



Boulder County Nature Association
P.O. Box 493, Boulder, Colorado 80306

**BOULDER COUNTY ECOSYSTEM SYMPOSIUM ABSTRACTS
MARCH 10, 1995**

WHAT HAVE WE DONE AND WHERE ARE WE GOING? Dave Hallock, Boulder County Nature Association and Boulder County Parks & Open Space.

The meeting of the Great Plains and the Southern Rocky Mountains has provided Boulder County with a locational advantage for attracting human settlement. It is probable that early peoples were attracted due to the relatively warm climate and substantial game populations. Intrusions of minerals in the mountains were discovered in 1859 which lead to a new wave of settlement. Finally, beginning with the post World War II period, there have been several spurts of growth tied to regional economic differences and a general infilling of the continent. The human population has increased from 850 inhabitants in 1860 to over 225,000 today.

The increase in human population has resulted in changes to the landscape. Native prairie has been reduced to 10% of its original land cover. Mountain forest, particularly foothill and montane types of ponderosa pine and Douglas fir, have greatly changed in structure. They are denser and more susceptible to high-intensity stand replacing crown fires yet are also absent of old-growth. Riparian and stream habitats have been altered due to water diversions, reservoirs, channelization and the introduction of nonnative fish. The loss of wetlands has been evident including a 20% decline in montane and subalpine willow carrs. Domestic grazing and human related activities have introduced and spread exotic plants.

Changes in wildlife populations have followed landscape modifications. Extirpated or declining species are generally wide-ranging, are perceived as threats or pests by people, had high market value at the turn of the century, or are restricted to native prairie habitat. New or increasing species are generally those which can take advantage of human dominated landscapes and features such as agricultural land, towns and lakes. Subtle wildlife community shifts toward species compatible with human landscapes appear to be occurring even in rural settings.

Predictions will be offered about future landscape and wildlife changes as we head into the 21st century.

PREHISTORIC HUNTER-GATHERERS IN THE GREATER INDIAN PEAKS ECOSYSTEM: ADAPTATIONS AND IMPACTS. James B. Benedict, Center for Mountain Archeology.

Prehistoric campsites and stone game-drive systems above timberline in western Boulder County document 10,000 years of high-altitude human habitation. The alpine tundra was used in summer and autumn by hunters and gatherers whose seasonal migrations took them on journeys of up to 300-400 kilometers during the course of a year. Their impacts on the land they utilized include increased fire frequency, increased predation on game-animal species, and probable range extensions of plant species with edible seeds, fruits, and nuts. Arrival of the horse in about AD 1700, and entry into a market economy based on the trade of hides and robes, beginning in the 1830's, caused severe pressure on large-game populations. By 1858, when the first white settlers arrived in Boulder, the county had already experienced a century and a half of ecological upheaval.

HABITAT FRAGMENTATION AND BIOLOGICAL DIVERSITY: PERSPECTIVES FROM A BOULDER COUNTY GRASSLAND. Sharon Collinge, University of Colorado Museum.

Habitat fragmentation is extremely widespread and poses one of the most serious threats to the conservation of biological diversity. I have conducted two major field experiments in a native grassland habitat near Boulder over the past three years to test certain key hypotheses regarding the ecological implications of habitat fragmentation. I chose to experimentally examine the responses

of insects in a native grassland habitat because species composition can be assessed before as well as after experimental fragmentation; the spatial structure of the habitat can be altered by mowing; and insects have been shown to be superior indicators of habitat degradation. Habitat fragmentation studies have primarily focused on forest habitats; very little is known about processes in native grassland habitats. I have studied changes in insect species composition due to experimental alteration of grassland fragment size, connectivity, and spatial arrangement.

The first experiment manipulated grassland fragment size and connectivity to examine the responses of insects to these two components of habitat fragmentation. Insect species richness was significantly affected by fragment size and connectivity. Small (1m²), isolated plots harbored fewer insect species by the end of the growing season than did small control plots established in continuous, unmown vegetation. Rare insect species were particularly sensitive to habitat fragmentation, and were significantly less abundant in the isolated plots compared to the control plots. Interestingly, there were no differences among completely isolated plots and plots with corridors in insect species richness. In a second experiment, I simulated four sequences of land conversion which varied in their particular spatial configuration. These sequences were chosen to represent broad scale patterns of landscape change. The four sequences involved progressive mowing of equal patterns of landscape change. The four sequences involved progressive mowing of equal areas (25%, 50%, 75%) of the plots, each sequence according to a particular spatial arrangement. Insect species composition varied significantly among the four habitat configurations at the 75% conversion stage. The two configurations with intermediate boundary length and an intermediate amount of interior habitat relative to the other two sequences contained the highest number of insect species at the 75% conversion stage. These two field experiments provide some of the first experimental evidence for changes in biological diversity as a direct result of changes in the spatial structure of the habitat.

DECLINES AND EXTINCTIONS OF BOREAL TOAD POPULATIONS IN COLORADO. **Cynthia Carey, Dept. of EPO Biology, University of Colorado.**

Boreal toads were once very plentiful in the mountains of Colorado above 8,500'. Starting in the mid-1970's toad populations began to decline in size and many populations became extinct. Entire drainages in some of the mountain ranges of Colorado are now empty of toads. Of about 200 known populations in the 1970's, only 6 known breeding populations remain. It is unknown at this time whether these populations are expanding, declining or stable but monitoring programs will begin this summer. The toad is now listed by the Colorado Division of Wildlife as "endangered" and is under consideration by the USFWS for federal listing. Montane leopard frogs died out in many locations about the same time as the toad, but major die-offs of montane salamanders are just now beginning to be observed.

The world-wide decline in amphibian populations is occurring on 6 continents. Since amphibian populations are declining or becoming extinct in such a wide variety of habitats over such a relatively short time (about 20 years), man-made factors are assumed to be the causal agent. UV radiation, pesticides and other toxicants, habitat destruction, acid-rain, and other factors have been hypothesized, but conclusive evidence is lacking in almost all instances.

We are working on the hypothesis that sub-lethal changes in the Colorado physical environment have caused stress that has caused immunosuppression in Colorado montane amphibians that made them vulnerable to bacterial infections.

HUMAN IMPACTS RELATED TO WILDLIFE FEEDING IN ROCKY MOUNTAIN NATIONAL PARK. **Jeff Connor, Therese Johnson, Jeff Mauguans, Rocky Mountain National Park.**

Rocky Mountain National Park is twenty-fifth in size of national parks in the country, yet ranks eighth in total visitation and fifth in fee revenue in 1994. Visitation has increased dramatically since World War Two. In 1945 340,000 people visited the park, in 1994, 3.1 million. As a comparison, Rocky Mountain is one-eighth the size of Yellowstone National Park, but receives the same number of visitors.

Wildlife feeding has been an issue since the earliest years of Rocky Mountain National Park's existence. Today we have visitors bringing their grandchildren who came with their parents to feed

wildlife. During the summer months our more popular viewpoints can be an almost urban zoo experience. Birds such as Clark's Nutcracker, Steller's Jay and Ravens concentrate at these viewpoints seeking handouts. At the same time chipmunks, golden-mantles ground squirrels, and yellow-bellied marmots are crawling over visitors seeking food. Visitors crawl over each other trying to feed the wildlife. Other wildlife that seek hand-outs include coyotes and deer. Black bears try to break into garbage cans, visitors cars and tents. The problem has escalated significantly in recent years possibly due to drought conditions. Wild food has been scarcer making handouts by visitors more enticing. Park employees are frustrated trying to manage this problem. While talking with a visitor(s) at one end of the parking lot about wildlife feeding, another visitor(s) at the other end begins feeding. The employee tries to talk to that visitor(s) and other visitor(s) start feeding wildlife back at the other end. Wildlife have suffered from this dilemma. In 1994 park rangers killed two coyotes. In 1993, eleven yellow-bellied marmots were run over by automobiles at one view point while crossing back and forth across the road.

Park management is taking a proactive approach to this problem by education and enforcement. We are designing new signs, handouts and press releases. Park interpreters will discuss the issue at evening programs and guided walks. Law enforcement rangers will become a little tougher enforcing our regulations. We will recruit a few, high quality, volunteers to assist with roving interpretation at selected sites.

We will also be reactive and try to prevent wildlife from becoming dependent on cheetos and potato chips. Our last resort will be the removal of problem wildlife.

THE CO-EXISTENCE OF PEOPLE AND ELK: RESEARCH IN ROCKY MOUNTAIN NATIONAL PARK. Therese Johnson, Rocky Mountain National Park.

Elk management has been an issue in Rocky Mountain National Park since the 1930's. In the past decade, the appropriate elk population size, along with associated affects on vegetation communities and biodiversity, has been increasingly questioned. Human land management practices, including development, fire suppression, irrigation, and introduction of exotic plants, have contributed to changes in vegetation conditions. Park managers currently do not have adequate information to make well informed management decisions.

In 1994, the National Park Service and the National Biological Survey initiated a 5 year research project designed to provide critical information needed to develop a sound elk management program in the park. The research objectives are: 1) to develop a reliable elk census technique; 2) to better understand the interactions between elk population dynamics, fire, hydrologic changes, and vegetation conditions; 3) to predict vegetation conditions and elk population dynamics that might be expected under alternative management strategies for elk, fire, and hydrologic conditions; and 4) to develop vegetation management goals for the park.

ENVIRONMENTAL IMPACTS OF PASSIVE RECREATIONAL TRAILS. Clinton K. Miller, City of Boulder, Department of Open Space.

Seventy years ago Aldo Leopold began to recognize the environmental consequences of managing land in absence of a land ethic. Since that time, natural resource managers have concentrated on how to ecologically accommodate commodity users such as loggers, miners and grazers. While the state of knowledge is evolving and techniques are being developed, resource managers are beginning to recognize good and bad management practices. However, there is a new challenge on the horizon. Inherent with population growth and changes in demography of the inland West comes increased fragmentation of the landscape. In addition, the continued popularity of outdoor activities stimulates ever increasing demand for access to the public lands. For example the City of Boulder Open Space system received over 1.3 million visits during 1993, an increase of 13% over previous years. Passive recreation (hiking, biking, equestrian use, running / jogging, dog exercise) associated with trails has traditionally been thought of as having little or no impact on the environment. On the contrary, passive recreational trails affect both plants and animals in a variety of ways with both short and long-term consequences. For example, individual animals may be killed by attacks from domestic pets or a particular species intolerant of human presence may disappear from a habitat bisected by a trail. Numerous factors influence the affect of a trail including;

habitat trail is located in, species being impacted, season, time of day, weather, location of trail, surrounding land use, intensity of visitor use, predictability of disturbance, and type of recreational activity. I discuss the types of impacts associated with recreational trails and their consequences for plants and animals. In addition, I will present management alternatives that may help reduce the impact of trails. Finally, I present options for the future to reduce long-term detrimental impacts on the environment from recreational trails.

EFFECTS OF FOREST FRAGMENTATION AT SKI AREAS ON BREEDING NEOTROPICAL BIRD GUILDS. Richard W. Thompson, Western Ecosystems, Inc.

Breeding birds, including resident birds and nearctic and neotropical migrants, are an excellent indicator of habitat quality. How forest-interior, old-growth, and edge bird communities are influenced by forest fragmentation as a result of ski trail development, was empirically tested by conducting replicated plot counts on treatment and control spruce-fir, lodgepole pine, and grassland habitats on Quail Mountain, Breckenridge, Monarch, and Vail Ski Areas.

Forest-interior bird diversity and abundance was negatively related to ski trail and natural forest fragmentation at the 4 ski areas. As forests are increasingly fragmented by ski trails, both obligate and obligate plus facultative forest interior species decline in the bird community. This relationship occurs in lodgepole pine and spruce-fir forests, but is strongest in the latter habitat. Forest fragmentation affects obligate forest-interior species to a greater degree than facultative species. Spruce-fir forest fragmentation at the 4 ski areas examined was around 50%. Regression equations predicted that at this level of fragmentation, all obligate forest-interior birds are eliminated from the conifer community. Furthermore, only 29% and 25% of the original obligate plus facultative forest-interior bird diversity and abundance remains on the developed ski areas, respectively.

Old-growth bird diversity and abundance was negatively correlated to ski trail and natural forest fragmentation in spruce-fir forests at the 4 ski areas. As forests are increasingly fragmented by ski trails, both obligate and obligate plus facultative old-growth species decline in the bird community. Old-growth birds are uncommonly associated with most lodgepole forests. Old-growth species are more common in old-growth spruce-fir stands versus second-growth spruce-fir stands, but they also occur in the latter type where suitable habitat is present. Old-growth species composed a small proportion of the avifauna in old-growth spruce-fir stands at Vail (14.4+/-1.95% and Monarch (11+/-1.41%) Ski Areas. Forest fragmentation affects obligate old-growth species, including three-toed woodpeckers, brown creepers, and red-breasted nuthatches, to a greater degree than facultative species, solely represented by golden-crowned kinglets. Spruce-fir forest fragmentation at the 4 ski areas examined was around 50%. Regression equations predicted that at this level of fragmentation, all of the original old-growth bird diversity and abundance values were lost from the 4 ski areas. At Vail, where spruce-fir fragmentation is slightly less than 50%, only 26% of the original old-growth bird diversity and 21% of old-growth bird abundance remains on developed portions of the mountain.

Diversity and abundance of edge bird species was positively related to increasing forest fragmentation at the 4 ski areas. As lodgepole pine and spruce-fir forests are increasingly fragmented by ski trails, both obligate and obligate plus facultative birds associated with forest edge, open canopies, and early successional habitats increase in the bird community. This relationship was consistently stronger for obligate edge species than for facultative edge species, and slightly stronger in spruce-fir versus lodgepole stands.

As conifer forests are fragmented, forest-interior, and old-growth species quickly decline and are replaced by species requiring both forested and non-forested habitats for life history functions. As fragmentation becomes extreme, grassland-interior species appear and increase in abundance in the bird community. Ski trail construction affects forest-interior and old-growth bird communities in a much larger area than the habitat directly lost through clearing. On the landscape lever, such fragmentation increases avian biodiversity, benefitting increasingly common edge species at the expense of relatively less common forest-interior species and, where present, relatively uncommon old-growth species.