

Scientific principles for management of City of Boulder Open Space lands

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Summary: Our goals are to articulate the scientific principles that inform key policies in the discussion of the City of Boulder Open Space and Mountain Parks (OSMP) Visitor Master Plan, and to outline possible ecological consequences of alternative actions regarding these policies. We concentrate on two main issues that were raised by the Community Group Forum (CGF) during the draft stages of the OSMP visitor plan: the use of the “precautionary principle” and restrictions on trail construction and off-trail use in the Habitat Conservation Areas (HCAs). We suggest that scientific information can usefully contribute to the debate about OSMP visitor use by describing the likely outcomes of particular actions proposed by stakeholders and managers. In particular, scientific knowledge can be used to articulate how current and proposed actions may affect the likelihood that OSMP lands will exhibit acceptable conditions now and in the future. The current OSMP Visitor Master Plan can incorporate general scientific principles to guide current actions, as well as refer to results of specific studies that have been done on OSMP lands. This collective body of research suggests, for example, that trail use and off-trail use can increase the likelihood of exotic plant species invasions, which degrade habitat quality for other species, such as native butterflies. We conclude that existing scientific information can be productively used to guide decision-making regarding Boulder OSMP lands.

1. Background: City of Boulder Open Space Charter

The City of Boulder Open Space Charter describes several purposes of Open Space lands. These purposes were originally presented as a comprehensive list of the goals that would be met by acquiring and preserving open space lands. The eight goals stated in the Charter can be grouped into three primary categories: (1) preservation of nature including wildlife, water, ecosystems, and scenery (2) passive recreation and (3) traditional agricultural use. Additionally, the Charter stated that the Open Space system would serve to define and limit urban growth, which would be accomplished regardless of the land use(s) occurring on the property.

Is it possible to simultaneously meet all of these goals with a single blanket set of regulations applied to all public lands? General scientific principles as well as results of specific scientific studies conducted on OSMP lands suggest that different human activities have different impacts on natural systems. Based on this scientific knowledge, it seems reasonable that properties should be managed differently based on which goal(s) they are intended to serve. Open Space managers have proposed this solution in the Draft Visitor Master Plan by identifying four types of “Management Areas,” including Resource/Recreation, Natural, Agricultural, and Habitat Conservation Areas. Proposed designations according to this scheme would result in different management strategies and a

different set of rules and regulations, specifically designed to meet goals stated in the Open Space Charter.

2. What is the precautionary principle, and what is its relevance to management of Open Space lands?

The precautionary principle can be articulated as an approach that seeks to **avoid unintended consequences of particular actions**. This principle is used widely in many scientific and policy contexts where future outcomes of particular actions are uncertain. For example, the precautionary principle has been invoked in discussions regarding the development and release into the environment of genetically engineered organisms. Because the consequences of such releases are not well-known, many scientists recommend a cautious approach to releasing these organisms into the environment, with attention to detailed, rigorous studies of the benefits and costs associated with genetically-engineered organisms and careful monitoring of these modified organisms.

Further, to avoid unintended consequences of particular actions, the intended consequences of particular actions must be clearly stated. In the case of discussions surrounding the OSMP Visitor Master Plan, intended consequences of management can be assessed by asking questions such as, “What do the citizens of Boulder want OSMP lands to look like in the future--5, 10, 20, 50 years from now?” “What configuration of trail access is acceptable?” “What condition of the natural environment is acceptable?” A recent editorial in the *Daily Camera* (December 5, 2004) noted, “...to date, we’ve seen no data demonstrating serious, systemic damage to open space lands.” This suggests that actions should avoid causing serious, systemic damage, and begs the question, “What would constitute such damage?”

3. What is the role of science in informing management decisions?

With clear answers to questions regarding the intended consequences of societal actions on OSMP lands, science can usefully enter this conversation by helping to describe the likely outcomes of particular actions proposed by stakeholders and managers. Scientific knowledge can be used to articulate how current and proposed actions may affect the likelihood that OSMP lands will exhibit acceptable conditions now and in the future. We suggest that scientific data can be used to determine ecological consequences of particular management actions. For actions that have uncertain outcomes, we recommend that OSMP prioritize data collection to evaluate the consequences of various actions so that decisions can continue to be made in the future based on the best available scientific data.

4. What scientific principles may inform decisions regarding increased trail construction and off-trail access on OSMP lands?

The current OSMP Visitor Master Plan can incorporate general scientific principles to guide current actions, as well as refer to results of specific studies that have been done on OSMP lands. This collective body of research suggests, for example, that trail use and off-trail use can increase the likelihood of exotic plant species invasions. Many exotic species

are also noxious weeds, such as diffuse knapweed and Canada thistle, which can cause declines of native plant and animal species. In fact, exotic species invasions are the second leading cause of species endangerment in North America. The City of Boulder OSMP spends thousands of dollars each year on weed control, so it is likely that further invasions of exotic species will cost more money in management and control. Further, research on OSMP lands has shown that grasslands with a greater proportion of exotic plant species support fewer native butterfly species, and fewer individuals of those species, than grasslands with a high proportion of native plant species (see below).

Scientific research has shown that off-trail recreational activities such as hiking and horseback riding can have multiple ecological effects on plant and animal communities as well as soil conditions. These effects can include trampling of vegetation and soil, and introduction of exotic species, noise, and movement. Additional effects such as nutrient loading via horse manure and urine, and pollution via littering are possible but less well studied. Human trampling of vegetation and soil can result in decreased plant cover and decreased species diversity. Trampling can also cause soil compaction, and decreased enzymatic activity of soil microbes. Although the intensity and duration of these effects can be related to the intensity and duration of trampling, the most severe soil compaction can occur during the first few passes.

Many studies have demonstrated the potential of trails to act as corridors for non-native species introduction. These findings imply that off-trail use could also spread non-native species, although most research on this subject has focused on the effects of trail rather than off-trail use. The effects of noise and movement on animal behavior are probably somewhat species specific. For example, a study on the effects of human activity on breeding behavior of Bald Eagles found that bald eagles decreased the time spent sleeping, maintaining nests, and feeding themselves and their young when humans were camped 100 m from a nest for 24 hours. Throughout the 24 hours, responses to humans decreased, suggesting that eagles habituated to the disturbance. Off-trail use could lead to multiple disturbances of short duration. Because modification in breeding behavior was greatest initially, the type of disturbances associated with off-trail use could cumulatively impact nesting behavior.

Native species on Boulder OSMP lands may be sensitive to further degradation caused by increased trail and off-trail use because many of these species have already declined due to urbanization of the Boulder Valley. For example, recent research in Boulder's native grasslands revealed distinct patterns in plant and animal distribution in relation to the percent of the surrounding landscape that was urbanized. The number of small mammal species and the number of individuals of each species declined significantly when only 5-10% of the surrounding landscape was urbanized. Similarly, birds of prey such as bald eagles and prairie falcons were absent from grassland habitats surrounded by urban development, but were present in grassland sites more distant from urban areas. These studies suggest negative effects of surrounding urban development on native grassland species in Boulder County.

Butterflies in Boulder's grasslands were unaffected by the amount of urbanization surrounding their grassland habitat, but were strongly affected by the quality of the habitat. As described above, grasslands with more exotic plant species were found to be lower quality

habitats for butterflies than those with fewer exotic species. In other words, grassland sites with a high abundance of exotic, invasive species supported fewer butterflies and fewer species of butterflies than sites with lower proportions of exotic species. If trails and off-trail use increase the abundance of exotic species, then sites with trails and off-trail use are likely to support fewer species of butterflies. These research results suggest that maintaining intact areas of native, high quality grassland in the Boulder Valley will be most important for the persistence of native butterfly species.

5. What are predicted impacts of human recreation on local “charismatic” species on City of Boulder OSMP lands?

We summarize here specific examples of a few of the imperiled species that occur on OSMP lands, which illustrate the opportunities for protection of these species within the context of visitor use.

Peregrine Falcon (*Falco peregrinus*) – The peregrine falcon returned to Boulder OSMP in 1991 after 33-year absence; roughly 1,650 breeding pairs are known to nest in the US and Canada. This species requires ledges on steep rock faces for nesting and is sensitive to roads, road construction and recreation, especially during the breeding season. Current protection on OSMP property includes seasonal closures to breeding sites. OSMP properties important to this species include Flatirons/Mountain Backdrop Natural Area (NA), Sanitas Valley/Red Rocks Resource/Recreation Area (RRA).

Wood Lily (*Lilium philadelphicum* L. var. *andinum*) – The wood lily is listed by the Colorado Natural Heritage Program as rare and imperiled. It is typically associated with wetland sites and also occasionally found in upland areas. This species is found on a number of OSMP properties, often in association with wetland areas. The primary threat to the persistence of this species comes from collecting. OSMP properties important to this species include Western Mountain Parks Habitat Conservation Area (HCA) – specifically Lost Gulch.

Hops Blue Butterfly – This butterfly species is found in the Rocky Mountain Front Range and nowhere else in the world. Listed by the Colorado Natural Heritage Program as “globally rare”, this species is dependent on high densities of its food plant, common (wild) hops which is also protected on OSMP property. OSMP properties important to this species include Flagstaff/Chautauqua RRA, South Mesa RRA.

White Adder’s Mouth Orchid (*Malaxis brachypoda*) – This species is known in Colorado only from Green Mountain Open Space and is listed by the U.S. Federal Government as Endangered or Threatened in much of its range. OSMP properties important to this species include Greenman Springs in Western Mountain Parks Habitat Conservation Area (HCA).