The Accomplishments of a Network— Priceless Resources: A Strategic Framework for Wetland and Riparian Area Conservation and Restoration in Montana 2008-2012—and Prioritization for 2013-2017

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The Montana Wetland Council provides a forum for scientists, mangers, regulators, and others to network and collectively advance wetland and riparian conservation. While these professions aren't typically known for their social dynamism, the passion for the resource holds together and propels this functioning network and has resulted in three National Wetland Award winners in the last 7 years. Five-year accomplishments include: Montana now has digital wetland and riparian maps for a majority of the state and these important aquatic resources are one of the state's supported 14 Montana Spatial Data Layers. Montana also has a new statewide In-Lieu Fee Program for impacts to aquatic resources throughout Montana under the auspices of the Corps' 404 and Section 10 regulatory programs. These and other accomplishments from the State's 2008-2012 Wetland and Riparian conservation strategy will be described along with what difference the accomplishments have made and opportunities they leverage for increased wildlife habitat protection and restoration. The next 5-yr strategy is currently in the makings. Hear about the 2013-2017 draft priorities and share your input to shape the collective direction of the Montana Wetland Council network.

estimates in the Yellowstone ecosystem are approximately 700 and approximately 1000 in the NCDE. Both of these populations appear to be approaching the carrying capacity of their ecosystems as evidenced by reduced subadult survival in the core areas of the Yellowstone ecosystem and dispersal of primarily subadults into peripheral habitats in both ecosystems. The expanding range and numbers of grizzlies is resulting in re-occupancy of habitats in Montana where grizzly bears had been extirpated for over 100 years. The objective of the Endangered Species Act (ESA) is to get listed species to the point at which protection of the ESA is no longer required. We review progress toward recovery and delisting and the reasons the grizzlies in these ecosystems have recovered including mortality control, habitat management, nuisance bear management, and outreach and education. We also describe future management once recovery and delisting have been achieved and how this management will assure the long-term future of this species in Montana.

Elk Movements and Brucellosis Transmission Risk in Southwest Montana

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The presence of *Brucella abortus* within free-ranging elk populations is an important conservation and management issue because of the risk of brucellosis transmission to livestock. Understanding elk distributions is necessary to forecast elk and livestock spatial overlap and the potential for brucellosis transmission. As part of a 5-yr brucellosis surveillance project, 30 adult female elk were captured and fitted with GPS collars in each of the winters of 2010, 2011 and 2012 in three southwest Montana study areas. We used elk location information to assess elk movements, and spatial overlap with livestock and adjacent elk herds. The elk movement results were further augmented with data from Wyoming and Idaho elk herds. The elk movement data shows interchange of females between elk herds during the transmission risk period. Resource selection models predicting elk distribution and spatial overlap with livestock during the transmission risk period were developed and extrapolated across the designated brucellosis surveillance area of Montana. We used the elk location data collected in this study to validate and refine models predicting elk distributions and spatial overlap with livestock during the risk period. Predictive models may be used as a tool for focusing management actions aimed at minimizing elk and livestock spatial overlap during the transmission risk period.

Estimating Lynx Habitat Under Future Fire Management and Climate Change Scenarios

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Climate changes have the potential to considerably alter the habitat of Canada lynx (*Lynx canadensis*), which are dependent on snowshoe hare throughout their range. Both species occupy areas of high altitude forest with dense cover of shrubs and saplings. The Fish and Wildlife Service has designated critical habitat for lynx, but there is little research on how these areas will change with a changing climate. We use the simulation model FireBGCv2 to run scenarios comparing climate change, fuel treatments, and fire suppression. Our results suggest that fire suppression has the most important future benefit in maintaining lynx habitat, as allowing natural fires to burn reduces the quality of lynx habitat over a fifty year modeling period. Although fires can generate the early seral stage that defines quality lynx habitat, their frequency prevents much of the modeling landscape from reaching this stage. Simulation modeling can provide a valuable platform to view the future of lynx habitat under climate change, but the limitations are numerous.

Winter Wheat – Finding a Balance Between Modern Agriculture and Prairie Nesting Ducks

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The Prairie Pothole Region (PPR) of North America is a highly valuable landscape for breeding waterfowl that has been predominantly converted to some form of agriculture in the last century. This is cause for concern since the extent of cropland has been strongly associated with declining numbers and nest success of ducks. With the recent increase in economic value of some cash crops and the potential to lose highly valuable nesting habitat in the Conservation Reserve Program (CRP), there has been an interest in evaluating alternative farming practices as potential breeding habitat for waterfowl. While past research has shown nest success of waterfowl to be very low in spring-seeded crops, limited research has assessed the potential of winter wheat, a fall-seeded crop, as a nesting habitat. We wanted to assess and compare the use and success of prairie-nesting ducks in winter wheat to perennial cover (CRP, grassland, etc.) in the PPR of North Dakota. We monitored duck nests (*Anas* spp.) in winter wheat (n = 1284) and perennial cover (n = 3244) from 2010-2012. We will use a model-selection based approach to evaluate nest survival after accounting for a variety of environmental (wetland density, vegetation density, etc.) and temporal covariates (initiation date, nest age, etc.) and predict that daily nest survival will be similar in both habitats. Results from this study will provide valuable insight for wildlife managers on the benefits and weaknesses of winter wheat as a breeding habitat for waterfowl.

Using Advanced Technology to Evaluate the Effects of Restoration Treatments on Bird Use of Shrubby Draws During Fall Migration

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In 2012, the MPG Ranch initiated efforts to restore ground cover and woody structure in several draws degraded by decades of cattle grazing. To evaluate the effects of restoration treatments, we are studying bird use of draws during fall migration, tracking changes in bird use as restoration progresses. To map bird occurrence at the scale of restoration treatments, we developed and tested an iPad application that allowed us to place bird detections directly onto high-resolution, geo-referenced aerial imagery. Along with an exact location, the application allows us to record descriptive information such as species, behavior, and substrate used. In our pilot season, we recorded observations of 1,061 birds. The Vesper Sparrow was the most commonly observed species. We were able to detect spatial and temporal trends in bird use of shrubby draws, with notable clustering in areas of established woody vegetation. We also detected several species using shrubby draws during fall migration that would not typically be found in this habitat type in the breeding season. In the future, we will make quantitative associations between bird detections and the presence of features such as shrub and tree cover or the presence of water. Given what we deemed a successful pilot season, we plan to continue the use of the iPad application during subsequent fall migrations as draw conditions change and habitat conditions presumably improve.

Twenty Years of Human-Grizzly Bear Conflict Management in Northwest Montana

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This paper examines and summarizes twenty years of human-grizzly bear (*Ursus arctos*) conflicts and management actions in northwest Montana from 1993 through 2012. Initial responses to the reported conflicts usually involved identifying the attractant and securing or removing the attractant. In many situations, the decision was made to trap and capture the grizzly bear. A total of 193 individual grizzly bears were captured 344 times in management actions which ranged from grizzly bears frequenting yards to grizzly bears breaking into cabins. When grizzly bears were captured their fate depended upon their age, sex, level of conflict, and classification based on the Interagency Grizzly Bear Guidelines. Grizzly bears were released on-site, translocated, or removed from the population. Translocations included long distance out of home range moves to short distance moves within the home range. Aversive conditioning techniques were tried involving the use of bean bag and rubber bullet rounds, cracker shells, and Karelian Bear dogs. New technology such as remote cameras, automated traps, and use of DNA were also used on this project. The success or failure of the different management actions is discussed and recommendations are made for future human-grizzly bear conflict management actions.

Montana Peregrine Falcon Survey: 2012

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The release of 617 captive-bred young during the 1980's and 1990's sparked the recovery of the Peregrine Falcon (*Falco peregrinus*) in Montana. By 1994, a mix of state, federal, and private biologists (Montana Peregrine Falcon Working Group) documented 13 known active Peregrine Falcon territories. For the following four years, the number of known territories averaged about 16, but then intensive survey efforts in 1999 documented a total of 28 territories. The number of active Peregrine Falcon territories discovered in Montana has increased yearly. Montana had a record number of 108 active Peregrine Falcon nests recorded during the 2012 field season. Montana Peregrine Falcon surveys are conducted in conjunction with the USDI Fish and Wildlife Service national surveys scheduled every 3 years, beginning in 2002 and ending in 2015. Annual survey objectives include the establishment of a citizens group (Project Peregrine Watch) to monitor individual Peregrine territories throughout the state, determine status and trends of Montana's Peregrine Falcon population, study all known historic Peregrine Falcon eyries, record occupancy and productivity at all active territories, locate new Peregrine Falcon territories, seek confirm and consolidate information from all public and private sources, record activity and locations of neighboring cliff-nesting raptors (Prairie Falcon (*Falco mexicanus*), Golden Eagle (*Aquila chrysaetos*), and the Red-tailed Hawk (*Buteo jamaicensis)*, and develop , a long-term and cost-effective monitoring program for determining annual status and population trends of the State's Peregrine Falcon population.

History of Woodland Caribou in Montana

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Within the contiguous U.S., woodland caribou (*Rangifer tarandus caribou*) were historically a resident of mature, deep-snow forests of northwest Montana, north Idaho and northeast Washington. Because of habitat changes, predation, and unregulated hunting, numbers dwindled to remnant populations or even extinction throughout their distribution within the U.S. By the 1950s, any caribou that might be observed in Montana were considered transitory from either southern British Columbia or north Idaho, where remnant populations still remain. In this paper, we review historical and current records of woodland caribou in Montana, discuss their biological requirements and legal status, and offer comments on future recovery efforts.

Nesting Ecology of Spiny Softshell Turtles on the Missouri River in Montana: Zoogeographic and Management Implications

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The nesting ecology of western spiny softshell turtles (*Apolone spinifera hartwegi*) in Montana, where they are at the northern extent of their range and a state Species of Concern, is poorly known. We used telemetry, visual surveys, observation from shore-based blinds, and remote cameras to document nesting behavior, habitat, and timing in a 97-km reach of the Missouri River. We located 25 nests in 2011 and 97 in 2012. Most nests were in mixed-gravel substrates; only 3 percent were in pure sand. Vegetative cover at nest sites was sparse. Mean distance of nests to the water's edge was 13.7 m and mean height above the water surface elevation was 0.7 m. Proportion of nests found on island and mainland habitats were similar in 2011, but 90 percent of nests were on islands in 2012. Predation occurred on 46 nests; mainland nests incurred higher predation rates than island nests. Nesting followed annual peak river stage, and mostly occurred in the afternoon. Durations of nesting, incubation, and emergence periods were similar in both years, but nesting and emergence occurred about three weeks later in 2011 than in 2012. Only 36 percent of nests were successful in 2011, but 60 percent were successful in 2012. Flooding in 2011 probably decreased nesting effort and success by reducing habitat availability and delaying the onset of nesting, which thereby prematurely ended incubation. However, flood events maintain and create nesting habitats by clearing vegetation and depositing substrates. Premature termination of incubation suggests that the northern range of this species is probably limited by successful incubation.

Wolverine Food Habits and Foraging Strategies in Glacier National Park, Montana

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From 2003-2007 we captured and instrumented 28 wolverines (*Gulo gulo*) in Glacier National Park to investigate reproduction and recruitment. We collected 189 scat samples at reproductive den, forage and rendezvous sites, and documented 90 prey species through observation and prey remains found at similar sites. Seasonal scat analysis provided evidence of differences in prey species consumed during winter (n = 170), summer (n = 19), and reproductive den (n = 103) periods. Ungulates were the most frequently observed prey found in all scats (71%; N=135), with Cervid remains being observed most often (37%; n = 70).

Hibernating rodents (ground squirrels and marmots) (36%; $n = 68$) were the next most utilized prey, with the third most documented prey being mice and voles (31%; $n = 56$). Vegetation (72%; $n = 169$), soil material (31%; $n = 59$), and bone (90%; $n = 171$) were also found in scats. Seasonal importance of prey was documented, with ungulates being the most observed prey in winter scats (75%; $n = 128$) and den period scats (79%; $n = 81$), and hibernating rodents being most observed in summer scats (47%; $n = 9$). A similar condition was found with analysis of all prey remains ($n = 90$); ungulates were consumed most often (69%; $n = 63$), with hibernating rodents as the second most documented prey (12%; $n = 11$). Wolverines exhibited seasonal dietary shifts in that ungulates were consumed most frequently during winter (77%; $n = 55$) and the den period (78%; $n = 17$), with hibernating rodents the most frequent prey documented in summer (50%; $n = 9$). Wolverine foraging strategies, including searching tree wells, fishing, decapitation, and food caching are also discussed.

Untangling Rocky Mountain Elk Ecology and Population Dynamics: A Regional Synthesis Across the Northwestern U.S.

Western Elk Research Collaborative (representatives from 7 state wildlife management agencies, 4 Cooperative Wildlife Research Units, 1 university, USDI National Park Service)

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The Western Elk Research Collaborative (WERC) is a group of state and federal biologists and university faculty that is pooling Rocky Mountain elk data from 7 states to understand factors affecting elk (*Cervus elaphus*) population dynamics at broad spatial and temporal scales. These "value-added" analyses leverage the considerable investment collaborators made to develop their respective datasets. Our initial efforts pooled data from 12 elk populations to evaluate calf survival and cause-specific mortality (Journal of Animal Ecology 80:1246-1257) and 45 datasets to assess adult female survival and cause-specific mortality (Journal of Applied Ecology in press). We will briefly describe those findings. We also seek to understand how reproductive output varies across space and time as a function of factors such as weather, plant productivity, and predation. Therefore, we are assembling population and reproduction data from our 7 state study area. The spatial and temporal (≤ 25 years) scales are unique and may provide insight into the effects of climate change on elk population dynamics. As a direct result of the exceptional cooperation and communication among collaborators … a signature success of WERC … we are developing an unprecedented Rocky Mountain elk dataset that will provide a fertile arena to investigate relevant management and research questions.

Camouflage Mismatch in Seasonal Coat Color Due to Decreased Snow Duration

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As a result of climate change, the duration of the ground snow cover in the temperate regions has shortened. We describe a novel and striking climate change effect on wildlife, whereby seasonal coat color becomes mismatched with background snow or lack of snow. Our objective was to quantify for snowshoe hares *(Lepus americanus)* the phenology of seasonal coat color change and potential for coat color mismatch, as first step in exploring whether hares can adapt to a decreasing snowpack. We quantified snowshoe hare molt phenology, mismatch and survival for three years at two sites in western Montana. We monitored over 450 hares weekly with radiotelemetry, quantifying the progression of the molts and snow cover. We observed considerable mismatch between hare coat color and their background during spring and fall seasons. Some level of plasticity was observed in the rate of the spring molt which mitigated the color mismatch. By contrast, onset of coat color molts remained constant. We used global circulation model downscaling at ecologically relevant scales (30m resolution) to predict changes in snowpack hares are likely to face in the future. According to our analysis annual average duration of snowpack will decrease by 29-35 days by mid-century and 40 - 69 days by the end of the century. Without evolution in coat color phenology, the reduced snow duration will increase the number of days that white hares will be mismatched on a snowless background by 3- 8 fold.

Poster Abracts

Citizen Scientists add to our Understanding of Bird Populations and Status Across Montana

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Montana Audubon, our partners, Audubon Chapter members, and bird enthusiasts across the state are increasingly involved in contributing time and talents to understanding bird populations, habitat associations, and trends. Birders contribute sightings to *eBird* or *Tracker*, reporting their observations from field excursions and their backyards. This information helps inform Montana Species of Concern listings and influences bird conservation and science priorities in the state and beyond. Montana Audubon also encourages citizen monitoring projects for single species and guilds, from Black Swifts to Golden Eagles. We are now home to the greater sage grouse (*Centrocercus urophasianus*) Adopt-a-Lek program which coordinates citizen scientists to monitor sage-grouse on over 50 breeding leks across Montana every spring. Finally, our Audubon chapters adopt and monitor Important Bird Areas across the state in order to conserve species of conservation concern and their habitats. Find out more about these volunteer efforts.

Black-Footed Ferret Recovery: Things are Looking Up!

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The black-footed ferret (*Mustela nigripes*) is considered one of the most endangered mammals in the world. Hindering the success of recovery efforts is the presence of Sylvatic Plague and a general intolerance of the ferrets primary prey, the prairie dog. To date, the only tools against plague at reintroduction sites have been vaccination of ferrets prior to release, application of pesticides, and translocation of prairie dogs into sites following an epidemic plague event. In addition to the high cost of plague management, ferret recovery is hampered by loss of habitat to sod-busting and development and ESA regulations that make landowners wary of finding or hosting a listed species. However, in recent years, innovative approaches to plague management, prairie dog conservation and ESA regulation have laid a new path for ferret recovery across Western states. These approaches include the following: 1) An MOU signed in 2012 by the USFWS, NRCS, USGS, Wildlife Services, and the Western Association of Fish and Wildlife Agencies facilitating cooperative conservation efforts with willing landowners to maintain ranch land in prairie habitat and the livestock operations that they support *while* providing for the conservation and recovery of wildlife species associated with prairie dogs, 2) Development of a safe harbor agreement that would provide regulatory assurances to land owners willing to allow ferret re-introductions, and 3) Development of a sylvatic plague vaccine meant to be dispersed at ferret reintroduction sites. Successful implementation of these new tools could result in ferret recovery within the next decade.

Where are Long-Toed Salamanders Found in a Game of Hide-And-Seek With Trout?

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In many alpine lakes, trout have been introduced for recreational fishing and have replaced native amphibians as top predators. In these systems, trout are associated with reducing the abundance of amphibians and have extirpated populations of long-toed salamanders (*Ambystoma macrodactylum*) from many lakes. Although rare, salamander coexistence with trout may occur in some lakes where habitat characteristics such as emergent vegetation and physical barriers are present, as these environments can provide refugia from predation. We sought to identify what key habitat features might allow this co-occurrence. We sampled seven lakes with salamanders and fish and seven with only salamanders in northwestern Montana between July and August 2012. We used minnow traps to capture salamander larvae and we quantified habitat characteristics (e.g., vegetation density, structural complexity) where salamanders were captured. We compared capture rates and habitat characteristics to determine whether lakes with and without fish differed. Preliminary results suggest that salamander capture rates were higher in lakes with fish (33%, 95% CI = 13-84%), but salamanders were smaller, as larvae had 68 percent shorter tails (51-91%) in lakes with fish. Despite these differences, we did not detect any differences in habitat characteristics. Unless minnow traps were used as refugia, our findings suggest that salamanders utilize similar habitat in these lakes regardless of the presence of fish. Future work will examine factors influencing salamander growth and tail length and determine whether adding habitat complexity is an effective strategy to facilitate coexistence of salamanders and fish.

Avian Monitoring with Autonomous Recording Units in the Bitterroot Valley, Montana

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Monitoring avian species over a vast landscape challenges researchers and land managers. Many current monitoring programs rely on point counts, banding stations, and other methods requiring skilled observers. Autonomous recording units (ARUs) compliment data from these more common field techniques. In September 2012, MPG Ranch installed three ARUs at low-, mid- and high-elevation locations to supplement concurrent data collected at passerine banding stations. A preliminary analysis of migrating passerine nocturnal flight calls revealed distinct temporal and spatial trends between sites and through the season. We detected more sparrow, warbler and thrush flight calls in September than in October and at the low-elevation site than at the high-elevation site. We plan to compare this analysis to the banding data collected by the University of Montana's Avian Science Center for additional patterns. The ARUs also recorded several infrequently detected or new species on the ranch. We detected a barn owl (*Tyto alba*) 16 times at the low- and mid-elevation

ARUs over a 29-day period in September and October. These detections represent the first documentation of a barn owl since property monitoring began in 2010. Additional acoustic monitoring will help determine if this was a migration or some other phenomena. The common poorwill (*Phalaenoptilus nuttallii*) was another uncommon species documented via ARUs. In the future, we plan to use ARUs to document the presence and vocalization phenology of several species (e.g., Flammulated Owl, Common Poorwill) breeding in difficult-to-access areas of the property. We also plan to acoustically monitor the 2013 spring passerine migration.

Montana Prairie Pothole Joint Venture Breeding Shorebird Monitoring Project

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Populations of several shorebird species in the Prairie Pothole Region (PPR) appear to be declining, largely because of loss of grasslands and wetlands. Marbled godwit (*Limosa fedoa*), long-billed curlew (*Numenius americanus*), willet (*Tringa semipalmata*), Wilson's phalarope (*Phalaropus tricolor*), upland sandpiper (*Bartramia longicauda*), American avocet (*Recurvirostra americana*) and Wilson's snipe (*Gallinago delicata*) are listed as priority species by Partners in Flight or the U.S. Shorebird Plan. In 2004, the USDI Fish and Wildlife Service, Habitat and Population Evaluation Team (HAPET) began conducting breeding shorebird surveys to complement existing waterfowl population and habitat evaluations for the partners of the Prairie Pothole Joint Venture in North Dakota, South Dakota and northeast Montana. Survey methodology was modeled after the Breeding Bird Survey (BBS) but modified to fit the breeding ecology of these shorebirds. In 2012, surveys were expanded to include the western portion of the Montana PPR. Data from these surveys will be used to estimate shorebird population densities and distribution; however, current survey methods do not take into account areas where shorebirds may have been present but undetected, possibly resulting in an underestimation of shorebird densities. Surveys will be modified in 2013 in an effort to allow for estimation of shorebird detection probabilities, while maintaining compatibility with previous data collection methods. Results from this research will allow land managers to integrate breeding shorebird conservation with ongoing waterfowl conservation actions in the Montana PPR. We summarize the objectives and field design of the project and report results of preliminary modeling from our 2012 efforts.

Assessing Genetic Diversity Between Bighorn Sheep Populations in Western Montana

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This study investigates two remote bighorn sheep populations in the southern Bitterroot Valley affected by a pneumonia outbreak in 2010. Limited information is available regarding the genetic relatedness among bighorn sheep populations and how pneumonia related die offs could impact genetic diversity and herd resilience to future outbreaks. To contribute to local research efforts we developed scat collection and DNA extraction protocol for advanced high school students in a community science program. This study gathers baseline information about the genetic relatedness between two relatively close but isolated populations, and will estimate the heterozygosity and the number of distinct alleles at several microsatellite loci. DNA from bighorn sheep scat was collected, extracted, and genotyped from samples in June of 2011 (n = 19) and 2012 (n = 25). The small sample size will reduce our ability to make broad conclusions; the number of samples represents about 20 percent of the estimated herd size in 2011 and 2012. Although our ability to make conclusions may be limited, this data could contribute to bighorn sheep management strategies for the Bitterroot and long term genetic monitoring for a sustainable population. Additional samples will be collected and analyzed yearly to look for changes in heterozygosity over time and in response to any future translocations.

Migrating and Overwintering Populations of Diurnal Raptors in the Bitterroot Valley, Montana

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We identified a major spring and fall migration of diurnal raptors over a low-elevation foothills site in the northeast Bitterroot Valley. We conducted full-time migration surveys in both seasons for 2 years. Red-tailed Hawks were the most abundant species counted in both seasons. During fall migration, species composition differed from other Montana hawk watch sites located on high-elevation ridges. We used a combination of survey techniques to assess overwintering populations of raptors in the Bitterroot Valley during the winter of 2012-2013. We developed an iPad application that allows us to map fine-scale occurrence of birds and used this method to document raptor presence at the north end of the valley. Citizen Scientists affiliated with Bitterroot Audubon performed systematic, broader-scale surveys at the south end of the valley. These two methods will likely document over 3,000 raptor observations by the end of winter 2013. Rough-legged and Red-tailed Hawks comprise the majority of raptor detections. We will examine these data for spatial and temporal trends in raptor occurrence.

Occupancy Dynamics of Avian Species in Relation to a Mountain Pine Beetle Epidemic

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Recent epidemics of mountain pine beetles (*Dendroctonus ponderosae*) will fundamentally alter Rocky Mountain forests, impacting management decisions related to fire, logging, and wildlife habitat. We evaluated effects of a recent mountain pine beetle epidemic on occupancy dynamics of 46 avian species. Seventy-six point count stations were randomly located in four, 250 ha study units within pine (*Pinus* spp.) forests in the Elkhorn Mountains, Montana. Each point was visited 3 times during the breeding seasons (May-Jul) 2003-2006 (pre-outbreak) and 2009-2011 (post-outbreak). We used a Bayesian hierarchical model of multi-species occupancy that accounts for imperfect detection and allows for estimates of rare, as well as common species. Occupancy was modeled for all species with respect to pre-outbreak years, year since the outbreak, and proportion of ponderosa pine. Results supported our prediction that occupancy rates would increase after the outbreak for bark-drilling woodpeckers (*Picoides* spp.). Occupancy rates of foliage-gleaning chickadees (*Poecile* spp.) and bark-gleaning nuthatches (*Sitta* spp.) declined soon after the peak in beetle-induced tree mortality (2008); however, their rates began to rise within 3 years. Bark-gleaning species' occupancy relationships with ponderosa pine changed after the outbreak. Our results will help inform forest management activities for the persistence of species that evolved with large-scale disturbances.

Proactive Management of Pneumonia Epizootics in Bighorn Sheep in Montana—Project Update

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Pneumonia epizootics are a major challenge for effective management of bighorn sheep (*Ovis canadensis*). Approximately half of the herds in Montana have suffered die-offs since the 1980s, many of which were pneumonia events. A set of models that identify risk of pneumonia and the best management decisions given that risk would be of great value for proactive management of pneumonia epizootics. Our first objective is to design and test a risk model that will help predict a herd's risk of pneumonia. We hypothesize that various factors increase risk through pathogen exposure, pathogen spread, and disease susceptibility. Analysis of these factors comparing herds with and without recent pneumonia histories using Bayesian logistic regression will allow us to design a risk model. Our second objective is to develop a proactive decision model that incorporates estimates of pneumonia risk to help evaluate costs and benefits of alternative proactive actions appropriate to those estimates. We will use a Structured Decision Making framework, which provides a deliberative, transparent, and defensible decision-making process that is particularly valuable in complex decision-making environments such as wildlife disease management. Together the resulting risk and decision models, to be completed this year, will help managers estimate pneumonia risk and identify the best management action based on both the severity of each herd's predicted risk and costs and benefits of competing management alternatives. Ultimately, this project will demonstrate the development and application of risk and decision models for proactive wildlife health programs in Montana Fish, Wildlife and Parks.

Exploring Adaptive Management for Greater Sage Grouse in Northern Montana in the Face of Climate Change

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A collaboration has begun in Montana among several state and federal agencies and non-governmental organizations interested in the management of greater sage grouse (*Centrocercus urophasianus*) in a > 5,000,000-ac (> 20,234-ha) landscape including the Charles M. Russell National Wildlife Refuge. The first step was conducting personal interviews with field biologists and managers in the general area to assess what management actions they are making. Using this information, we conducted an on-line survey to further identify those actions and how they are made. Finally, almost 40 managers and scientists met to discuss whether an adaptive management approach might be useful to gain an understanding of the interaction among habitats and management actions and how this will be affected by annual weather and climate patterns. A conceptual model of how these factors affect the life cycle of grouse has been drafted, and we are gathering comments on it. The intent is for that to be used as an ecological response model for assessing the effects of possible climate change scenarios. Future work will entail: (1) further delineation of management actions and the social networks associated with them, (2) building and evaluating a working model using rapid prototype methods, (3) conducting futures analyses of associated landscapes, (4) continuing to foster collaborative effort, and (5) working one-on-one with managers to evaluate model and adaptive management applicability using such tools as LCMAP (Landscape Conservation Management and Analysis Portal).

Montana Golden Eagle Conservation Guidelines

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The Montana Golden Eagle Working Group is preparing guidelines to address conservation concerns for golden eagles (*Aquila chrysaetos*) related to land use change and population-level mortality factors. The guidelines focus primarily on avoiding, minimizing and mitigating adverse impacts to golden eagles. The USDI Fish and Wildlife Service Draft Conservation Plan Guidance explains the Service's approach to issuing programmatic permits for eagle take and provides adaptive management guidance for the conservation of golden eagles related to land-based wind energy facilities. The Montana guidelines are intended to address a wider array of golden eagle conservation concerns and potential anthropogenic impacts, and compliment implementation of the industry-focused Draft Eagle Conservation Plan Guidance in Montana. We will present a summary of the status of and threats to golden eagle populations and habitats. Then we will discuss our draft conservation guidelines that outline strategies for maximizing reproductive potential and survival of the eagle population in Montana. We also will present some options for mitigation when negative impacts to eagles cannot be avoided or minimized.