
RECONNECTING ATTRIBUTES OF RIVER ECOSYSTEMS: A DYNAMIC CATCHMENT
APPROACH TO RIVER CONSERVATION-PRESERVATION-RESTORATION MAS-CPE

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Large catchment basins may be viewed as ecosystems in which natural and cultural attributes interact around centers of organization within the geohydraulic continuum of the river corridor. Rivers are four dimensional environments, involving processes that connect upstream-downstream, channel-groundwater and channel-floodplain zones, and all these vary temporally. Natural and human disturbances sever these interactive pathways, resulting in lost ecosystem capacity to sustain native biodiversity and productivity. Contemporary river ecology theory can address remediation of the combined effects of human disturbances, such as stream regulation, pollution and food web manipulation. A river's physical continuum and its biodiversity and productivity are controlled by abiotic factors that derive from cut and fill alluviation mediated by catchment water yield. Re-regulation of flow in a whole catchment context,

coupled with elimination of pollutants and constraintment of nonnative biota, can bring natural restoration to damaged habitats from headwaters to mouth. Protocols for restoration of river ecosystems damaged by flow regulation are: restoration of peak flows (reconnect and reconfigure thalweg and floodplain habitats); stabilization of base flows to revitalize the varial zone; maximization of dam passage to restore meta population structure; reliance on natural habitat restoration as opposed to artificial propagation of fisheries, artificial instream structures and food web control, and adaptive management. Although restoration to aboriginal state is not expected, rapid and substantial recovery of native biodiversity and productivity is possible, especially in rivers with a substantial part of the continuum still free flowing. The cost may be less than expected because the river does much of the work.

BIOLOGICAL SCIENCES - TERRESTRIAL

**DISEASE SURVEILLANCE OF COYOTES IN RELATION
TO BLACK-FOOTED FERRET REINTRODUCTION, 1995 ^{TWS}**

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Disease is an important component in black-footed ferret (*Mustela nigripes*) reintroduction efforts. Canine distemper and sylvatic plague are two

of the primary diseases of concern. The 1992 Black-footed Ferret Disease Ecology Workshop recommended that a disease survey be done before

reintroduction. Carnivores have been used to document the presence of disease on black-footed ferret reintroduction sites. Predator control of coyotes (*Canis latrans*) was undertaken by the U.S. Department of Agriculture Animal and Plant Health Inspection Service, Animal Damage Control (APHIS, ADC) on an area approximately 12,500 ha. around the proposed black-footed ferret reintroduction site in South Phillips County, MT. Disease surveillance was conducted in conjunction with the predator control by Montana Dept. of Fish, Wildlife and Parks personnel. Blood and tissue samples were taken from 50 of the 67 coyotes killed by APHIS, ADC. Sylvatic plague, canine distemper, tularemia, toxoplasmosis, and five serovars of leptospirosis were tested for. Positive titers for plague ($\geq 1:16$) were found in

95.0% and 55.6% of the adult and juvenile coyotes, respectively. Titers high enough to be considered positive for distemper ($\geq 1:16$) were present in 80.0% of the adult coyotes and 11.1% of the juvenile coyotes. There were no coyotes that tested positive for tularemia or leptospirosis. The toxoplasmosis results were not available for this paper. The results of this study are similar to those found for South Phillips County, Montana. The consistent level of plague positive and distemper positive coyotes found in these studies indicates that plague and distemper may be continuous or even endemic within the population. More research is needed to determine the actual persistence of these diseases. The presence of plague and distemper may pose a serious threat to reintroduction and management efforts of the black-footed ferret.

CONNECTIVITY MODEL TO ASSESS LANDSCAPE LINKAGES FOR SPECIES
IN THE SNOQUALMIE PASS ADAPTIVE MANAGEMENT AREA^{WTWS}

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A computer model to predict linkages between the North Cascades and the South Cascades for high and low mobility species was developed to assist in meeting the objectives of the Snoqualmie Pass Adaptive Management Area. Previous difficulties in

determining connective patterns across large-scale landscapes have involved assessing impacts of transportation corridors, analyzing future management options and lack of knowledge about how species disperse through the landscape. A computer model was

developed that used suitable and dispersal habitat and potential barriers to movement, such as cliffs, lakes, or unsuitable habitat. Five species or species groups were chosen to represent critical species or species issues associated with this adaptive management area; wolverine, spotted owl, fisher, Cascades red fox, and the low-mobility old growth-obligates guild. The model was adjusted to evaluate aquatic systems as well. The results were maps for each species produced by GIS, which identified areas where a species may be able to disperse

and where significant barriers would likely prevent dispersal. A moving-window road density analysis was added to assist in predicting the most likely path a species would utilize, moving north and south along the Cascade crest. This analysis allowed us to map out critical connective corridors through the Snoqualmie Pass Adaptive Management Area, which further assisted us in developing standards and guidelines as well as land exchange strategies. Models will be refined for further analysis and integration with transportation planning.

DEVELOPMENT OF A LANDSCAPE-SCALE GIS DATABASE TO ASSESS WILDLIFE USE OF MANAGED FORESTS^{WTWS}

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Our objective was to establish a design for sampling wildlife populations in intensively managed forest landscapes in western Washington that would enable us to investigate habitat relationships at stand (30-80 ha), sub-basin (watersheds 4,000-12,000 ha), and basin (watersheds 60,000-81,000 ha) scales simultaneously. We established study sites in 24 forest stands, including 6 replicates in each of 4 forest structural classes: clearcut, pre-canopy, closed canopy, and harvest age. To provide a framework for analysis of landscape-scale influences on diurnal breeding bird, forest-floor small mammal, bat, and amphibian populations under study in these stands, we located our sites in sub-basins that were representative of those under intensive forest management, but which included a range of variation in landscape conditions. We quantified landscape conditions by integrating classified Landsat imagery with other

GIS base layers and landscape pattern indices. We classified the satellite imagery into 5 seral stages and used principal component analysis, cluster analysis, and discriminant function analysis to classify sub-basins into 4 distinct landscape types. One of these types represents landscapes under intensive forest management, such as those having approximately equal proportions of relatively small patches of clearcut, young, and mature seral stages with little, if any, old-growth forest. We located study sites only in this landscape type; stands were distributed among 7 sub-basins occurring in 4 basins. Preliminary analysis of amphibian community data confirms the validity of our approach, and suggests that community composition is more strongly influenced by landscape-scale influences operating at the scale of basins than by those occurring at the sub-basin or stand scales.

AGE AND SEX STRUCTURE AND FECUNDITY OF MONTANA PINE MARTEN^{TWS}

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Age and sex structure of Montana's pine marten (*Martes americana*) were determined from 2521 trapper collected skulls for the winter trapping seasons 1987 through 1993. Age was determined from radiographs and cementum annuli. Fecundity and pregnancy rates were determined by examining 383 reproductive tracts from female martens. Corpora lutea were counted in hand sectioned and histologically prepared ovary pairs. The average number of corpora lutea found in ovaries of pregnant females was 2.62 (N=225, SD=0.79). The mean number of corpora lutea found in martens from northwestern Montana (3.1) was significantly different than the mean for southwestern Montana (2.5) (F=6.97, P<0.05). Placental scars were not detected in reproductive tracts cleared in winter green oil or fixed in 10% formalin but not cleared. Pregnancy rates for female martens aged 1.5 and greater

than 2.5 years were 85.5% and 95.5%, respectively. The number of males per female in annual harvests ranged from 1.01 to 1.49. The percent juveniles in the annual harvest statewide varied from 33.2-63.7 percent. Juveniles per mother (>2.5) ranged from 2.55-8.71 during the 5 winters. The number of juveniles per adult female (>1.5) ranged from 1.14-4.18. The mean age of martens harvested was 1.57 (N=2358, SD=1.71). A significant decline in the number of juveniles in the harvest occurred throughout Montana in 1992-93. The proportion of males in the harvest has declined from 1989-1993. Age distributions from annual harvests in northwestern and southwestern Montana were similar. Possible causes for variations in data between years and geographic regions of Montana are discussed. The relevance of trends in the observed data to pine marten populations are discussed.

HUMAN/LION AND LIVESTOCK/LION INTERACTIONS IN MONTANA^{TWS}

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Reports of 245 mountain lion (*Felis concolor*) incidents in Montana were compiled and examined each fiscal year (FY) from July 1989 until July 1995. Incidents include a significant conflict between a human and lion or livestock and lion that had serious consequences. Livestock/lion incidents comprised

50.2% (N=123) of the total reports while human/lion incidents comprise 49.8% (N=122). Livestock/lion incidents were stratified according to the class of livestock involved. Human/lion incidents were classed as human attacks, predatory/aggressive incidents, pet attacks, and nuisance incidents. The

number of lion incidents in Montana has increased from 23 in FY 1990 to 48 in FY 1995. The number of human lion incidents was highest in FY 1991 and declined during the following 4 years. The number of livestock/lion incidents has increased from 8 in FY1990 to 35 in FY1995. The class of livestock most frequently preyed upon by lions was domestic sheep followed in rank by horses, goats, cattle, poultry, llamas and rabbits. Most of the human/lion and livestock/lion incidents occur between the month of June and November. Age and physical condition of lions involved in all incidents are best characterized as young lions (ages 1-4) in good

condition. The sex ratio for livestock incidents was significantly different than for human/lion incidents ($\text{Chi}^2 = 17.47$, $\text{d.f.} = 1$, $P < 0.05$). Males were more likely to be involved in livestock/lion incidents. Human/lion incidents were most common in western Montana valleys characterized by corridor type residential development. Livestock/lion incidents were most common in central Montana mountainous regions where sheep production is high or in western valleys where hobby ranchers raised livestock. The role of management and socioeconomic factors influencing lion incidents are discussed.

THE NESTING ECOLOGY OF THE INTERIOR LEAST TERN ON THE YELLOWSTONE RIVER, MONTANA ^{TWS}

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We estimated the population density of the interior least tern (*Sterna antillarum athalassos*) on the Yellowstone River, Montana, quantified available nesting habitat at 3 river-flow rates, and characterized nesting habitat, during the 1994-1995 breeding seasons. In 1994, the run-off from mountain snow-pack occurred 1 month earlier than historically or in 1995. Mean monthly flow rates in 1995 exceeded historical rates by approximately 1,500 cubic meters/second (cms), and rates in 1994 by 600 cms. A larger number of adult least terns was observed during 1994 ($n=40$), than in 1995 ($n=24$). In 1994 and 1995, peak nest initiation occurred between the weeks of 8-21 June ($x = 457.4$ cms, $\text{SE} = 73.1$), and 22 June - 5 July ($x = 1,064.4$ cms, $\text{SE} = 99.1$), respectively. Vegetated channel bars were exclusively used for nesting during both years; 10 different channel bars were colonized, 9 were used in 1994, 5 of which were

recolonized in 1995. Average colony size was 1.93. Therefore, least terns on the Yellowstone River did not nest in large groups. Mean reproductive estimates were: apparent nest success, 79.3%; fledglings/nest attempt, 0.69; and clutch size, 2.45. A longer breeding season, due to earlier peak flows and lower river levels earlier in the season, likely contributed to more successful reproduction in 1994: 23 young were fledged in 1994, whereas only 1 was fledged in 1995. Weather related mortality was presumed to be the cause in 1995. Nests were not inundated from floods during either season. Human disturbance of nesting colonies was not observed on the Yellowstone River. Though predators were present within the study area, only 1 predation event was witnessed: a woodhouse toad (*Bufo woodhouseii*) was observed ingesting a 1-2 day old chick. Terns nested on vegetated channel bars that were

exposed above river level the longest amount of time throughout the breeding season. In addition, height measurements taken along the crest of the cobble dome toward the upstream point, were not different. As river levels dropped, more habitat was available on nesting than on non-nesting channel bars. Consequently, nesting habitat with flat cobble domes was less susceptible to inundation. The rapid stage fluctuation and sediment carrying capacity of the free-flowing Yellowstone River likely contributes to the maintenance of the early successional stage of channel bar nesting habitat, and aides in the

deposition of sediment on channel bars. Though inundation from dam releases on the Yellowstone River is nonexistent, there is a danger of flooding nesting terns from controlled tributaries, Big Horn and Tongue Rivers. Simultaneous releases from dams, especially during increasing discharge rates of the Yellowstone, would place least tern reproductive efforts on the Yellowstone River in serious danger of inundation. Communication between individuals responsible for water regulation on the Big Horn and Tongue Rives will help prevent human induced mortality of the Yellowstone River least tern population.

**A NORTHERN ROCKIES RESERVE SYSTEM
FOR GRIZZLY BEARS AND OTHER WILDLIFE ^{MAS-CPR}**

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We propose a scientifically based Northern Rockies regional reserve system designed to perpetuate landscape-scale ecological processes and viable populations of native species, including wide-ranging mammal predators such as the grizzly bear. Based on population viability analyses and landscape-scale habitat analyses utilizing Geographic Information System (GIS) technology, a network of secure habitat areas comprising more than 140,000 sq. km was delineated. Four essential elements of reserve system design presented by conservation biologist Noss were used: 1) core areas; 2) buffer zones; 3) biological linkage corridors; 4) restoration areas. Economic analyses by economists Power and Garrity demonstrated that

this proposal can be implemented at a net savings to the U. S. taxpayer, a moderate impact on timber industry employment, and with a net gain in overall jobs and improved habitat conditions for numerous aquatic and terrestrial species. The legislative version of this proposal is currently before the U.S. Congress as The Northern Rockies Ecosystem Protection Act (H.R. 852). An administrative version has been submitted for inclusion in the Bitterroot Grizzly Bear Reintroduction Environmental Impact Statement as "The Conservation Biology Alternative for Grizzly Bear Population Restoration in the Greater Salmon-Selway Region of Central Idaho and Western Montana."

**THEODORE ROOSEVELT MEMORIAL RANCH:
A LIVING LEGACY FOR WILDLIFE DIVERSITY ^{TWS}**

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Theodore Roosevelt Memorial Ranch (TRM Ranch) was purchased by the Boone and Crockett Club in 1986 as a research and demonstration site, as part of the Club's Wildlife Conservation Program at The University of Montana. The 6,000 acre ranch, located on the Rocky Mountain Front in north central Montana, is typical for the Front landscape — a diverse transition zone between the Great Plains and the Rocky Mountains. The TRM Ranch is currently operated as an economically viable livestock operation with emphasis on seasonal habitat for a diversity of wildlife species such as Rocky Mountain elk, mule deer, grizzly bear, mountain lions, raptors, prairie grouse, and native cutthroat trout, among others.

Maintaining lands as productive wildlife habitat that also provides livelihood for people based on natural assets is fundamental to the Club's conservation program. Sustaining healthy relationships between people, land and resources on TRM Ranch and the surrounding region requires practical knowledge on the ecological relationships between geology, vegetation, water quality, wildlife and people. Only with this information can sustainable resource management and the natural and cultural legacy of people, land and resources be maintained on TRM Ranch, the Rocky Mountain Front and the Northern Rocky Mountains.

**SUSTAINING ELK THROUGH SOCIAL AND ECONOMIC DEVELOPMENT:
PAST, PRESENT AND FUTURE ON MONTANA'S ROCKY MOUNTAIN FRONT ^{TWS}**

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Sustaining elk (*Cervus elaphus*) and other wildlife in a dynamic society and landscape undergoing rapid social and economic change requires an integration of six key factors: regulation of harvests,

security of seasonal habitats, science-based population and habitat management, broad-scale public support, encouragement of compatible land uses, and social and economic

benefits to land owners and resource managers. These factors are essential principles for wildlife conservation within the realm of sustainable development and ecosystem management. They apply equally to private as well as public lands given that wildlife are public resources which often depend on private lands. Elk represent a broad community of wildlife species, requiring large open spaces of diverse and productive ecosystems, relatively secure from intensive human disturbances. Montana's Rocky Mountain Front illustrates the evolution of elk management in three major phases: from an early era of public land reserves with harvest regulations through habitat acquisition and science-based management to an ecosystem approach that integrates social, economic and environmental goals for wildlife on public and private lands. The Front provides a classic case, rich in the history and tradition of attempts to integrate wildlife conservation with human uses of the land, from the days of Forest Reserves to the Sun River Game Preserve, state game ranges, and land use regulations, to current Boone and Crockett Club efforts at Theodore Roosevelt Memorial

Ranch. Only recently has the mix of conservation strategies begun to embrace all the key factors for sustainable development. Currently, the social, ecological and economic values of elk on the Front are great and growing. But the pace of change in landownership and land uses places these values at risk if elk and landowners are not accorded significant roles in the social and economic future of the region. This paper explains how elk conservation has evolved along the Front and discusses how sustainable development principles must be integrated to ensure that elk and other wildlife will continue to play strong roles in the future of the Front. The case draws upon historical data and studies as well as current research and pilot programs in various social, economic and environmental settings. The empirical data clearly show a natural unfolding of historic successes in response to past and present management and point to future changes that could improve the likelihood of conserving wildlife and their beneficial uses in dynamic landscapes that will accommodate other human uses.

FECAL TESTOSTERONE CONCENTRATIONS IN TERRITORIAL AND NONTERRITORIAL PRONGHORNS AND SOUTHERN WHITE RHINOCEROSES ^{TWS}

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Testosterone levels are correlated with aggressive behavior patterns and onset of the rut in many ungulate

species. The objective of this study was to investigate if testosterone concentrations correlated with spatial

organization in males displaying variable spacing systems. In our lab, methodology has been developed to measure reproductive function noninvasively, using fecal and urinary steroid hormone metabolites. We sampled male pronghorn (*Antilocapra americana*) from two populations in which males were organized differently. Males from the more territorial population tended to have higher

testosterone levels. In southern white rhinoceros (*Ceratotherium simum simum*) males, territorial males had significantly higher testosterone levels than nonterritorial males. These results were independent of age. Our preliminary results illustrate the feasibility of noninvasive methodology to study physiological correlates of behavior in wildlife populations.

**A FUNCTIONAL ANALYSIS OF CONSERVATION PRIORITY:
NOCTURNAL AERIAL INSECTIVORES** ^{MAS-CPR}

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Recently, it has been suggested that ecologists begin to supplement species and community type richness estimates of conservation priority with evaluations of ecosystem functional group species density. No prioritizing methodology has been tested for vertebrate functional groups. An evaluation of nocturnal aerial insectivore species depth as made by plotting species distributions on grids 137.5 km on a side superimposed on an equal area projection map of the contiguous US and recording species presence/absence within each square.

An area of low functional group depth in the Great Plains has been identified. Measures of temporal, spatial and dietary overlap were estimated from the literature. Moderate to high overlap of temporal and dietary components and low to moderate overlap of spatial components were found. Data incompatibility and scarcity were identified as limitations of the analytical method. Local conservation of *Eptesicus fuscus* and *Chordeiles minor*, two widely distributed species, and preservation of wooded areas is recommended for the central Great Plains.

**PUBLIC PARTICIPATION IN ECOSYSTEM MANAGEMENT
FOR WILDLIFE CONSERVATION AT THE LANDSCAPE LEVEL** ^{WTWS}

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People are often the last to be considered in ecosystem management. Yet public involvement represents an

opportunity for mutual learning and collaboration. Those of us facilitating ecosystem management will benefit as

we learn to rely more on local people's knowledge, experience, skills and creativity. The presentation examines the value of involving affected interest groups from the onset. Illustrations are drawn from the author's research and extension experiences in the U.S. Pacific Northwest and from other countries of the world. No one participatory approach suits all situations. Seven questions are provided to guide our decisions about planning a participatory approach: 1) What will the conceptual framework be? Decisions need to be made on the purpose of participation, scale, desired outcomes and applications; 2) Who should be involved? Knowing the interest groups, and how to identify them will be key; 3) What collaborative process will be

used? A facilitator or leadership team will be essential, as well as certain skills, resources, and knowledge of techniques; 4) Where will needed support and resources come from? 5) What are the incentives for people's collaboration? Participants will need to see something in it for themselves; 6) What are the potential barriers to collaboration? A common vision or mutual interest will reduce the barriers; 7) How will the collaborative approach be evaluated? Ideally, participants should have a central role in assessing the approach and the ways it might be improved. Public participation is not so much about giving more benefits to people, rather it is about giving more responsibility to local people.

BIG GAME HABITAT ENHANCEMENT THROUGH TIMBER HARVEST AND PRESCRIBED FIRE: FOR THE BIRDS? ^{TWS}

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Enhancement of big game winter range (forage) has been a focus of the FWP/USFS mitigation efforts for Hungry Horse and Libby Reservoirs. Breeding bird point counts and habitat measurements are being conducted to determine if habitat enhancement prescriptions in coniferous forest stands effectively restore wildlife habitat values in addition to their use by elk, deer and bighorn sheep. Our study design includes comparison of breeding bird communities before and after treatment, between treatment types, and between treatments and control stands. We now have three consecutive years (1993-95) of data from 91 individual enhancement areas at Firefighter Mountain (Flathead NF), primarily small (<8ha) seed-tree

cuts in seral lodgepole pine and larch. At Libby (Kootenai NF), our sample includes 52 larger units (10-150ha) in ponderosa pine/Douglas-fir forests treated with various combinations of canopy removal and/or prescribed fire. Species turnover is rapid and dramatic in the timber sale units in lodgepole. Species richness is strongly tied to the density of residual snags in recently cut units. Fire-dependent cavity-nesters, such as the Northern Flicker and the Mountain Bluebird, are the first species to colonize the sites. There are no consistent patterns of decline or increase for either migrant or resident species taken as a group, and canopy-dependent decliners included both neotropical migrants, such as

Townsend's Warbler and residents, including the Golden-crowned Kinglet. Second-growth and deciduous shrub-dependent species, such as the Lazuli Bunting, show a lag-time in response, becoming established 2-3 years following treatment. Species richness is therefore similar to adjoining untreated forest within three years of the initial entry in mixed conifer stands, and increases in comparison to controls within the same time frame in lodgepole pine stands. At Libby, the greater size and structural diversity of treatment units support a greater diversity of breeding species, particularly in units with riparian inclusions, robust shrub

cover, and patchy removal of undergrowth/canopy. Individual species effects, especially for declining species, are being assessed by analysis of frequency of occurrence and relative abundance, mean number within 50m. In order to further assess the suitability of treated habitats, we will initiate nest success monitoring for key species during 1996, to see if apparent species benefits also mean improved productivity. These data are being used for development of management guidelines and refinement of enhancement techniques as we enter a new planning phase in the wildlife mitigation program.

WOLVES, GRIZZLY BEARS AND THE ENDANGERED SPECIES ACT: MOVING PAST THE POLARIZATION ^{TWS}

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While Yellowstone wolf restoration is a landmark conservation achievement, it is a poor conservation model. The process took too long, it cost too much, and the public remains polarized. The greatest irony may be that wolves are among the easiest endangered species to recover. Their restoration does not cause significant economic impact nor does it require major land use changes. The reintroduction of grizzly bears to central Idaho and western Montana may provide a better conservation model. Conservation groups have collaborated

with local citizens, labor unions and the timber industry to craft a reintroduction proposal that will restore grizzly bears while minimizing impacts on local economies and local people. The centerpiece of this proposal is creation of a Citizen Management Committee that has significant authority for management of the reintroduced bears. Providing citizens a major role in endangered species management may be a breakthrough concept that could increase local acceptance for recovery programs.

THE EFFECTS OF ROADKILL MORTALITY ON THE WESTERN PAINTED TURTLE IN THE MISSION VALLEY, WESTERN MONTANA ^{TWS}

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I monitored a population of western painted turtles (*Chrysemys picta bellii*) in the pothole region of the Mission Valley (western Montana) in response to local concern about intense roadkill mortality on US Highway 93 and a proposal to widen the highway. Road-killed turtles were collected from May through August 1995 along a 7.2 km section of US 93 adjacent to the Ninepipe National Wildlife Refuge. Femurs were removed from each dead on the road (DOR) turtle for laboratory age determination (sectioning at Matson's Lab, Milltown, MT). Turtle mortalities spanned the monitored section of US 93 and occurred throughout the field season. A total of 205 turtles were found DOR. Additional turtles were killed but did not remain on the road for collection; others were killed outside of the field season. The DOR turtles ranged from 0 to 26 years

old ($x = 10.1 \pm 6.27$, $n=125$). Of the DOR turtles, 39% were male, 22% were female, and 39% could not be sexed. Seven gravid females were found DOR (15% of the specimens known to be female), and 4 of these contained intact, countable clutches. The average clutch size for these combined with other dead turtle specimens (e.g. those found on other roads) was 9.8 ± 3.9 ($n=8$). Gravid female ages ranged from 7 to 17, with a mean of 11.9 ± 3.2 ($n=10$). I used the relationship between age and plastron length to develop an age-predicting regression equation for live turtles trapped in the mark-recapture part of the study. Survival rates of turtles in ponds at different distances from US 93 will be compared using life table analysis. Management recommendations are suggested based on roadkill data and literature review.

MARKET BASED SPORT HUNTING AS A MEANS TO FUND FISH AND WILDLIFE CONSERVATION ON THE FORT BELKNAP INDIAN RESERVATION ^{TWS}

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In 1988, the Assiniboine and Gros Ventre Tribes of the Fort Belknap Indian Reservation in north-central Montana began a fish and wildlife management program. Funding for this program was initially tied to 638 contracts from the Bureau of Indian Affairs. Both Tribal members and nonmembers are

permitted to hunt and fish on the Reservation. License fees for the Tribal members are comparable to Montana state resident hunting and fishing license fees. Nonmember hunting and fishing fees are market based and are designed to provide funding for fish and wildlife conservation.

Nonmembers hunting of prairie dogs was permitted at the inception of this program and the program has been successfully expanded to nonmember trophy hunting of pronghorn, mule deer, bighorn sheep, and bison. In addition, nonmember upland game bird hunting and nonmember fishing is permitted. During 1995, a total of 322 and 720 conservation permits were issued to Tribal members and nonmembers, respectively as a prerequisite for purchasing hunting and fishing licenses. Total revenue from management of fish and wildlife on the Reservation during 1995 exceeded \$155,000. Prairie dog shooting remains

the most popular hunting attraction on the Reservation generating over \$22,000 of revenue during 1995, and pronghorn hunting and sale of bison are the two largest sources of income, each exceeding \$45,000. Guiding, tourism, and bed-and-breakfast facilities are developing as spin-off industries. The Fort Belknap Tribal Council passed a resolution during 1995 approving comprehensive game codes, and fish and wildlife personnel have recently initiated an effort to form an Inter-Tribal Fish and Game Commission to coordinate hunting and fishing among Montana's seven reservations.

INTEGRATING WILDLIFE-HABITAT DIVERSITY AND LANDSCAPE DESIGNS WITH SIMULATION MODELING ^{WTWS}

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Managers of forested landscapes in the Pacific Northwest region are under increasing pressure to consider trade-offs between wildlife diversity and resource extraction objectives of alternative land-use designs. Such assessments are hampered by current limitations in projecting stand and landscape dynamics under natural and anthropogenic disturbances. To improve on our ability to evaluate land-use designs, a landscape-based simulation system is being developed that integrates models of vegetative dynamics, natural disturbances, forest management activities, and wildlife-habitat associations. This system is based on a simplified version of a more detailed, individual-based tree dynamics model called ZELIG.PNW and can simulate a large number (1,200+) of mixed-aged, mixed-species stands over long time periods (200+ yrs). Inputs to the model include spatially referenced stand types of a current landscape and estimates of structure and composition of each stand,

environmental variables related to topography and climate, and measures of natural disturbance regimes such as windthrow and flooding potential. Animal-habitat association models are being developed as part of the Coastal Landscape Assessment and Simulation (CLAMS) study that use structure and composition information simulated by the vegetative dynamics model to assess probability of species occurrence and habitat quality. Land-use designs are specified using textual scripts prior to program initiation. Outputs from simulation runs include vegetation maps, and tallies of harvested timber and habitat diversity for specified species. Although primarily designed to evaluate effects of stand- and landscape-patterns on animal-habitat diversity, other ecosystem properties that use state variables provided by the simulation system are proposed for a more complete assessment of ecosystem properties under alternative land-use designs.

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Integrated Landscape Management (ILM) is a cooperative management plan developed between landowners and fish and wildlife managers. This is a Department of Fish and Wildlife (WDFW) process for converting from species-by-species management to a broader, landscape (ecosystems), proactive approach. This represents a major shift in management philosophy. The Washington Department of Fish and Wildlife is testing this approach in the 839,010-acre Lewis-Kalama River watershed located in southwest Washington. A Citizens' Advisory Group is working with the Department to identify the desired future conditions for fish and wildlife for the year 2014. Geographic Information Systems (GIS)

and remote sensing technology are being used to illustrate the current and future habitat conditions and where objectives for multiple species and habitats are unlikely to be met in 2014 using current land management practices. When current planned practices will not meet common objectives, WDFW will work with landowners to develop voluntary agreements to achieve the desired change in habitat conditions. Final products will include watershed based species, habitat, and recreation plans and GIS maps that can be used to protect and recover threatened and endangered species while providing wildlife viewing, fishing and hunting opportunities.

DISPERSAL OF COYOTES IN YELLOWSTONE NATIONAL PARK:
WHY LEAVE HOME? ^{TWS}

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Why an animal leaves its home range or territory is a question often raised by ecologists. We examined the dispersal of coyotes (*Canis latrans*) from 5 resident packs in Yellowstone National Park, by observing 49 coyotes for 2,456 hours from January 1991 to June 1993. We previously found that pups were not

allowed equal access to ungulate carcasses (resource defense by older coyotes). Instead, pups spent much of their time hunting small mammals. We also found that pups were poorer hunters of small mammals than adults and yearlings. Thus, we reasoned that social rank and access to food could

play a major role in dispersal patterns among Yellowstone coyotes. We found that coyotes that subsequently dispersed were (1) low-ranking pups or betas that spent little time with other members of their pack, (2) they were typically subordinate during interactions with other members of their pack, hence were of low social rank, (3) they had little or no access to ungulate carcasses during winter when compared to higher-

ranking philopatric individuals in the pack, and (4) during the winter of 1992-1993, dispersing coyotes captured small mammals at a significantly lower rate than philopatric pups and betas. Coyotes that remained in their territory were higher-ranking and bided their time for the breeding position, while low-ranking coyotes dispersed to either adjacent or distant territories.

FOREST ECOSYSTEM MANAGEMENT AND PUBLIC INVOLVEMENT: A CASE STUDY IN WEST-CENTRAL ALBERTA ^{WTWS}

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A Forest Conservation Strategy for the Province of Alberta is being developed that recognizes the global necessity of conserving biodiversity and using our biological resources wisely. Canadian Forest Products, Ltd. (Canfor) supports both federal and provincial strategies of maintaining viable and healthy forest ecosystems from the corporate to the division level. The development of federal and provincial conservation strategies is unprecedented, and their implementation will undoubtedly affect the way forestry is practiced in Canada. Canfor actively solicited public participation in their management plan development process through the formation of a Forest Management Advisory Committee comprised of key stakeholders, and a Forest Ecosystem Management Task Force comprised of experts in the fields of ecology, forest

management, and wildlife biology from government and academia to serve as a scientific technical group to Canfor in the development of the Forest Management Plan. Both the Task Force and Advisory Committee are providing input into the management plan design and will review the draft management plan prior to its formal submission to the government. Successful implementation of Forest Ecosystem Management offers several opportunities. It will: 1) demonstrate Canfor's commitment to sound forest stewardship, which will likely be a factor in future land tenure renewals on Crown lands, 2) assist Canfor in producing products that will be certified as originating from a sustainable forest and 3) play a role in maintaining the integrity of the forest resources of Alberta, a benefit to be shared by all Canadians.

**BREEDING SONGBIRDS OBSERVED ALONG NOXON RAPIDS AND CABINET
GORGE HYDROELECTRIC DEVELOPMENTS IN NORTHWESTERN MONTANA^{TWS}**

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Washington Water Power Company (WWP) conducted breeding songbird surveys during 1993 and 1994. Point-count techniques were used to characterize the bird community in habitats found along Noxon Rapids and Cabinet Gorge Hydroelectric Developments (HEDs). Calculations of relative abundance, frequency of occurrence, and diversity were made by habitat. Percent of total relative abundance for nesting and foraging guilds was also assessed. The Releve method was used at each point sampled to characterize the vegetative structure and configuration of habitats. In 1993, a total of 86 points were surveyed in four habitats: mixed conifer, open conifer, hardwood, and riparian. Ninety-one points were sampled in 1994, with the addition of agricultural habitats. Together, 1993 and 1994 surveys documented 88 songbird species during breeding bird surveys and an additional

19 species during other field surveys. Total number of species by habitat ranged from 16 (hardwood) to 37 (open conifer) in 1993, and from 16 (agricultural) to 44 (riparian) in 1994. Results from this study show the bird communities associated with the WWP projects along the Clark Fork River exhibit expected species and population characteristics for the available habitat. Species composition, relative abundance, frequency of occurrence, and diversities, are comparable to other studies in the region using similar methods. The mixed conifer and riparian habitats that are widespread and often occur adjacent to the reservoirs showed high overall species diversity and the greatest species richness. Habitats with similar vegetative structure often had similar bird communities indicating habitat structure is an influencing factor.

**A REGIONAL APPROACH TO WILDLIFE CONSERVATION AND WILDLAND
RESTORATION: THE ROADS SCHOLAR PROJECT^{MAS-CPR}**

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The wildlands of the Northern Rockies continue to diminish in size, primarily due to new road building and

associated industries, such as logging and mining, that construct, maintain, and utilize roads on lands managed by

the United States Forest Service (USFS). As roadless lands decrease, secure habitat for grizzly bears and other wildlife species sensitive to roads decreases as well. The Roads Scholar Project (RSP) seeks to determine the actual condition of selected wildlife management units with regard to road density and road closure status. This project combines aerial photo and transportation map inventories with field surveys and Geographic Information System (GIS) analysis, to identify, assess, analyze, and display the current condition of wildlife habitat in selected management units in Montana, northern Idaho, eastern Washington, and northwestern Wyoming. Roads Scholar Project reports include specific

suggestions for improved management for habitat security, road closures, and wildland restoration. The USFS' management of its roads system has been found to be inaccurate, either due to unidentified roads that exist on the ground but not in agency inventories, ineffective road closures that misrepresent the condition or use level of known roads, or both. Effective road closure and obliteration programs on the wildlife management units included in this study will be instrumental for the successful protection of road- and disturbance-sensitive species of the Northern Rockies, and also will play a pivotal role in restoring a degree of wildness to lands that have endured high levels of human activity.

THE PACIFIC GREENWAY: A STUDY IN LANDSCAPE ECOLOGY ^{WTWS}

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Greenways are protected linear corridors that connect landscape features such as wildlife, recreation, cultural and geological areas and are managed for conservation or recreation, or both. One of the critical goals of wildlife conservation today is to stem the tide of habitat loss and fragmentation by preserving habitat integrity and landscape linkage. By linking ecological function and structure, a greenway corridor system can protect biodiversity, provide open space needs and allow for economic growth. The Pacific Greenway is a farsighted effort to create and preserve an important natural and recreational corridor between the Pacific Coast and the Portland area. It will begin at Portland's 5,000-acre Forest Park, and help preserve a critical wildlife travel corridor connecting the park with Oregon's Coast Range. It will be an

unbroken ribbon of wetland, meadows, streams and river valleys winding along ridge tops and through public and private forest lands. Where feasible, hiking, biking and equestrian pathways will link the rural communities and showcase their historical and environmental assets in a manner that will bring some diversification to the rural economic base and complement existing business, farm and forestry practices. The Pacific Greenway is now in Phase II, a public outreach program to engender local citizen and corporate cooperation. Meetings have been held with community civic organizations, city, county, state and federal government officials, historical societies, timber company executives and private landowners. A strong and committed local citizen-based effort is essential. Every effort is made to utilize local expertise in designing the route.

Although greenway/wildlife corridors are no panacea, they must be considered systematically and integral to the protection of ecological function and

structure and central to a sustainable landscape conservation and recreation strategy.

STATUS OF AMPHIBIANS AND REPTILES IN WESTERN MONTANA ^{TWS}

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In western Montana, 9 amphibians and 9 reptiles are known to occur, with 2 other amphibians, the Idaho Giant Salamander (*Dicamptodon aterrimus*) and Wood Frog (*Rana sylvatica*), which have been reported but not confirmed. Cooperative projects between the Montana Natural Heritage Program and the Kootenai, Lewis and Clark, Bitterroot, and Helena National Forests have provided much recent data, along with additional surveys completed by the Flathead National Forest and Kirwin Werner on the Flathead Indian Reservation. Some incidental observations have been received from other biologists. During 1993-1995, seven species of amphibians and nine species of reptiles were recorded on 459 survey sites and from incidental observations. The Long-toed Salamander (*Ambystoma macrodactylum*), Tailed Frog (*Ascaphus truei*), and Spotted Frog (*Rana pretiosa*) appear common and widespread in western Montana. The Tiger Salamander (*Ambystoma tigrinum*), Coeur d'Alene Salamander (*Plethodon idahoensis*), Rough-skinned Newt (*Taricha granulosa*), Western Toad (*Bufo boreas*), Pacific Chorus Frog (*Pseudacris regilla*), Western Chorus Frog (*Pseudacris triseriata*), and Leopard Frog (*Rana pipiens*) are either very locally

distributed, declining, apparently rare or else their current status is unclear. The Bullfrog (*Rana catesbeiana*), an introduced species, is known from several sites in western Montana. The Painted Turtle (*Chrysemys picta*), Racer (*Coluber constrictor*), Gopher Snake (*Pituophis catenifer*), Common Garter Snake (*Thamnophis sirtalis*), Western Terrestrial Garter Snake (*Thamnophis elegans*), and Western Rattlesnake (*Crotalus viridis*) appear common and widespread in western Montana. The Northern Alligator Lizard (*Elgaria coerulea*), Western Skink (*Eumeces skiltonianus*), and Rubber Boa (*Charina bottae*) are either very locally distributed, declining, apparently rare, or else their current status is unclear. Much information is still needed on many species in western Montana. Adults of all species in Montana can be identified using: Reichel, J. D. and D. Flath. 1995. Identification of Montana's amphibians and reptiles. Montana Outdoors 26(3):15-34. A book on the reptiles and amphibians of Montana is in the planning stages and may be completed within two years. Persons wishing to report observations or participate in the statewide monitoring program should contact the Montana Natural Heritage Program.

BOVINE TUBERCULOSIS IN A SOUTHCENTRAL MONTANA MULE DEER ^{TWS}

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An outbreak of bovine tuberculosis in a southcentral Montana game ranch prompted this study to determine if the disease had been transmitted to surrounding wildlife. Samples from 41 free-ranging mule deer (*Odocoileus hemionus*) and 3 free-ranging white-tailed deer (*Odocoileus virginianus*) were collected from November 1993 through January 1994 and tested for tuberculosis. Methods used for testing included gross and histologic examination, and bacterial culture and identification

techniques. Mycobacterial lesions were noted in 2 free-ranging mule deer, and *Mycobacterium bovis* was isolated from lymph nodes of one of these deer upon culture. Restriction Fragment Length Polymorphism DNA fingerprinting revealed that mycobacterial isolates from the infected mule deer were identical to those from the adjacent infected game-ranch elk (*Cervus elaphus*) (D. Whipple, pers. comm.), suggesting that the disease may have spread from captive to wild cervids.

REINTRODUCTION OF WOLVES INTO CENTRAL IDAHO ^{TWS}

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Prior to European settlement, gray wolves (*Canis lupus*) inhabited much of the intermountains of western United States. Wolves were eliminated from Idaho along with most of the lower 50 states (except northeastern Minnesota) by 1925. Wolves were listed under the Endangered Species Act in 1973, and recovery goals recommended (1) natural wolf recolonization in northwestern Montana, (2) reintroduction of wolves into Central Idaho (quick release) and Yellowstone National Park (delayed release), and (3) wolf management be turned over to the states and local tribes. On March 7, 1995, the Nez Perce Tribe signed a 5-year cooperative agreement with the U.S. Fish and Wildlife Service and authored the Nez Perce Tribal Wolf Recovery and Management Plan for

Idaho which permits the Tribe to act as the lead agency responsible for recovery and management of wolves in central Idaho. Fifteen wolves were reintroduced into central Idaho in January 1995 and 20 wolves were released in January 1996. Reintroduced wolves were radio-collared and monitored using aerial telemetry. Most wolves released in 1995 moved relatively short distances for 1-3 weeks before traveling more extensive distances. Initial movements were generally northeast. No known breeding occurred in 1995, however 4 pairs formed by January 1996. Wolf B-13 was illegally shot in January 1995 and wolf B-3 has not been located since March 1995. The remaining 33 wolves are aerial radio-tracked throughout the year and tracked on the ground during winter.

**WILDLIFE HABITATS AND SPECIES ASSOCIATIONS WITHIN OREGON
AND WASHINGTON LANDSCAPES - BUILDING A
COMMON UNDERSTANDING FOR MANAGEMENT ^{WTWS}**

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Work under this project will further develop the species-habitat relationship information for some 785 species of terrestrial and marine birds, mammals, reptiles, and amphibian species, and their associated habitats, in Oregon and Washington. Three main products are planned: (1) a 600-page document containing 22 chapters reflecting the multi-species/ecosystem approach to wildlife conservation in the Pacific Northwest, (2) a CD-ROM containing detailed life history and habitat relationship appendices and a query-driven access format to be included with the document, and (3) the narrative and

appendices will be developed for INTERNET access. To assist in developing the document and database information, four working teams have been established: a Science Team, a Species-Habitat Team, a Digital Products Team, and a Management Applications Team. The time-line for this project is from November 1995 - September 1998; it is anticipated that during (or before) September 1998 a camera-ready version of the document will be submitted for formal publication through the USFS-PNW Publications Office. This paper presents the approach and current status of the project.

**ECOSYSTEM MANAGEMENT IN THE INTERIOR COLUMBIA RIVER BASIN:
AN ALTERNATIVE APPROACH ^{WTWS}**

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In general, the debate over appropriate ecosystem management in the interior Columbia Basin has focused on two competing paradigms. Some authors demand intensive management of forest structure at the stand and

landscape scale. Other authors argue that intensive management holds little promise for ecosystem restoration and that attention should be focused on establishing a system of interconnected core reserves protected from intensive

silvicultural management. We examine the strengths and weaknesses of these two approaches and determine that neither of these approaches used alone would adequately conserve biological diversity and restore the stand and landscape structure characteristic of natural disturbance regimes. A review of current ecological conditions indicates that past management activities such as fire suppression, logging, and grazing have significantly altered disturbance regimes and the integrity of ecological communities in some areas. On the other hand, these conditions are not ubiquitous. There remain many areas of high ecological integrity, such as roadless areas, where fire suppression and other management activities have been less intensive. Given the variability in current conditions, we argue that an integrated

ecosystem management approach is needed that combines the best elements of the two competing paradigms. Ecological integrity can be sustained by concentrating restorative activities in areas that are degraded, while protecting those areas that are not. In other words, ecosystem management in the interior Columbia Basin should include a range of land allocations, each with differing management objectives and applications. The framework for an integrated approach should include: a) an actively managed reserve system protecting both aquatic and terrestrial systems; b) restorative treatments applied according to assessment at multiple scales including the site; and c) the application of management suitability standards based on ecological criteria.

ASSESSING THE RELATIVE VALUE OF WILDLIFE HABITAT IN A FUTURE GROWTH ZONE OF WESTERN WASHINGTON ^{WTWS}

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Recent legislation in Washington state requires municipalities to designate an Urban Growth Management Area (UGMA) where future development will be concentrated. The City of Olympia, located at the south end of Puget Sound, recently completed a study that mapped and assessed the relative value of wildlife habitat within the 22-square-mile Olympia UGMA. Wildlife habitat was mapped from infrared aerial photographs and digitized into a Geographic Information System (GIS) database. An evaluation process was designed that rates the relative value of wildlife habitat;

this process was based on a review of the literature of the ecology of fragmented habitats. The most important evaluation parameters were parcel size, parcel shape, primary cover type, documented presence of endangered or threatened wildlife species, or presence of rare habitat types. Habitats were rated as I through IV. More specific measurements of habitat characteristics, such as forest age, snag density, and amount of downed woody debris, were used to separate those habitats in the two middle categories.

Habitats were partitioned into evaluation units based on their physical division by roads, agricultural fields, or developed land. Approximately 20% of the habitat mapped was chosen as "priority habitat" targeted for preservation efforts. Although the rating was based solely on biological

criteria, the selection of priority habitats includes biological and sociological considerations. Large parcels (> 75 acres), medium parcels (75 - 20 acres), and small parcels (< 20 acres) were targeted for preservation with an emphasis placed on choosing parcels that could sustain wildlife other than edge-adapted species.

COMMUNITY-BASED LANDSCAPE CONSERVATION IN ECOSYSTEM MANAGEMENT FOR WILDLIFE ^{WTWS}

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Fostering stronger communities is an important element in developing and implementing successful public policies for ecosystem management. Facilitation, mediation and dispute resolution have been employed to resolve major natural resource policy disputes in the Northwest leading to the Chelan Agreement for cooperative water resource management, the Timber/Fish/Wildlife Agreement and other major, multiparty natural resource agreements. Less well known, but also very important, is a consensus-building model called the Fellowship/Community Circle developed by the Northwest Renewable Resources Center (NRRC) to integrate community decision-making models with technical ecosystem planning and integrated landscape management in critical watersheds. The best science and technology and the most innovative policy solutions will not succeed if affected communities are not involved

in a meaningful way in developing these solutions and in building local relationships to support implementation. The Fellowship/Community Circle model is a cross-cultural program intended to develop a broad support network for community cooperation. The model's focus is on developing a "sense of place" or mutual connections to shared geography, landscape or ecosystem. Discovering this "common ground" helps participants address, understand and accept their differences. The model does not answer questions such as "How can we better protect and enhance wildlife habitat in our ecosystem?" Instead, it helps build the relationships, trust and synergy that can produce answers to such questions. The model has been applied successfully three times in Washington state, and opportunities to apply it in and out of state are being developed by NRRC and Madrona Resource Associates.

THE CONSERVATION RESERVE PROGRAM AS A CATALYST FOR LOSS OF GRASSLAND BIODIVERSITY IN MONTANA ^{TWS}

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Many well intentioned government programs often produce unexpected results because financial incentives are not carefully considered prior to implementation. The Conservation Reserve Program (CRP) was intended to take highly erodible cropland out of production and place it in grass cover for a period of 10 years. In Montana, over 2.8 million acres of croplands have been enrolled in the CRP since 1985. This represents approximately 20% of Montana's cropland. One noticeable result of this program was a doubling of government payments to Montana farmers. On a per acre basis, the CRP contracts averaged 58% greater than the average private lease for croplands. An unexpected result of the program was the conversion of an extensive, but undetermined, amount of native prairie to croplands. Sodusting is permitted under the 1985 Food Securities Act provided that a farmer files a conservation plan with the Soil Conservation Service (now Natural Resource Conservation Service (NRCS)) prior to plowing. Although there has been no official effort to track the extent of sodusting in Montana, there are several indications that it has been extensive. The CRP program did not result in a decline in crop acreage planted in Montana or a decline in fertilizer sales. A two-year study by the

U.S. Fish and Wildlife Service in five north-central Montana counties found that sodusting was common and one third of the farmers breaking sod were enrolled in the CRP. We interviewed six NRCS district conservationists, and four reported that sodusting was a significant problem in their area with three of them attributing this to the CRP. Over 95% of the acreage enrolled in the Montana CRP was planted to nonnative grass species with crested wheatgrass (*Agropyron cristatum*) being the most common species planted. Monocultures of crested wheatgrass or other nonactive plants do not replace the biodiversity lost when native prairie is converted to croplands. In addition, crested wheatgrass has relatively little value to many grassland wildlife species and it may even contribute to a further decline in soil fertility. The net effect of the CRP in Montana has been to accelerate loss of grassland biodiversity. This investigation has shown that there is a need for the Federal Government to fully evaluate the ecological impacts of the CRP in Montana prior to implementing similar programs. There is also a need for research on restoring grassland biodiversity to idled or abandoned croplands.

SEASONAL MOVEMENTS AND HABITAT USE BY BIGHORN SHEEP FROM TOM
MINER BASIN AND POINT OF ROCKS WINTER RANGES, MONTANA ^{TWS}

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The upper Yellowstone River Valley has provided winter range for Rocky Mountain bighorn sheep (*Ovis canadensis*) for thousands of years. Some sheep populations declined during the 1980s, but others may have recolonized into new ranges. Montana Department of Fish, Wildlife, and Parks, the National Park Service and the US Forest Service all share the responsibility for management of the sheep and sheep habitat in the Yellowstone area. I conducted a study during 1994 and 1995 to gather more information on recent sheep movements and use in the Tom Miner Basin area for these agencies. The objectives were (1) determine summer-fall range use patterns for sheep in the Tom Miner Basin with emphasis on changes in distribution in the past decade, (2) assess the likelihood that fires in 1988, elk, and activities controlled by humans, including livestock grazing, hunting, hiking, and development, have affected habitat

range and (3) compare vegetation coverage, plant species composition, and relative intensity of ungulates in areas occupied by sheep in 1975 with the same sites in 1994-95 and new areas since 1975. In the spring of 1995, 10 ewes were radio collared on the Tom Miner and Point of Rocks winter ranges. I tracked the ewes through the winter of 1995. The ewes in Tom Miner Basin remained within the basin throughout the summer season. The Point of Rocks ewes had movements ranging from Corwin Springs to Hyalite Basin south of Bozeman. I used pellet and grazing transects to assess summer and fall habitat utilization of elk and cattle on sheep winter range. From 1975 to 1995 elk use increased, cattle use remained the same, and sheep use decreased. This information will help manage sheep populations of the upper Yellowstone River Valley.

POLLINATION BIOLOGY OF THE THREATENED PLANT, *SILENE SPALDINGII* ^{MAS}

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Silene spaldingii is a partially self-compatible perennial plant found in the Palouse region of Washington, Idaho and Oregon and disjunct in northwest Montana. It is listed as threatened or endangered in all four states in which it

occurs. We observed pollinators of *S. spaldingii* for ≥ 20 hrs at each of five sites throughout the range of the species. A bumblebee, *Bombus fervidus*, accounted for $\geq 83\%$ of pollination bouts at all sites. Eleven of 13 bumblebees collected bore

pollen of *S. spaldingii*. The mean number of visits per flower per day varied from 0.3 to 21.2. The mean proportion of aborted fruits varied between 0.08 and 0.31, and there was a significant negative correlation between the rate of flower visitation and the rate of abortion ($r = -0.39$, $P < 0.001$). There was a tendency for pollinator constancy and visitation rates to be lower at sites with larger displays of flowers that

compete for bumblebee service. The exotic weed, *Hypericum perforatum* was an important competitor at one site. Our results suggest that small, isolated populations of *S. spaldingii* may not persist, while most larger populations are not threatened by pollinator limitation assuming bumblebees are protected from pesticide application and high fire frequencies.

CORRELATES OF VARIABLE SPATIAL ORGANIZATION IN TWO PRONGHORN POPULATIONS^{TWS}

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While variation in the spatial organization of pronghorn antelope (*Antilocapra americana*) is well documented, the underlying reasons for the differences, whether ecological or physiological, are not understood. The objectives of this study were to quantitatively describe pronghorn spacing systems and to determine the correlates of variable spatial organization in two populations. During 1994 and 1995, I collected behavioral and space use data from individually recognized males at Wind Cave National Park, South Dakota and on private land north of Billings,

Montana to determine if males differed, within and between populations, in group size, types and rates of specific behavior patterns, and in amounts of home range overlap. I also analyzed testosterone content in fecal samples collected from known males and measured characteristics of the food base. Males at Wind Cave National Park maintained classic territories, whereas males near Billings were less territorial. I will discuss differences in behavior patterns, testosterone levels, and forb species diversity as well as correlations between those variables and spatial organization.

AMPHIBIAN SURVEY OF GLACIER NATIONAL PARK, MONTANA^{TWS}

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A herpetological survey was undertaken in Glacier National Park from 1990-94. Range maps were generated for each species from location

and elevation data processed via GIS. Five species of amphibians were recorded at 141 sites along with three species of reptiles. The western spotted

frog (*Rana pretiosa*) occurred at elevations to 1800 m and was found parkwide near small lakes, ponds, and creeks. The northern long-toed salamander (*Ambystoma macrodactylum*) was found in woodlands and wet meadows west of the Continental Divide at elevations between 1050 and 1500 m. This salamander was uncommon on the east side of the park with most sightings recorded in the lower Waterton Valley; none were found in the upper Missouri River drainage of Glacier National Park. The western toad (*Bufo boreas*) was widely distributed to elevations as high as 2250 m, but the species was not abundant at most locations. Tailed frogs (*Ascaphus truei*) were found in small, cold, high gradient streams at mid-elevations throughout the Middle Fork drainage, but occurred only intermittently in the North Fork and upper Missouri River

drainages. Tailed frogs were observed at a single location in the South Saskatchewan River drainage. Range of the Pacific tree frog (*Pseudacris regilla*) was restricted with most sightings made near the community of West Glacier, Montana, or at breeding ponds a few km upstream along the Middle Fork of the Flathead River. Lack of historic data about the herpetofauna of Glacier National Park precluded a definitive analysis of recent population trends. However, all species previously reported from the park were found and the status of several species considered questionable for the local region was resolved. The impact of introduced trout on park amphibians is unknown, but it is likely that the present distribution of some amphibian species has been influenced by fish stocking that took place between 1912 and 1972.

OSPREY MANAGEMENT ON MONTANA POWER EQUIPMENT ^{TWS}

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As osprey (*Pandion haliaetus*) numbers rebounded following the banning of DDT in the 1970s, nesting activity on MPC electrical equipment increased. This increased activity caused problems for MPC and the osprey in the form of outages, equipment damage, electrocutions, and nest/pole fires. A program of installing platforms and deterrents was instituted. In 1994, a special purpose permit allowing us to handle and transfer osprey nests was obtained from USFWS. This required development of a formal

management plan and monitoring of permitted nests. MPC field personnel were informed of the new guidelines, and the MPC Environmental Department began monitoring. An inventory of existing nests was also initiated. We are presently evaluating the effectiveness of the various nesting platforms and deterrents in use on our system with the intent of providing recommendations to MPC field personnel before the osprey return next spring.

RELATIONSHIP BETWEEN AGE AND HORN SIZE IN PRONGHORN ^{TWS}

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We collected data on age and horn length for 47 male Pronghorn (*Antilocapra americana*) harvested on Fort Belknap Indian Reservation, Montana. Ages ranged from 1.5 to 6.5 years ($X = 3.5$). Horn length ranged from 11.6 to 16 inches, ($X = 13.56$). We found no correlation between age and horn length in Pronghorn from this population. These findings have implications for pronghorn management, breeding biology and evolutionary ecology. Mean age was younger than expected, and turnover seems to be high, even in

lightly harvested populations ($\leq 10\%$ / annum). Large horns can occur on young male pronghorn, providing opportunities for trophy harvest without managing for older age classes. If horn size is used as a secondary sexual characteristic during breeding, younger males may have higher breeding success than older males. If horn size does not contribute to reproductive success, then large horns must have other functions in an evolutionary context.

ECOLOGICAL RELATIONSHIPS BETWEEN BEARS AND PREDATION BY COUGARS ON UNGULATES ^{TWS}

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Black bears (*Ursus americanus*) or grizzly bears (*Ursus arctos*) visited 26 of 106 ungulates killed by cougars (*Felis concolor*) that we found in Glacier National Park, Montana, and in Yellowstone National Park, Wyoming, from 1990 to 1995. Bears displaced cougars from carcasses in 16 of these 26 visitations. We estimated that cougar predation provided an average of 3.4

kg/day (range = zero to 12 kg/day) of biomass to bears and other scavengers that fed on cougar-killed ungulates. This biomass was potentially an important proportion (up to 290%) of the daily energy needs of bears when compared to their caloric requirements as reported in the literature. We suggest that ungulate carrion provided as a result of cougar predation could be

important nutritionally to bears in some areas and seasons. We estimated that when bears displaced cougars from their ungulate kills, single adult cougars lost an average of 1.1 kg/day of ungulate biomass, or 29-45% of their daily food requirements. Cougar predation rates on ungulates were significantly higher ($P = 0.04$) when

bears displaced them from their kills than when bears did not displace cougars. Biologists modelling or measuring cougar predation rates should be aware that losses to scavengers may not be trivial.

¹Deceased

DETERMINING THE STATUS AND TRENDS OF AMPHIBIAN POPULATIONS IN THE NORTHERN INTERMOUNTAIN WEST ^{TWS}

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Over the past several years, there have been growing concerns over population trends of some amphibians, especially in the western United States. Apparent declines in relatively undisturbed areas, such as national parks and designated wilderness areas, have been particularly alarming. Several amphibian characteristics, such as their thin, moist skin and biphasic life cycles, make them particularly sensitive to environmental change. Declines in amphibian population are of concern because of (1) the loss of biodiversity; (2) the disruption of some ecosystems processes to which amphibians are functionally important; and (3) because they may provide an early indication of changes in environmental health. A wide variety of factors have been implicated in amphibian population declines, including habitat modification, pollution, the introduction of exotic species, and disease. Because the data on amphibian population status and trends are few and inadequate to determine the extent and causes of amphibian declines, several types of studies are required to address these

issues. Wide-scale, comparative amphibian surveys have provided the best evidence that some amphibian populations have undergone declines. Monitoring programs are needed to describe population dynamics and identify potential causes of fluctuations. A key issue is distinguishing between "natural" and anthropogenic causes of population changes. Finally, experimental studies are needed to test hypotheses concerning the causes of populations declines. Adaptive management will be required to apply and evaluate the findings of these studies to resource management. Several organizations have been helpful in addressing the problem of amphibian declines. The IUCN/SSC Declining Amphibian Population Task Force (DAPTF) serves to coordinate efforts to gain an understanding of declining amphibians, communicate information concerning amphibian populations, and enlist the support of appropriate scientific disciplines needed to address these issues. Montana is located in the DAPTF's Rocky Mountain region. A number of biologists in Canada and the

United States are working to develop a North American Amphibian Monitoring Program to provide "a statistically defensible program to monitor the distributions and abundance of amphibians in North America, with applicability at the state, provincial, ecoregional, and continental scales." The Pacific Northwest Amphibian and Reptile Consortium (PNARC), a special committee of the Society for Northwestern Vertebrate Biology, serves as a regional umbrella organization for individuals interested in the

conservation of native species of amphibians and reptiles. PNARC activities/projects include an annual meeting, a membership directory, a publication on standardized survey and monitoring protocols, and training for surveying and monitoring amphibian populations. The Montana Natural Heritage Program and the Idaho Museum of Natural History have developed and are maintaining herpetological databases for Montana, and Idaho and the Greater Yellowstone Ecosystem, respectively.

CASCADE CHECKERBOARD PROJECT ^{WTWS}

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The Cascade Checkerboard Project was established in 1994 by the Sierra Club to further conservation and restoration of the forest ecosystem of the central Cascade Mountains of Washington state. Acknowledging its advocacy position, it endeavors to educate and mobilize the public to affect forest management decisions. The project focuses on land ownership adjustments and resource plans on both public and private lands. Land exchanges, public purchases and private donations of land are encouraged to optimize ecological patterns in this strategic corridor. Priorities for public acquisition are roadless areas and river corridors, those undisturbed habitats that will differ most dramatically under public or private ownership. The nearly completed Weyerhaeuser/National Forest exchange/donation package and the proposed Plum Creek exchange are

major examples. Public lands considered for exchange already have roads and are partially logged. Among the major resource plans that the Project has reviewed are the Forest Service's Snoqualmie Pass Adaptive Management Area plan and Plum Creek Timber Company's habitat conservation plan (HCP) prepared under provision of the Endangered Species Act. It was found that the HCP provides regulatory certainty for the company, but considerable uncertainty for the long term health of wildlife species due to loss and fragmentation of late-successional forests and questions about modeling techniques. Restoration of natural processes are also key elements of the project. These include anadromous fish passage, fire regimes, wildlife crossing of I-90, and road decommissioning.

STATUS OF AMPHIBIANS AND REPTILES IN EASTERN MONTANA ^{TWS}

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Data from museums, the literature, and unpublished reports was compiled and put into a database. Locations of all site specific reports were digitized and tied to the database in an ARC-INFO format. In the Great Plains and island mountain ranges of eastern Montana, 10 amphibians and 14 reptiles are known to occur, with another amphibian, the Wood Frog (*Rana sylvatica*), reported but not confirmed. Cooperative projects between the Montana Natural Heritage Program and the Lewis and Clark, Helena, and Custer National Forests have provided the most recent data, along with some additional surveys completed in conjunction with other research. Some incidental observations have been received from other biologists. During 1994-1995, nine species of amphibians and thirteen species of reptiles were recorded on 224 survey sites and from incidental observations.

The Tiger Salamander (*Ambystoma tigrinum*), Woodhouse's Toad (*Bufo woodhousii*), and Western Chorus Frog (*Pseudacris triseriata*) appear common and widespread in eastern Montana. The Spotted Frog (*Rana pretiosa*) appears common in the island ranges where it occurs. The Western Toad (*Bufo boreas*), Great Plains Toad (*Bufo cognatus*), Canadian Toad (*Bufo hemiophrys*), Plains Spadefoot (*Scaphiopus bombifrons*), and Leopard Frog (*Rana pipiens*) are either very locally distributed, declining, apparently rare or else their current status is unclear. The Bullfrog (*Rana*

catesbeiana), an introduced species, is known historically from several sites in eastern Montana; whether it currently maintains populations there is unknown. The Painted Turtle (*Chrysemys picta*), Racer (*Coluber constrictor*), Gopher Snake (*Pituophis catenifer*), Common Garter Snake (*Thamnophis sirtalis*), Western Terrestrial Garter Snake (*Thamnophis elegans*), Plains Garter Snake (*Thamnophis radix*), and Western Rattlesnake (*Crotalus viridis*) appear common and widespread in eastern Montana. The Spiny Softshell (*Trionyx spiniferus*), Snapping Turtle (*Chelydra serpentina*), Short-horned Lizard (*Phrynosoma douglasi*), Sagebrush Lizard (*Sceloporus graciosus*), Western Hognose Snake (*Heterodon nasicus*), Milk Snake (*Lampropeltis triangulum*), and Smooth Green Snake (*Opheodrys vernalis*) are either very locally distributed, declining, apparently rare, or else their current status is unclear.

Much information is still needed about all the species in eastern Montana. Adults of all species in Montana can be identified using: Reichel, J. D. and D. Flath. 1995. Identification of Montana's amphibians and reptiles. Montana Outdoors 26(3):15-34. A book on the reptiles and amphibians of Montana is in the planning stages and may be completed within two years. Persons wishing to report observations or participate in the statewide monitoring program should contact the Montana Natural Heritage Program.

WINTER FOOD HABITS OF THE PINE MARTEN IN MONTANA ^{TWS}

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Food habits of the pine marten (*Martes americana*) were determined by examining the stomach and colon contents of marten carcasses collected from Montana fur-trappers during December, January and February of 1985-86 through 1991-92. Carcasses of over 2,000 martens were submitted for examination. These yielded 611 stomachs and 560 colons which contained food items. Over half of the useable stomach and colon samples were collected from southwestern Montana (Fish, Wildlife and Parks Region 3). This area includes the Montana portion of the Greater Yellowstone Ecosystem. Mammals were the most important food group in all years and areas, with small rodents

("mice") being the major category of prey eaten. Microtines (*Microtus* spp. and *Clethrionomys gapperi*) comprised the bulk of the identifiable small rodent remains. Annual and geographic differences were noted in the winter diet. *Pinus albicaulis* nuts became an important alternate food item in southwestern Montana during a winter when whitebark pine cones were abundant and small rodents were scarce. Large mammals eaten included carcasses presumably scavenged by martens. The percent of juveniles in the harvest and corpora lutea counts were lowest in 1989-90 when the percent of small rodents in the winter diet of the marten was low.

SEASONAL MOVEMENTS AND HABITAT USE OF THE HIGHLAND/PIONEER MOUNTAINS BIGHORN SHEEP HERD OF SOUTHWEST MONTANA ^{TWS}

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A study of the Rocky Mountain bighorn sheep (*Ovis canadensis canadensis*) within the Highland and Pioneer Mountains was conducted on a seasonal basis during 1994. Data were collected in regards to home ranges, sex and age composition, population estimation, food habits, and possible competition with mule deer (*Odocoileus hemionus*) and/or cattle. Three subpopulations exist within this herd, winter and summer home ranges for each subpopulation was assessed with telemetry data from 36 radio-collared

ewes. Home ranges varied from 6.40 to 32.97 km². Sex and age composition was determined from 5985 observations of individual sheep (includes multiple observations of the same animal), resulting in 1994 mean lamb:ewe and ram:ewe ratios of 43.6 lambs and 54.4 rams per 100 ewes, respectively. Feeding site, fecal, and rumen analysis showed that graminoids were dominant vegetation type making up the diet of the bighorn sheep during all seasons. Comparisons of mule deer and bighorn sheep diets during the winter showed

dissimilarities with bighorn sheep consuming greater amounts of graminoids than did mule deer ($p = 0.0002$). The summer diets of bighorn sheep and cattle were similar in regards to forbs and shrubs, yet cattle

consumed more graminoids than bighorn sheep ($p = 0.0005$). This study represents the 1994 seasonal movements and habitat use of the bighorn sheep within the area immediately prior to a die-off.

THE SNOHOMISH ESTUARY WETLAND INTEGRATION PLAN ^{WTWS}

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This plan was developed for the protection, restoration and enhancement of 12,000 acres of wetland habitat in the Snohomish River estuary on Puget Sound 25 miles north of Seattle in Snohomish County, WA. The area was inventoried and assessed using the Indicator Value Assessment (IVA) protocol and an extensive database was developed using rapid assessment techniques. A base map was created with 1:24,000 scale color infrared aerial photography (August 1993) using Arc/Info Version 7.0.3 and Arc/Info Macro Language to produce normalized IVA data files linked by a unique numeric wetland complex identifier to maps of field observations, March through October 1994. Wildlife planning tools were developed for diverse users to make planning and management decisions at multiple geographic scales. Programmatic recommendations were made for ecosystem management,

watershed and open space planning, habitat restoration and monitoring, species management, environmental stewardship, and future studies. A development footprint was identified with the lowest rated wetland complexes and existing transportation infrastructure. Eight restoration sites were identified with technical and economical feasibility and biophysical criteria. Compensation policies for vegetated wetlands and mudflats were developed. Sixty-eight percent of the study area's vegetated wetlands and 89% of the estuary's mudflats have relatively high performance levels in the IVA wildlife and water quality improvement functions. The estuary supports at least 63 bird, 15 mammal, and 4 herpetile species with over 40 PHS-listed species. Therefore, we believe that the estuary is not seriously degraded and has a high potential for successful restoration.

UNGULATE POPULATION AND VEGETATION RESPONSE TO HABITAT MANIPULATIONS AT LIBBY DAM ^{TWS}

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Distribution patterns, home ranges and population characteristics of mule deer (*Odocoileus hemionus*) and bighorn sheep (*Ovis canadensis canadensis*) were quantified before and after habitat manipulation activities occurred on the Libby Dam project area. In addition, vegetation response was also measured. Bighorn sheep showed a positive response by increasing utilization of treatment units and adjacent habitat. A change in overall distribution of mule deer was less apparent than for sheep. Four mule deer changed from a migratory to a resident pattern and 3 shifted established winter home ranges. The proportion of deer using spring and fall transitional ranges decreased from 69% pretreatment to 0% posttreatment. Home range sizes were variable over time for both species and revealed no clear relationship to habitat manipulation. Sheep and deer

population estimates over the study period were variable, but did not support the hypothesis that populations should exhibit an increase in response to habitat manipulations. Bighorn natality and recruitment declined over the study period. Natality for mule deer also declined between the pretreatments to posttreatment periods. There was no significant decline in survival for sheep during winter and spring between treatment periods. Survival rates for mule deer declined between periods, but not significantly. Shrub frequency and volume measurements demonstrated a positive response to manipulation as did forage production. Results of monitoring indicated that sheep and deer exhibited a positive behavioral response to habitat manipulation, but a long-term improvement in population dynamics was not evident from the data.

RETURN OF BLACK-FOOTED FERRETS TO MONTANA: NOTES FROM THEIR FIRST WINTER ON THE NORTHERN PLAINS ^{TWS}

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Thirty-five black-footed ferret (*Mustela nigripes*) kits and five adults were released into black-tailed prairie dog (*Cynomys ludovicianus*) towns on the UL Bend National Wildlife Refuge in south Phillips County, Montana. There were three separate releases, beginning

on October 6, 1994, spaced about two weeks apart. All black-footed ferrets had individually coded transponder chips implanted behind the right ear and each one was fitted with a radio transmitter collar. National Biological Service personnel set up radio tracking stations

and monitored the ferrets' movements nightly through the end of November 1994. Telemetry results suggested at least half (20) of the released ferrets were killed by coyotes (*Canis latrans*). By the first of December 1994 only two radios were still functioning. A three-night extensive spotlight survey (Dec. 1, 2, and 3) immediately following the termination of the radio telemetry effort turned up eight surviving black-footed ferrets. Montana Fish, Wildlife and Parks (FWP) personnel began monitoring the surviving ferrets following the spotlight survey. Random spotlight searches from a vehicle were used to locate ferrets. A method to individually identify the free-ranging ferrets without capturing them was developed using the transponder chip technology (Stoneberg, in press). A six inch diameter ring antenna, attached to an AVID Company (Norco, CA) Standard Reader, was placed around the prairie dog hole containing the ferret.

When the ferret put its head through the antenna an identifying number was displayed on the reader. The eight ferrets located during the spotlight survey in early December 1994 were all observed during the winter/spring monitoring. An additional female, first observed in March, brought the number of known survivors to nine. All of the known survivors were born in 1994 (kits) and the sex ratio was three males to six females. Five had been preconditioned by being exposed to prairie dogs in outdoor pens prior to release. The monitoring indicated females had smaller winter territories, and were less active than males. Prairie dogs reacted to the presence of ferrets by plugging burrows with dirt, and ferret digging or trenching increased during the winter.

The 1994 black-footed ferret reintroduction effort culminated with the sighting of two litters, each with two kits, in July 1995.

DAILY ACTIVITY PATTERNS OF WESTERN TOADS ON THE TARGHEE NATIONAL FOREST, IDAHO^{MAS}

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Populations of many amphibian species appear to be declining in locations all over the world, including the Pacific Northwest. For example, many populations of the western toad (*Bufo boreas*) have undergone decline or local extinction throughout much of their range. Answers to questions about amphibian decline and plans to conserve species such as the western toad require knowledge of the natural history and normal behavior of healthy animals, preferably in their natural environments. With the use of radio

transmitters (1.8 g, externally mounted), we conducted a focal-animal study on the daily activity pattern and movements of individual free ranging western toads. This study was conducted during July and August of 1994 and 1995 on the Targhee National Forest, Idaho. We observed four adult male toads each year. Observation periods were three hours and occurred throughout the 24 hour day. Dependent variables included activity index (number of active minutes per total minutes), distance moved (cm per total

minutes), and number of feeding strikes (strikes per total minutes). Independent variables included hour of day, air temperature, and relative humidity. Considerable individual variance existed between toads. Surface activity rate peaked between 2100 and 2400 hours. Surface activity occurred over a broad range of temperature (-2°C to 27°C) and occurred over a broad range of relative humidity (60%-100%).

Distance moved increased during the night as toads moved from a daily retreat site to water or warm substrate. Most movements took place between 5°C and 16°C with low distance movement above 16°C. Movements increased as relative humidity increased above 75%. Feeding strike rate peaked during mid-day and occurred over a broad range of temperature and relative humidity.

HABITAT CONSERVATION PLANNING FOR THE SNOHOMISH COUNTY PARK SYSTEM^{WTWS}

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A peer-reviewed Habitat Conservation Plan (HCP) was developed to provide basic information and recommendations for habitat management and planning in Snohomish County park system under WA Interagency Commission on Outdoor Recreation requirements. The HCP was developed for use at multiple geographic scales by a variety of users to incorporate habitat management into park planning through principles of ecosystem management, conservation biology and eventually landscape ecology. A driving tour of all lands owned, comanaged or approved for acquisition in 1995 was included in this first County-wide habitat inventory. A tabular and digital database was begun from the latest county-wide data and park reports obtainable. Primary sources were the WA GAP Analysis, WA River Information System and Priority Habitat and Species programs, supplemented by other resource agency

data, County Growth Management Fish and Wildlife Critical Areas maps and Pilchuk Audubon Society records. Two draft system-wide species and habitat maps were designed with ArcView 2.1 software. Terrestrial wildlife planning tools were developed for application within the framework of the County park planning process benchmarks. Aquatic habitat planning tools should be developed in the future. Two Gap Analysis Program land classification ground-truthing training sessions were held with professionals and volunteers for a future pilot park habitat inventory. Individual park master plans and management recommendations could be made for park habitats identified under the preliminary significant habitat criteria suggested. The HCP could be useful in coordination between municipal park system HCPs in the County and County government departments.

HANTAVIRUS AND DEER MICE IN WESTERN MONTANA ^{TWS}

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In 1994 an interagency study was initiated in Montana to: describe the prevalence of hantavirus antibodies in deer mouse (*Peromyscus maniculatus*) populations in various habitats, identify how prevalence varied with mouse population dynamics, and examine the temporal and spatial variation of antibody prevalence. In addition, it was hoped that antibody positive mice would be found to share specific life-history characteristics, such as sex, age, and reproductive status. Eighteen mark-recapture trapping grids were established at six locations

throughout western Montana. Small mammal populations on these grids have been trapped monthly through two summers. Populations on twelve grids were tested for antibodies during each trapping period. Six grids were set aside as controls to evaluate the impact of blood collection on survival rates. Antibody prevalence rates will be discussed in regards to habitat types and population characteristics. Also, a comparison of antibody positive and negative mice will be presented with a discussion of positive mouse characteristics.

DETERMINATION OF REPRODUCTION IN ELK THROUGH OBSERVATION AND BEHAVIOR ^{TWS}

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We suggest a method to determine calving in elk (*Cervus elaphus*) based on daily movement, behavior and observations of cows. During calving season (May 15 - June 15), cows that restricted their movements to ≤ 1.25 ha and isolated themselves showed calving behavior and either were or were recently pregnant. When approached, cows with a neonate ≤ 4 days old were

nervous and had a strong fidelity to the area, often staying within 100 m. Subsequent observations of cows known to have calved can determine calf survival but not causes of mortality. We give examples from our experience with radio-marked Rocky Mountain elk (*C. e. nelsoni*) cows in Montana and unmarked Roosevelt elk (*C. e. roosevelti*) cows in Oregon.

ELK PREGNANCY RATES IN THE SOUTH FORK OF THE FLATHEAD, MONTANA ^{TWS}

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Preliminary data indicate the pregnancy rate among Rocky Mountain elk (*Cervus elephas nelsoni*) ≥ 2 years old in the South Fork of the Flathead River study area to be $62 \pm 13\%$. Pregnancy was determined by dissection of uterii, rectal palpation, blood analysis for pregnancy-specific protein B, and observation/behavior of radio collared

cows. Incidence of pregnancy in the South Fork is lower than that found in other Rocky Mountain elk populations and does not differ from that reported for Roosevelt elk (*C.e. roosevelti*). Ecology of elk in the South Fork, management implications, and future research needs are discussed.

IMPACT OF RECREATIONAL SHOOTING ON PRAIRIE DOG COLONIES ^{TWS}

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The Bureau of Land Management (BLM) has encouraged recreational shooting as a means of controlling prairie dog (*Cynomys ludovicianus*) populations and as a recreational use of public lands. We investigated the impacts of recreational shooting on prairie dog population dynamics, activity patterns, or vegetation conditions in prairie dog towns. Hunters were required to complete a BLM questionnaire regarding shooting pressure on colonies, and we used hunter surveys to measure the strength of association between shooting effort and changes in population size/structure and activity patterns. We used marked subsamples to estimate prairie dog densities during the spring and fall on 10 hunted colonies in 1994 and 9

hunted and 8 non-hunted (control) colonies in 1995. We measured a greater decrease in prairie dog density on hunted colonies compared to non-hunted colonies in 1995. There was a positive correlation between shooting pressure and change in density on hunted colonies. Prairie dog behavior also varied between hunted and non-hunted colonies. Prairie dogs spent more time in an alert posture on hunted colonies than on control colonies, and individual prairie dogs could be approached more closely on non-hunted colonies. We found that the percent cover for 4 categories: grasses, forbs, shrubs and total cover, did not differ between hunted and non-hunted colonies.

ACTIVITY PATTERNS AND TIME BUDGETS OF GRIZZLY BEARS IN THE SWAN MOUNTAINS OF MONTANA ^{TWS}

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Since the fall of 1987, South Fork of the Flathead Grizzly Bear Project personnel have captured 49 grizzly bears (*Ursus arctos horribilis*) using Aldrich foot snares. Captured bears > 1 year of age were fitted with motion sensitive radio collars. Data was collected to determine if there are differences in activity budgets and patterns between age, sex, and reproductive classes and if there are differences when bears are in roaded versus unroaded portions of their home ranges. Activity budgets and patterns were recorded using a Lotek SRX400

telemetry scanner/receiver with a Telonics omni-directional antenna. Activity data was collected during 3 seasons, spring, summer, and fall of 1992, 1993, and 1994. While sampling bear activity, bears were continuously monitored 72 hours at least twice per season. A total of 19 bears were sampled resulting in 21538 quarter hour activity observations. Preliminary results suggest that grizzly bears in the South Fork are diurnal in their activity patterns, spending approximately 75 percent of each day in an active state.

INFLUENCE OF MOUNTAIN CLIMBERS ON ACTIVITY BUDGETS OF FORAGING GRIZZLY BEARS IN GLACIER NATIONAL PARK, MONTANA ^{TWS}

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Grizzly bears (*Ursus arctos*) commonly forage on adult army cutworm moths (*Euxoa auxiliaris*) during the summer on high elevation talus slopes in Glacier National Park (GNP), Montana, and had the potential to be disturbed by mountain climbers. Thus, we characterized the activity budgets of adult grizzly bears during 1989 and 1992 to determine potential impacts of climber disturbance on their foraging behavior. Time spent foraging on moths decreased ($P < 0.05$) and time spent

moving within the foraging area and aggressive behaviors increased ($P < 0.05$) when climbers were detected by bears. Climber disturbance reduced grizzly bear energy intake, increases energy expenditure, and may negatively affect productivity. We recommend the establishment of alternative climbing routes or seasonally-limited access regulations, not only to allow bears to forage uninterrupted, but also to reduce the potential for bear-human encounters.

**BREEDING ECOLOGY OF FERRUGINOUS HAWKS
AT THE KEVIN RIM IN NORTHERN MONTANA ^{TWS}**

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In 1993-94, we studied a population of ferruginous hawks (*Buteo regalis*) in northern Montana that had a high density of breeding pairs. We calculated survival of nests during 5 stages of nesting and estimated juvenile post-fledging survival. We also investigated the relationships between nest survival and productivity of ferruginous hawks and habitat and nest-site variables. A 170.9 km² area at the Kevin Rim Key Raptor Area (Bureau of Land Management) contained 24 occupied ferruginous-hawk territories in both 1993 and 1994; a breeding density of 7.12 km²/pair. Nest survival was 0.75 from occupancy to egg-laying (SE = 0.06, n = 48), 0.86 from egg-laying to hatching (SE = 0.06, n = 36), and 0.65 from hatching to fledging (SE = 0.09, n = 31). Sixty-five percent of occupied nests survived to hatching (SE = 0.07, n = 48), and 42% survived to fledging (SE = 0.07, n = 48). Mean productivity values for the 2 years combined were 2.10 eggs (SE = 0.21), 1.75 nestlings (SE = 0.21), and 0.96 young fledged (SE = 0.19) per occupied territory (n = 48). Mean clutch and brood sizes were 2.81 (SE = 0.16, n = 36) and 2.71 (SE = 0.16, n = 31), respectively, and mean number of

young fledged/successful nest was 2.30 (SE = 0.21, n = 20). Twenty-three of 27 radio-marked juveniles of known fate survived to disperse from the study area (S = 0.85, SE = 0.07). Univariate and multivariate analyses indicated that ferruginous-hawk nest survival and productivity were related to proximity of nests to cultivated fields, active oil wells, secondary roads, and other breeding raptors, as well as to the number/intensity of these variables within 1.6 km of occupied nests. Levels of human disturbance related to mineral development and agricultural activities did not appear to negatively impact breeding ferruginous hawks. However, increases in these activities could pose a potential threat and should be discouraged. There is reason to believe that the ferruginous hawk population at the Kevin Rim has had inadequate recruitment to sustain itself during the past 5 years. Low prey availability may be responsible for poor reproductive success. Further research is needed to determine if the population's growth rate remains negative over a longer period. If reproductive rates remain low, management plans to increase prey populations may be necessary.

**EFFECTS OF SELECTION CUTTING AND PRESCRIBED BURNING
ON SOIL NITROGEN IN A PONDEROSA PINE FOREST ^{MAS-CPR}**

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We compared the effects of single tree selection cutting and underburning on available Nitrogen (N), N

mineralization potential, and microbial biomass and activity, at two depths in the mineral soil under ponderosa pine