybridizing. External characters are useful for species identification—fur quality differs and martens have more clearly delineated throat spots and a longer tail; however, other morphological characteristics do not differ. The shape of the baculum is reportedly a useful diagnostic character, but sables with marten-shaped baculums have been found. Paleontologists used measurements of the lower jaw to distinguish martens from sables, but high variability in these traits confounds some identifications. Our goal was to develop a technique for distinguishing pine martens and sables using epigenetic skull characteristics. We included 1,150 sables from throughout the study area, and 427 pine martens from the European part of Russia in our analyses. Results of discriminant analysis based on 22 non-metric skull traits resulted in 91% correct species classifications. Intraspecific analyses of craniological variation of the sable and the pine marten resulted in fewer than 45% correct classifications. Craniological variation among sables was higher than martens, but may reflect the absence of marten samples from a large proportion of the study area. The magnitude of variation in these traits differs between the species, perhaps as a result of their different phylogenetic histories.

STONE MARTEN (*MARTES FOINA*) HABITAT USE IN A MEDITERRANEAN ECOSYSTEM: INTEGRATING SELECTION FROM MULTIPLE SCALES

Santos, M.J.[1,2] and M. Santos-Reis[2]

[1]Department of Land, Air and Water Resources, University of California Davis, One Shields Avenue, Davis, California 95616 USA, mjsantos@ucdavis.edu; [2]University of Lisbon, Faculty of Sciences, Center of Environmental Biology / Department of Animal Biology, Ed. C2 3º Piso, Campo Grande, 1749-016 Lisboa, Portugal.

Inherently heterogeneous ecosystems present special challenges to organisms selecting habitat. Individuals may respond differently to habitat patterns than populations, depending on the scale at which patterns occur and the perception needed to identify those patterns. We used a combined data set of stone marten capture and radio-tracking locations at 3 scales of analysis (1-m, 25-m and 450-m-radius plots) to determine whether (1) patterns of habitat use are influenced by the scale of analysis, and (2) our understanding of habitat-use patterns is improved by integrating information from multiple spatial scales. We used generalized linear models to test the effects of land cover, distance to roads, distance to streams, and patch size on the presence or absence of stone martens during foraging and resting activities. We found that, at the smallest scale, foraging activities were more likely to occur closer to streams and to the edges of patches and farther away from roads, than resting activities. However, at the intermediate scale, these activities were influenced primarily by land cover, with pastureland positively affecting the likelihood of foraging and resting activities. In addition, riparian vegetation appears to be linked to foraging, whereas orchards and cork oak woodlands were associated with resting. At the largest scale, all land cover and distance variables positively affected the likelihood of foraging and resting activities, probably due to the patchy nature of the landscape. All models had a high correct classification rate for the presence of stone martens during both foraging and resting activities (>70%). These results suggest that multi-scale analysis provide complementary information on stone marten habitat use. The integration of this information into a management strategy suggests that the maintenance of a patchwork of pasturelands, orchards, riparian vegetation, and cork oak woodlands is likely to encompass stone marten resting and foraging habitat. However, it is important to acknowledge that additional road development and decreased surface water availability are likely to negatively influence stone marten foraging activities in Mediterranean ecosystems.

PATTERNS IN THE DISTRIBUTION, OCCUPANCY AND SURVIVAL OF PACIFIC FISHERS IN THE SIERRA NATIONAL FOREST, CALIFORNIA

Sweitzer, R.A. and R.H. Barrett

Department of Environmental Science, Policy, and Management, College of Natural Resources, University of California, Berkeley, California 94720 USA, sweitzer@nature.berkeley.edu.
Pacific fishers (*Martes pennanti*) were formerly widespread in mixed-conifer forests across mountainous areas of northwestern California and in the Sierra Nevada of eastern California. These animals are now much reduced in the Sierra Nevada, and it is possible that the isolated

population of fishers in the southern Sierra Nevada will continue to decline as the USDA Forest Service implements fuel-reduction measures (Strategically Placed Land Allocation Treatments; SPLATS) to mitigate risk of catastrophic wildfire. In October 2007 we initiated an 8-year study of fishers in the Bass Lake Ranger District, Sierra National Forest to determine population limiting factors, and to evaluate the effects of SPLATS on resource use, survival, and persistence of fishers in the southern Sierra Nevada. We are using repeated surveys of 1-km^2 blocks of forest habitat with automatic cameras, mark-recapture, and intensive monitoring of individual collared fisher to evaluate how SPLATS contribute to changes in habitat use, dispersal, survival, and reproduction by fisher. Fishers were detected in 63% of 254 grids surveyed from Oct 2008 to Apr 2009, but detection rates were highest in areas predicted to encompass suitable habitats based on a predictive model developed by the Conservation Biology Institute. A total 44 individual fisher have been captured since December 2007, of which 19 have subsequently died. Predation has been the most common source of mortality (n = 10) whereas disease and vehicles strikes along a major highway have contributed to at least 8 deaths (4 each for disease and roadkill). The best-fit model explaining our data on mortalities suggests that survival was similarly high for males and females during summer, fall, and winter, but lowest for both sexes during spring. More detailed analyses of data on occupancy, movements, and survival from our first 2 years of research will be presented.

USE OF SCAT-DETECTOR DOGS TO SURVEY FISHERS IN THE SIERRA NATIONAL FOREST, CALIFORNIA.

Thompson, C.M., K.L. Purcell, R.E. Green, and J.D. Garner

USDA Forest Service, Pacific Southwest Research Station, 2081 E. Sierra Av., Fresno, California 93710, USA, cthompson@fs.fed.us.

The use of dogs trained to locate the scat of target species, has increased significantly in recent years. As a non-invasive survey technique with high probability of detection, detector dogs hold great promise for monitoring secretive species such as forest carnivores, yet their accuracy and efficiency across a range of environments remains untested. As part of the ongoing Kings River Fisher Project, we conducted semi-annual scat-detector dog surveys for fisher (*Martes pennanti*) presence in the Kings River area of the Sierra National Forest, California. Ongoing study objectives include generating density estimates through genetic mark-recapture, testing the utility of scat locations to evaluate habitat use, and collecting dietary information. Between October 2006 and June 2009, we conducted 6 surveys and collected >2,000 scats. Dog accuracy, defined as the percentage of collected samples confirmed to be fisher, averaged 56% over all surveys, and ranged from 45 to 62% by season and 40 to 78% by dog. Genetic amplification success to species level was moderate (76%) and to the individual level was low (12%). Habitat-selection patterns were similar between scat locations and telemetry triangulations, though scat locations showed a greater association with typical fisher habitat, such as riparian corridors and large trees and snags. We present our experience with the strengths and weaknesses of detector dog surveys for fishers, the variety of data available from scat-based analyses, and the potential for combining scat-detector dog surveys with more traditional monitoring techniques to improve the precision of demographic estimates.

USING LANDSCAPE GENETICS TO ASSESS THE GENETIC CONNECTIVITY OF FISHERS IN THE SIERRA NEVADA

Tucker, J.M.[1], R.L. Truex[2], M.K. Schwartz[1], F.W. Allendorf[3], and J.S. Bolis[4]

[1]USDA Forest Service, Rocky Mountain Research Station, 800 E. Beckwith, Missoula, Montana 59801 USA, jtucker@fs.fed.us; [2]USDA Forest Service, Pacific Southwest Region, 2480 Carson Road, Placerville, California 95667 USA; [3]University of Montana, Division of Biological Sciences, 32 Campus Drive, Missoula, Montana 59812 USA; [4]USDA Forest Service, Pacific Southwest Region, 57003 Road 225, North Fork, California 93643 USA.

The emerging field of landscape genetics combines landscape ecology, population genetics, and spatial statistics to examine how landscape features affect genetic connectivity. Previous genetic studies have found the population of fishers (*Martes pennanti*) in the Sierra Nevada to have extremely low genetic diversity and high genetic structure, indicating that the population may be divided into 2 or more isolated subpopulations. Through an ongoing U.S. Forest Service carnivore monitoring program, we have collected a large, geographically representative set of genetic samples from this population. Genetic material was collected non-invasively from 2006 to 2008 using barbed-wire hair-snares installed at baited track-plate stations. Individuals and gender were identified using 10 microsatellite loci and a y-linked gender specific marker. To date, we have successfully identified over 100 individuals from sample units across the southern Sierra Nevada. We conducted a landscape genetics analysis to assess population structure and identify landscape features correlated with high and low levels of gene flow. Our analysis confirms that this population of fishers has relatively low genetic diversity, but also revealed that there is far greater genetic connectivity throughout the population than has been previously reported.

MULTIPLE-SCALE HABITAT RELATIONSHIPS OF *MARTES AMERICANA* IN NORTHERN IDAHO, USA

Wasserman, T.N.[1], S.A. Cushman[2], D.O. Wallin[1], and J. Hayden[3]

[1]Huxley College of the Environment, Western Washington University, 516 High St Bellingham, Washington 98225 USA, moonhowlin@yahoo.com; [2]USDA Forest Service, Rocky Mountain Research Station, 800 East Beckwith, Missoula, Montana 59801 USA; [3]Idaho Department of Fish and Game 2885 W. Kathleen Ave, Coeur D'Alene, Idaho 83815 USA.

We used non-invasive hair snaring to detect American marten (*Martes americana*) in northern Idaho, USA. Individuals were genetically analyzed using 7 microsatellite loci and individuals were the units of observation. We used multi-model inference in a logistic regression framework and AIC to model multiple-scale habitat selection by American marten within our study landscape. The study area is a 3,000 km^2 section of the Selkirk, Purcell, and Cabinet Mountains encompassing the Bonners Ferry and Priest River Ranger Districts of the Idaho Panhandle National Forest. A priori, we selected several variables we believed would be strongly related to American marten occurrence based on previous research. These variables included elevation,

seral stage, percent canopy closure, road density and probability of occurrence of the 3 dominant tree species, Douglas-fir (*Pseudotsuga menziesii*), western redcedar (*Thuja plicata*), and subalpine fir (*Abies lasiocarpa*). These variables were modeled at a variety of spatial scales, and landscape metrics were used to describe a variety of habitat features. Our results suggest that at the scale of home ranges, marten select landscapes with high average canopy closure and low fragmentation. Within these unfragmented landscapes, marten select foraging habitat at a fine scale within mid-elevation, late-seral mesic forests. This analysis suggests that optimum American marten habitat in northern Idaho consists of landscapes with low road density, low density of non-forest patches, with high canopy closure and large areas of middle-elevation, late-seral mesic forest. Comparison of current landscape conditions to those expected under the historical range of variability indicates that road building and timber harvest in the past century likely have dramatically reduced the amount of suitable marten habitat in northern Idaho. Our results highlight the importance for this species of conserving remaining mid-elevation, late-seral mesic forests and the potential benefits of closing and revegetating forest roads.

PATTERNS OF SPACE USE BY FISHERS IN THE BOREAL FORESTS OF NORTHEASTERN BRITISH COLUMBIA

Weir, R.D.[1], E.C. Lofroth[2], I.K. Mattson[3], and E.M. Phinney[4]

[1]Artemis Wildlife Consultants, 4515 Hullcar Road, Armstrong, British Columbia V0E 1B4 Canada, rweir@artemiswildlife.com; [2]British Columbia Ministry of Environment, P.O. Box 9338 Stn Prov Gov, 2975 Jutland Road, Victoria, British Columbia V8W 9M1 Canada; [3]Ecosystem Science and Management Program, University of Northern British Columbia, 3333 University Way, Prince George, British Columbia V2N 4Z9 Canada; [4]Louisiana-Pacific Canada Ltd., 116-116th Avenue, Dawson Creek, British Columbia V1G 3C8 Canada.

To better understand spatial relationships of fishers (*Martes pennanti*) in the boreal mixed-wood forests of Canada, we monitored 17 free-ranging radio-tagged fishers near Dawson Creek, British Columbia between 2005 and 2009. We estimated home range size and location for each fisher using the 95% isopleth of the utilization distribution generated from the fixed-kernel method with the smoothing parameter selected by least-squares cross-validation. Home ranges were well distributed across the study area and averaged 32.1 km² (SD = 15.0, n = 13) for females and 198.8 km² (SD = 51.1, n = 4) for males. Unlike other areas in British Columbia, female fishers changed their patterns of space-use over time, with considerable overlap between home ranges of adjacent resident females. Male fishers moved extensively across the landscape. Their home ranges overlapped portions of the home ranges of between 1 and 6 radio-tagged females, and occasionally overlapped the home ranges of other males. Although home ranges of fishers in boreal mixed-wood forests of northeastern British Columbia were similar in size to elsewhere in the province, the overall density of fishers in the forested landscape may be higher because more areas are capable of supporting home ranges.

FOOD HABITS OF MARTENS (*MARTES FOINA* AND *MARTES MARTES*) IN SOUTHERN POLAND

Wierzbowska, I.A.[1], M. Eskreys[1], H. Okarma[1], and A. Zalewski [2]

[1]Institute of Environmental Sciences, Jagiellonian Uniwersity, 7 Gronostajowa, 30-387 Krakow, Poland, i.wierzbowska@uj.edu.pl; [2]Mammal Research Institute, Polish Academy of Sciences, 1c Waszkiewicza str., 17-230 Bialowieza, Poland.

The main purpose of this study was the assessment of diet composition and feeding habits of stone martens (*Martes foina*) and pine martens (*Martes martes*) inhabiting various habitats in southern Poland. Except for urban areas where only the stone marten is recorded, both species have sympatric distributions in Poland. For our research, we chose 3 national parks (Ojcow National Park ONP, Gorce National Park GPN, and Tatra National Park TPN), and 1 large metropolitan urban area, the city of Krakow. Our studies were conducted between 2003 and 2008. Feeding habits of martens were studied by scat analysis. The material was collected along designated transects with respect to various habitats in the study areas. The total length of our transects was 84 km. Scats were collected once a fortnight throughout the year to evaluate differences among seasons. The total number of collected scats was 307 in the national parks and 431 in the city. Food composition was expressed by both percent of biomass consumed (% Bio) and percent of occurrence (% Occ) in scats. The biomass of consumed prey was calculated by using the coefficients of digestibility. Several food categories were defined, including birds, mammals, fruits and grains, other plant materials, insects, and trash. The diet of martens from the city centre was dominated by birds (63% Bio). However, in the suburbs of Krakow, diets were composed mainly of plant material (fruit and grains) (45% Bio). In the national parks, martens consumed mainly mammals, including rodents, insectivores, and sometimes the carrion of larger mammals such as hares, deer, and domestic animals. Mammalian food fraction constituted more than 80% of consumed biomass in TPN and 63% in GPN, respectively, whereas in ONP, martens foraged mainly on plant material (60% Bio). Trash was an important component of marten diets, indicating adaptations of these species to anthropogenic resources.

DEVELOPING AND TESTING A FISHER LANDSCAPE HABITAT SUITABILITY MODEL FOR INTERIOR NORTHERN CALIFORNIA.

Zielinski, W.J.[1], J.R. Dunk[1,2], J.S. Yaeger[3], D.W. LaPlante[4]

[1]USDA Forest Service, Pacific Southwest Research Station, Arcata, CA 95521 USA: bzielinski@fs.fed.us; [2]Department of Environmental and Natural Resource Sciences, Humboldt State University and USDA Forest Service, Pacific Southwest Research Station, Arcata, CA 95521 USA; [3]U.S. Fish and Wildlife Service, Yreka, CA 96097 USA; [4]Natural Resource Geospatial, Yreka, CA 96097 USA.

The fisher (*Martes pennanti*) has been the subject of a number of previous landscape-level habitat modeling efforts in California. However, a predictive landscape model has not been developed specifically for the Klamath Mountains region in north-central California. Our objective was to model the relationship between fisher distribution and mapped environmental

variables for use when addressing management and conservation concerns. Surveys ($n = 145$ sample units) used a pre-existing national systematic sampling grid based on the Forest Inventory and Analysis (FIA) system as the basis for selecting sample locations. Each sample unit was composed of 6 sooted and baited enclosed track-plate stations. We used non-parametric logistic regression, a subset of Generalized Additive Models (GAMs), to evaluate the relationship of the detection and non-detection of fishers to landscape habitat variables. We developed 291 *a priori* univariate and multivariate candidate models from 12 categories of landscape-level habitat variables. The 4 top-ranked models were averaged and included variables indicative of sites with favorable abiotic conditions, dense canopy, large-diameter trees, hardwood presence, and an abundance of diverse prey. Including variables to account for spatial autocorrelation of detections did not improve model fit. Model skill was intermediate, both in reclassifying the developmental data and in classifying an independent set of data. Mapped probability of occurrence resulted in a very heterogeneous surface for this study area, indicative of the sharp environmental gradients. We anticipate the model being useful for evaluating the effects of large-scale vegetation management and habitat distribution and connectivity.

Attachment C.

Udpate/Status Report on The SNAMP Fisher Study

Fisher Workshop, Western Section TWS
January 29, 2010
Visalia, CA

Rick A. Sweitzer & Reginald H. Barrett
College of Natural Resources Department of Environmental Science, Policy & Management
University of California, Berkeley

SNAMP Fisher Study: Objectives other Basics

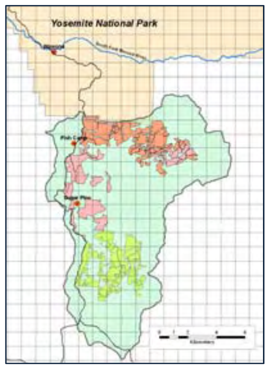
1. Determine population parameters, & limiting factors
2. Evaluate effects of fuel reduction treatments (SPLATS) on resource use, survival, & the likelihood of continued persistence in the southern Sierra Nevada

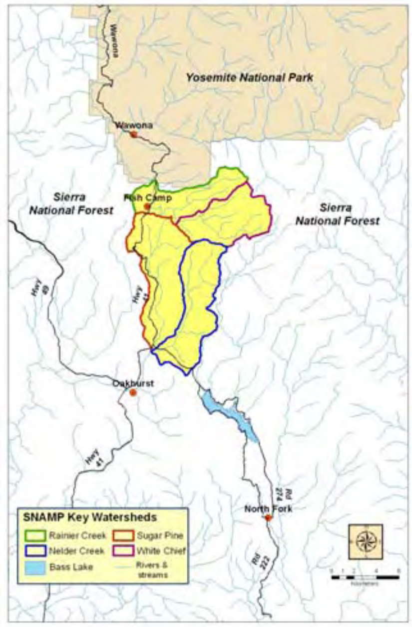
METHODS (brief):

- Radiocollar fishers for data on: survival, movements, dispersal, den locations
- Digital cameras for: estimating distribution, occupancy in areas of treatments, verify den structures, data on fecundity

SNAMP Fisher Study: Background & Study Area

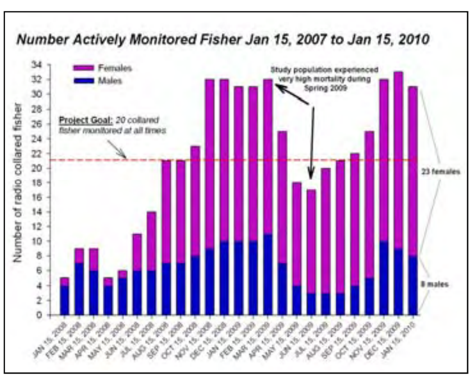
- 8 year study initiated in Sept 2007 - Bass Lake Ranger District, Sierra National Forest
- Focused/high intensity research within four key watersheds where fuel treatments are planned during period of research

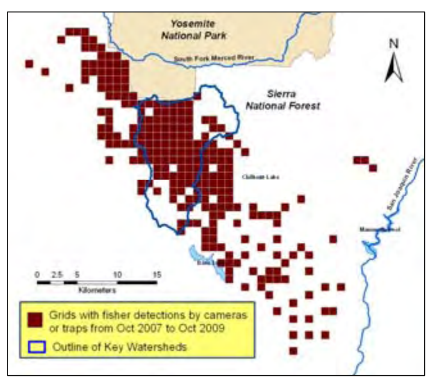




SNAMP Fisher Study: Current Status

- 62 total individual fishers (24 males, 38 females); currently 31 fishers being monitored
- In 3rd year of research effort, approaching 3rd denning season
- Before treatment data collected for areas to be treated beginning summer 2010
- Compiling and analyzing data *(occupancy modeling data covered in detail earlier)*



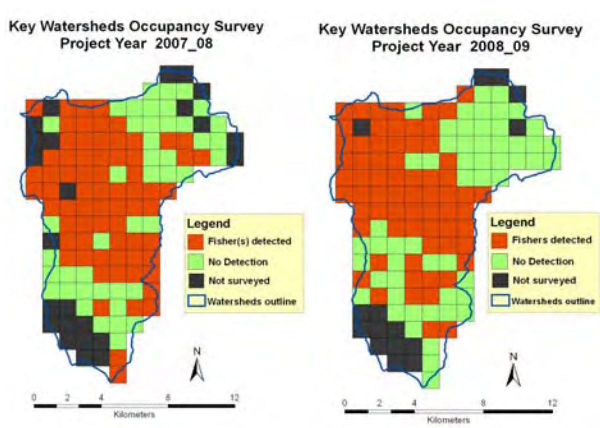


Update/New Information from the SNAMP Fisher Project:

- **We've defined several "Indicators for Fisher Management" within our study area**
- **Data on these parameters will be reported annually during "Integration" meetings hosted by SNAMP Public Participation (*typically in July*)**

1. **Occupancy** in key watersheds
2. Adult female **survival** rate
3. **Population** size in key watersheds

New Findings: Occupancy Surveys in Key Watersheds



Project Year 2007_08	Project Year 2008_09	Project Year 2009_10
Fisher Active Grids: 69	Fisher Active Grids: 67	Fisher Active Grids: 68
No fisher detection: 44	No fisher detection: 55	No fisher detection: 51
Naïve occupancy: 61%	Naïve occupancy: 55%	Naïve occupancy: 57%

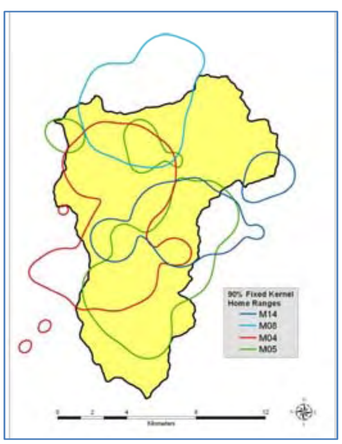
New Findings: *Reproduction/Fecundity/Survival*

- ❖ Reproduction similar in Year 1 (80%) and Year 2 (81%)
- ❖ Fecundity was estimated as 1.45 ± SD 0.52 kits/female for 11 adult females in 2009
- ❖ Overall survival = 66.4% but varies by sex, age, lower in SNAMP area than in Kings River:
- ❖ All male: 53.1%, All female: 73.9
- ❖ Adult female: 83.6
- ❖ Continuing active collaboration with Kings River Study

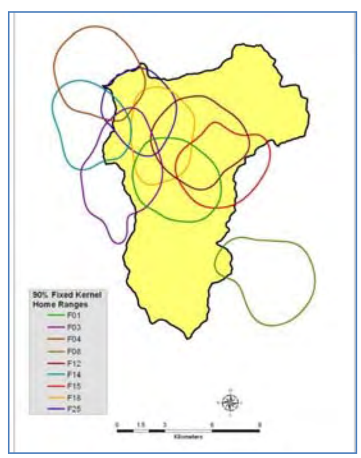
Craig Thompson will provide detailed review of combined data on survival

New Findings: Numbers of Fishers Using Key Watersheds during Population Year 2 (01 Apr 08 – 31 Mar 09)

90% fixed kernels - males



90% fixed kernels - females

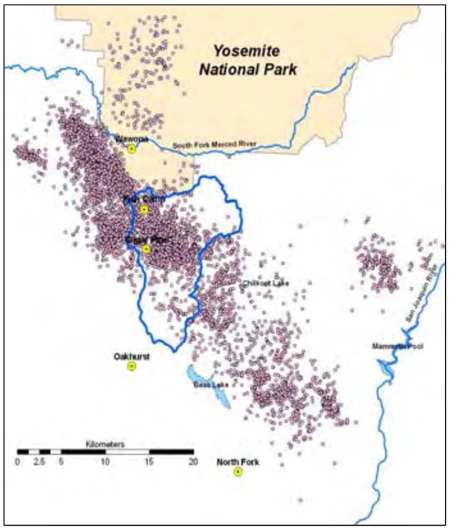


Population Year 2: *8.5 adults using Key Watersheds Area*

New Findings: Data on home range size for fishers in SNAMP study are larger than anywhere else in California

- SNAMP Fishers 2008-09 95% Fix Kernels
  Avg 15 adult females: 28.4 ± SE 1.8 km^2
  Avg 6 adult males: 64.3 ± SE 10.1 km^2
- Ability to locate individual animals 4-6 times/week by aerial telemetry is likely explanation *(don't miss very much on fisher movements)*
- Recorded 6065 positions during aerial telemetry (≈ 2025 in Key Watersheds)

Implications: might be difficult to contrast data on movements/home ranges with Kings River Study fishers

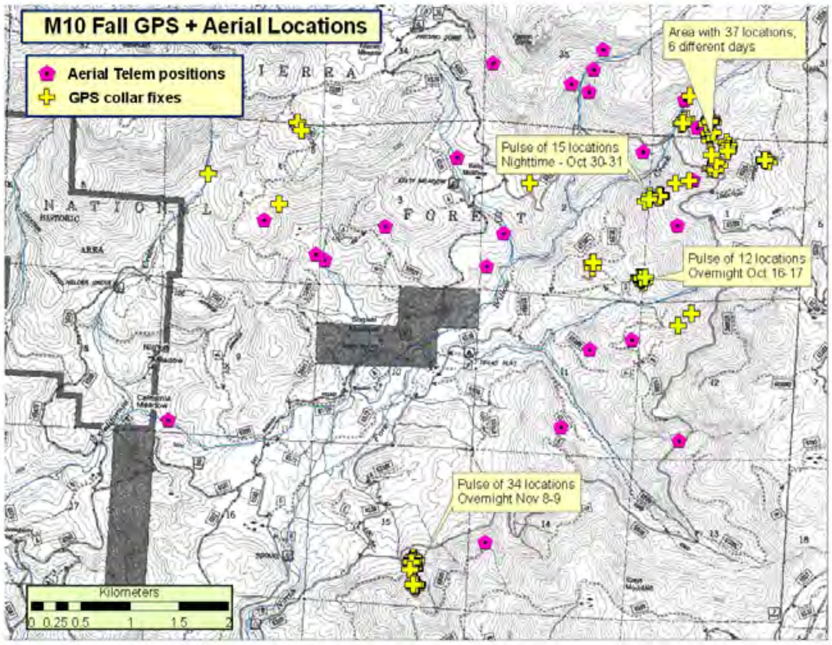


New Findings: GPS Collars & Fishers

- *2x size & nearly 2x as heavy as VHF collar…*
- *Have both GPS & VHF beacons - separate batteries*
- *Battery life ≤ 4 months - VHF = 18-24 months*
- *GPS fixes stored in memory, remotely downloadable*
- *size may prevent females from entering/exiting dens*
- *Programming features very flexible – hope is we'll obtain movement information can't get any other way*

RESULTS/COMMENTARY
- *GPS collars deployed on 7 animals*
- *2/7 deployments - units failed*
- *Field tests – accuracy 8 m to 57 m*
- *Acquired 516 GPS locations, fix rate has been low (< 29%)…*

SNAMP Fisher: New Findings & New Questions



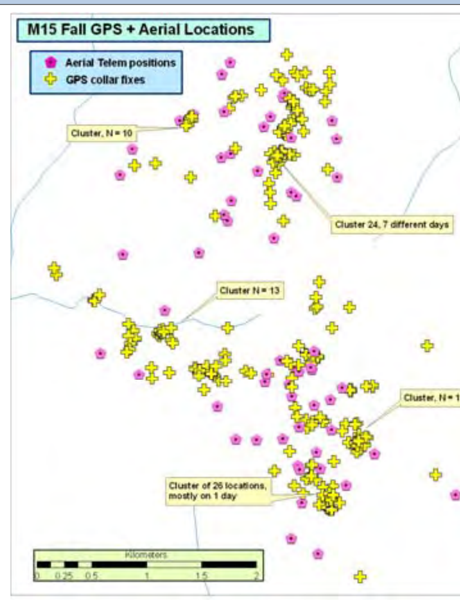
New Questions: GPS Collars & Improving But More to Do

- We locate each individual animal ~ 5 days/week - Do GPS collars tell use something different about movements we're not getting by high intensity aerial telemetry?

Results:

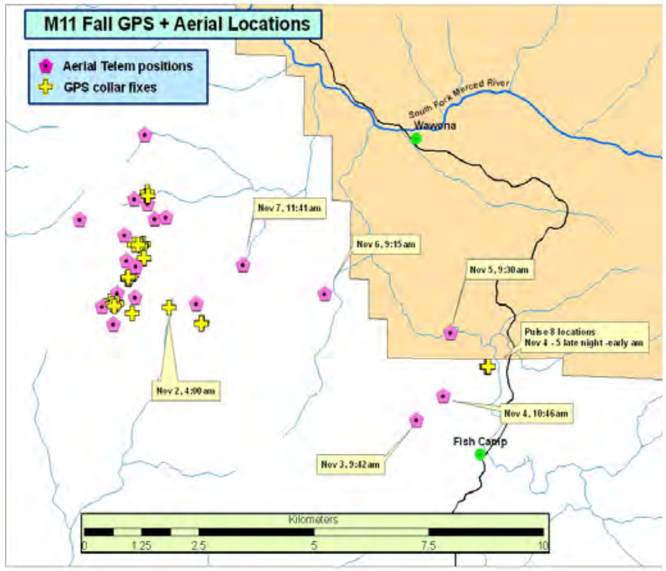
GPS locations are bounded within areas of movement based on aerial telemetry – answer to question above is *"not really"*

But, clustering of positions is apparent for all GPS collared animals – *what do clusters represent for habitat use?*



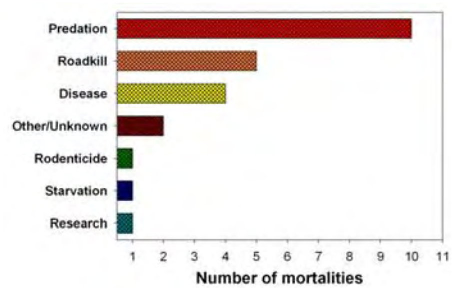
New Questions: GPS Collars – Low rate of achieving fixes needs to improve to avoid mproving But More to Do

- Fix rate (# achieved fixes/# scheduled fixes) has been low (< 25%)
- Result has been missed data on key movements occurring within animal home ranges
- Adapting our collar scheduling to try to improve on fix rate, while also working with manufacturer to improve technology



<u>News Results</u>: Detailed Data on Causes of Mortality

- Causes of mortality documented for 20 collared + 4 noncollared fishers
- Major causes of mortality include predation (9-10), roadkill (4), and disease (4-5)
- 1st capture mortality on SNAMP in October 2009 (*drug –related*)



Teva Animal Health, Inc. expands a voluntary nationwide recall of Ketamine Hydrochloride Injection, USP CIII 100mg/mL in 10mL vials

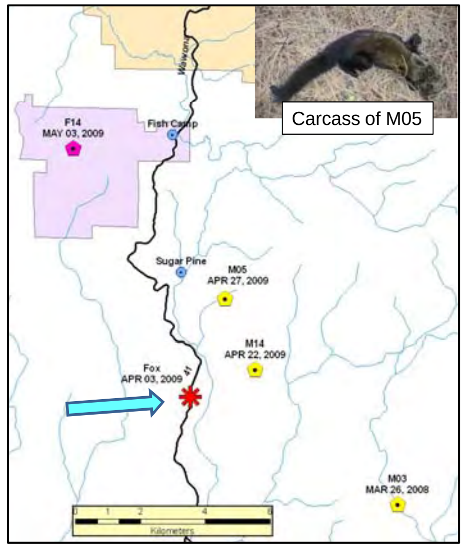
<u>From Recall alert Dec. 21, 2009:</u>
"This recall is being conducted as a result of an increased trend in serious adverse events associated with this product including *lack of effect, prolonged effect, and death*"

<u>Predation</u>: *7-8 bobcat, 2 mt lion, 5 pending*

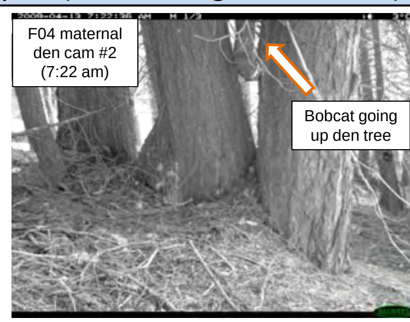
<u>Disease:</u> *3-4 canine distemper, 1 toxoplasmosis*

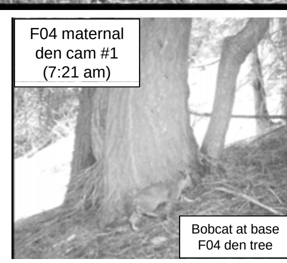
New Findings: CDV Epizootic occurred in SNAMP Project Study Area during April to early May 2009

- Sick gray fox – died after capture (April 3) on Hwy 41 near Cedar Valley exhibiting symptoms of CDV
- Carcasses of M14 & M05 picked up nearby on April 22 & April 28; both confirmed as having died from active infection with CDV
- Adult female fisher (F14) with an ongoing CDV infection was killed by predator (left uneaten), 1 week Later
- Collaboration with Mourad Gabriel/UC Davis has been extremely valuable and will continue



New Findings: Most Fisher Predation in SNAMP Project Area Now Linked to Bobcats by DNA analyses (Greta Wengert, UC Davis)



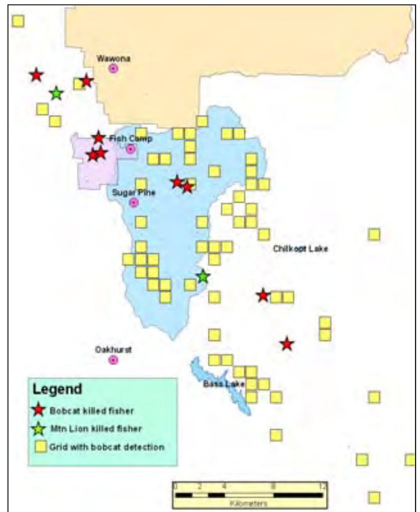


** F04's female kit (F20) from Spring 2008 was killed by a bobcat less than 1 mile from this den tree on May 15, 2009

SNAMP New Findings: High levels of bobcat predation (N = 8-9)

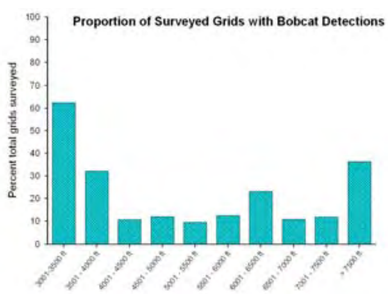
- 8-9 SNAMP fishers killed by bobcats
- All bobcat kills have been female fishers (3 adults, 6 juveniles)
- 2 of 3 adult females reproductive at death
  - *F09 – 2 kit embryos in carcass*
  - *F14 – denning female (1-2 kits in den tree)*
- Greta will begin trapping to collar bobcats in SNAMP study area for assessing bobcat-fisher interactions (*new collaboration*)

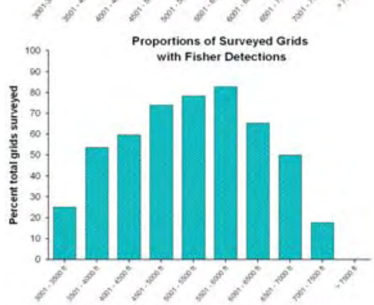
Bobcat cache of F09 carcass



SNAMP Fisher will provide logistical support and all information we have/acquire on bobcats to facilitate the collaboration

New Findings: Data on Grid Detections for Bobcats & Fisher Indicates Likely Presence of Interspecific Competition





Implications/Consequences of High Predation by Bobcats and Disease in SNAMP Fisher Project Study Area

Differences/lower survival for Fishers in SNAMP Study area compared to Kings River Study area

<u>New Questions</u>:

1. What is the source of CDV infection?
2. How likely for another epizootic to occur in area in the future?
3. Should we consider vaccinating fishers as part of captures
4. Why does bobcat predation occur at high level in SNAMP Area?

SNAMP Fisher Study: Acknowledgments

Funding & Logistics: USDA Forest Service (Mike Chapel, Peter Stine)

MOU Partners & Agencies: US Fish and Wildlife Service, California Dept of Fish & Game, Yosemite National Park

SIERRA NEVADA
ADAPTIVE
MANAGEMENT
PROJECT

SNAMP Fisher Crew & Volunteers: Joe Bridges, Brady Neiles, Carrie O'Brien, Rebekah Jensen, Taylor Gorman, Jason Massarone, Wendy Mitchell, Wendy Sicard, Thomas Thein, Geoff and Lindsay Cline, Jeff Schneiderman, Jana Ashling, Caroline Jablonicky, Sarah Bassing, Adrianna Beaudette, Shelly Vogel, Mark Ratchford, Rob Wise, Zac Eads, Thomas Day, Kyle Wagner, Jenny Ruthven

USFS Aviation Supervisor John Litton, Pilots Bill Bulfer, Curtis Haney, Jim Irving, Dan English

Kings River Fisher Study: Kathyrn Purcell, Craig Thompson, Rebecca Green, Jim Garner

Sierra NF Bass Lake Ranger District: Dave Martin, Anae Otto, Theresa Lowe, Kevin Williams

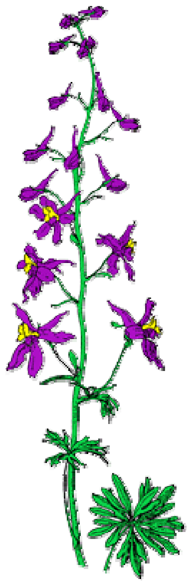
UC Davis Collaborators: Mourad Gabriel, Greta Wengert, Local Housing – Bruce Persson

Attachment D.

Old Growth at a Crossroads:

U.S. Forest Service Northern Region National Forests' noncompliance with diversity provisions of their Forest Plans and the National Forest Management Act Regulations

August, 2003



Jeff Juel
The Ecology Center, Inc.
801 Sherwood Street, Suite B
Missoula, Montana 59802
406-728-5733
ecocenter@wildrockies.org
www.wildrockies.org/teci

The Ecology Center is a citizen conservation organization founded in 1988, dedicated to protecting the remaining wildlands and wildlife of the Northern Rockies region. The Ecology Center works to enforce environmental laws and ensure that stewardship of our public lands is based on sound science and sustainable practices.

Introduction

The United States Forest Service Northern Region is composed of 13 national forests, including all those in the state of Montana and those in the northern half of Idaho.

The purpose of this report is to investigate the Forest Service's level of compliance with federal regulations that implement the National Forest Management Act, more specifically those parts of the regulations dealing with old-growth forests and the wildlife species that depend upon them. The information is important because of the increasing demands placed on national forests to meet natural resource needs, resulting in reduced habitat for many forest species. This report is especially timely since the forest plans of the national forests of the Northern Region have exceeded their intended 15-year lifetimes, and the Forest Service is beginning the legally-mandated forest plan revision process.

Acknowledgement

This report updates and refines discussion presented in an earlier report, "An Assessment of Old Growth in the Northern Region of the USDA Forest Service" by Angela Farr, Libby Hinsley, and Mari Yoshimura of the Environmental Studies Program, University of Montana, December, 2002. I have borrowed liberally from their third chapter entitled "Forest Planning" as a starting point, and have refined and updated that information. That report can be found at: http://outerlimits.wildrockies.org/PNF:byName:/Ecosystem_Defense/Federal_Agencies_TECI/Forest_Service/Region_1/Regional_office/

The National Forest Management Act

The 1976 National Forest Management Act (NFMA) provides guiding principles for the management of our national forests. NFMA required the Secretary of Agriculture to "promulgate regulations… that set out the process for the development and revision of the land management plans…"

Those regulations, which set out the details of Forest Service implementation of NFMA, were written in 1974, then amended and adopted in 1982. The NFMA regulations (36 CFR §219 *et seq.*) require the Forest Service to develop **forest plans** for all national forests. The steps in forest planning include gathering inventory data, analyzing the management situation, forming management alternatives with public comment, and estimating and evaluating the potential effects of implementing the various alternatives. After Forest Plan approval, the effects of its implementation are to be continuously monitored and evaluated. Forest plans are to be completely revised once every 15 years—essentially new plans are to be developed, again in conformance with the requirements of NFMA and the NFMA regulations.

Compliance with NFMA occurs at various levels. NFMA implementing regulations must be consistent with the National Forest Management Act. In turn, Forest Plans must be consistent with the NFMA implementing regulations, which specify how Forest Plans are to be written and implemented. Finally, the Forest Service must implement management that is consistent with the Forest Plans. NFMA reads: "Resource plans and permits, contracts, and other instruments for the use and occupancy of National Forest System lands shall be consistent with the land management plans." This report investigates compliance only at the latter two levels—1) consistency of the Forest Plans with the implementing regulations and 2) consistency of Forest Service management with the Forest Plans.

Old Growth and Old-Growth Species in the Regulations and the Forest Planning Process

The NFMA regulations do not explicitly require protection of old-growth forests, possibly because they were developed before the term "old growth" became widely used. The regulations address old growth indirectly, however, in provisions calling for the protection of biodiversity and maintaining sufficient habitat to support viable populations of all plant, fish and animal species. And without exception, the Forest Plans of the national forests of the Northern Region, all adopted in the late 1980s, recognize old-growth forests as a component of biological diversity necessary for sustaining many wildlife species. For example, the Forest Plan of the Kootenai National Forest states, "Roughly 58 wildlife species on the Kootenai find optimum breeding or feeding conditions in the "old" successional stage, while other species select old-growth stands to meet specific needs."[1]

The definition of old growth—regardless of the location or setting—generally includes old, live trees with many of them in varying stages of decay, large snags, large downed logs, multiple canopy layers, and patchy horizontal canopy cover. When native forests are converted to plantations of young trees by clearcut or similar logging techniques, such structures are eliminated or severely reduced. Even partial cutting or so-called "salvage" logging reduces the amounts of these structures relative to an unmanaged forest. Since these structures provide

[1] Kootenai National Forest Plan, Appendix 17 page 2.

habitat components absolutely necessary for some wildlife species, the reduction of diversity of habitat components leads to fewer species being able to use the forest, causing a reduction in biological diversity of the forests as a whole. The remaining native or lightly managed forests containing these structures thus have increased value for maintaining biological diversity. **Essentially, old-growth forests are a surrogate, or proxy, for measuring biological diversity in the national forests.**

To ensure the protection of biological diversity, the NFMA regulations require the Forest Service to: **inventory**, evaluate **diversity**, maintain **viable populations**, select **management indicator species**, and **monitor and evaluate** forest plan implementation (Table 1).

Table 1. Sections of 36 CFR 219 (NFMA regulations) relating to diversity and old-growth forests.

Require-ments	Definitions	Relevant Clauses of NFMA Regulations
Inventory		Each Forest Supervisor shall obtain and keep current inventory data appropriate for planning and managing the resources under his or her administrative jurisdiction. [219.12 (d)]
Diversity	The distribution and abundance of different plant and animal communities and species within the area covered by a land and resource management plan. (219.3)	Forest planning shall provide for diversity of plant and animal communities. ...Inventories shall include quantitative data making possible the evaluation of diversity in terms of its prior and present condition. (219.26)
Viable Population	Having the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed in the planning area. (219.19)	Provide for adequate fish and wildlife habitat to maintain viable populations of existing native vertebrate species. [219.27(a)(6)]
Management Indicator Species (MIS)	The species selected because their population changes are believed to indicate the effects of management activities. [219.19 (a)(1)]	Identify and select MIS [219.19 (a)(1)]. Establish objectives for the maintenance and improvement of habitat for MIS [219.19 (a)]. Planning alternatives shall be evaluated in terms of both amount and quality of habitat and of animal population trends of the MIS [219.19 (a)(2)].
Monitoring and Evaluation	A program that considers the effects of management on land, resources, and communities adjacent to or near the National Forest [219.7(f)].	Monitoring shall provide a quantitative estimate [219.12(k)]. Population trends of MIS will be monitored and relationships to habitat changes determined [219.19(a)(6)].

The regulations require forest plans to have standards and guidelines for land and resource planning and management. Relevant standards may include the amount and distribution of old-growth forests, and methodology for measuring the amount of old growth. The regulations also require forest plans to select management indicator species (MIS) and to contain provisions for periodic monitoring and evaluation of the effects of implementing forest plans.

Old-growth Management Indicator Species (MIS)

To meet the requirements to maintain and enhance native and desired non-native species the Forest Service adopted management indicator species (MIS) “because their population changes are believed to indicate the effects of management activities” (36 CFR §219.19). These species are selected from five categories:

1. Endangered and threatened plant and animal species
2. Species with special habitat needs that may be influenced significantly by planned management programs
3. Species commonly hunted, fished, or trapped;
4. Non-game species of special interest
5. Additional plant or animal species whose population changes indicate the effects of management activities

Each National Forest in the Northern Region has selected at least one MIS explicitly because the species is believed to depend on old-growth habitat. Some national forests also chose MIS for similar habitat needs, such as mature forests or snags for cavity nesting. Table 2 displays management indicator species selected by each Northern Region national forest.

Table 2. Management Indicator Species of the Northern Region National Forests

National Forest	Old Growth and other related MIS
Beaverhead	northern goshawk (Douglas-fir forests), pine marten (spruce-fir forests)
Bitterroot	pine marten, pileated woodpecker
Clearwater	northern goshawk & pileated woodpecker; also pine marten (mid- to high-elevation mature forests)
Custer	northern goshawk
Deerlodge	pileated woodpecker (Deerlodge & Philipsburg Ranger Districts), northern goshawk, and northern three-toed woodpecker
Flathead (1986)	Barred owl, pileated woodpecker, and pine marten
Flathead (after Forest Plan Amendment 21)	gray wolf, peregrine falcon, grizzly bear, Canada lynx, northern goshawk, boreal toad, common loon, wolverine, harlequin duck, fisher, flammulated owl, black-backed woodpecker, Townsend’s big-eared bat, northern leopard frog, northern bog lemming.
Gallatin	pine marten (moist Spruce sites); northern goshawk (dry Douglas-fir sites)

Helena	pileated woodpecker and northern goshawk; also pine marten for “mature tree” and hairy woodpecker for “snag dependent species”
Idaho Panhandle	northern goshawk, pileated woodpecker, pine marten
Kootenai	pileated woodpecker (for both old growth and cavity nesting habitat)
Lewis and Clark	northern goshawk; also northern three-toed woodpecker for “tree cavity-conifer”
Lolo	pileated woodpecker, northern goshawk
Nez Perce	pileated woodpecker, northern goshawk, pine marten, and fisher

Along with MIS, the Forest Service maintains a list of “sensitive” species. Sensitive species are defined by the Forest Service Manual (FSM 2670.5) as plant and animal species identified by a Regional Forester for which population viability is a concern, as evidenced by: a) significant current or predicted downward trends in population numbers or density; or b) significant current or predicted downward trends in habitat capability that would reduce a species’ existing distribution. The Northern Region’s list of sensitive wildlife species includes some that depend upon old-growth habitat, such as the northern goshawk, wolverine, fisher, flammulated owl, black-backed woodpecker, and Townsend’s big-eared bat. The Canada lynx, recently listed as a “threatened” species under the Endangered Species Act, is an old-growth dependent species that was previously on the Northern Region’s sensitive species list.

MIS Monitoring Requirements in Forest Plans

The NFMA regulations require the Forest Service to monitor the effects of forest plan implementation, and periodically report the monitoring results. Specific to MIS, the NFMA regulations at 36 CFR §219.19(a)(6) require: “Population trends of MIS will be monitored and relationships to habitat changes determined.” This means that, on a regular basis, the Forest Service is to perform sampling of MIS populations, assess the changes experienced by the habitats of each MIS, and synthesize those two sources of information to make a determination as to the relationship between habitat changes and the resulting population changes for each national forest.

The Forest Plans in the Northern Region vary in how they respond to the monitoring requirements of the NFMA regulations relating to old-growth habitat and old-growth MIS. Table 3 summarizes the monitoring requirements contained in each of the Forest Plans.

Table 3. Old Growth and Old-Growth MIS Monitoring Requirements by Forest

National Forest	Monitoring Requirements
Beaverhead	Monitor old-growth acres/number of animals annually, reporting every 5 years.
Bitterroot	Acres of old growth by habitat type, land class, and management area, to be measured every 3 years and reported every 5 years. Pine marten and pileated woodpecker populations will be monitored in relation to habitat changes, based on 3 transects annually, reported annually.
Clearwater	MIS population trends will be monitored and reported every 5 years.
Custer	Forest Plan does not contain requirements to monitor old growth or old-growth MIS
Deerlodge	Monitor old-growth habitat in order to respond to any unacceptable deviation from past measurements. To be monitored annually and reported every 5 years.
Flathead (before Forest Plan Amend. 21)	Monitor barred owl (hooting count); monitor pileated woodpecker (rapping count); number of pine marten pelts from Montana Dept. of Fish, Wildlife, and Parks records.
Flathead (after Forest Plan Amendment 21)	Monitor occupancy of old-growth forest by old-growth associated wildlife species; monitor bird distribution, productivity, and survivorship in monitoring stations; monitor distribution of forest carnivores; monitor vegetation composition, structure, and pattern, in relationship to estimated range of natural variability by Subbasin; monitor proportion of old-growth forest and patch sizes, by Subbasin and watershed; Monitor implementation and effectiveness of restoration efforts by Potential Vegetation Group.
Gallatin	Determine population trends of old-growth MIS and their relationships to habitat change, reporting every 5 years.
Helena	Monitor old-growth habitat (pileated woodpecker, hairy woodpecker and goshawk) and pine marten track counts. Measuring annually and reporting every 5 years.
Idaho Panhandle	Monitor population trends of old-growth MIS, measuring annually and reporting every 5 years.

Kootenai	Monitor pileated woodpecker population levels, measuring annually and reporting every 5 years. Measure old-growth habitat amount and condition annually, reporting every two years. Measure cavity habitat condition and amount annually, reporting every 5 years. Measure habitat for indicator species and population trends, monitoring annually and reporting every 5 years.
Lewis & Clark	Monitor population levels of MIS and their relationship to habitat trends. Annually monitor active nesting territories for northern goshawk and report annually; measure percent optimum habitat for northern three-toed woodpeckers annually and report every 5 years.
Lolo	Monitor habitat for old-growth MIS. As monitoring technology becomes available, population trends will be monitored. In the interim, habitat parameters such as old-growth acres and condition, and snag densities will be monitored as an indicator of population trends. Monitor effectiveness of old-growth habitat areas that are harvested on every timber sale, reporting every 5 years. Monitor post-sale snag densities on 10% of timber sales, reporting every 5 years.
Nez Perce	Monitor population levels of old-growth MIS, reporting every 3-5 years.

As Table 3 indicates, the Forest Plans for the Custer, Beaverhead, Bitterroot, Deerlodge, Flathead, Helena, and Lewis & Clark national forests do not explicitly require monitoring of "population trends" as required by the NFMA regulations. Of those, the Custer, Deerlodge, and Flathead forest plans have no requirements to conduct MIS counts whatsoever, whereas the Beaverhead, Bitterroot, Helena, and Lewis & Clark forest plans contain some kind of requirement to count the species but don't state that determining "population trends" is the point of the monitoring.

Table 3 also shows that monitoring requirements found in the Beaverhead, Bitterroot, Deerlodge, Flathead, Helena, Kootenai, and Lolo forest plans explicitly require the Forest Service to periodically measure the amount of old-growth habitat, or keep track of changes in habitat for old-growth MIS.

Perhaps a better test of the forest plan monitoring requirements' consistency with the NFMA regulations' MIS monitoring requirements would consider which are written to specifically seek an understanding of the relationship between changes in old-growth habitat and population numbers of the MIS. Forest plans for the Bitterroot, Gallatin, and Lewis & Clark national forests are the only ones whose monitoring requirements are written in this way.

Old-Growth Inventories in Northern Region Forest Plans

As stated above, the NFMA regulations don't mention old-growth forests and therefore don't specifically require the Forest Service to keep inventories of old growth. But the regulations as, 36 CFR §219.26 do require that "Inventories shall include quantitative data making possible the evaluation of diversity in terms of its prior and present condition."

Perhaps the most significant, and concrete step taken policy-wise by the Forest Service regarding old-growth forest inventories came in 1989. At that time, Forest Service Chief Dale Robertson charged all Regional Offices to develop ecological definitions of old-growth types within their boundaries, to aid in performing old-growth inventories across all National Forest System land. "Regions with support from Research shall continue to develop forest type old growth definitions, **conduct old growth inventories**, develop and implement silvicultural practices to maintain or establish desired old growth values, and explore the concept of ecosystem management on a landscape basis." (See Appendix 1 page 57, emphasis added.) In response, in 1992 a team of Northern Region specialists released a report (Green et al., 1992) to serve as the tool for inventorying old growth on each national forest. Green, et al. (1992) arrived at definitions of the various types of old growth found in the Region, and the report included criteria for areas to be considered old growth (See Appendix 1).

There is wide variation among the Northern Region national forests as to how their forest plans treat the issue of inventorying and protecting old growth. Some forest plans require retention of a minimum percentage of the Forest as old growth. Although individuals of most species may not use an area as large as an entire national forest, the Forest Service recognizes that sustaining populations is an issue that must be dealt with in the larger landscape context: "Distributions of common wildlife species as well as species at risk encompass much larger areas than typical project areas and in most cases larger than National Forest boundaries."[2] Some Forest Plans require protection of a certain percentage of old growth within smaller geographic areas, such as by watershed, in response to the NFMA regulations' requirements that wildlife habitat must be well-distributed. Some Forest Plans have both forest-wide and distribution standards. Still other Forest Plans have no numerical requirements for old-growth protection nor provisions for maintaining an old-growth inventory. Table 4 illustrates the various approaches found in the Forest Plans.

Table 4. Summary of Northern Region forest plans' old growth requirements*

National Forest	Forest Plan requirements for old growth
Beaverhead	Maintain at least 10% of the Douglas-fir and spruce component of each timber compartment as old growth. (Timber compartments are roughly 10,000 acres)
Bitterroot	Maintain either 3% or 8% of the suitable timber in each major drainage as old growth, depending on Management Area.
Clearwater	Maintain at least 10% of the Forest in old-growth habitat, selecting at least 5% of each timber compartment to manage as old-growth habitat.
Custer	Meet the habitat requirements for a minimum viable population of old-growth dependent species.
Deerlodge	Manage 5% of each timber compartment for old growth
Flathead (after	Minimize management actions within existing old growth to

[2] Dry Fork Vegetation Project Environmental Assessment, Lewis and Clark National Forest, Appendix D at page 9, March 2000.

adoption of Amendment 21)	those actions necessary to restore or maintain old-growth composition and structure consistent with historical succession and disturbance regimes.
Gallatin	Maintain at least 10% of each timber compartment containing suitable timber in old-growth condition.
Helena	Manage 5% of each third order drainage for old growth.
Idaho Panhandle	Maintain at least 10% of forested land as old growth, reflecting approximately the same habitat type series distribution as found on the Forest. In timber compartments that have old growth as 5% of the forested portion, maintain at least 5% as old growth.
Kootenai	Maintain at least 10% of the Forest land below 5,500 feet in elevation as old growth, and 10% of each major drainage on the forest as old growth, distributed among the various major habitat types.
Lewis & Clark	Retain 5% of commercial forest land within each timber compartment as old growth.
Lolo	No quantitative old-growth standard
Nez Perce	Maintain 10% of the total forested acres as old growth, maintaining no less than 5% within each prescription watershed or combination of watersheds totaling 5,000 to 10,000 acres.

**Note: some of the requirements displayed are simplifications of what is written in the Forest Plan.*

Current status of Northern Region National Forests' old-growth inventories

Beaverhead National Forest

The Beaverhead Forest Plan old-growth standard requires that for each timber compartment, 10% of the Douglas-fir and spruce component will be maintained in old-growth condition, that old-growth stands will be range from ten to several hundred acres in size, and that the old-growth stands will normally be selected in areas not allocated to timber management. The Forest Service has stated that there is no inventory of old growth for this national forest.[3] Apparently the closest thing the Forest has to an old-growth inventory is an electronic database list of timber stands under the category "Potential Old Growth – Field or Remote".[4] The Forest Plan has no definition of "potential" old growth. With the presently available information, it is impossible to assess whether the Forest is maintaining 10% of the Douglas-fir and spruce component in each timber compartment as old growth, as required by the Forest Plan, or if old-growth habitat is well-distributed across the Forest.

Bitterroot National Forest

[3] January 31, 2002 letter responding to a Freedom of Information Act request.
[4] Ibid.

The Bitterroot Forest Plan contains standards for old-growth management that take into account the importance of old-growth patch size and distribution for maintaining viable populations of old-growth dependent species. For example, within some Management Areas[5] (MAs), the Plan specifies that old-growth stands should be 40 acres in size or larger and indicates that old growth should be distributed over the management area.

The Forest Plan requires some MAs (specifically, MAs 1, 2, 3a, 3b, and 3c) to contain a minimum percentage of old growth. In MA 1, the Forest is to maintain 3% of the suitable timberland within each third order drainage as old growth. In MAs 2 and 3a, the Forest is to maintain 8% of suitable timberland in every third order drainage as old growth. In MA 3b, the Forest is to maintain 50% old growth in fisheries riparian areas and 25% old growth in nonfisheries riparian areas. And in MA 3c, the Forest is to maintain 8% of non-riparian suitable timberland in each area of MA 3c as old growth.

The Bitterroot National Forest has stated that the old-growth inventory is almost complete, and has provided numbers for areas that had been at least partially surveyed for old growth.[6]

Data provided by the Forest Service gives total acres contained in Management Areas 1, 2, 3a, and 3c by third order drainage, along with the percentage inventoried as old growth. The tentatively inventoried old-growth totals in each of MAs 1, 2, 3a, and 3c respectively, are 37,649; 20,704; 22,102; and 3,053 acres.[7] However, the data do not display the number of acres of "suitable timberland" in each third order drainage, for those MAs. As the wording of the standards indicates, that information is needed to demonstrate compliance with the minimum percent old-growth standards.

The data for some third order drainages lists acres under a category of "no survey" and for other third order drainages, no data were reported. This is because those third order drainages are located in Wilderness or roadless areas with no acreage of MAs 1, 2, 3a, 3b, or 3c.[8] Also, there are no numbers provided for acres of old growth in MA 3b. This is because Management Area 3b "is a part of all the Management Areas adjacent to streams … ." [9] This suggests that some areas of old growth must be double-counted to show compliance not only with the MA 3b standard, but a standard for another MA as well.

As the old-growth inventory information stands, it is not possible to adequately determine compliance with the quantitative Forest Plan standards.

Clearwater National Forest

The Clearwater Forest Plan has a standard requiring the Forest Service to maintain at least 10% of the Forest in old-growth habitat. The Forest Plan also specifies that the old growth should be distributed by selecting at least 5% of each roughly 10,000-acre watershed (timber compartment) or a combination of smaller watersheds (subcompartments) within forested nonwilderness areas to manage as old growth. When not enough actual old growth is found during timber sale project analyses, the Forest Plan requires allocation of "replacement" old

[5] National Forests are divided into various "Management Areas," which each having a different resource emphasis as determined during the Forest Planning process.
[6] November 19, 2002 letter responding to a Freedom of Information Act request.
[7] Ibid.
[8] John Ormiston, Bitterroot NF, personal communication 12/6/02.
[9] Ibid.

growth to meet the 5% distribution standard. The Forest Plan gives no criteria for selecting "replacement" old growth.

The Forest Plan states that the minimum patch size that can be considered old growth is 25 acres. Forest Plan guidelines suggest that old-growth stands should be distributed across the major habitat types found in the Forest in proportion to the occurrence of those habitat types. Furthermore, the Forest Plan suggests that for Pileated Woodpeckers a 300-acre stand should be managed as old growth in each 10,000-acre watershed. This 300-acre patch is recommended to be contiguous, but if not available it may be divided into 100-acre units as long as they are contained within two square miles. Finally, these patches are recommended to be at least 200 yards wide at some point.

The Clearwater National Forest has estimated there is 152,685 acres of old growth in the non-Wilderness portion of the Forest, and has estimated there are 37,000 acres of old growth in the Selway-Bitterroot Wilderness[10]. These figures total 189,685 acres, which is 10.3% of the Forest. However, Forest Service documents show that when preparing timber sales for many geographic areas, the field verification process revealed that the Forest had significantly overestimated the amount of old growth thought to be in the area. This is likely because something like 75% of the timber stands on the Clearwater had never been surveyed on-the-ground, with the vast majority of old growth having only been "tentatively" identified using less precise remote survey methods.[11] Adding to this uncertainty is the fact that "replacement" old growth (allocated during project analysis to meet the 5% distribution standard) is included in the total 189,685-acre (10.3%) estimate.

Given these uncertainties, the Clearwater NF old-growth inventory was subjected to litigation in federal court when the Forest Service proposed logging old growth. In the case, *Wilderness Society v. Bosworth*, the Plaintiffs alleged that the old-growth status reports used to support the Forest Service's claim that it was meeting the 10% standard failed to account for the overestimates discovered during field verification. The Court agreed, and enjoined the Forest Service from logging old growth on the Clearwater because it could not prove it was meeting the forest-wide 10% Forest Plan standard.

Custer National Forest

The Custer Forest Plan provides vague standards regarding old growth protection. It states, "Old growth will be managed to at least meet the habitat requirements for a minimum viable population of old growth dependent wildlife species." The Forest Plan does not state what constitutes a minimum viable population of the northern goshawk, which is the management indicator species selected by the Forest Plan for old-growth habitat.

The Forest Service indicates they use an electronic database to track old growth on the Custer, in a category called "saw timber sized."[12] This category includes stands of trees as small as 9 inches diameter breast height.[13] Since what the Custer NF counts as old growth includes stands of trees that are much smaller than currently accepted (i.e., Green et al., 1992) criteria, the old-growth inventory's accuracy is very questionable. Thus, it is impossible to tell how much of

[10] Data from FOIA response/letter dated February 1, 2002.
[11] December 11, 2001 email message from the Clearwater National Forest.
[12] March 27, 2001 letter responding to a Freedom of Information Act request.
[13] Ibid.

the Forest is old growth or if it is well-distributed across the Forest, as required by NFMA regulations.

Deerlodge National Forest

The Deerlodge Forest Plan old-growth standards require that 5% of each timber compartment will be managed for old growth. The Forest Service has stated that there is no inventory of old growth for this national forest.[14] Apparently the closest thing to an old-growth inventory is an electronic database list of timber stands under the category "Potential Old Growth – Field or Remote" (Ibid.). The Forest Plan has no definition of "potential" old growth. With the presently available information, it is impossible to assess whether the Forest is maintaining 5% of each timber compartment as old growth, as required by the Forest Plan, or if old-growth habitat is well-distributed across the Forest.

Flathead National Forest

The Forest Plan for the Flathead National Forest, written in 1986, did not contain quantitative standards for protecting old growth. However, following an administrative appeal of the Forest Plan, the Chief of the Forest Service directed the Flathead National Forest to amend the Forest Plan, and in the interim the Flathead was directed to maintain at least 10% old growth in each third order drainage. In 1999, the Flathead NF adopted Forest Plan Amendment 21, "Management Direction Related to Old Growth Forests." The Amendment does not set a quantitative standard, but it does require the Forest Service to maintain all existing old growth. However, the Amendment does not prohibit logging old growth, allowing logging to "restore" old growth: "Vegetation management within old growth shall to the extent feasible retain old growth composition and structure consistent with native disturbance and succession regimes." (Flathead National Forest 1999). Amendment 21 also requires specific numbers of old-growth components (snags, replacement snags, and pieces of coarse woody debris) be retained in all timber sale cutting units. Amendment 21 also dropped the original Forest Plan old-growth indicator species and adopted as indicator species the Forest's list of Threatened, Endangered, and Sensitive species, including those that depend on old growth for habitat.

When its complete old-growth inventory was requested, the Forest Service referred to copies of landscape assessments rather than providing specific locations of old-growth stands or the amount of old growth in the Forest.[15]

Gallatin National Forest

The Gallatin Forest Plan standard for old growth requires the Forest Service to maintain 10% of each timber compartment containing suitable timber in old-growth condition. The Forest Service has indicated that there is no forest-wide old-growth inventory.[16] This is because old growth allocations are only completed on a project-by-project basis, for example when an area is being analyzed and prepared for a timber sale.[17] Only 40 of a total of 139 compartments forest-

[14] January 31, 2002 letter responding to a Freedom of Information Act request.
[15] March 19, 2002 letter responding to a Freedom of Information Act request.
[16] February 11, 2002 letter responding to a Freedom of Information Act request.
[17] Ibid.

wide have had their structural stages analyzed.[18] The available information is not adequate to determine if sufficient, well-distributed old-growth habitat exists on the Gallatin.

Helena National Forest

The Helena Forest Plan standards for old growth require the Forest Service to manage 5% of each third order drainage as old growth. The Forest Service has indicated that they do not have a forest-wide old-growth inventory for the Helena NF because old-growth allocations are made on a project-by-project basis, i.e., when timber sales are prepared for specific geographic areas.[19] A forest-wide inventory is "in process."[20] Current information is inadequate to tell whether the Helena NF is maintaining at least 5% of each third order drainage as old growth, as required in its Forest Plan.

Idaho Panhandle National Forests

The Forest Plan for the Idaho Panhandle National Forests contains a standard to maintain 10% of the forested portion of the land as old growth, and the Plan also specifies that the distribution of old growth should be across forest habitat types, reflecting approximately the same habitat type series distribution as is found on the Forest. The Forest Plan also states that the Forest Service is to maintain at least 5% of the forested portion of those old-growth management units that have 5% or more existing old growth.

The accuracy of the IPNF old-growth inventory has also been subject to recent litigation. Leading up to litigation, Forest Plan Monitoring and Evaluation reports consistently stated that 213,542 acres (9.2%) had been identified as old growth. When doing analyses for timber sales, the Forest Service has validated the inventory for the geographic area in question. As was the case with the Clearwater NF litigation, in court Plaintiffs alleged that the forest-wide inventory did not take into account Forest Service documents revealing that some areas previously assumed to be old growth turned out to not meet old-growth criteria during field verification.[21] The Court agreed, stating that the IPNF "database has been found to overstate old growth by 32-56%" (U.S District Court of Washington, 2002[22]).

There is differing information as to how much old growth is in each of the old-growth management units. Forest Service information showed that 78 of the forest's 164 total old-growth management units (47.6%) lacked 5% allocated old growth.[23] Confusingly, more recently the Forest Service stated it does not have information on the amount of old growth in the old-growth management units.[24]

Subsequent to initiation of the litigation, the IPNF issued Forest Plan Monitoring and Evaluation Reports that presented updated old-growth data. The Fiscal Year 2001 report represents 250,259 acres (10.8%) of old growth on the Forest. However in response to a Freedom of Information Request for documentation on the additional old growth, the IPNF was unable to provide it.[25]

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[18] Ibid.
[19] Personal communication, Dennis Heffner of the Helena NF, October 21, 2002.
[20] Ibid.
[21] Jan. 16, 2001 Declaration submitted by author to the Court, based upon Forest Service documents.
[22] Federal Court Order dated March 29, 2002 in the case *Lands Council v. Vaught*.
[23] Idaho Panhandle NF letter dated November 28, 2000.
[24] FOIA response/letter dated October 15, 2002.
[25] Ibid.

There is still significant doubt as to the accuracy of the old-growth inventory on the Idaho Panhandle NF, and whether it can be relied upon to conclude that Forest Plan old-growth standards are being met.

Kootenai National Forest

The Kootenai Forest Plan states, "At any time 10% of the Kootenai National Forest land base below 5,500 feet in elevation will be in an old-growth timber condition, providing habitat for those wildlife species dependent on old growth timber for their needs. The old growth will be spread evenly through most major drainages, and will represent the major forest types in each drainage." The Kootenai National Forest designates Management Area 13 to provide the special habitat necessary for old-growth dependent species.

MA 13 actually did not represent the 10% old growth at the time of Forest Plan adoption. Forest-wide, there are 1,865,000 acres of national forest land below 5,500 feet in elevation[26] but the Forest Plan only allocated 124,230 acres (6.67%) to MA 13.

A recent Forest Service report shows a total of 115,725 acres (or 6.2%, of the national forest land below 5,500 feet in elevation) are considered old growth.[27] This is approximately 70,775 acres short of meeting the 10% forest wide standard. The same report also indicates that 154 of the 255 compartments, or 60% of them, have been completely reviewed and an additional 47 compartments, or 18% of them, were partially inventoried. The Forest Service has identified at least 10% old growth in 135 of the 279 compartments, or 48% of them, forest wide.[28]

More recently, in the context of litigation, the Kootenai NF has claimed it has now identified 10.3% of the forest land below 5,500 feet as old growth. On June 27, 2003, the U.S. District Court's ruling rejected the figures as tentative, stating "Whether it turns out that the Forest Service is factually right is a matter for the agency to reconsider in light of its full inventory of the forest and the opportunity for public comment."[29]

Lewis and Clark National Forest

The Lewis and Clark Forest Plan requires the Forest Service to maintain 5% of the commercial forest land within each timber compartment as old growth. Old-growth allocations on the Lewis and Clark National Forest are completed on a project-by-project basis, when timber sales are prepared for specific geographic areas[30]. A recent Forest Service report shows that a total of 82,279 acres on the Forest meet their criteria for old growth and that 31,313 of those acres are allocated for retention to meet Forest Plan Standards[31]. That report displays old-growth acres according to project area or landscape assessment area. Project areas and landscape assessment areas are generally much larger than timber compartments, the latter being the subject of the Forest Plan 5% old-growth standard. Hence, the report is not adequate to show whether or not the Forest Service is maintaining the quantity and distribution of old growth as required by the Lewis and Clark Forest Plan.

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[26] Page 2 of Fiscal Year 2001 Forest Plan Monitoring and Evaluation Report, published September 2002.
[27] Ibid.
[28] Results of analysis by Ecology Center's Bill Haskins, November 27, 2002, based upon Kootenai NF information.
[29]Federal Court Order dated June 27, 2003, page 23 in the case *Ecology Center v. Castaneda*
[30] 10/24/02 personal communication with Lewis and Clark NF's Chuck Marks.
[31] Forest Plan Monitoring and Evaluation Report for Fiscal Years 2000 – 2001, page 42.

Lolo National Forest

The Lolo National Forest's 1986 Forest Plan contains no quantitative standard for old growth. The relevant Forest Plan standards were rather vague and related to monitoring old-growth acres and condition. The Forest Plan set Management Area 21 as the MA designated for old-growth habitat, to be well-distributed over the Forest. MA 21 standards set minimum stand sizes of at least 30-40 acres and required the old growth to be well-distributed, without specifying what that meant. In 1994, the Lolo National Forest adopted a discretionary guideline of maintaining 8% of the forest land as old growth.[32] However, MA 21 is not nearly 8% of the entire Forest. The Forest Plan Final Environmental Impact Statement states that the Lolo National Forest is made up of 2,112,597 acres. Eight percent of that is 169,008 acres, but the Forest Plan only allocated 41,303 acres to MA 21—only about 2% of the Forest.

Recently, the Forest Service stated that Lolo National Forest old-growth inventories are done during broad scale landscape studies that occur when timber sales are prepared for specific geographic areas, and that the Forest does not have a single, comprehensive forest-wide inventory.[33]

Nez Perce National Forest

The Nez Perce Forest Plan requires 10% of the total forested acres be maintained as old growth. The Forest Plan also specifies that at least 5% of the forested acres in each prescription watershed or combination of watersheds totaling 5,000-10,000 acres will be maintained as old growth, thus incorporating distribution as part of its old-growth requirements. The Forest Plan further states that if less than 5% of a particular watershed is in old-growth condition, the Forest may assign the additional acres from an adjacent drainage to make up the deficiency.

It is difficult to tell how much old growth it takes to meet the 10% requirement because of ambiguities concerning the amount of "forested acres". The Forest Plan indicates that the Nez Perce National Forest contains 2,218,040 acres (Forest Plan FEIS at B-1) but only 1,972,717 acres are actually "Forested Land" (Forest Plan FEIS at B-4). Also, the Forest Plan states that the Forest Plan "establishes management standard for lands administered by the Nez Perce National Forest" and that "(t)his …excludes 117,073 acres …in the Hells Canyon Wilderness and National Recreation Area, which is administered by the Wallowa-Whitman National Forest" (Forest Plan at I-1). The Forest Service also did not intend to include MA 20 (the MA designated to contain the Forest's old growth) in designated Wilderness.[34] If the 766,224 acres of Wilderness, Wild and Scenic Rivers, and Research Natural Areas, as described in the Forest Plan FEIS are subtracted from the total acres managed by the Forest, that leaves a total of 1,089,420 acres for which the 10% Forest Plan standard would seem to apply.

Ten percent of this total figure is 108,942 acres, yet the Forest Plan allocated only 64,659 acres to MA 20. This only represents about 5.9% of the total acreage. However, the Forest Plan states, "there are approximately 35,570 acres of this management emphasis which occur as inclusions in other management areas" (Forest Plan at III-56). Including those acres that occur in other Management Areas, the total acres included in MA 20 plus other MAs managed as old growth would come to 100,229 acres. This would represent a total of 9.2%, which would seem to

[32] April 29, 1994 "Old Growth Strategy" letter from Forest Supervisor to District Rangers.
[33] 10/24/02 personal communication with Lolo NF Biologist Mike Hillis.
[34] 11-13-02 personal communication with Nez Perce NF's Dave Green.

approach the Forest Plan standard of 10%. But this could be misleading, because the Forest Plan does not specify exactly how much in each of the other MAs that make up the 35,570 acres of this management emphasis occur as inclusions in other MAs. This means that some of this 9.2% could include double-counted acres. Adding to the confusion is that the Forest Plan states that MA 20 itself "contains inclusions of other management areas" (Forest Plan at III-56) totaling 156,650 acres, and some of those MAs are considered suitable for timber management by the Forest Plan. Obviously, the issue is very unclear. Because of these unresolved ambiguities it is currently not possible to determine whether or not the Forest Service is maintaining the total amount of old growth the Forest Plan requires.

Based on a recent response to a request under the Freedom of Information Act (FOIA), the Nez Perce National Forest also does not have a single, comprehensive forest wide inventory[35]. As with many other national forests in the Northern Region, old-growth inventories are generally only accomplished for project areas during assessments prepared for timber sales.[36] Hence, the old-growth inventory is incomplete.

Analysis of old-growth MIS monitoring from Northern Region National Forest Monitoring and Evaluation Reports

Forest Plan Monitoring and Evaluation Reports were analyzed for old-growth MIS monitoring results, following from NFMA regulations that require "Population trends of the management indicator species will be monitored and relationships to habitat changes determined." [36 CFR §219.19(a)(6).] Generally, only reports from 1996 to present (over the past five fiscal years) were analyzed, because monitoring requirements (as displayed in Table 3) require reporting at least every five years. This also corresponds to NFMA regulations requirements: "The Forest Supervisor shall review the conditions on the land covered by the plan at least every 5 years to determine whether conditions or demands of the public have change significantly." (36 CFR §219.10.)

<u>Beaverhead National Forest</u>

The most recent Forest Plan Monitoring and Evaluation report, for fiscal year 2001, "evaluates the effects the Mussigbrod and Middle Fork fires on individual resources by Forest Plan Monitoring." That report states, "the amount of spruce-fir and mature-old lodgepole pine forests totally consumed and the use of burned areas by marten need to be determined so that the fire's impact on pine marten population viability can be evaluated" and "the amount of Douglas-fir and mature-old lodgepole pine forests totally consumed and the use of burned areas by goshawks need to be determined so that the fire's impact on northern goshawk population viability can be evaluated." The report for fiscal year 1999 focused on riparian habitat health, stream channel condition, water quality, and fish habitat conditions, not responding to the Forest Plan old-growth MIS monitoring requirement. Likewise, a "Forest Monitoring and Evaluation Report" for fiscal year 1998 also was narrowly focused, on "Vegetation Treatment." Prior that the most recent report was for fiscal year 1996, which stated, "There were no projects implemented in 1996 believed to adversely influence old-growth indicator species or the related wildlife community." Thus, we

[35] February 22, 2002 letter responding to a Freedom of Information Act request.
[36] Ibid.

conclude that monitoring reports provide no indication of population trends of MIS, and no understanding of the relationship between changes in old-growth habitat and population numbers of the MIS.

Bitterroot National Forest

Monitoring reports for fiscal years 1997-2001 had essentially the same information for the pine marten. They reported miles of transects monitored for marten tracks (750) from 1988-1996, that one marten track was seen for approximately every 6.7 miles transected, and that "We have now established a baseline population index with which to compare future information."

The fiscal year 1997 report stated: "Over 550 miles of transects have been systematically run since 1988" and for the 2001 report the total miles of transects increased to 865 miles. Over those 865 miles, the Forest Service recorded for pileated woodpeckers "an average of 0.20 calls or sightings per mile of transect." Yearly sightings/calls per mile are reported in the 2001 report also. That report identifies many possible sources of variability in the data over the years, which "makes it difficult to determine whether pileated populations are changing, and if so, why."

The reports provide no indication of population trends of pine martens, did not indicate any clear trend in pileated woodpecker populations, and present no understanding of the relationship between changes in old-growth habitat and population numbers of either MIS.

Clearwater National Forest

Monitoring reports for fiscal years 1997-2001 provide no indication of population trends of old-growth MIS. The reports include statements such as "Trends in population numbers are correlated with overall old-growth acres maintained on the Forest as directed by the Forest Plan. A normal population of pileated woodpeckers and goshawks were commonly observed across the Forest and coincide with maintenance of old-growth habitat." Also, reports state that pine martens are very common in higher elevations and continue to be trapped with no limits or harvest restrictions being considered. Reports mention that new locations of northern goshawk nests have been found on Potlatch Corporation lands in the Clearwater River basin. Monitoring reports provide no indication of population trends of MIS, and therefore advance no knowledge of the relationship between changes in old-growth habitat and population numbers of the MIS.

Custer National Forest

The Custer National Forest has not issued Forest Plan Monitoring and Evaluation Reports in the last five fiscal years, and even if it had, the Forest Plan doesn't require monitoring of its habitat or population trends.

Deerlodge National Forest

The Forest Service administratively combined the Beaverhead and Deerlodge National Forests in the mid-1990s, and reports for years subsequent to fiscal year 1996 are the same for the Beaverhead NF (see above). The 1996 report stated that twenty goshawks were observed on the Forest since 1994 and that most goshawk surveys were being done in conjunction with project analyses. The Deerlodge NF's reporting provides no indication of population trends of old-growth MIS, and thus offer no data on the relationship between changes in old-growth habitat and population numbers of old-growth MIS.

Flathead National Forest

Since Amendment 21 changed the Forest Plan monitoring requirements in 1999, this report analyzes MIS monitoring under both monitoring regimes. Prior to Amendment 21, the Flathead National Forest issued a single report for fiscal years 1993-1997. That report states that a total of 221 habitat blocks were delineated during project planning from 1992-1997, and that transects for pileated woodpeckers and barred owls were conducted from 1990-1992. The report includes a table with the number of transects completed and number of individual birds or pairs of birds observed. The report also provides a table with the number of pine marten trapped for each of four years, and a table indicating the number of marten track transects run for three different periods and the number of tracks found. None of the data are represented as indicating population trends.

A single Forest Plan Monitoring and Evaluation Report has been issued since Amendment 21 was adopted in 1999, one entitled "Forest Plan Monitoring and Evaluation Report 1998-2000." It has no mention of indicator species as per before Amendment 21, and no information on the monitoring items relating to old growth or old-growth MIS as adopted by Amendment 21.

The Flathead NF has provided no reporting of population or habitat trends of any old-growth MIS and has not demonstrated an understanding of the relationship between changes in old-growth habitat and populations of old-growth MIS.

Gallatin National Forest

The Gallatin National Forest has only issued monitoring and evaluation reports twice in the past six years, those being for fiscal years 1996 and 1997. Previous to that, reports were issued for fiscal years from 1988-1992. There was no old-growth MIS information in the two most recent reports.

Helena National Forest

Over most of the past 10 years, monitoring and evaluation reports were part of the landscape assessment process covering a relatively small part of the Forest. The Helena did issue forest-wide Monitoring and Evaluation Reports for fiscal years 2000 and 2001.

The fiscal year 2001 report states that the pileated woodpecker and hairy woodpecker sightings are noted in Northern Region Land Bird Monitoring surveys and in biologists' project field notes. It also states that the Forest conducts annual surveys of known nest sites. Pine marten track surveys were conducted in conjunction with Canada lynx track surveys. The same report mentions results of goshawk nest site surveys and detections of hairy woodpeckers, pileated woodpeckers, and goshawks in the Land Bird Surveys but no mention of pine marten detection. The fiscal year 2000 report provides similar, but less detailed information. Monitoring reports for fiscal years 2000 and 2001 provide no interpretation of the survey data in regards to population trends of old growth, mature forest, or snag-dependent MIS. Thus, any relationship between changes in old-growth habitat and population numbers of old-growth MIS are unknown.

Idaho Panhandle National Forests

Monitoring reports for fiscal years 1997-2001 provide no indication of population trends of old-growth MIS. The 1999, 2000 and 2001 reports did not report on old-growth MIS. The 1997 and 1998 reports discussed nest site surveys for the northern goshawk but stated that because monitoring efforts were not consistent, population trends were impossible to determine. The 1998 report discussed pine marten surveys in 1992, 1993, 1995, and 1997 but stated that population trends are unknown. The 1998 report states that the Forest has done very little pileated woodpecker monitoring, mentions the Northern Region Land Bird program, and indicates available data is insufficient for determining population trends. This strongly implies that any relationship between changes in old-growth habitat and population numbers of old-growth MIS are unknown.

Kootenai National Forest

Monitoring reports for fiscal years 1997-2001 were analyzed for information on population trends of old-growth MIS. Only the 1997 report contained such information. It cites data collected in the Northern Region Land Bird program during 1994, 1995, and 1996 and mentions personal observations by Forest biologists. The Land Bird program sampled 530, 579, and 545 points on the Kootenai those three years, respectively, with observations of 49, 32, and 48 pileated woodpeckers. Although the data do not clearly determine population trends, the Kootenai anticipates the Land Bird program to continue on the Forest, "contingent upon available funding."

On June 27, 2003, the U.S. District Court ruled directly on the issue of MIS monitoring on the Kootenai, with the Judge's order reading: "the Forest Service is out of compliance with …monitoring requirements" and ruling, "It is not clear … that the Forest Service knows enough about native wildlife species to assure viability of old-growth dependent species."

Lewis and Clark National Forest

Since issuing a Forest Plan Monitoring and Evaluation Report in 1994, the Lewis and Clark National Forest has only issued two reports, one for Fiscal Year 1999 and one for 2000-2001. Only information from the 2000-2001 report is discussed herein, because it summarizes the monitoring of all goshawk nest territories to date (1990-2001).

The Forest monitors known nesting territories, noting the number active the year surveyed. The number of known territories grew fairly consistently, from zero in 1990 to 35 in 2001. However not all known territories were monitored each year—as few as zero five different years up to 32 in 2001. There were fewer than 10 active territories documented most years. The four latest years of monitoring found 0, 10, 11, and 9 active territories respectively, and most years there were far fewer. Because of the variability of monitoring efforts, the population trend is not clear. Information on observations of northern three-toed woodpeckers is not provided. Thus, MIS monitoring results offer no data on the relationship between changes in habitat and population numbers of the MIS.

Lolo National Forest

Monitoring reports for fiscal years 1997-2001 were analyzed. Although a Forest Plan standard (requirement) is to "Monitor habitat for old growth MIS" and population trends will be monitored "as monitoring technology becomes available," no information on population trends of old-growth MIS is presented. There is a Forest Plan requirement to monitor how logging in old-growth stands affects old-growth habitat. Such information is presented for timber sales that affected old growth, along with discussions on how well snag retention requirements for timber sales have been met, but there is no reporting on the logged areas' conformance with old-growth criteria. And none of the monitoring reports present interpretation of the relationship between changes in old-growth habitat and the populations of old-growth MIS.

Nez Perce National Forest

The fiscal year 2001 Monitoring and Evaluation Report stated that surveys were undertaken for pileated woodpeckers in only one year since 1992, and that no formal surveys were undertaken for pine marten and fisher. The report also states that three known goshawk nest territories were monitored, with no goshawk use of the territories noted. No pine marten, northern goshawk, or fisher surveys were mentioned in the fiscal year 2000 report. The fiscal year 1999 report mentions four sets of marten tracks observed on a single 18-mile transect. The 1999 report mentions call-playback tape surveys for goshawks, with approximately 180 call stations and approximately 2000 acres surveyed, mentions two sightings, and mentions monitoring of two known nest sites that proved to be inactive that year. The 1998 report states that one set of marten tracks were observed on the 18-mile loop, and that no fisher tracks were seen. The 1997 report states that fisher and marten surveys were not undertaken due to inadequate funding, and that no new goshawk nests or sightings occurred that year. Monitoring reports from the past five years provide no indication of population trends of any of the old-growth MIS. Thus, any relationship between changes in old-growth habitat and population numbers of old-growth MIS on the Nez Perce National Forest remains unknown.

Summary

From this review of Forest Plan Monitoring and Evaluation Reports issued by Northern Region national forests from at least the past five years, it is clear that none of them present data sufficient to reveal population trends of their management indicator species. Furthermore, none of the Northern Region national forests appear to have investigated the relationship between old-growth MIS habitat changes and old-growth MIS population numbers.

Conclusions

This report investigated how Forest Plans and Forest Service management have complied with NFMA regulations in regards to old-growth forests and the wildlife species that depend upon old-growth habitat. All of the forest plans for Northern Region national forests have been implemented for at least 15 years, which was their maximum lifespan as intended by NFMA. The results of this report are rather striking, in that it appears that many of the promises made for protection of biological diversity have not been kept.

Perhaps most striking is the failure of all Northern Region national forests to properly track population trends of old-growth management indicator species (MIS) during the life of the forest plans. This means that the Forest Service lacks the data to be able to understand how old-growth MIS populations change in response to management-induced or other changes to their habitats. The Northern Region national forests have not complied with the NFMA regulations' requirement: "Population trends of the management indicator species will be monitored and relationships to habitat changes determined." [36 CFR §219.19(a)(6).]

Another striking finding is that the accuracy of national forest old-growth inventories is highly questionable. Four of the national forests have forest plans that require a certain amount of old growth be maintained forest-wide. Three of those forests (Clearwater, Idaho Panhandle, and Kootenai) have been involved in litigation that challenged the accuracy of their forest-wide old-growth inventories. In each case, a federal court ruled the inventory was not accurate enough to insure that the total amount of old-growth habitat required by the forest plans was actually being maintained. The fourth, the Nez Perce National Forest, does not currently have a comprehensive forest-wide old-growth inventory.

Of the other nine national forests of the Northern Region, none have forest plans that explicitly require keeping forest-wide old-growth inventories, although some contain implications in that direction. Of those nine, only the Bitterroot represents itself as having an essentially complete forest-wide inventory. However, not even the Bitterroot's inventory is satisfactorily in harmony with forest plan allocation requirements.

In sum, none of the national forests in the U.S. Forest Service Northern Region have complied with the biological diversity requirements of the National Forest Management Act as applied to old-growth forests and the wildlife species that depend upon them. The amount of old growth that currently exists on these forests is apparently unknown. As the Forest Service enters the revision phase for new forest plans, none of the national forests has collected the data that would allow them to understand how their management under the original forest plans has affected population trends of these wildlife species. This is not what Congress envisioned when NFMA was passed into law.

Appendix 1

Green, P., J. Joy, D. Sirucek, W. Hann, A. Zack, and B. Naumann, 1992. Old-growth forest types of the northern region. Northern Region, R-1 SES 4/92. Missoula, MT.

To download or view a copy of this reference, go to:
http://outerlimits.wildrockies.org/Ecosystem_Defense/Science_Documents/Green_et_al_1992.pdf

USDA United States Department of Agriculture | Forest Service | Clearwater National Forest | 12730 Highway 12
Orofino, Idaho 83544

File Code: 1960/2640 **Date:** December 7, 2006
Route To:

Subject: Old Growth Direction

Attachment E.

To: Staff Officers, Rangers

Recently, the Clearwater National Forest has received updated information using Forest Inventory and Analysis (FIA) data that has estimated the amount of old growth forest-wide on the Clearwater National Forest to be 9.4 percent (mean) with a 90 percent confidence interval of old growth between 7.3 percent (lower bound) to 11.8 percent (upper bound). (See, *Estimates of Old Growth for the Northern Region and National Forests*, Report Number 06-03, November 1, 2006, and *Estimates of Old Growth for the Clearwater National Forest*, Report Number 06-06, November 27, 2006.) The mean of this estimate is below the Clearwater Forest Plan standard of maintaining 10 percent old growth forest-wide.

The national Forest Inventory and Analysis (FIA) program is a congressionally mandated, statistically-based, continuous inventory of the forest resources of the United States. FIA provides a statistically-sound estimate of old growth both at the forest and regional level. *Estimates of Old Growth for the Clearwater National Forest*, Report Number 06-06, November 27, 2006 summarizes the FIA information for the Clearwater National Forest in relation to old growth.

I recognize that the Clearwater National Forest has updated its own old growth database which indicates there is 18 percent old growth on the Clearwater – substantially more than the FIA estimate. However, the accuracy of estimates from this database has not yet been determined. To be conservative in our management of old growth, FIA will be used to estimate the percent of old growth forest-wide for the Clearwater National Forest until such time as the Clearwater National Forest can assess the accuracy of other estimates.

The Clearwater National Forest has not proposed projects that involve regeneration harvest of old growth since 1996 and will continue to not propose such projects. Further, since FIA data indicates that the Clearwater may not meet the 10 percent Forest Plan standard we will take additional steps to insure that we are moving the Forest towards meeting that standard. For projects that do not yet have NEPA decisions, I have decided to defer regeneration harvest in stands that are within 20 years of meeting the Green et al old-growth definition. The purpose of this is to insure that those stands that are within 20 years of becoming old growth are available as recruitment for future old growth, moving us towards meeting the 10 percent Forest Plan standards. The prescriptions for prescribed burns will be written to accomplish a similar intent of providing recruitment of future old growth by not being written with the intended result of creating regeneration stands.

Attachment A, *Old Growth Guidance – Clearwater National Forest*, shows that the Clearwater is rapidly moving toward meeting its Forest Plan old growth standard. The analysis indicates that the estimated amount of old growth would exceed the 10 percent standard 10 years after the inventory date (2002). Further this analysis shows that in 20 years not only will the mean be above the 10 percent Forest Plan standard, but the lower bound of the 90 percent confidence interval will also be above the 10 percent standard, at 10.3 percent (with the upper bound at 15.5 percent). This is expected as the Clearwater National Forest is approximately 1.8 million acres with 987,000 acres of that in suitable forest land and the Forest has conducted harvest activities averaging only approximately 1,100 acres per year from 2001 to 2005. Please refer to the Attachment A, *Old Growth -- Clearwater National Forest,* for additional background information and for further guidance on how to implement this memo.

The Clearwater National Forest is in transition. We are revising our Land and Resource Management Plan using a newly developed planning rule. Soon we will have a proposed revised Land and Resource Management Plan. Using a combination of fire, mechanical treatment, and commercial timber harvest, the Forest, consistent with the Forest Plan, will focus vegetation management from one of timber production in some areas and use of fire in other areas to more integrated projects across the Forest prioritized and targeted to protect values at risk.

We have many accessible “middle-aged” stands in need of treatment for forest health, wildlife habitat improvement, and other reasons. As we move forward, we need to consider these needs along with priorities identified from the Regional Restoration Strategy, recommendations of Senator Crapo’s elk collaborative, biological opinions concerning listed species, and the Forest Plan as amended by PACFISH.

The Forest expects to use stewardship contracting and the full range of tools available to achieve diverse and sustainable vegetation on the landscape. Future projects will reflect the integration of the need to ensure health and productive wildlife habitat, clean and abundant water, and healthy forests.

This memo applies during this interim time before we have a new Plan or until there is new information. This guidance, while somewhat conservative, maintains options for the future as our proposed Revised Plan is finalized. I recognize that this memo may cause additional field work before you undertake project decisions and I ask you to consult with Paul Moroz for any questions concerning this guidance.

I thank you for you support and understanding as we wend our way through this time of transition.

/s/ Tom Reilly
THOMAS K. REILLY
Forest Supervisor

Enclosures: 2

Attachment A to December 7, 2006 letter:

Old Growth Guidance - Clearwater National Forest

An analysis using Forest Inventory and Analysis data and Green and others (2005) criteria for old growth, estimates that the amount of old growth on the Clearwater National Forest is below the forest plan standard of 10% (see Table 1 below).

Table 1: Estimates, confidence intervals and standard error of old growth on the Clearwater National Forest

Forest	Estimated Percent Old Growth	90%-Confidence Interval - Lower Bound	90%-Confidence Interval - Upper Bound	Stand ard Error	Total Num PSUs	Num Forested PSUs
Clearwater	9.4%	7.3%	11.8%	0.014	305	300

For detailed information on how these estimates were derived, using Forest Inventory and Analysis data and the Region's definition for old growth, see *Estimates of Old Growth for the Northern Region and National Forests*, Report Number 06-03, November 1, 2006 and *Estimates of Old Growth for the Clearwater National Forest*, Report Number 06-06, November 27, 2006 available on the R1 FRM Inventory website.

Further analysis of the current inventory was conducted to indicate when the estimate of old growth should be above the forest plan standard.

This analysis was conducted by iteratively adding 10-year increments to the field-sampled age of each tree in the dataset. Each new age-increment was assessed to determine if the plot met the Green and others (2005) old growth criteria. Following are the results of that analysis:

Future old growth for the Clearwater National Forest:

Description	Estimated Percent Old Growth	90%-Confidence Interval - Lower Bound	90%-Confidence Interval - Upper Bound	Standard Error	Total Num PSUs	Num Forested PSUs
Future old growth – 10yrs	11.3%	9.0%	13.9%	0.015	305	300
Future old growth – 20 yrs	12.7%	10.3%	15.5%	0.016	305	300

The analysis indicates that the estimated amount of old growth would exceed the 10% standard 10 years after the date inventory (2002). Further, this analysis shows that in 20 years not only the mean will be above the 10% Forest Plan standard but also lower bound of the 90% confidence interval will be above the 10% standard at 10.3% (with the upper bound at 15.5%).

Based on this analysis, any stand currently identified as old growth or meeting future old growth, within 20 years of inventory date, will be deferred from regeneration harvest and will be reserved to contribute to future old growth. This will ensure that the Forest will be moving towards the desired condition within a reasonable timeframe. Any prescriptions for prescribed burns will be written to accomplish a similar intent of providing recruitment of future old growth and not written with the intended result of creating regeneration stands.

Project-level analysis:
The Clearwater National Forest will utilize the following methodology at the project level to implement the above guidance.

- For all mature stands proposed for harvest, that may be old growth or may be within 20-years of meeting the old-growth criteria, will have a current field stand exam. This Region 1 FSVeg old growth report will be run on the stand exam data in order to determine if the stand currently meets minimum old growth standards or will meet standards within 20 years of inventory.
- For prescribed burns that may encompass old growth or may be within 20-years of meeting old growth criteria, prescriptions will be written to accomplish the intent of maintaining existing old growth and providing recruitment of future old growth and not written with the intended result of creating regeneration stands. Project areas proposed for prescribed burns with these prescriptions should comply with R1 Supplement FSH 2409.17 to determine if the stands proposed for prescribed burning currently meet old growth criteria or will meet old growth within 20 years of inventory.

Sample R1 FSVeg Old Growth Report

Old Growth Report

R1 Reports

Setting Id	01050626010046	Setting CN	526593010361
Project Name	STAND EXAMINATION	Exam Purpose	CI
Measurement Date	01-SEP-90	Exam Level	Tree:3 Veg:2 DW:1 SC:0

Stand Acres 14 Number of Plots Installed 14 Habitat Type Code 690

Old-Growth Criteria Used

Old-growth Zone	ID
Old-growth Forest Type	PICO
Old-growth Habitat Type Group	J

Thresholds for tree/setting to qualify as old growth

Minimum trees/acre meeting age andDBH criteria	10
Minimum tree DBH	13
Minimum tree age	120
Minimum basal area/acre ≥ 5" DBH	60

Current Condition

Stand Attributes

Number of trees/acre meeting age/dbh criteria	9.4
Basal area/acre ≥ 5" DBH	91.4
Meets old-growth definition?	No

Associated Characteristics

Vertical Structure	2
Snags/Acre ≥ 9"	4.5
Coefficient of Variation% -- DBH [live trees ≥ 9" DBH]	271.40
Live trees/acre ≥ 9" with dead/broken tops	0
Down logs/acre ≥ 9" diameter (at intersection)	cannot assess
Live trees per acre ≥ 9" with decay	0

Future Condition (years indicated are added to current tree age, no growth or mortality included)

Future old growth: 10 Years	Yes
Future old growth: 20 Years	Yes
Future old growth: 30 Years	Yes
Future old growth: 40 Years	Yes

Attachment F.

Final Report

Meta-analysis of resting site selection by the fisher in the Pacific coastal states and provinces

Submitted by:

Steven W. Buskirk
Catherine M. Raley
Keith B. Aubry
William J. Zielinski
Michael K. Schwartz
Richard T. Golightly
Kathryn L. Purcell
Richard D. Weir
J. Scott Yaeger

12 March 2010

Introduction

Habitat associations of the fisher (*Martes pennanti*) are of concern in western North America because the species has undergone dramatic reductions in distribution and abundance (Gibilisco 1994), with human-caused habitat change implicated as a contributing factor (Zielinski et al. 1995). Several studies of habitat selection by fishers have been conducted in the Pacific coastal states (California and Oregon; e.g., Zielinski et al. 2004, Purcell et al. 2009) and provinces (British Columbia; e.g., Weir and Corbould 2008), but the extent to which the patterns reported in those studies vary geographically is unknown, complicating conservation planning. Specifically, reliable information on the extent to which habitat selection by fishers is consistent across habitat variables and geographic areas is urgently needed. This will permit managers, who often must include information on the potential effects of land management activities in environmental documents, to generalize about the likely effects to fisher habitat, even when research from the geographic area of interest is not available.

Here, we report on a meta-analysis of data on habitat selection at resting sites by the fisher in the Pacific coastal states and provinces. We chose to analyze selection of resting sites because they are believed to represent key components of fisher habitat (Powell and Zielinski 1994; Zielinski et al 2004). Resting sites (the structure used for resting as well as the vegetation and topographic features in the immediate vicinity) are important to fishers for thermoregulation and protection from potential predators (Weir et al. 2004, Zielinski et al. 2004). Additionally, because most fisher researchers in our analysis area have investigated resting-site selection, and have data to contrast used and available resting sites, these are the most common and strongest datasets available for a meta-analysis of fisher habitat selection. It is important to understand that the results reported here relate to habitat conditions within resting sites only; we have not evaluated the consistency of selection for the resting structures themselves, which would require a separate meta-analysis of different datasets.

A meta-analysis is a statistical approach for combining and estimating the strength of results obtained from multiple studies that ask similar questions. In a meta-analysis, the individual study is the focus of statistical analysis (Arnqvist and Wooster 1995:236), rather than a smaller entity, such as the number of animals or observations. The statistical measure that is compared across studies is the effect size, which typically compares some response attribute of a treatment with that for a control group (Gurevitch et al. 2001) using a metric that is discounted for within-study variances and sample sizes. The use of continuous or categorical co-variates to explain differences among studies generally follows the approaches of analyses of variance. Meta-analyses of ecological data are common (Gurevitch et al. 2001), but those examining geographic variation in wildlife habitat selection are extremely rare.

Conducting a meta-analysis of habitat selection at resting sites by the fisher within its Pacific coastal range presents both challenges and opportunities. First, the number of studies that have been conducted is small, compared to the scores or hundreds (e.g. McClelland and Naish 2007, Connor et al. 2000, Prugh et al. 2008) that form the basis for many meta-analyses. Second, available data were characterized by covariates that could reasonably be expected to affect cross-study patterns. For example, habitat selection in fishers and closely related American martens (*M. americana*) has been shown to vary with age, reproductive condition, and season of study (Buskirk and Powell 1994). Studies of fisher habitat selection that were available to include in a meta-analysis had variable sex ratios among study animals that generally favored females (males: 10-50% of samples, depending on study) and age ratios that favored adults (juveniles 0-30% of samples, some unknown). An additional source of variation was geographic differences in ecological conditions; i.e., the habitat choices available to fishers varied among studies.

On the other hand, the data sets we considered were not limited to those published in the primary literature, so “inclusion bias” should not have occurred. Inclusion bias refers to the tendency of researchers and journal editors to limit published results to statistically significant relationships, thereby misrepresenting the frequency of non-significant findings. Thus, in our analyses, no exaggeration of apparent habitat selection should have occurred. Further, although studies were not completely consistent in their methodologies, the use of standardized effect sizes reduces the effect of these inconsistencies by using the same metric to calculate them. This is one of the strengths of conducting a modern statistical meta-analysis compared to other approaches for synthesizing research results (e.g., narrative reviews, vote-counting; Gurevitch et al. 2001). The principal investigators who directed the studies included in the meta-analysis participated in data compilation and reduction to ensure that differences among data sets were further minimized.

Methods

Before the primary authors of this report solicited data from other researchers, we used 3 fisher radiotelemetry datasets for which one of us was the primary principal investigator (K. Aubry, Cascade Range in southern Oregon; W. Zielinski, Klamath Mountains and southern Sierra Nevada in California) to develop a list of potential variables to include in the meta-analysis. Our initial process involved several steps: (1) identifying a suite of habitat variables that were associated with fisher resting sites, common to the 3 studies examined, and likely to have been measured by other researchers; (2) establishing measurement criteria associated with each habitat variable (e.g., tree and log decay-condition classes and minimum sizes of logs, trees, and snags); and (3) determining units of measure for each variable (e.g., m^3/ha for log volume, aspect measured as degrees from southwest). Subsequently, we developed a data-entry spreadsheet that included detailed descriptions of each variable to ensure that investigators for each study compiled their data and computed summary statistics consistently. The spreadsheet also included a list of data-documentation questions designed to provide us with detailed information on the sampling design and methods employed in each study.

We identified 10 independent studies that used radiotelemetry to investigate resting site habitat selection by fishers in the Pacific coastal states and provinces and were candidates for inclusion in a meta-analysis. Several criteria had to be met in order for a study to be included: (1) use was quantified by measuring habitat conditions in the vicinity of rest structures, and availability was quantified by measuring habitat conditions at random or systematic sites located within each study area; (2) estimates of various habitat attributes at resting sites included the structure used by fishers for resting (e.g., log rest structures were included in estimates of mean log volume); (3) data collection had been completed; (4) resulting data had been checked for errors and summarized by the principal investigator; and (5) any single data set had to include ≥20 resting sites from at least 3 females, or ≥20 resting sites from at least 3 males. Recognizing the scarcity of habitat selection data for fishers (especially males) from some regions, we adopted a relatively low minimum sample size. However, if this criterion could not be met, we invited cooperators to contribute whatever data they had collected, because even small data sets could be included in descriptive summaries. Ultimately, principal investigators from eight independent fisher studies contributed data to this meta-analysis (Fig. 1, Table 1). Two studies in northwestern California were not included: one study did not have a completed availability data set, and the principal investigators of a second study felt that their sampling methodology was too dissimilar from that employed by other studies to be included in a meta-analysis of habitat selection at fisher resting sites.

To select the final set of variables to include in the meta-analysis, we (1) reviewed available literature to identify habitat attributes that were important for distinguishing fisher resting sites from available sites in the Pacific coastal states and provinces (e.g., Seglund 1995, Mazzoni 2002, Yaeger 2005, Zielinski et al. 2004, Weir and Corbould 2008), (2) identified attributes for which the mechanism of influence on resting behavior was apparent, and (3) selected variables that we believed were not co-linear and for which we had adequate data (i.e., from as many of the eight studies as possible). The nature of the data available to us precluded rigorous investigation of the covariance structure. Although we compiled data for more than 40 potential variables, the number that could reasonably be included in the meta-analysis of eight studies, and still control for Type I errors, was considerably fewer. Our final set of nine variables included slope (%), aspect (degrees from SW), vegetation cover (% cover of all vegetation $\geq$2 m above the ground), log volume (volume [m^3/ha] of moderately decayed [decay classes 1-4 (Maser et al. 1979)] logs $\geq$26 cm in mean diameter), basal area of large conifers (basal area [m^2/ha] of live conifer trees 51-100 cm dbh), basal area of large hardwoods (basal area of live hardwood trees 51-100 cm dbh), basal area of large snags (basal area of moderately decayed [decay-classes 3-7 (Maser et al. 1979)] snags 51-100 cm dbh), mean dbh of conifers (mean dbh of live conifer trees $\geq$10 cm dbh), and mean dbh of hardwoods (mean dbh of live hardwood trees $\geq$10 cm dbh) (Table 2). Sample sizes for most studies were too small to allow the disaggregation of sexes; therefore, results presented here are biased toward females (Table 1). Results for females only can easily be generated from the data in hand.

To conduct the meta-analysis, we calculated two different estimates of standardized effect sizes and associated variances for each study: Cohen's *d* and the log response ratio (*lr*), both of which are described by Hedges and Olkin (1985) and Gurevitch et al. (2001). These are the two most commonly used effect-size metrics, differing in the size of their variance penalty. Because their calculations differ, we included both metrics in our analyses to evaluate the consistency of our findings. We calculated the weighted grand mean effect size ($\bar{\bar{E}}$; Gurevitch et al. 2001:209), and represented variance graphically as 95% confidence intervals (CIs).

Results

Within their Pacific coastal range, fishers exhibited strong cross-study patterns in selection of resting site attributes for each of the nine variables and two effect-size metrics considered (Fig. 2). Pooled cross-study standardized effect sizes (*d* and *lr*) were positive, and 95% CIs did not include 0. Thus, we found consistent selection for sites that had larger values for the attributes measured at resting sites than at availability sites. Examining cross-study patterns among studies for individual variables (Figs. 3-11; for clarity, only results for Cohen's *d* are shown), we detected some exceptions to the general pattern of positive effect sizes. Hoopa Valley was negative for slope (Fig. 3), Pilot Creek and Tule River were negative for aspect (Fig. 4), Hoopa Valley was negative for vegetation cover (Fig. 5), and Kings River was negative for both mean dbh of conifers (Fig. 10) and mean dbh of hardwoods (Fig. 11). The results for the log response ratios were similar, and are available upon request.

Discussion

Among the eight studies included in the meta-analysis, fishers exhibited remarkably consistent selection for each of the nine variables considered. Overall, selection of habitat attributes was positive; i.e., indicative of preference, rather than avoidance. We noted a few exceptions for single attributes in individual studies whereby selection was either not different from 0 or negative. However, both standardized effect size metrics showed positive cross-study mean values for all of the attributes we considered (i.e., 95% CIs did not overlap 0); thus, within the analysis area, fishers exhibited consistent patterns of selection for the resting site attributes we analyzed. Consequently, our results indicate that the nine variables we considered represent important components of fisher resting habitat throughout its Pacific coastal range.

In any meta-analysis, the choices of effects to quantify and co-variates to consider are constrained by the data that were collected in each study. For meta-analyses of habitat selection, spatial scale is a critically important consideration. To investigate resting site habitat selection, sample plots are restricted to a small area surrounding a resting structure or random point; consequently, most of the attributes that are typically measured at resting sites are related to forest structure. For a structure-dependent species like the fisher, this constraint likely pre-determines the strong positive results that we detected. If we had considered data collected at larger spatial scales, we likely would have included habitat attributes that were significantly and negatively associated with resting site selection. To our knowledge, however, the multiple independent data sets that would be needed to conduct a meta-analysis of fisher resting habitat selection at larger spatial scales are not available at this time.

All of the habitat attributes we analyzed either have been included in published models for selection of resting sites by fishers (e.g., Zielinski et al. 2004, Purcell et al. 2009), or have been postulated to represent important habitat components for fishers throughout their range (e.g., Powell 1993, Powell and Zielinski 1994, Buskirk and Powell 1994). However, ours is the first study to investigate the generality of fisher habitat associations derived from multiple independent radio-telemetry studies conducted over a broad geographic area. We demonstrated that all nine of the attributes we analyzed provide habitat value to fishers at resting sites across their Pacific coastal range, in the face of substantial variation in environmental conditions at these sites. Thus, even among study areas where forest conditions varied substantially (e.g., tree sizes, species composition, conifer/hardwood ratios, etc.), fishers selected sites for resting that, compared to random sites, were more mesic in temperature and moisture regimes (i.e., aspects oriented further from southwest), higher in vegetation cover, steeper in slope, and that contained a relatively greater volume of logs and a higher prevalence of large trees (i.e., relatively high basal area of conifers, hardwoods, and snags 51-100 cm dbh, and relatively large-diameter conifers and hardwoods).

Clearly, several of the attributes we analyzed are likely to exhibit autocorrelation, but the nature of the data available to us precluded rigorous investigation of the covariance structure. Consequently, in geographic locations where one or more resource selection functions for fisher resting site habitat have been derived (i.e., where additional variables have been evaluated, and appropriate variable-reduction techniques have been applied to ensure the independence of variables included in resulting models), models specific to that area should take precedence over the results presented here. However, in areas where fishers have not been studied and data on resting site habitat use or selection is lacking, our findings provide empirical support for management or conservation actions for fishers that promote the retention or development of one or more of the variables included in this meta-analysis. It is important to understand, however, that resting site habitat suitability is only one of many potentially important components of overall fisher habitat quality. Denning habitat, as well as foraging habitat, escape cover, and other habitat attributes that are measured at much larger spatial scales, may be equally or more important than resting site habitat quality. Thus, managing only for one or more components of resting site habitat suitability may not result in benefits to fisher populations if other important components of fisher habitat quality are limited or unavailable.

Acknowledgments

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List of figures

Fig. 1. Current distribution (hatched areas) of the fisher in the Pacific coastal portion of its range, with the locations of studies included in the meta-analysis indicated by red circles. Current distribution is based on information produced by the Interagency Fisher Biology Team (Lofroth et al. 2010) and reflects substantial range losses historically; fishers were presumably once distributed more widely in coniferous forest habitats in the Pacific coastal states and provinces (Gibilisco 1994). The current distribution of fishers in neighboring provinces and states is not shown.

Fig. 2. Pooled cross-study standardized effect sizes (Cohen's *d*, and the log response ratio, *lr*) for fishers, sexes pooled, for habitat attributes measured in four (log volume), seven (basal area of large snags), and eight (all other attributes) study areas in the Pacific coastal states and provinces. Error bars indicate 95% CIs. All effect sizes are >0, showing a significant cross-study pattern in resting site selection by fishers for each of the nine variables analyzed.

Fig. 3. Standardized effect sizes (Cohen's *d*) for selection of slope by fishers at resting sites in eight study areas in the Pacific coastal states and provinces, arranged by geographic latitude (left is northernmost study).

Fig. 4. Standardized effect sizes (Cohen's *d*) for selection of aspect by fishers at resting sites in eight study areas in the Pacific coastal states and provinces, arranged by geographic latitude (left is northernmost study).

Fig. 5. Standardized effect sizes (Cohen's *d*) for selection of vegetation cover by fishers at resting sites in eight study areas in the Pacific coastal states and provinces, arranged by geographic latitude (left is northernmost study).

Fig. 6. Standardized effect sizes (Cohen's *d*) for selection of log volume by fishers at resting sites in four study areas in the Pacific coastal states and provinces, arranged by geographic latitude (left is northernmost study).

Fig. 7. Standardized effect sizes (Cohen's *d*) for selection of basal area of large conifers by fishers at resting sites in eight study areas in the Pacific coastal states and provinces, arranged by geographic latitude (left is northernmost study).

Fig. 8. Standardized effect sizes (Cohen's *d*) for selection of basal area of large hardwoods by fishers at resting sites in eight study areas in the Pacific coastal states and provinces, arranged by geographic latitude (left is northernmost study).

Fig. 9. Standardized effect sizes (Cohen's *d*) for selection of basal area of large snags by fishers at resting sites in seven study areas in the Pacific coastal states and provinces, arranged by geographic latitude (left is northernmost study).

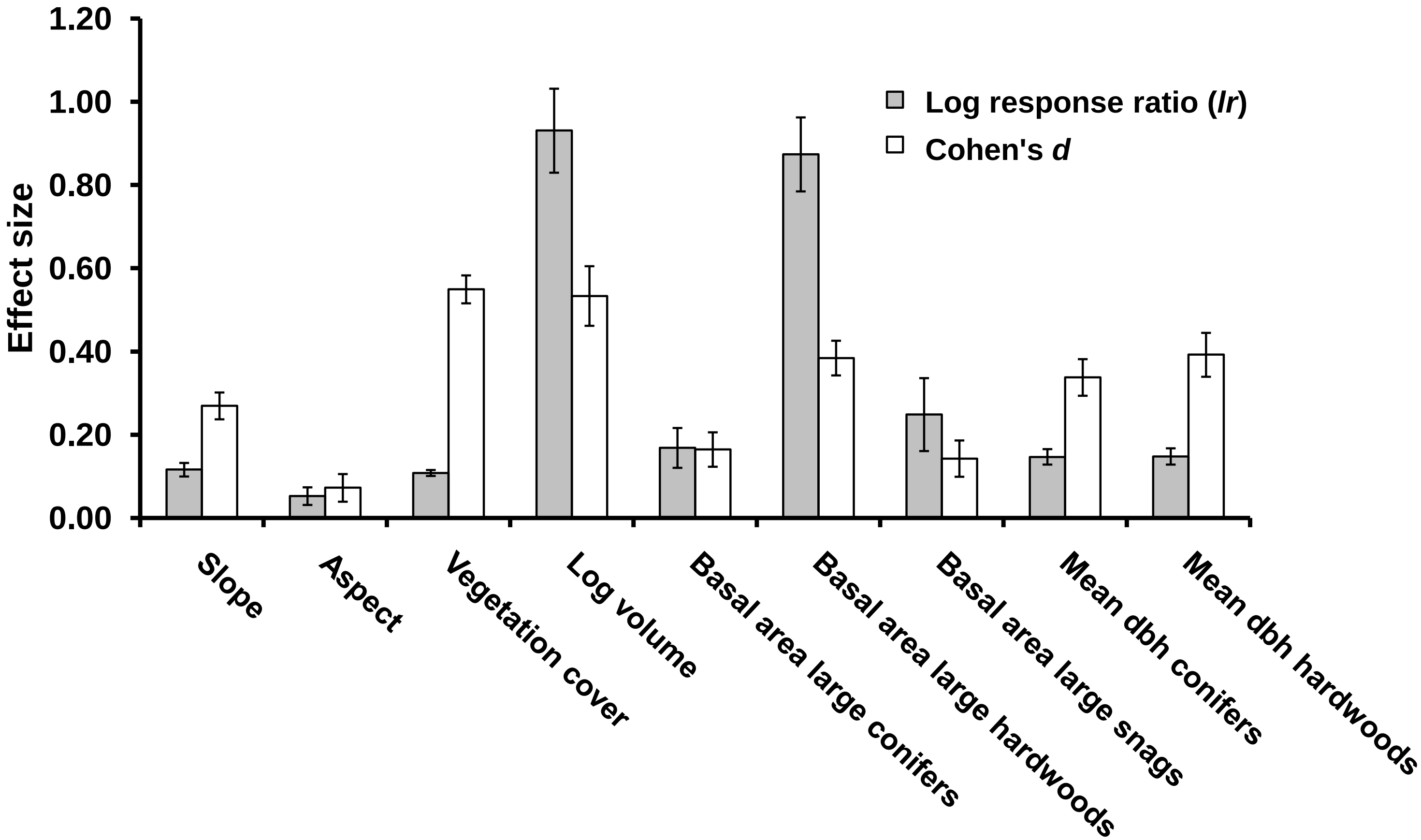
Fig. 10. Standardized effect sizes (Cohen's *d*) for selection of mean dbh of conifers by fishers at resting sites in eight study areas in the Pacific coastal states and provinces, arranged by geographic latitude (left is northernmost study).

Fig. 11. Standardized effect sizes (Cohen's *d*) for selection of mean dbh of hardwoods by fishers at resting sites in eight study areas in the Pacific coastal states and provinces, arranged by geographic latitude (left is northernmost study).

Fig. 1

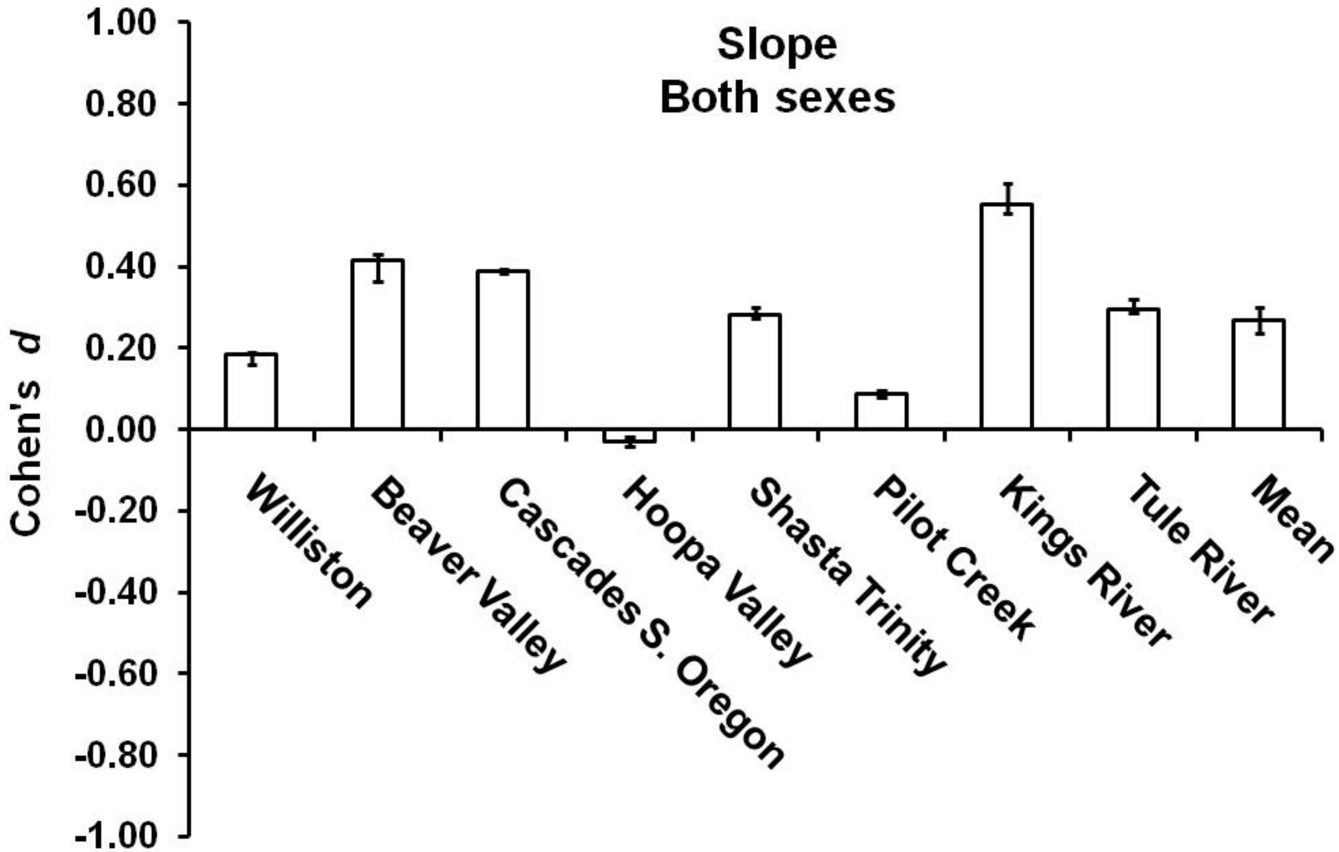

Williston
Beaver Valley
British Columbia
Washington
Pacific Ocean
Oregon
Southern Oregon
Cascades
Hoopa Valley
Shasta Trinity
Pilot Creek
California
Kings River
Tule River
Studies included in a meta-analysis of fisher resting habitat
Current distribution of fishers in the Pacific coastal states and provinces

Fig. 2



1.20
1.00
0.80
0.60
0.40
0.20
0.00
Effect size
Log response ratio (lr)
Cohen's d
Slope
Aspect
Vegetation cover
Log volume
Basal area large conifers
Basal area large hardwoods
Basal area large snags
Mean dbh conifers
Mean dbh hardwoods

Fig. 3


Slope
Both sexes
Cohen's d
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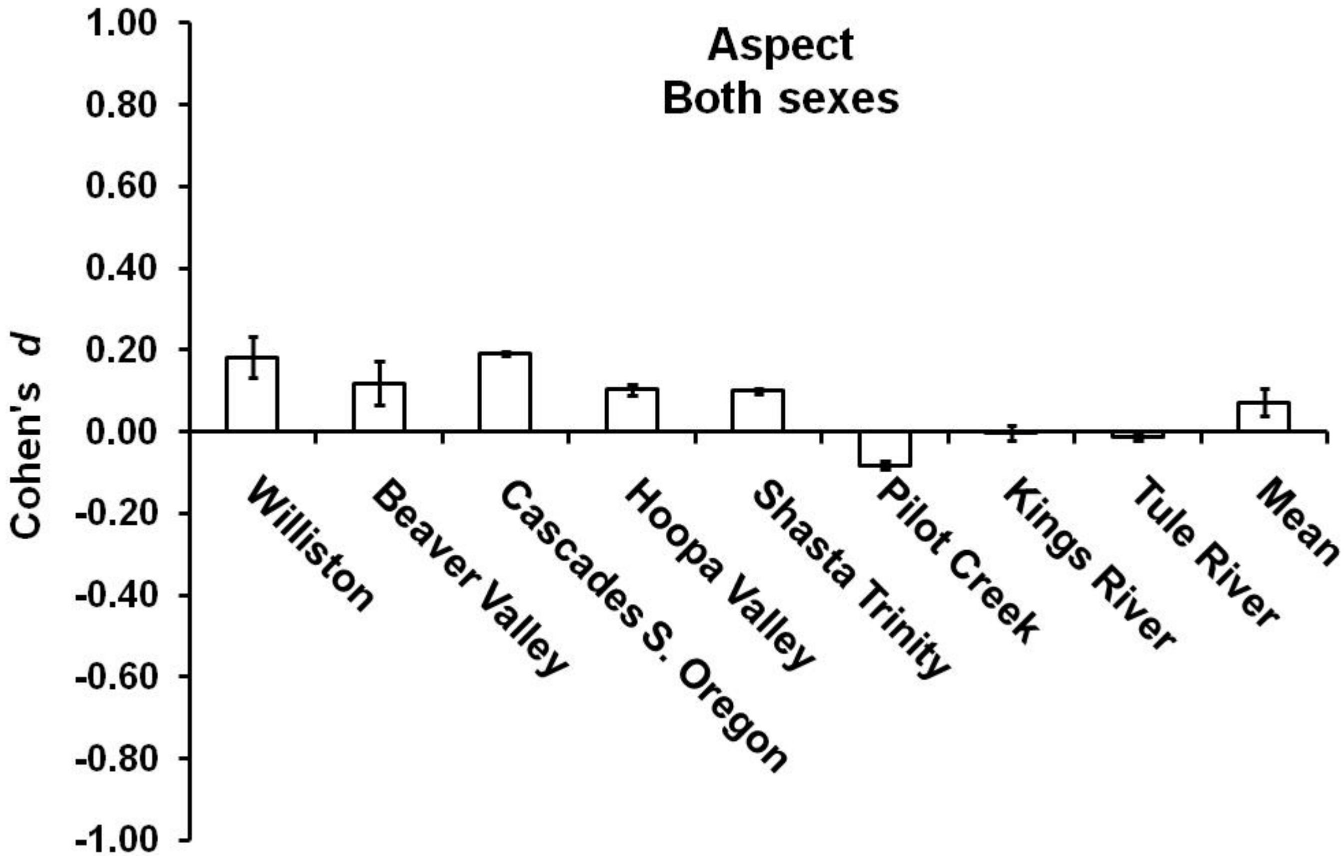
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
-0.80
-1.00
Williston
Beaver Valley
Cascades S. Oregon
Hoopa Valley
Shasta Trinity
Pilot Creek
Kings River
Tule River
Mean

Fig. 4



Aspect
Both sexes
Cohen's d
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
-0.80
-1.00
Williston
Beaver Valley
Cascades S. Oregon
Hoopa Valley
Shasta Trinity
Pilot Creek
Kings River
Tule River
Mean

Fig. 5

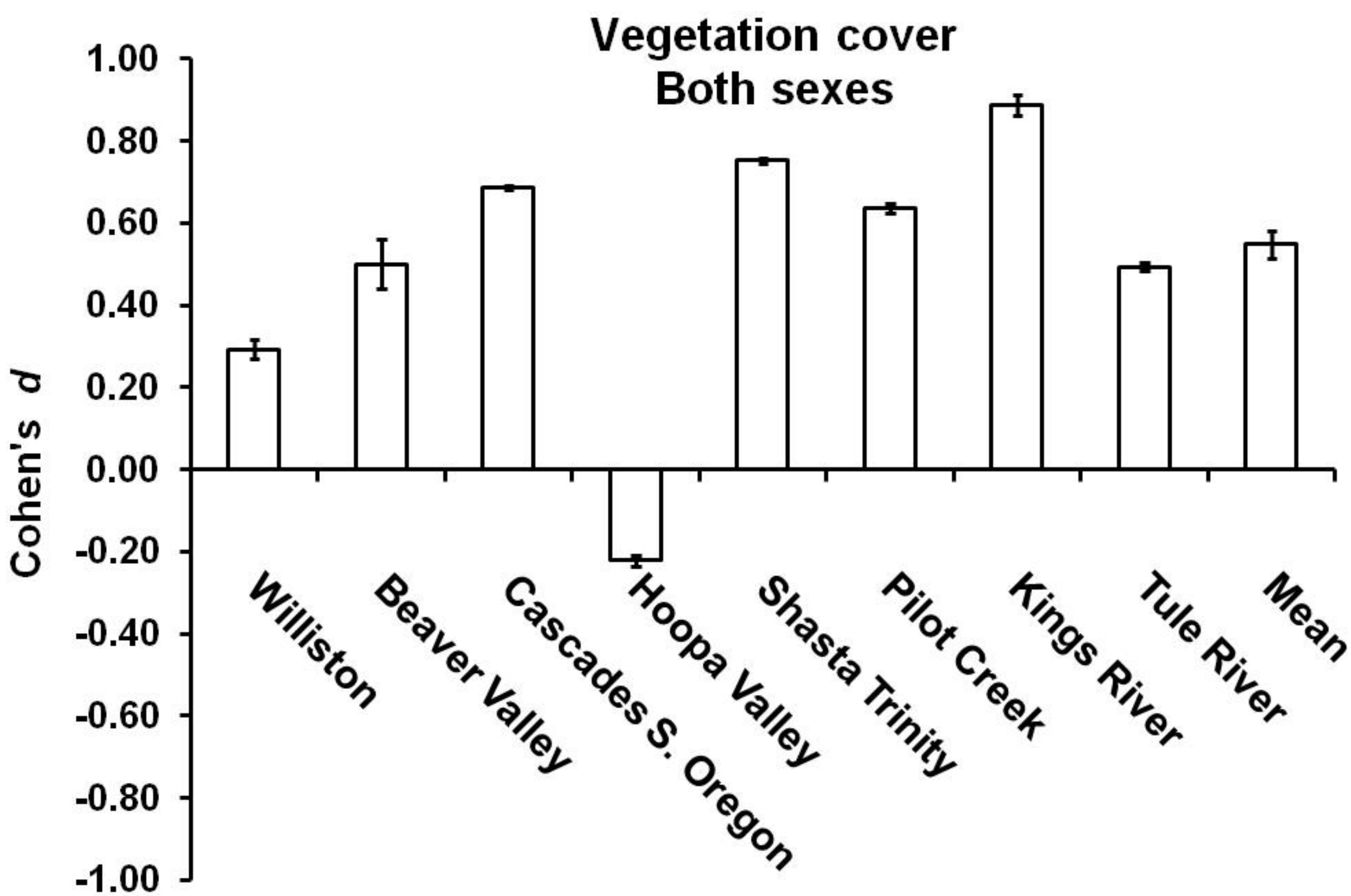
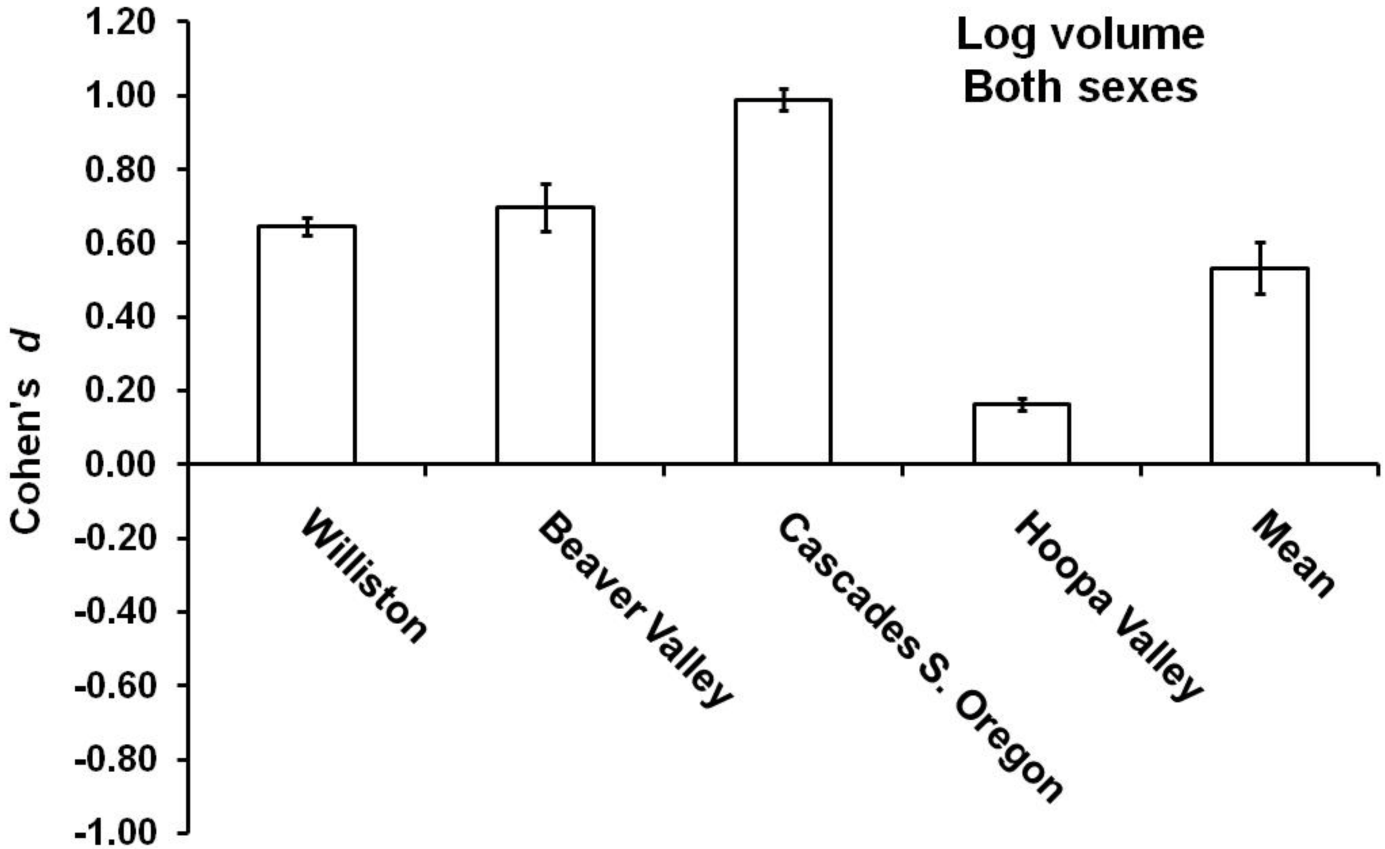

Vegetation cover
Both sexes
Cohen's d
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
-0.80
-1.00
Williston
Beaver Valley
Cascades S. Oregon
Hoopa Valley
Shasta Trinity
Pilot Creek
Kings River
Tule River
Mean

Fig. 6


Log volume
Both sexes
Cohen's d
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1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
-0.80
-1.00
Williston
Beaver Valley
Cascades S. Oregon
Hoopa Valley
Mean

Fig. 7

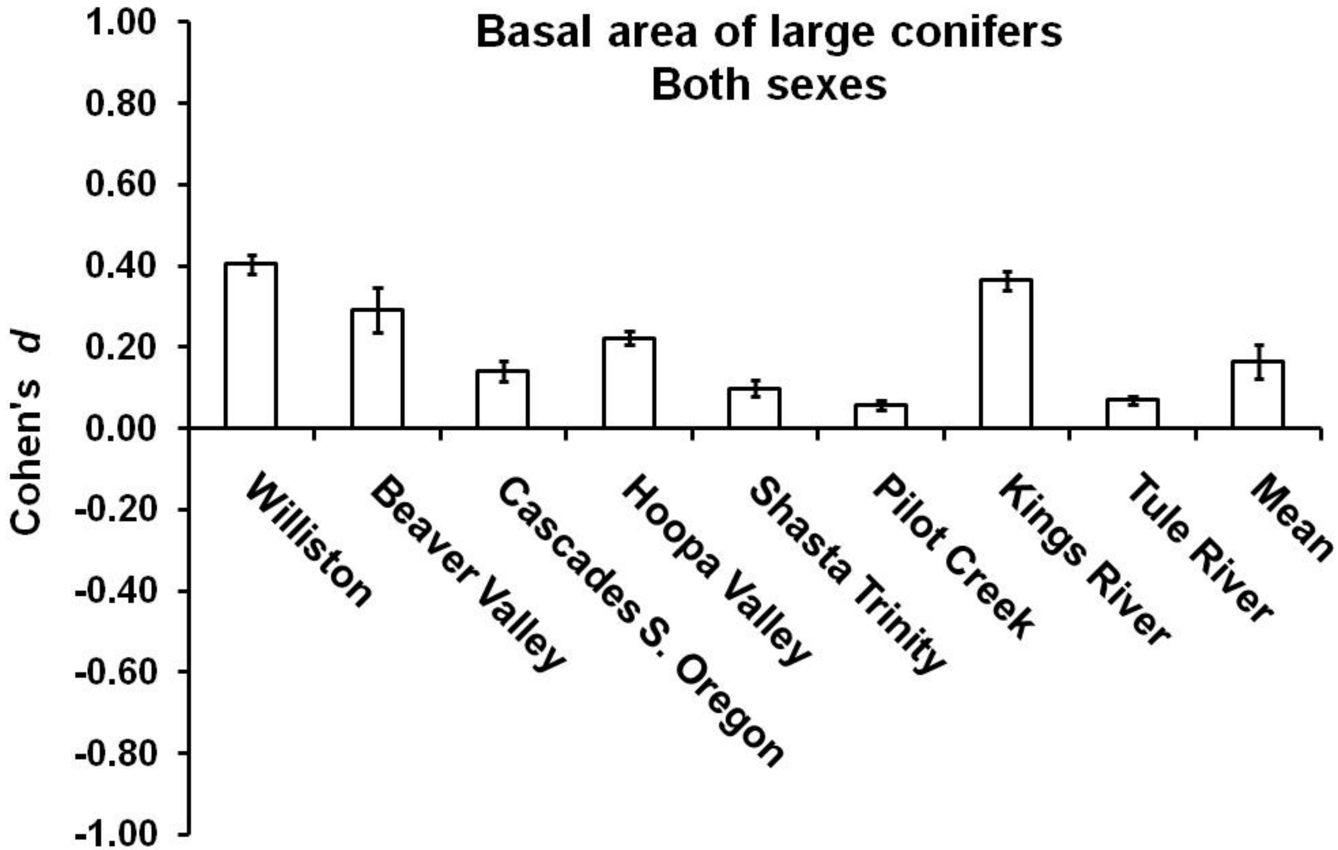

Basal area of large conifers
Both sexes
Cohen's d
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
-0.80
-1.00
Williston
Beaver Valley
Cascades S. Oregon
Hoopa Valley
Shasta Trinity
Pilot Creek
Kings River
Tule River
Mean

Fig. 8

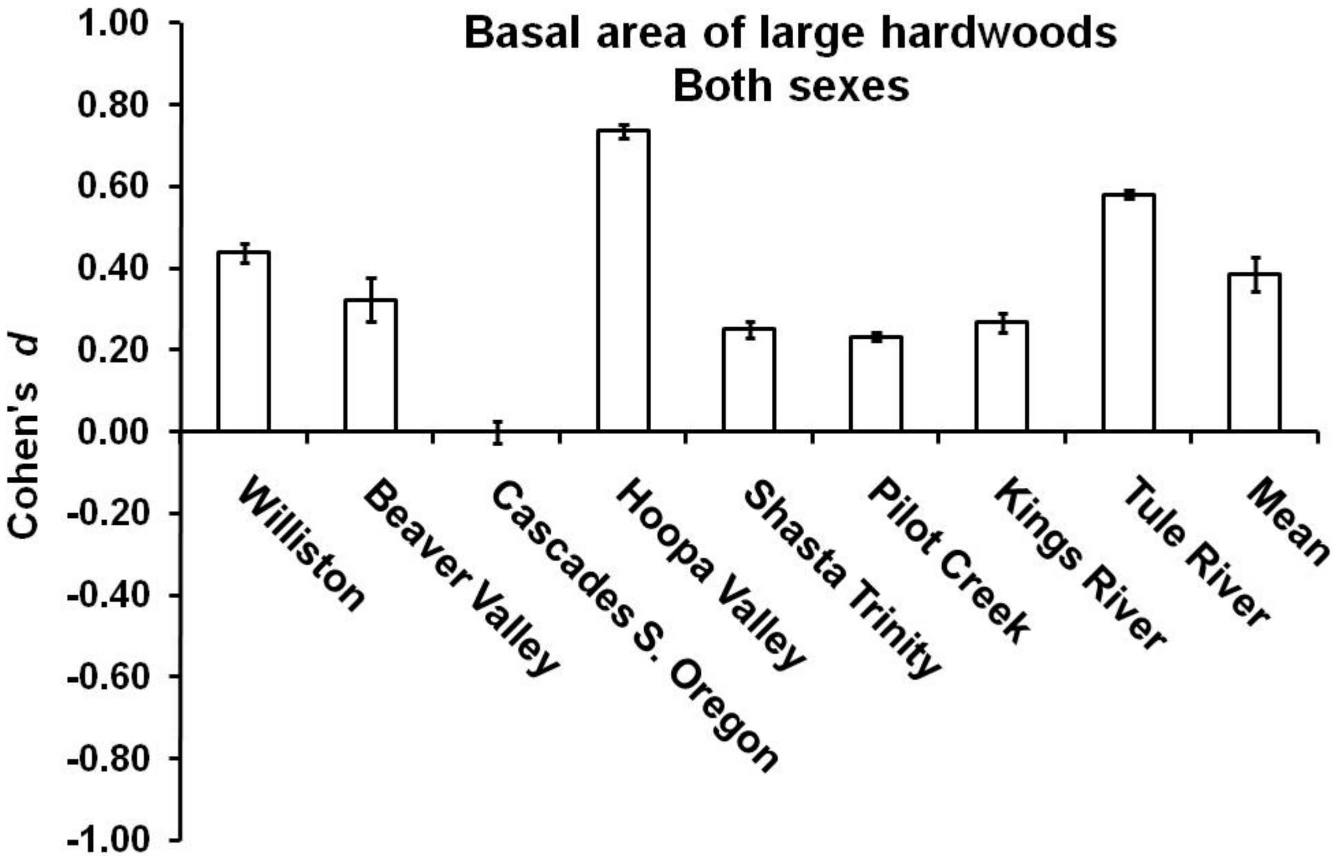

Basal area of large hardwoods
Both sexes
Cohen's d
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
-0.80
-1.00
Williston
Beaver Valley
Cascades S. Oregon
Hoopa Valley
Shasta Trinity
Pilot Creek
Kings River
Tule River
Mean

Fig. 9

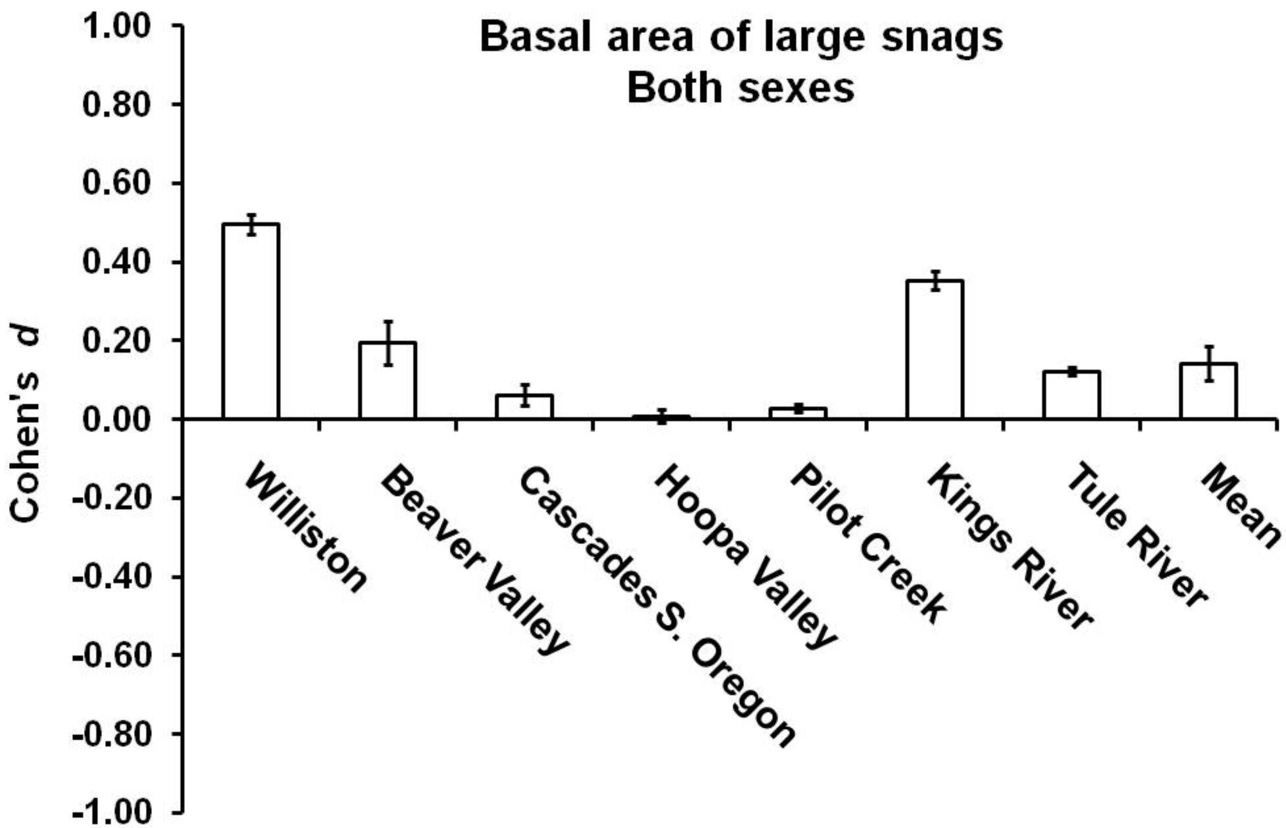
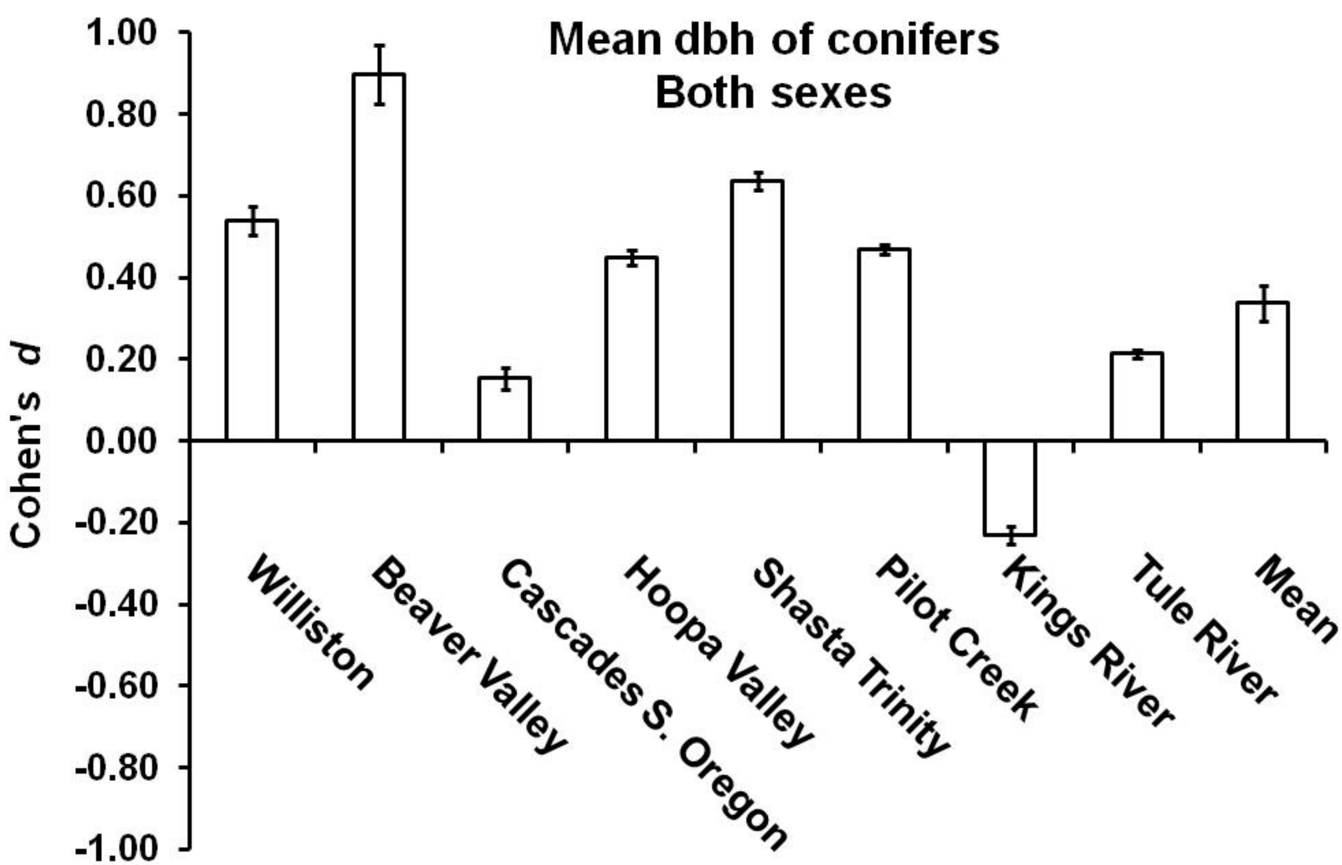

Basal area of large snags
Both sexes
Cohen's d
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
-0.80
-1.00
Williston
Beaver Valley
Cascades S. Oregon
Hoopa Valley
Pilot Creek
Kings River
Tule River
Mean

Fig. 10



Mean dbh of conifers
Both sexes
Cohen's d
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
-0.80
-1.00
Williston
Beaver Valley
Cascades S. Oregon
Hoopa Valley
Shasta Trinity
Pilot Creek
Kings River
Tule River
Mean

Fig. 11

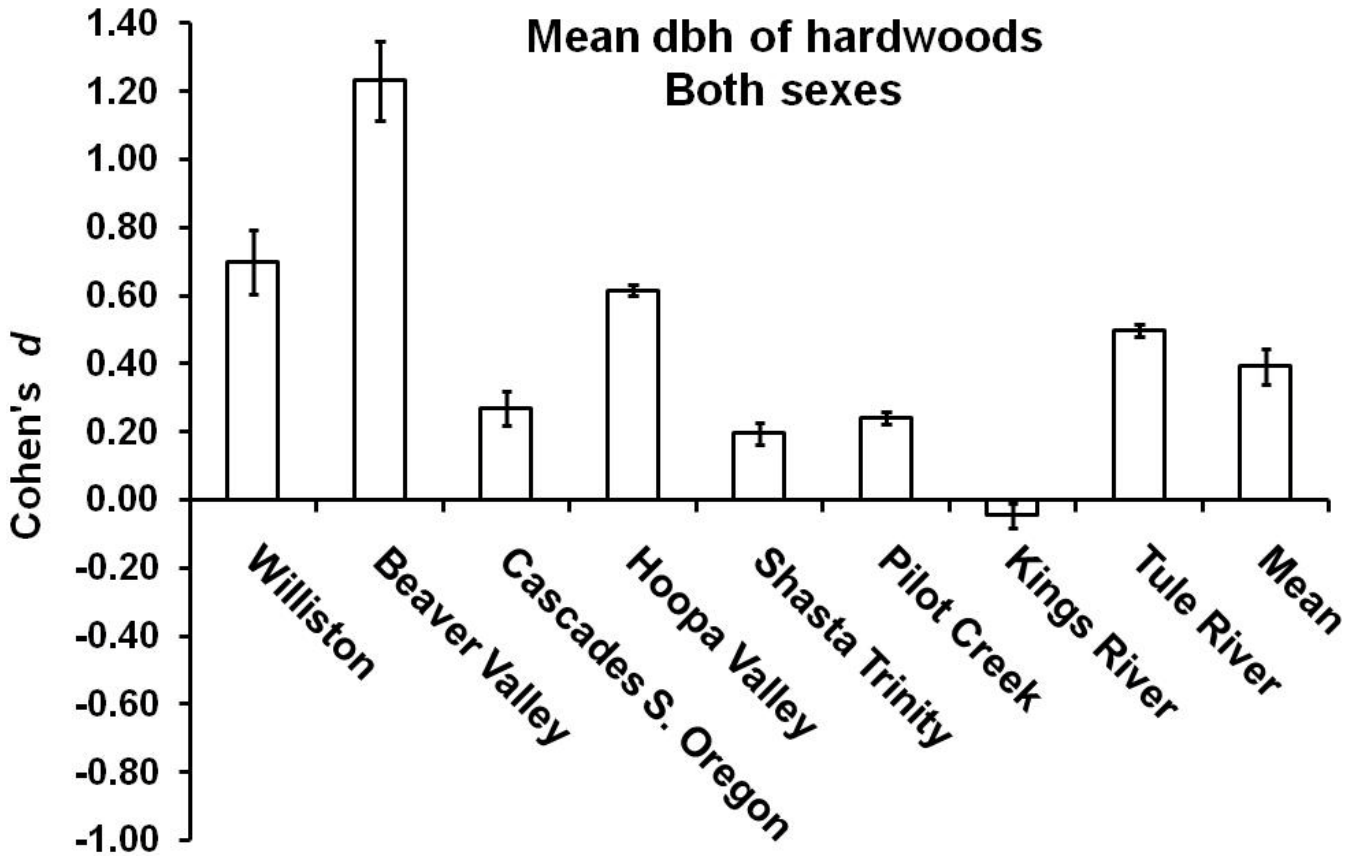

Mean dbh of hardwoods
Both sexes
Cohen's d
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
-0.80
-1.00
Williston
Beaver Valley
Cascades S. Oregon
Hoopa Valley
Shasta Trinity
Pilot Creek
Kings River
Tule River
Mean

Table 1. Radiotelemetry studies of fishers in the Pacific coastal states and provinces included in the meta-analysis of resting site habitat selection.

		Sample size[a]						
Study area	Principal investigators	• fishers	• sites	• fishers	• sites	Random sites	Age of fishers	Season of resting sites
Williston, north-central British Columbia	R. D. Weir and F. B. Corbould	8	23–53	3	7–10	61–121	Mostly adults (1• , 1• juvenile)	All except September and October
Beaver Valley, north-central British Columbia	R .D. Weir	8	20–30	1	1	61–72	Mostly adults (2• , 1• juvenile)	All except May and July
Cascade Range, southern Oregon	K. B. Aubry and C. M. Raley	4–12	39–229	3–5	38–152	79–373	Mostly adults (3• , 1• juvenile)	All; ~1/3 winter and 2/3 other seasons
Hoopa Valley Indian Reservation, northwestern California	J. S. Yaeger and J. M. Higley	7–10	102–168	3–7	15–34	129	Mostly adults (1• , 1• juvenile)	All except July
Shasta Trinity National Forest, northwestern California	R. T. Golightly	6–11	42–204	3–12	60–254	81–245	Mostly adults	All
Pilot Creek, Six Rivers National Forest, California	W. J. Zielinski	13	120–121	7	52–74	191	Mostly adults (1• juvenile)	All; most (~90%) during non-winter
Kings River, Sierra National Forest, California	K. L. Purcell and A. K. Mazzoni	6	42–57	5	17–21	160	All adults	October - May
Tule River, Sequoia National Forest, California	W. J. Zielinski	11–13	133–238	9	47–87	194	Mostly adults (2• juveniles)	All; ~1/3 during winter and 2/3 during other seasons

[a] In all studies, sample sizes for study animals, resting sites, and random sites varied among habitat attributes measured; consequently, the numbers shown here represent the range of variation in sample sizes among datasets.

Table 2. Resting site habitat attributes included in the meta-analysis of fisher habitat selection in the Pacific coastal states and provinces, and the number of studies that measured each variable.

Habitat attribute	No. of studies
Slope (%)	8
Aspect (degrees from SW)	8
Vegetation cover (% cover of all vegetation ≥2 m above the ground)	8
Log volume (volume [m^3/ha] of moderately decayed [decay classes 1-4[a]] logs ≥26 cm in mean diameter)	4[b]
Basal area of large conifers (basal area [m^2/ha] of live conifer trees 51-100 cm dbh)	8
Basal area of large hardwoods (basal area of live hardwood trees 51-100 cm dbh)	8
Basal area of large snags (basal area of moderately decayed snags [decay classes 3-7[a]] 51-100 cm dbh)	7[c]
Mean dbh of conifers (mean dbh of live conifer trees ≥10 cm dbh)	8
Mean dbh of hardwoods (mean dbh of live hardwood trees ≥10 cm dbh)	8

[a] Decay condition classes for logs and snags are from Maser et al. (1979).
[b] Data on log volume were not available for the Shasta Trinity, Pilot Creek, Kings River, and Tule River study areas in California.
[c] Data on basal area of snags were not available for the Shasta Trinity study area in California.

David Gaillard

From: John Carter [wwshed@comcast.net]
Sent: Thursday, June 03, 2010 11:32 AM
To: David Gaillard
Cc: jonathan@westernwatersheds.org
Subject: RE: Fishers

Attachment G.

Follow Up Flag: Follow up
Flag Status: Flagged

David:

I could not tie down the date, only that is was about the 2004 time period. My neighbor got no photos, and we could only go over all the possibilities using photographs of different mammals it could have been. Other than the fisher, none matched my friend's description and that is the one he picked.

One thing to note is our property has been ungrazed now for 15 years, with nearly 1000 acres of riparian, aspen, sagebrush, conifer, all recovering nicely from a hundred years of livestock grazing. The change in habitat has been remarkable over this period. We have had a healthy population of porcupines until recent years. Fishers are predators of porcupines and at one time, I felt maybe they were preying on the porcupines as numbers dropped until sightings were rare and sign (bark removal) disappeared. Of course, porcupines may be declining regionally, I just don't know.

I would point out that the Bear River Range in which the property lies, is heavily grazed by livestock and heavily roaded. This fragmentation has reduced the quality of this extremely important wildlife corridor that connects the Greater Yellowstone Ecosystem to the Uintas and Southern Rockies. I expect our land is the best habitat around as it is managed for minimal disturbance to habitat and wildlife.

Use any of this anecdotal information you like if you think it would help.

Thank you for inquiring.

John Carter
Utah Director
Western Watersheds Project
Box 280
Mendon, Utah 84325
435-881-5404
wwshed@comcast.net

From: David Gaillard [mailto:DGAILLARD@defenders.org]
Sent: Wednesday, June 02, 2010 12:16 PM
To: John Carter
Cc: jonathan@westernwatersheds.org
Subject: RE: Fishers

Hi John and Jonathan, I am checking in with you again with the fisher comment deadline fast approaching (June 15).
John, any luck getting a date for your sighting?
Both of you—would it be okay to use some or all of this email correspondence chain below as an attachment to our comments?
Thx! Dave.

David Gaillard, Rocky Mountain Region Representative
Defenders of Wildlife, 303 W. Mendenhall, Suite 3, Bozeman, MT 59715
406.586.3970 (ph), 406.587.0216 (fax), dgaillard@defenders.org (email)

From: John Carter [mailto:wwshed@comcast.net]
Sent: Tuesday, April 20, 2010 5:26 PM
To: David Gaillard
Subject: RE: Fishers

Yes, it is 4 miles east of the town of Paris on the road to the Caribou NF.

Hmmm, the date. I will have to consult my journal and see if I noted Tony's potential sighting. I did that and didn't find it.

Let me ask him what year and month it was. Maybe he will recall.

You should know, his 20 acres is between two of my parcels and I have set aside 890 acres for wildlife under a conservation easement. I have battled with BLM and neighboring property owners over their cattle, trespass etc and have been able through hard work to keep the place cattle free for nearly 18 years. Habitat is great, so am not surprised if one was seen as we have great resident and migratory wildlife.

If you don't hear from me in the next few days, remind me as I am preparing for court.

Thanks,

johncarter

From: David Gaillard [mailto:DGAILLARD@defenders.org]
Sent: Tuesday, April 20, 2010 4:09 PM
To: John Carter; 'Jonathan B. Ratner '
Subject: RE: Fishers

Thx John, very interesting.

Is this east of Bear Lake, ID?

Also, do you have a date?

Here is website to submit comments to USFWS, due June 15:
http://www.regulations.gov/search/Regs/home.html#home
Search for docket number FWS–R6–ES–2010–0017 and
then follow the instructions for submitting comments.
Thx, Dave.

--
David Gaillard, Rocky Mountain Region Representative
Defenders of Wildlife
303 West Mendenhall, Suite 3
Bozeman, MT 59715
406-586-3970

From: John Carter [mailto:wwshed@comcast.net]
Sent: Monday, April 19, 2010 11:41 AM

To: 'Jonathan B. Ratner '; David Gaillard
Subject: RE: Fishers

Jonathan and David:

The sighting was on my neighbors property in Paris Canyon, Idaho.   He saw it twice.   Because I doubted the sighting, I went over my mammal guide and photos of every conceivable critter it could have been and he picked the Fisher. Beyond that, I don't have any other info except I am alwasy on the lookout when on our property.

John Carter

From: Jonathan B. Ratner [mailto:jonathan@westernwatersheds.org]
Sent: Monday, April 19, 2010 11:17 AM
To: 'David Gaillard'
Cc: 'John Carter'
Subject: RE: Fishers

Nope the only other fisher sighting I have ever heard of in this whole general area was in the Bear River Range and I think it was a bio who got that one.

I am CC ing John Carter who told me about it, so he can put you in touch with the observer

Can you give me email address for submitting?

From: David Gaillard [mailto:DGAILLARD@defenders.org]
Sent: Monday, April 19, 2010 10:37 AM
To: Jonathan B. Ratner
Subject: RE: Fishers

Thanks Jonathan, this is very cool information and certainly unusual.
The presence of fishers in Wyoming and GYE in general is a big question, and significantly affects the DPS boundary.
It would be great if you could related your observations in a letter to FWS to include in the record (due June 15) and cc me as well.
Any other observations of fishers in Wyoming you could add to your letter and/or send to me would be helpful as well--thx again! Dave.

--
David Gaillard, Rocky Mountain Region Representative
Defenders of Wildlife
303 West Mendenhall, Suite 3
Bozeman, MT 59715
406-586-3970

From: Jonathan B. Ratner [mailto:jonathan@westernwatersheds.org]
Sent: Friday, April 16, 2010 8:10 AM
To: David Gaillard
Subject: Fishers

David,

For your info, for what its worth, I have run into fishers on at least 4 occasions in the Winds (Titcomb Basin to little Seneca Lake area) over a period of about 7 years. 3 were winter with tracks. Obvious mustelid, same pattern as marten but way bigger and loping gait was way longer than any marten I have ever seen.

4th was summer, camped at the base of Dinwoody Pass (yes I know this is not what anyone would think of as fisher habitat) one came right up to me within 20 feet of my tent. Danced around back and forth for at least 5 minutes and then left.

I have never done fisher work and know very little of them but these were no marten that is for sure! Take a marten and multiple by 4

Jonathan B. Ratner
Director - WWP Wyoming Office
PO Box 1160
Pinedale, WY 82941
Tel: 877-746-3628
Fax: 707-597-4058