Planning Trails with Wildlife in Mind

A HANDBOOK FOR TRAIL PLANNERS

TRAILS AND WILDLIFE TASK FORCE • COLORADO STATE PARKS • HELLMUND ASSOCIATES

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GREAT OUTDOORS COLORADO

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FOR COPIES OF THIS HANDBOOK

To obtain a single copy of this handbook, send a large, stamped (6 first-class stamps), self-addressed envelope (minimum 9"x12") to the address above or download the handbook from our website:

http://www.dnr.state.co.us/parks/

For multiple copies, please contact the Trails Program at the address above.

Printed on recycled paper.

Welcome

Dear Trail Planner:

How can trails best be planned and managed to recognize the needs and sensitivities of wildlife and the environment? What impacts do trail development and use have on wildlife? What can we do to minimize these impacts?

These are some of the important questions that prompted Colorado State Parks—in cooperation with Great Outdoors Colorado—to convene a state-wide Trails and Wildlife Task Force.

The Task Force was comprised of key stakeholders and experts on habitat and recreation issues.

With the increasing use of trails, a growing statewide population, and Coloradans' tremendous love of both trails and wildlife, this seemed to be an ideal time to develop a handbook on wildlife issues for trail planners.

Task Force Objectives

Over a period of nine months, the Task Force and support staff have worked to identify critical issues and sources of information about trails and wildlife, to document case studies, and to present the information in a practical format.

Dynamic format that needs your contributions

In many ways this handbook can never be finished, but we can continue to learn and use the growing body of knowledge to improve our planning efforts. It is an evolving document about a subject that is just beginning to be studied and understood. We plan to update this handbook regularly and ask you to send information and suggestions through either the comment form in the back or by visiting our website:

www.dnr.state.co.us/parks/

The Colorado State Trails Program

Since it was established in 1971, the State Trails Program has been active in encouraging trail development around the state. Recreational trails are a priority of Colorado State Parks, and provide for a significant part of the outdoor activities available in Colorado.

Stuart Macdonald
Colorado State Trails Coordinator

Contents

1. Introduction

Few things are loved more by Coloradans than trails and the outdoors. With participation in outdoor recreation at unprecedented levels, access to nature is clearly an integral part of living in our state. Too much outdoor recreation, however, can sometimes put at risk the very natural resources upon which it is based.

This handbook will help trail planners and builders balance the benefits of creating trails and being stewards of nature, especially wildlife.

Trails make many positive contributions to conserving nature. They can help:

• restore degraded stream corridors and other habitats in the process of trail building;

• guide recreationists away from sensitive wildlife habitat and into more adaptable settings;

• educate people about wildlife issues and appropriate behavior in the outdoors; and

• build broad constituencies for wildlife conservation by putting people in contact with nature.

Trails affect wildlife in a range of ways

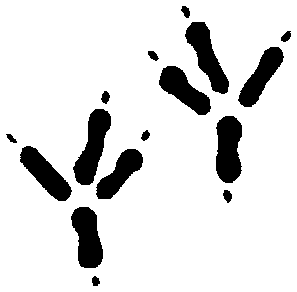
Typically, the impacts to wildlife from trails aren't as great as those from intensive development. More and more, however, we realize that—no matter how carefully we tread and no matter how much we desire to "leave nothing but footprints and take nothing but pictures"— building trails can effect wildlife. By entering an area, we may change the ecology of a system that is complex and frequently hard to understand.

Sometimes the effects of building and using a trail are minor and fleeting. Other times they may be more substantial and long-lasting.

Trails can be effective wildlife management tools

Let's take a typical situation. Land managers intentionally choose not to build a trail to a particularly sensitive area, perhaps a heron rookery. People hear of the rookery and make their own paths to it. Many of the visitors are careful in how and when they approach the herons.

Before long, however, many paths braid through the trees and planners are pressured into doing something. They decide to harden one of the trails and build an observation deck at an appropriate distance from the herons. Finally, with great effort—over many years—most of the social trails are revegetated.



Rules of thumb in the face of scientific uncertainty

In situations such as the heron rookery, scientists say the specific effects of trails on wildlife are usually uncertain. These complex interactions are just beginning to be understood and few unequivocal ecological principles for trail planners are known.

Because of this uncertainty, this handbook offers **rules of thumb** rather than iron-clad principles. These rules of thumb are helpful suggestions based on practical experience, extrapolations from the sometimes sketchy scientific literature, and just plain common sense. They are experienced guesses that may prove useful even though they may not be "right" in every situation. Each could appropriately be prefaced with phrases such as, "when possible" or "in general."

Perhaps the greatest contribution of these rules of thumb is that they raise issues that trail planners might not otherwise anticipate. Also, if most relevant rules of thumb cannot be met, it may indicate a trail should not be built in that location.

Even if scientists were certain of the specific impacts of trails—something that should become better known over the coming years—that knowledge still has to be balanced with the benefits of trails. Scientific facts alone don't dictate what should be done with a specific trail. It is the larger framework of laws and community desires that determine what should—or must—be valued and protected.

Handbook purpose and organization

This handbook, which was developed as part of Colorado State Parks' Trails and Wildlife Project, is divided into six main parts:

Chapter 1: Introduction.

Chapter 2: Wildlife and Trails Primer gives an overview of important wildlife and other environmental issues and suggests a range of approaches to planning trails with wildlife in mind.

Chapter 3: Wildlife and Trail Planning Checklist is a sequence of wildlife-related questions and possible steps to consider in planning a trail.

Chapter 4: Case Studies presents specific trail projects and the wildlife-related lessons learned in the process of planning each trail.

Chapter 5: Sources of Information identifies a wide range of information sources, including websites, data bases, publications, and people.

Chapter 6: Glossary defines wildlife terms likely to be encountered in further reading.

How to use this handbook

There are many ways to use this handbook. Readers who are new to wildlife issues may choose to read the handbook from cover to cover. Others may want to turn first to the wildlife planning checklist (or its summary on the next page) to find issues for which they would like more background. Others may wish to look up a specific topic or source of assistance.

The handbook's two major sections—the primer and the checklist—are offered as distinct ways of accessing the same issues and information. Readers are free to choose the approach that best fits their circumstances.

This handbook should not be thought of as a cookbook, with a one-size-fits-all approach. Every trail project is different and the important ecological issues will vary widely with the kinds of trails, wildlife, and habitat.

The Primer introduces topics

If you have general questions about the interactions of wildlife and trails, the primer—which is organized around broad wildlife topics—is a good place to start. In addition to key concepts and rules of thumb, references are presented for each topic.

The Checklist suggests steps

The checklist focuses specifically on wildlife issues of trail planning and is designed to mirror comprehensive planning processes. This should make it easier to integrate the information into the ways trails are already being planned.

If you are beginning to plan a trail and want to find appropriate ways of including wildlife issues, the checklist may be a practical aid. It raises important questions through each step of the planning process.

Overall Handbook goals

This brief document functions best at raising issues, presenting background, offering suggestions, and providing references to other, more in-depth, sources of information. The authors hope that the handbook also will encourage more discussion and study of wildlife and trails issues.

Overview of the Wildlife and Trails Planning Checklist (See Chapter 3 for details.)

Step A. Getting the Whole Picture

1. *Include wildlife in the trail vision*

   Look at the broader landscape of the area where you are considering a trail. What opportunities or constraints are there for trails and wildlife in the broader landscape? What plans are there for other trails or wildlife across the landscape? Do you foresee any cumulative trail impacts by adding a new trail? Ask the help of a biologist and other professionals, as needed. What kinds of goals and activities do you foresee for the trail? What are your wildlife goals for the trail project?

2. *Organize & communicate*

   Share your ideas and findings with other community members, including trails and wildlife enthusiasts and property owners and managers. Find ways, such as community meetings, field trips, or a web site to discuss ideas and issues related to the possible trail. What opportunities are there for both recreation and wildlife protection in the corridor? Do the ideas seem to complement or conflict?

   Research and inventory

3. Find information about local wildlife habitats. Conduct an inventory of the area's sensitive plants, animals, and critical habitat. Note any special opportunities for wildlife education. To the degree possible, understand the existing impacts to wildlife in the area.

Step B. Considering Alternatives

1. *Prepare and evaluate alternative concept plans*

   Looking across the broader landscape, identify and evaluate several distinct alternative alignments for a trail. (Where an existing trail is to be upgraded, alternatives might include different management strategies.) Use this handbook's rules of thumb and other information to guide the design, to help maximize the opportunities, and to minimize the constraints for wildlife. Get professional trail planning help, as needed. Are there opportunities to use the trail as a catalyst to restore degraded habitats and preserve pristine areas? Review the alternatives with the community and appropriate land managers and select a preferred plan to refine.

2. *Design the trail*

   Develop designs, budgets, time tables, and management strategies for the preferred plan. Review and refine the plan with the help of a wildlife biologist.

Step C. Building & Managing

1. *Part 1: Acquire and construct the trail*

   If land is to be acquired for the trail, look for additional areas that can be set aside at the same time for wildlife conservation. Implement the plan, being careful to impact wildlife as little as possible during construction.

2. *Part 2: Manage and monitor the trail*

   Have a clear plan to manage the trail corridor and activities within it. Monitor the effects of the trail on plants and wildlife and adjust management plans as appropriate. Look for ways to involve the public and to provide educational opportunities.

The Colorado State Parks Trails Program will be updating this handbook periodically and invites your comments and suggestions. (Colorado State Parks—Trails Program, 1313 Sherman Street, Room 618, Denver, CO 80203 or e-mail: MacTrail@aol.com)

Additional current information about wildlife issues in trails planning may be found in the Trails section of the Colorado State Parks website:

http://www.dnr.state.co.us/parks/

Some overall observations

In creating this handbook, we found a number of overarching themes:

• When planned with wildlife in mind, trails can be effective management tools that help reduce the impacts of people on wildlife.

• A trail is more than a thin line traversing the landscape. To respect wildlife, a trail must be planned in conjunction with its zone of influence.

• In building a trail, we may choose to impact wildlife and habitats, but we should do so with an understanding of the implications.

• In many cases, scientific knowledge alone can't determine whether wildlife impacts are great enough to preclude a trail. The decision also should be based on community values, including the benefits the trail will offer the public.

• Wildlife don't necessarily see the landscape the way we do. What may appear to a person to be a minor change may be perceived quite differently by wildlife.

• If we learn to see the landscape more as wildlife do, we can find trail alignments that will have less impact on their surroundings.

• Understanding both the existing and potential impacts of a trail to wildlife can help set more realistic goals for a trail project.

• Native biological diversity is much more than a count of the species found in an area. Instead, it is a broader concept that includes all facets of our natural living heritage.

• The best strategy in planning trails is always to avoid impacts to wildlife. The next best is to minimize the impacts. The last resort is to mitigate for impacts.

• Plan and manage a trail in ways that help make users more predictable to wildlife so they can acclimate to people.

COLORADO'S WILDLIFE ARE VARIED AND INTERESTING

When planning trails with wildlife in mind, it may be helpful to think of specific wildlife species as part of your trail users group, along with recreationists. There are several good introductions to our state's wildlife, including:

Armstrong, David Michael; James P. Fitzgerald, Carron A. Meaney 1994. *Mammals of Colorado.* University Press of Colorado, Boulder, Colorado.

Benedict, Audrey DeLella 1991. *Sierra Club Naturalist's Guide to the Southern Rockies*. Sierra Club Books, San Francisco.

Emerick, John C.; Cornelia Fleisher Mutel 1992. *From Grassland to Glacier: The Natural History of Colorado.* Johnson Publishing Co., Boulder, Colorado.

Kruger, Frances Alley; John Fielder; Carron A. Meaney, Denver Museum 1995. *Explore Colorado: From Plains to Peaks.* Westcliffe Publishers, Englewood, Colorado.

Rennicke, Jeff 1996. *Colorado Wildlife*. Falcon Press, Helena, Montana.

Whitaker, John O., Jr. 1996. *National Audubon Society Field Guide to North American Mammals.* Alfred A. Knopf, Inc. New York, New York.

2. Wildlife and Trails Primer

Knowing how wildlife respond to recreationists and their trails is a vital part of planning trails. This section of the handbook gives an overview of the major wildlife issues relevant to trail planners and provides references for more in-depth study. The topics presented here are some of the most important for incorporating wildlife concerns into trail planning

Key Concepts and Rules of Thumb

Key concepts are presented as an introduction to each Primer topic. To make the concepts practical, rules of thumb are also given with each topic. The rules of thumb are intended as helpful advice for wildlife situations that are generally too complex for ironclad, universal principles.

For more detailed discussions

References for further reading are given with each Primer topic. These books are general in nature, and readily available in bookstores. More detailed information—on how individual species relate to trails, for example—may be available through the Colorado Trails and Wildlife Bibliographic Data Base. (See Chapter 5: Sources of information.)

A RULE OF THUMB IS:

1 : a method of procedure based on experience and common sense.

2 : a general principle regarded as roughly correct but not intended to be scientifically exact.

Practical advice is offered in each of these volumes. For example, in each chapter, Knight and Gutzwiller offer "management options for coexistence," Smith and Hellmund include planning guidelines, and Dramstad and colleagues offer useful principles of landscape ecology.

Full citations for the most common references are given below.

Dramstad, W., J. Olson, and R. Forman, 1996. *Landscape Ecology Principles in Landscape Architecture and Land-Use Planning*, Island Press, Washington D.C.

Forman, R. 1995. *Land Mosaic: The Ecology of Landscapes and Regions.* Cambridge University Press, Cambridge.

Forman R. and M. Godron, 1986. *Landscape Ecology.* John Wiley and Sons, New York.

Knight, R. and K. Gutzwiller, eds., 1995. *Wildlife and Recreationists: Coexistence through Management and Research.* Island Press, Washington, D.C.

Noss, R. and A. Cooperrider, 1994. *Saving Nature's Legacy: Protecting and Restoring Biodiversity.* Island Press, Washington, D.C.

Smith, D. and P. Hellmund, 1993. *Ecology of Greenways.* University of Minnesota Press, Minneapolis, Minn.

A. Trails and their zones of influence

Key Concepts

As with anything we build in the landscape, **a trail changes its surroundings**. Some of these changes are minor and temporary—such as when a deer moves away from an approaching hiker, to return to browse once the hiker has gone. Other changes have wider ramifications and duration—such as when aggressive bird species follow trails, expanding their habitat, displacing sensitive species, and preying on songbirds and other sensitive neotropical birds.

These changes to a trail's surroundings may extend for hundreds or even thousands of feet on either side of a trail. (They are sometimes referred to as trail distance effects.)

Collectively these effects define a **zone of influence** associated with a trail. This zone is also the primary experience area for recreationists using the trail. Without wildlife in this zone, trail users would have a less diverse experience.

There is a **natural variability** to landscapes, so the width of a zone of influence varies along a trail's length.

Some of the effects characteristic of a trail's zone of influence are what biologists refer to as **edge effects**. Edges attract more **generalist species** at the expense of **more specialist species**, which have fewer options in increasingly human-dominated landscapes. (There are more and more ecological edges in the world as a result of increasing human development of all kinds.)

The specific edge effects of a trail and their associated widths depend on the **characteristics of the trail** (how wide it is and its type of users, for example) and the **surrounding landscape** (how sensitive local wildlife are).

Trailheads and other **trail facilities**, which have their own characteristics and impacts on wildlife, contribute to the extent of a trail's zone of influence and should not be forgotten in the planning process.

A trail's area of influence should be planned and managed as an integral part of the trail. This influence zone should provide recreationists with meaningful interactions with nature, without infringing on sensitive habitat.

Rules of Thumb

A.1 Always some impact. Any trail will have at least some negative impacts on wildlife. Such impacts must be weighed with the benefits of the trail.

A.2 The broader view. In considering wildlife, don't focus solely on the narrow width of the trail's treadway; also consider the wider area it may influence.

A.3 Sensitive vs. non-sensitive. Trail corridors may encourage some species of wildlife, such as jays, raccoons, and other edge-loving generalists, but these species are already increasing across the landscape and may not need encouraging.

A.4 Negative effects. Trails may negatively affect species that need conditions (such as specific vegetation or light) that are altered in trail construction.

A.5 Degraded areas. Seek out degraded areas that have the potential to be restored when aligning a trail, rather than creating another disturbed area.

A.6 Edges. Align a trail along or near an existing human-created ecological edge, rather than bisecting undisturbed areas. When this is possible, the trail will not create a totally new ecological edge.

A.7 Avoid sensitive wildlife. Keep a trail—and its zone of influence—away from specific areas of known sensitive species, populations, or communities. Where appropriate, use glimpses of these areas as opportunities for educating trail users.

A.8 Think thin. In constructing or upgrading a trail, disturb as narrow an area as possible to help minimize the zone of influence.

Radiating out from every trail is a zone of influence, the width of which varies with local conditions over the length of the trail. Planning a trail with this in mind can greatly help anticipate the future interactions of the trail and wildlife.

A.9 Screening. Locate trails and supporting facilities in areas where they can be screened and separated from sensitive wildlife by vegetation or topography. This approach is less disturbing to wildlife and reduces the amount of energy wildlife must use in reacting to recreationists.

A.10 Rewarding trails. Provide trail experiences that are diverse and interesting enough that recreationists are less inclined to create their own trails and thereby expand the zone of influence.

A.11 Predictability. The more predictable human actions are, the more adaptable wildlife may be to those actions.

Further Reading

Dramstad, W., J. Olson, and R. Forman, 1996. *Landscape Ecology Principles in Landscape Architecture and Land-Use Planning,* Island Press, Washington D.C., pp. 27-29.

Noss, "Wildlife Corridors" in Smith, D. and P. Hellmund, 1993. *Ecology of Greenways.* University of Minnesota Press, Minneapolis, Minn., pp. 58-59.

Noss, R. and A. Cooperrider, 1994. *Saving Nature's Legacy: Protecting and Restoring Biodiversity*. Island Press, Washington, D.C., pp. 197-203.

Forman R. and M. Godron, 1986. *Landscape Ecology*. John Wiley and Sons, New York, pp. 108-109.

Forman, R. 1995. *Land Mosaic: The Ecology of Landscapes and Regions.* Cambridge University Press, Cambridge, pp. 81-111.

Variable	*Example interactions*
VEGETATION	Some types of vegetation, such as dense forests, can visually screen trail users more than others.
WILDLIFE SPECIES	Some species are more sensitive to human activities than others.
SEASON	Certain times of the year, such as breeding season, may be more sensitive than others for wildlife. Also, during dormant periods, some plants may be less easily impacted.
TIME	During resting, feeding, or other specific times of the day, wildlife may be more susceptible to disturbance.
WEATHER	In cold weather, recreationists may have greater impact on wildlife because of the increased energy wildlife must expend to avoid the recreationists.
TRAIL/USER LOCATION	Wildlife may respond differently if trail users are above or below them, on or off a trail.
SURROUNDING LAND USE	Trail impacts may be less significant in an already disturbed area.
INTENSITY/LEVELS OF USE	More intensive or higher levels of trail use may have farther-reaching impacts.
PREDICTABILITY	The more predictable trail users are, the more likely their presence can be incorporated into the daily strategies of wildlife.
RECREATIONAL ACTIVITY	There is greater impact when recreationists bring along dogs. Also the speed of activity influences the level of disturbance

How wide an area will be influenced by a trail is determined by many variables in a complex interaction. Some of these variables and examples of their effects on the interactions of wildlife and recreationists are shown above. (Adapted from Clinton Miller, City of Boulder Open Space, 1994)

B. Avoiding large natural areas

Key Concepts

Typically as we go about building communities—and especially the infrastructure that supports them—we cut across and through streams and forests, windbreaks and prairies—the natural systems around us. This tends to leave ever-smaller areas that are even more directly impacted or influenced by humans.

This **habitat fragmentation** is considered by many biologists to be the single greatest threat to biological diversity. Some species, such as lynx and wolverine, for example, may not survive without **large, unbroken blocks** of habitat.

There is little specific knowledge of how much a trail may contribute to these factors or ultimately help degrade biological diversity. The extent of the impacts depends on a number of factors, including the **type of habitat,** the **species present**, and the **characteristics of the trail**, including how heavily it is used by people.

As mentioned above, trails have zones of influence (of variable width) associated with them. Taking this added width into account, it is easier to understand how a region criss-crossed with trails could end up with few areas not somehow influenced by humans.

In a complex series of interactions, fragmented habitats may see:

• an **influx of plant and animal species** (usually generalists) that like or tolerate the new conditions of light, wind,or human presence; and

• a **decline of species** that cannot tolerate these conditions or are adversely impacted by the species newly arriving in the trail's zone of influence.

The new species may include weeds and other exotic plant species, as well as predators that eat the eggs or young of indigenous wildlife.

These new conditions and interactions can change the trail's zone of influence in ways that **may not be obvious** to the casual observer.

The impacts of a trail on the biological diversity of a large area that has already been heavily disturbed may not be significant. For example, constructing a trail through a young, even-aged stand of lodgepole pine that has regrown after clearcutting may not change how wildlife use the area. If the stand has very low diversity of wildlife—as is often typical of this type of habitat—it is even possible wildlife diversity might increase with the creation of the trail.

Protecting large, undisturbed areas of wildlife habitat should be a priority. Deciding whether or not to build a trail that may contribute to fragmentation is a tradeoff that the local community or land manager will have to make.

Rules of Thumb

B.1 Big habitat areas. When possible, leave untouched large, undisturbed areas of wildlife habitat. They are an important—and rapidly vanishing—resource. Identify and seek to protect all such areas when aligning a trail.

B.2 Edge trails. It is better to route a trail around the edge of an area of high quality, undisturbed habitat, than through its center.

B.3 Trail density. Keep the density of trails lower within and near pristine or other high quality areas to reduce the contribution of trails to fragmentation.

B.4 Stepping-stone patches. Avoid small patches of high quality

HOW TO EXTRAPOLATE PRACTICAL INFORMATION FROM A SCIENTIFIC JOURNAL ARTICLE

There may be no existing specific studies of wildlife and the potential impacts of a trail for your particular area, but you can still get help from scientific journal articles and other sources. It may take time to get used to scientific jargon, but it is possible to cull practical information from such sources with patience.

In particular in reading an article, consider: Are the species of wildlife examined in the study the same as my project? Is the habitat type the same? Are the trail uses you anticipate similar to those studied, if any?

Through this process, you can start to develop new rules of thumb to apply to your trail project.

habitat in routing a trail. Such patches may be important stepping stones used by wildlife to move across the landscape.

B.5 Balancing needs across landscapes. It is easier to balance competing wildlife and recreation needs across a landscape or region than it is on a specific trail project within a smaller area.

Trails should be routed away from large, undisturbed areas of sensitive wildlife habitat, such as the forest in the left of this illustration. Such areas are a valuable natural resource that is rapidly disappearing from the American landscape. With their loss go species of wildlife that cannot survive without extensive, undisturbed habitats.

Further Reading

Smith, "An Overview of Greenways" in Smith, D. and P. Hellmund, 1993. *Ecology of Greenways.* University of Minnesota Press, Minneapolis, Minn., pp. 2-4.

Forman, R. 1995. *Land Mosaic: The Ecology of Landscapes and Regions.* Cambridge University Press, Cambridge, pp. 405-434.

Noss, R. and A. Cooperrider, 1994. *Saving Nature's Legacy: Protecting and Restoring Biodiversity.* Island Press, Washington, D.C., pp. 50-54.

Harris, L.D. 1984. *The Fragmented Forest: Island Biogeography Theory and the Preservation of Biotic Diversity.*

C. Tools for a broader view

Key Concepts

It's only when looking at the **broader landscape over time** that one can discover how wildlife use a place and what impacts activities in one area will have in another.

Fortunately, the relatively new discipline of landscape ecology provides useful tools for describing and analyzing broad landscape patterns and functions.

Looking across a **landscape**, especially from above, you typically see a mix of **patterns**—a wetland patch here, a stream corridor there. These components of the landscape function in varying ways for wildlife.

Knowing the locations of patches, corridors, and matrices—the structural elements of the landscape—helps identify edges and habitat blocks. How these elements of the landscape are used by wildlife varies from species to species: what is an edge for one species may not be for another.

Part of understanding the broader picture is **looking at the landscape over time.** Such a perspective makes clear that how wildlife use the landscape can be very dynamic. There may be substantial changes in how wildlife use the landscape from season to season and year to year.

Looking at changes across landscapes and over time, it is easier to make a trail compatible with a larger conservation effort. Such a regional plan seeks to balance trails and wildlife goals across the region. This is one way to make certain that there is a balance between streams with roads and trails and undeveloped streams devoted to wildlife habitat.

One framework for making a plan for a landscape or region—a part of which could be a trail plan—is that developed by Noss and Cooperrider (1994). Their approach divides an area into core biological reserves that are surrounded by buffers and connected by wildlife corridors. The core areas are strictly for nature preservation. In each successive buffer more human activities are allowed.

Trails might go into the core areas only rarely but would be more common in buffer areas.

With this kind of coordinated plan there it is easier to accommodate competing objectives.

The Noss and Cooperrider approach is similar to the Forest Service's landscape assessment and planning effort.

Rules of Thumb

C.1 Regional view. Plan a trail consistent with a regional or landscape-wide plan that identifies where trails should go and which areas should be conserved for wildlife. Balance the needs of wildlife and recreationists across that larger perspective.

C.2 Already disturbed areas. Site a trail where there are already human-created disturbances or in areas of less sensitive habitat.

Landscape ecology provides many useful tools for understanding and documenting the landscapes through which trails pass. By identifying a landscape's patches (such as the stands of trees in the illustration), corridors (e.g., the stream), and surrounding matrix (e.g., grasslands), it may be easier to find the best alignment for a trail, one that fits the landscape.

C.3 Landscape structure. Analyze the landscape noting the patches, corridors, and matrix—the landscape structure—as they might be used by species of special interest.

C.4 Corridor crossings. Minimize the number of times prominent landscape corridors—such as riparian zones—are crossed by a trail. These corridors may serve as important conduits and habitat for wildlife.

C.5 Smaller, isolated patches. Avoid smaller, isolated patches when laying out a trail, but do give users an experience of the varied landscape.

C.6 Sensitive patches. Avoid patches that are habitat for threatened, endangered, or other species of concern.

C.7 Involving conservation advocates. Enlist the help of conservation advocates in planning trails. Find opportunities to integrate trails and open space planning.

Further Reading

Dramstad, W., J. Olson, and R. Forman, 1996. *Landscape Ecology Principles in Landscape Architecture and Land-Use Planning,* Island Press, Washington D.C.

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Thorne, James 1993. "Landscape Ecology," in Smith, D. and P. Hellmund, 1993. *Ecology of Greenways.* University of Minnesota Press, Minneapolis, Minn., pp. 23-42.

Forman R. and M. Godron, 1986. *Landscape Ecology*. John Wiley and Sons, New York, pp. 83-225.

Forman, R. 1995. *Land Mosaic: The Ecology of Landscapes and Regions.* Cambridge University Press, Cambridge.

D. Habitat quality varies

Key Concepts

Not surprisingly, **types of habitat** vary widely in the number and kinds of wildlife using them. (Frequently habitat type is used as a surrogate for wildlife use because vegetation is easier to observe and map.)

For example, the 33 habitat types included in the Colorado Division of Wildlife's "Latilong" data base potentially have a range from 35 species for tundra to 302 for lowland riparian areas.

The top two ranking habitat types, in terms of overall numbers of species and the most threatened or endangered species, are riparian, which illustrates why there is so much interest in conserving such areas found near water.

None of this is to suggest the **number of species** is the only or best measure of a habitat's value to wildlife, although some habitats are used by more species of wildlife than others.

Tundra (33), for example, because of its severe climate, has a low diversity of wildlife species. Yet tundra plays a vital role in the lives of species that are important components of Colorado's biodiversity.

Lodgepole pine forests (19) tend to have a moderate to low diversity of plants and animals. Because typically they are dense forests, recreationists may not be seen or heard by wildlife from as great a distance as open areas.

An important consideration in aligning a trail is the relative **resiliency** of habitats that might be crossed.

Rules of Thumb

D.1 Variety of experience. Route a trail through varied habitat types to enrich user experiences, but avoid small patches of species-rich habitats.

D.2 Potential vs. actual species. Determine which species of interest actually occur in the area you are studying. Wildlife data bases sometimes list species that potentially occur within a given habitat type; not all of these species may actually be found there.

D.3 Screening. Consider the physical characteristics of habitat types when routing a trail. For example, trail users may be screened in some forest types.

D.4 Habitat variability. Even within a single type of habitat, some elements may be of greater importance to wildlife than others. For instance, shrubby thickets of snowberry or American plum within riparian habitat provide very important cover and food for birds and small mammals.

Further Reading

Kruger, Frances Alley; John Fielder; and Carron A. Meaney, Denver Museum 1995. *Explore Colorado: From Plains to Peaks.* Westcliffe Publishers, Englewood, Colorado.

COLORADO HABITAT TYPES	NUMBER OF SPECIES	THREATENED & ENDANGERED	SPECIAL CONCERN SPECIES
1. Riparian Lowland (below 6000 ft.)	302	5	8
2. Riparian Transition (6000-9000 ft.)	222	6	2
3. Piñon-Juniper Forest	179	1	5
4. Scrub Oak	153	2	0
5. Urban Areas	146	2	0
6. Agricultural Areas with Trees	142	1	3
7. Open Water—Lakes or Reservoirs	139	5	14
8. Marshes/Bogs	130	5	5
9. Ponderosa Pine Forest	128	4	0
10. Shortgrass Prairie	126	3	11
11. Mountain Mahagony	112	1	0
12. Greasewood/Sagebrush or Saltbush	111	0	6
13. Sagebrush/Rabbitbrush	111	1	4
14. Riparian Highland (above 9000 ft.)	111	3	1
15. Tallgrass Plains	89	1	1
16. Mountain Meadow/Parkland	89	4	3
17. Sagebrush	86	3	1
18. Spruce-Fir Forest	86	4	1
19. Lodgepole Pine Forest	81	5	1
20. Douglas Fir Forest	78	4	1
21. Mixed Grasses of Disturbed Areas	78	1	1
22. Aspen Forest	70	4	0
23. Shortgrass Semi-Desert	70	0	2
24. Wet Open Ground	69	3	3
25. Cholla Cactus Grassland	65	0	1
26. Open Water—Streams/Rivers	64	4	9
27. Shortgrass-Mountains	64	0	0
28. Limber Pine Forest	60	1	0
29. Bristlecone Pine Forest	56	0	0
30. Sand Sage Prairie	54	1	2
31. Cropland	44	2	2
32. Alpine Transition	40	1	0
33. Tundra	35	0	0

Use of habitats by wildlife varies widely. The number of wildlife species potentially found in the various types of habitat listed in the Colorado Division of Wildlife's "Latilong" data base varies widely. This ranking shows why riparian areas are so significant to Colorado's wildlife. Note: The data base includes mammals, birds, reptiles, and amphibians, but not fish. (Dave Weber, Colorado Division of Wildlife, 1998.)

E. The importance of streamside areas

Key Concepts

Riparian areas play a disproportionately large role in maintaining biodiversity, especially in Colorado and other western states. The hydrology and vegetation of riparian areas—usually starkly contrasting with surrounding habitats—create very high biological diversity. (The term **riparian** refers to the area associated with streams and other bodies of water.)

For example, of the 627 vertebrate species listed in the Colorado Division of Wildlife's "Latilong" data base as occurring in the state (including mammals, birds, reptiles, and amphibians), 458 species (73 percent) use riparian, stream, lake, or marsh habitat types for at least some part of the year. More than 80 percent of Colorado **breeding birds** are dependent on riparian areas.

Not all riparian areas are high in habitat quality. Because they are attractive to people, frequently riparian areas have seen many human uses and are degraded. Trails projects can be catalysts for restoring such areas.

Because they help concentrate human use and thereby reduce trampling, trails can reduce the impacts of people on riparian areas.

By understanding the relative quality of riparian areas, it may be possible to find places within the riparian zone for trails that will have less impact on wildlife.

Plants in riparian soils are especially vulnerable to **trampling** because compacting soils damages and limits roots, reduces aeration, decreases soil water, and destroys soil structure.

Where horses, pedestrians, and others cross streams, erosion can result which may affect fish habitat. Also if rest rooms are not available, the impacts of human waste may be considerable.

Fishing is a type of managed recreation that has direct impacts on habitat, as well as fish. Of special concern are the extensive **social trails** often created along banks by anglers, sometimes in sensitive riparian areas.

Rules of Thumb

E.1 Regional balance. Looking across the landscape or region, find a balance between the riparian areas that have trails and those devoted to wildlife conservation.

E.2 Habitat restoration. Use the process of building trails as a catalyst to restore degraded stream corridors.

E.3 Removing grazing. Whenever possible, use a trail as a catalyst to restrict cattle and other stock from good quality riparian areas.

E.4 Strategic entries into riparian zone. For both habitat and maintenance reasons, it is better to run a trail just outside the riparian area (perhaps on a topographic bench) and bring it in at strategic places, than to keep it continuously close to a riparian area.

E.5 Not encircling ponds. In routing a trail near a pond or lake, don't run it completely around the body of water. Instead, leave some shoreline without a trail to allow water birds the option of moving away from people to the far side of the pond.

E.6 Beaver ponds as attractions. Occasionally taking a trail to beaver ponds may provide an opportunity for trail users to see wildlife habitat close at hand. Beaver are not as likely to be disturbed by recreationists as other wildlife, but be careful of sensitive species that also use beaver ponds.

E.7 Stream crossings. Minimize the number of times a trail crosses a stream. However, stream crossings may be needed to avoid critical habitat areas.

E.8 Stream confluences. Avoid crossings where two or more streams come together. These are particularly important nodes for wildlife.

E.9 Stream buffers. To maintain natural processes along a stream corridor, maintain an interior or upland buffer on both sides of a stream, which is wide enough to control overland flows from the surrounding landscape, provide a conduit for upland species, and offer suitable habitat for floodplain species displaced by beaver flooding or channel migration.

E.10 Poor riparian habitat. In riparian areas of variable habitat quality, route a trail closer to a stream where habitat quality is poorer.

E.11 Approaching streams. Give trail users the opportunity to be near water or they will find ways themselves, likely with greater overall impact than if a trail is provided.

E.12 Wider conservation. Use public support of trails to protect riparian corridors.

E.13 Restoring wetlands. Restore wetlands near a trail to expand cover, food, and nesting opportunities.

Further Reading

Binford and Buchenau, "Riparian Greenways and Water Resources," in Smith, D. and P. Hellmund, 1993. *Ecology of Greenways.* University of Minnesota Press, Minneapolis, Minn., pp. 69-104.

Carefully consider how and where to route a trail through a streamside area. These riparian zones are rich habitat for wildlife. The illustration shows a trail alignment running primarily outside the riparian area, but moving into it at places where wildlife is less likely to be disrupted. (Left: plan view, right: sketch.)

F. Species and places of special interest

Key Concepts

While some species (such as bald eagle and Ute ladies-tresses orchids) and habitats (such as wetlands) have **legal status** that must be respected in the process of trail building, others may deserve special attention because of the **value placed on them by a local community**.

Threatened and endangered are legal designations applied to certain species of plants and animals perceived to be in danger of potentially becoming extinct, either in the world, country, or state.

For those working in Colorado, there are two lists of threatened or endangered (T&E) species. One is issued by the federal government, the other by the Colorado Division of Wildlife.

The federal T&E list includes species that are in danger of becoming extinct nationally. The Endangered Species Act, which provides some protection for these species, is administered by the U.S. Fish and Wildlife Service.

The degree to which the law protects species on the list is complicated and varies depending on the individual species. It is best to discuss specific situations with U.S. Fish and Wildlife Service (USFWS) personnel. (See website: http://www.fws.gov/pullenl/cais /tespec.html or call the Service's Colorado Field Supervisor, 303-275-2370.)

To review the Endangered Species Act see http://www.fws.gov/r9endspp/esa.html#Lnk03

If your project includes a federal action, permit, or funding and will impact a federally listed species, you must contact the USFWS for what is known as a Section 7 consultation. Even if your project has no association with the federal government, if you believe there may be an "incidental takings" of a federally listed species you must have a Section 9 consultation with the Fish and Wildlife Service.

The State of Colorado T&E list includes species that are in danger of becoming extinct in Colorado, but not necessarily in the country. Almost all species on the Federal list are on the Colorado list, but the Colorado list includes several species that are common elsewhere in the country, but rare in this state.

Colorado law gives no protection to the habitat of species on the state list, but provides for increased penalties for directly killing such animals.

The Colorado Division of Wildlife administers the law, and its personnel—either the district wildlife manager or the habitat biologist in a region—should be contacted with questions about state-listed species. (For a copy of the complete list, visit the Division of Wildlife's website: http://www. dnr.state.co.us/wildlife/T&E/list.html or request a free copy of the brochure: "Non-game Wildlife Regulations" from: Colorado Division of Wildlife, Order Fulfillment Center, 6060 Broadway, Denver, CO 80216.)

The Division of Wildlife only offers advice and does not approve or reject projects.

Some **wetlands** are protected by federal legislation. Special (404) permitting is required before they can be disturbed. (See sidebar opposite.)

Other **specially designated areas** to take note of include:

- proposed wilderness study areas
- wilderness areas
- inventoried roadless areas
- USDA Forest Service research natural areas and areas with a prescription emphasizing wildlife, flora, fauna, or ecological values
- BLM areas of critical environmental concern
- wild and scenic rivers
- Colorado State Natural Areas,
- significant archeological sites, and
- other officially protected areas.

Extra care and research should be taken when proposing a trail in any of these areas or in areas that may be of local concern.

Plans for trail construction that will affect a stream must, by Colorado law (Senate Bill 40), be approved by the Colorado Division of Wildlife, if they are being done by a state agency or with state funding.

Rules of Thumb

F.1 Avoiding sensitive areas. Generally avoid specific areas where there are known species, populations, or communities of special interest and where potential impacts of a trail are uncertain. This is especially true of breeding sites of big game and raptors.

F.2 Spur trails. When it is appropriate to provide access to a more sensitive area, use a spur (i.e., dead-end) trail instead of a through trail because spur trails tend to have lower volumes of traffic. This is because, given a choice, people tend to stay on a through path rather than take a spur.

F.3 Expert advice. Check with the U.S. Fish and Wildlife Service and the Colorado Division of Wildlife about special species and places. Check with the U.S. Army Corps of Engineers regarding impacts to wetlands.

Further Reading

In general there is considerable information available for individual species and specially designated areas.

WETLANDS PERMITS

Before you disturb a wet area to build a trail or a bridge, you should determine if you will need a wetlands permit from the U.S. Army Corps of Engineers.

The federal government defines a wetland as an area with saturated soil in low depressions, secondary stream channels, or in areas that "appear to feel wet." In most cases, wetlands created by people are subject to the same protection as naturally occurring wetlands.

Wetlands regulations include filling, draining, excavating, and flooding.

Section 404 of the Clean Water Act establishes a program to regulate the discharge of dredged and fill material into waters of the United States, including wetlands.

There are two basic types of 404 permits issued by the Army Corps, individual and general. An individual permit is usually required for potentially significant impacts. However, for most discharges that will have only minimal adverse effects, the Army Corps often grants general permits. These may be issued on a nationwide, regional, or statewide basis for particular categories of activities (e.g., minor road crossings, utility line backfill and bedding) in order to expedite the permitting process.

When applying for a permit you must show that you are in compliance with the EPA §404b(1) guidelines. These include:

1) avoiding wetland impacts where practicable,

2) minimizing potential impacts to wetlands, and

3) providing compensation for any remaining unavoidable impacts through activities to restore or create wetlands.

Other permit application requirements include a §401 Water Quality Certification from the appropriate Regional Water Quality Control Board.

If threatened or endangered species may be affected by the proposed activity, the Army Corps will consult with the appropriate Federal agency (e.g., U.S. Fish and Wildlife Service) to obtain a biological opinion on the affects to the species.

For more information see the following websites:

http://www.epa.gov/owow/wetlands/

http://www.epa.gov/docs/Region4Wet/overview.html

http://ceres.ca.gov/wetlands/permitting/sec_404.html

Or call the U.S. Army Corps of Engineer.

G. A site's existing impacts

Key Concepts

It is very rare that an area proposed for a trail hasn't already seen **at least some impact** from humans. The questions then become—How disturbed is the site? What kinds of impacts to wildlife already exist there?

With this kind of **ecological evaluation**, it will be easier to set reasonable wildlife goals for a trail or to evaluate the tradeoffs between wildlife and trails. Every trail project should have wildlife goals.

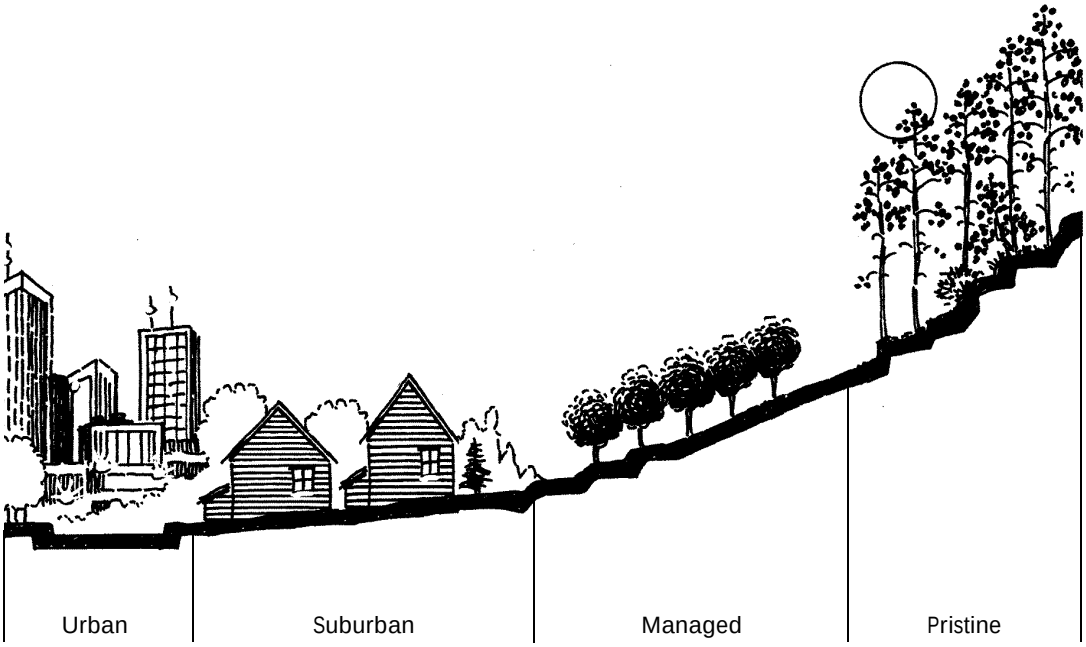
The specific wildlife goals and rules of thumb you apply will partly depend on **how disturbed a site is**. Typically, urban landscapes are heavily disturbed and restoring habitat may be the principal wildlife goal. In more pristine settings, preserving what is already there and minimizing impact may be the major concerns.

An important first step is determining where a site fits on the gradient of human modification ranging from urban (highly modified) to pristine (few modifications).

Even portions of **wilderness areas** may have had some human impacts from activities such as mining, forestry, or road building. Understanding these modifications can help guide trail alignments. For example, trails might follow **ecological edges** created by historic roads or timber cuts.

In gauging how modified an area already is, there are some practical questions to ask:

- Generally, what kind of wildlife habitat is present? What condition is it in?
- Are the plants and animals typically associated with that habitat actually present? Is the ecosystem already impoverished to some extent?
- What are and have been the human impacts to wildlife in the area?
- What are the surrounding land uses and condition of habitat? How close is any nearby development? Are there already roads bounding the area under consideration for a trail, posing obstacles to wildlife movement?
- Overall, to what extent is the site insulated from external forces?
- What opportunities are there to improve habitat on the site?



Assessing the amount of human disturbance already along a potential trail alignment can help set more realistic wildlife goals for a trail project. Trail alignments may pass through one or more of the general levels of modification along a gradient from urban to pristine.

Rules of Thumb

G.1 Patterns of disturbance. The best trail alignments work with the existing patterns of disturbance already in a landscape, rather than imposing an entirely new set.

G.2 Existing human disturbance. Before setting wildlife goals for a trail project, consider the degree to which an area has already been modified by people.

G.3 Urban limitations. In urban landscapes there are often few options for routing trails other than streetside (where there are not many ecological implications) and along streams and other drainages often already transformed for flood control.

G.4 Restoring habitat. Trail projects can aid wildlife by being catalysts for restoring habitat, creating wetlands, and planting native plant species for food, cover, and visual screening.

G.5 Seeking professional help. Without special training, it's easy to overlook or oversimplify wildlife issues. Get professional assistance whenever possible.

Further Reading

Thorne, "Landscape Ecology," in D. Smith and P. Hellmund, 1993. *Ecology of Greenways.* University of Minnesota Press, Minneapolis, Minn., p. 27.

Forman R. and M. Godron, 1986. *Landscape Ecology.* John Wiley and Sons, New York, pp. 286-310.

H. How wildlife respond to trails

Key Concepts

The construction of a trail **directly impacts** the habitat it displaces. Specifically, vegetation removed in the process of building a trail is no longer available for use by wildlife.

Once a trail is built, its physical presence also can change its environs. The trail may have created a new **ecological edge**, perhaps increasing the light intensity and prompting a shift in the composition of wildlife and plant species, thus **changing biological diversity**.

Impacts of a trail will depend on the **type of trail use** (e.g., hiking, snowmobiling, biking). These uses do not represent a continuum with hikers at the low-impact end and motorized recreationists at the high end; wildlife impacts are more complicated than that.

That is why, for example, some wildlife refuges allow auto tours but not walking tours because many wildlife species are less fearful of people in vehicles.

Sometimes the response of wildlife to a trail **doesn't last long,** as when a bird stops feeding as a hiker approaches, only to continue eating after the hiker has passed. With **increasing levels of use** and **changes in the type of use,** there may be sufficient disturbance along a trail that some wildlife may move away permanently. **Predictability** can be a major factor in how much disturbance a trail user causes. If trail users stay on a trail they are more likely to be perceived as acting in a predictable fashion and therefore as less of a threat.

Dogs can cause considerable disturbance (because they may chase and kill wildlife), but less so if they are on a **leash** and don't leave the trail.

Paradoxically, **bird watching** and other forms of nature viewing that intentionally seek out close encounters with wildlife may have a significant impact.

Factors affecting the **short-term impact of human disturbance** on wildlife include:

- Type of species and flushing distances;
- Type and intensity of human activity
- Time of year and time of day; and
- Type of wildlife activity (feeding, nesting, roosting, migrating).

For example, a slowly moving birdwatcher may impact the birds he approaches, but only over a more localized area than a speeding motorcycle that may have a briefer impact on any one area, but impact a broader area.

Wildlife characteristics, including type of animal, group size, age, and sex, also determine the response to a disturbance.

Disturbance by humans can cause nest abandonment, decline in parental care, shortened feeding times, increased stress, and possibly lower reproductive success.

If an animal responds to a noise as soon as it hears it, noisy vehicles may affect it at a greater distance than humans can typically be heard.

Trails often pass through areas used by hunters. **Hunting**, by design, affects wildlife. In general, even though hunting reduces animal populations annually, it is often of short duration, closely controlled, and can be used as a wildlife management tool.

In weighing impacts to wildlife, attention is often given to effects on biological diversity. **Biodiversity** is not equivalent to species diversity. It is more than just a count of how many species use an area.

"Biodiversity is the variety of life and its processes. It includes the variety of living organisms, the genetic differences among them, the communities and ecosystems in which they occur, and the ecological and evolutionary processes that keep them functioning, yet ever changing and adapting" (Noss and Copperrider).

Although the presence of large numbers of exotic species may boost the count of species in an area, it would probably indicate **declining biodiversity** due to loss of native species. Exotic species frequently outcompete natives and replace them.

Rules of Thumb

H.1 Lack of wildlife knowledge. Because there isn't much detailed knowledge about the effects of human disturbance on wildlife, be cautious in planning a trail, carefully weighing the alternatives.

H.2 Make do. Use the best wildlife information available, even if it is scarce. Get the advice of a biologist.

H.3 Considerable differences. Not only do different species respond differently to trails, different populations of the same species may respond differently, based on previous encounters with people.

H.4 Concentrated use. Generally, it is better to concentrate recreational use rather than disperse it. If social trails have developed in an area, it is probably better to consolidate them into one or a few trails.

H.5 Type of trail use. Some wildlife are more alarmed by hikers than by people who stay in their vehicles, especially if the vehicles don't stop.

H.6 Dog controls. If dogs are to be allowed on a trail where there are sensitive wildlife, the dogs should be leashed or excluded seasonally to reduce conflicts.

H.7 Screening. The natural visual screening of a trail in a wooded area frequently makes most wildlife tolerate greater human disturbance than they would in open terrain. In some areas, it may be possible to plant a vegetative screen or build a screening fence to accomplish similar effects.

H.8 Impacts vs. benefits. Don't assume all wildlife impacts can be resolved through management. There may be situations where the negative impacts of a trail to wildlife outweigh the benefits to trail users and a trail should take a different alignment.

H.9 Breeding areas. Either avoid wildlife breeding areas or close trails through them at the times such wildlife are most sensitive to human disturbance.

H.10 Enforcing closures. If there won't be sufficient resources to enforce a trail closure during wildlife-sensitive seasons, consider rerouting the trail through another area.

Species	Disturbance Factor	Flight Distance*
Mule deer	Person on foot—In low disturbance area	330 m
	— In medium disturbance	250 m
	— In high disturbance	200 m
	— recommended to avoid most flight	191 m
Mule deer	person afoot in winter	200 m
Elk	person afoot in winter	200 m
	highway vehicles	77 m
Elk	cross country skiers in—high use area	15 m
	— low use area	400 m
Mountain sheep	person afoot in winter	50 m
Golden plovers	people on trail	200 m
Eider ducks	land-based disturbance—with a dog	103 m
	— without a dog	52 m
American Kestrel	winter disturbance of person afoot	75 m
Merlin	winter disturbance of person afoot	125 m
Prairie Falcon	winter disturbance of person afoot	160 m
Rough-legged hawk	winter disturbance of person afoot	210 m
Ferruginous Hawk	winter disturbance of person afoot	140 m
Golden Eagle	winter disturbance of person afoot	300 m
Bald Eagle	land activities near roost on shoreline	250 m
Great Blue Heron	land-based activities	200 m
	water-based activities	100 m

*Note: Flight distance is the measurement from the source of the disturbance to the animal when the animal physically flees to a safer location, not the distance at which the animal first responds or is aware of the disturbance.

Flight Distances for a variety of wildlife. Studies have documented a range of responses by wildlife to various forms of disturbance. (This chart was developed from a review of the published literature by Clinton Miller, City of Boulder Open Space, 1994). While these numbers don't specify how far a trail needs to be from wildlife to avoid disturbance, taken together they illustrate a variability based on the species of wildlife and types of disturbance.

Further Reading

Knight and Cole, "Wildlife Responses to Recreationists," in Knight, R. and K. Gutzwiller, eds., 1995. *Wildlife and Recreationists: Coexistence through Management and Research.* Island Press, Washington, D.C., pp. 51-69.

Knight and Cole, "Factors that influence Wildlife Responses to Recreationists," in Knight, R. and K. Gutzwiller, eds., 1995. *Wildlife and Recreationists: Coexistence through Management and Research.* Island Press, Washington, D.C., pp. 71-79.

Noss, R. and A. Cooperrider, 1994. *Saving Nature's Legacy: Protecting and Restoring Biodiversity.* Island Press, Washington, D.C.

I. What happens to plants near trails

Key Concepts

The most readily **observable impact** of trail recreationists is to vegetation near trails. While these impacts tend to be very localized, they have broader implications because they alter habitat conditions and, in turn, affect wildlife. In most cases, however, these impacts to vegetation are much less than the trampling that results when there is no trail to channel people.

Of special concern should be impacts to plants that have been designated as **threatened, endangered**, or **sensitive.**

If recreationists don't stay on trails, they tend to:

- reduce the density of plants near a trail by trampling and picking;
- compact soil and contribute to erosion;
- alter the composition of species by damaging existing plants, creating bare spots that favor exotic species, the seeds of which are introduced by trail users and their pack animals; and
- in the process, change the vertical structure and spatial pattern of vegetation.

The conditions along trails also can allow weedy, **exotic plants** to invade natural areas. Weeds are a problem because frequently they are more aggressive than native species and yet don't provide the habitat that wildlife get from native species. (Typically, weeds are also less successful at inhibiting soil erosion than native plants.)

Recovery times from trampling vary widely with habitat type,with alpine ecosystems some of the slowest to recover.

In alpine ecosystems, herbaceous meadows are most quickly modified by walking, fellfields with cushion forms are less affected, and turf meadows are least affected of all. Heavy trampling will destroy a turf ecosystem in eight weeks, while a rock-desert (fellfield) will be destroyed in only two weeks.

Rules of Thumb

I.1 Keeping users on trails. In areas with sensitive vegetation, provide a well-designed trail to encourage users to stay on the trail. Use signs, educational materials, and even barriers as appropriate.

I.2 Native plants. In natural areas, use native plants in revegetating along trails because these are the plants wildlife depend upon.

I.3 Weed-free feed. Require use of weed-free feed for horses and other pack animals so they don't spread weeds along trails.

I.4 User education. Educate trail users about the results of direct impacts to vegetation and indirect impacts to wildlife.

I.5 Toilets. Provide toilets at trailheads and other key locations to reduce damage to surrounding vegetation.

I.6 Weed control. To prevent weed spread, control aggressive weeds along trails, especially at trailheads.

I.7 Trampling. Design trails with proper drainage and sustainable gradients so users are less likely to trample vegetation along alternate routes.

I.8 Wet areas. Route a trail around meadows and other wet areas and build up a dry trail in areas where seasonal water creates boggy soil.

I.9 Improving existing trails. To minimize ground disturbance and possible spread of weedy species, reconstruct an existing trail instead of rerouting it.

Further Reading

Cole and Landres. "Indirect Effects of Recreation on Wildlife,"in Knight, R. and K. Gutzwiller, eds., 1995. *Wildlife and Recreationists: Coexistence through Management and Research.* Island Press, Washington, D.C., pp. 183-202.

Cole, "Minimizing Conflict between Recreation and Nature Conservation," in Smith, D. and P. Hellmund, 1993. *Ecology of Greenways.* University of Minnesota Press, Minneapolis, Minn., pp. 105-122.

J. Managing trails with wildlife in mind

Key Concepts

While the specific activities associated with managing a trail come after it has been built, an understanding of **how a trail will be managed** must be part of planning the trail. Management is a poor substitute for a lack of planning.

Trail management is more effective when it is **planned up front**, rather than later as a corrective for poor trail location.

Because environmental conditions change along the length of a trail, it is often useful to identify distinct **zones** along the trail, where management reflects differences in wildlife habitat and recreation use.

Adaptive management—in which the process of managing a trail can be used to learn more about impacts to wildlife—is especially appropriate for trails given the uncertainties of potential wildlife impacts.

The best laid trail plans, carefully crafted and built with wildlife in mind, can be disrupted by people who choose to make trails of their own. **Social trails** are one of the biggest challenges facing trails planners and managers, who may have worked long hours to provide trails that respect wildlife. Social trails degrade vegetation and may increase soil erosion.

Offering wildlife interpretation and environmental education to trail users can play an important role in reducing impacts to wildlife. People more readily protect what they understand and appreciate. Interpretive programs, guided tours, staff interactions, signs, brochures, maps, and videos all can be effective in communicating appropriate visitor behavior among wildlife.

Carefully **monitor** the trail corridor to detect social trails early. Then use brush, boulders, signs, or other means to dissuade use.

Monitoring and other aspects of effective trail management may seem like luxuries, but they are actually basic **stewardship** requirements. Finding the resources to accomplish this stewardship will require the same levels of creative effort as building the trail.

Volunteers can be tremendously helpful in managing trails. They can serve as trailhead hosts or trail guides who offer information about wildlife and trail regulations. They can conduct interpretative programs and help with trash pickup and other maintenance tasks. Volunteers can enforce rules and educate trail users about seasonal wildlife closures, inventory and monitor wildlife, and much more.

Trails present good opportunities for the public to understand wildlife. Whether conducted by volunteers or paid staff, offering **wildlife interpretation and environmental education** to trail users can play an important role in reducing impacts to wildlife. People more readily protect what they understand and appreciate.

Interpretive programs, guided tours, staff interactions, signs, brochures, maps, and videos can all be effective in communicating appropriate visitor behavior among wildlife.

Sound **regulations** are needed to protect wildlife, but they also need to be enforced.

Rules of Thumb

J.1 Early management planning. Plan how to manage a trail's wildlife issues before its alignment is set.

J.2 Resolving conflicts. Don't depend on management to resolve wildlife conflicts that can be avoided by careful alignment in the first place.

J.3 Increased demands on management. More careful management of resources will be required when a trail passes through or near sensitive habitat.

J.4 Predictability. Wildlife accept the more predictable disturbances of people (and dogs) on trails more readily than off trails.

J.5 Weed-free feed. Using weed-free feed for packstock will help minimize weed invasions.

J.6 Discouraging generalists. Encourage visitors not to leave food or garbage around to further support generalists species.

J.7 Multiple approaches. Use a combination of management techniques to facilitate the coexistence of recreationists and wildlife.

J.8 Volunteers. Enlist the help of trail users in monitoring wildlife use of the trail corridor and other activities.

J.9 General references. To protect wildlife, when describing points of sensitive, ecological interest near a trail—sites you want people to know about, but not visit,—don't indicate the direction or distance to the spot.

J.10 User facilities. Provide facilities, such as blinds, viewing areas, and boardwalks, for visitors to see wildlife with minimal disturbance.

J.11 Interpretation. Interpretation and environmental education are very important management tools. If people value wildlife and understand the implications of their own actions, they are less likely to behave in ways that are harmful to wildlife.

Further Reading

Larson, R., "Balancing Wildlife Viewing with Wildlife Impacts: A Case Study," in Knight, R. and K. Gutzwiller, eds., 1995. *Wildlife and Recreationists: Coexistence through Management and Research.* Island Press, Washington, D.C., pp. 51-69.

"Agencies and Volunteers: Conducting Your Own Volunteer Projects," Volunteer for Outdoor Colorado, 1990. To order: Volunteers for Outdoor Colorado, 600 South Marion Parkway, Denver, CO 80209, (303) 715-1010.

"Organizing Outdoor Volunteers, Second Edition," Appalachian Mountain Club Books, 1992. To order: Appalachian Mountain Club Books, P.O. Box 298, Graham, NH 03581, (800) 262-4455.

K. Making informed decisions

Key Concepts

Any trail will have at least some impact on wildlife. Therefore, deciding whether the recreational value of a trail outweighs those impacts is a **community choice**, or in some cases, a **legal question.**

To conform to legal requirements it is important to check with state and federal wildlife agencies. In order to understand community values related to wildlife and trails, there needs to be a **public process** associated with a project.

There are many public **involvement techniques** and abundant sources of information about them. An important first step in understanding how a community values wildlife and trails is recognizing that there are probably many subgroups within a community—many **publics**. These groups may hold very different values and may need to be invited into the process in different ways.

It is easiest to reach **consensus** among groups with differing values when there is a common understanding of the issues at hand. That is one of the main purposes of this handbook.

More and more often today, communities are not just discussing their present needs and desires for trails and wildlife, but also ways of leaving choices for future generations. The concept of **sustainability** is about meeting the needs of the present without compromising the ability of future generations to meet their own needs. In the case of wildlife and trails, sustainability is about enjoying trails today without precluding the ability of future generations to enjoy wildlife.

A trail that is contributing to the sustainability of an area is meeting people's fundamental desire to experience nature while not compromising the ecological integrity of the area. This implies careful planning of trails so that they do not seriously degrade biodiversity.

With this kind of forward-looking perspective, it is especially appropriate to restore degraded areas for trails. Improving degraded habitat (i.e., correcting past mistakes) is better than entering undisturbed areas and it acknowledges our obligation to future generations.

Rules of Thumb

K.1 Sweeping statements. In discussing trails and wildlife, avoid sweeping generalities about wildlife impacts that may not be possible to substantiate or even be true in a specific situation.

K.2 Public values. Scientific study doesn't reveal how the public values wildlife. Various kinds of wildlife may be valued quite differently from a public and a scientific perspective.

K.3 Broader perspective. Frequently, disagreements over trails and wildlife can be resolved by balancing objectives over the broader landscape. It may be harder to balance competing interests of wildlife and trails in the same confined area.

K.4 Public process. Don't assume everyone in your community values trails or wildlife in the same ways you do. Invite broad public participation on every trail project.

L. Land ownership

Key Concepts

Many longer trails cross from one **jurisdiction** to another. This has ramifications for how the trail is planned and specifically how wildlife issues are considered. If a trail will cross **federal lands**, a more careful environmental analysis may be required.

Federal agencies, such as the USDA Forest Service and the Bureau of Land Management have their own environmental review processes in most cases. These agencies also have land management plans that identify where they believe trails should and should not go.

It is important early on in a trails project to contact the federal, state, and local agencies with jurisdiction over lands you are considering. This is not just because they manage the land and have the ultimate say as to what happens, but also because they most likely have **important wildlife information** and **knowledgeable experts**.

The **National Environmental Policy Act** (NEPA) outlines an environmental review process for reviewing projects proposed with federal lands or funds. NEPA can seem intimidating to those first encountering it. (Contact the manager of the federal property early in the process for advice.) Because the NEPA process would have been followed for an adopted federal forest or other land management plan, it may be possible that additional environmental review is not needed for a specific trail project. Often reconstruction or minor trail rerouting may be approved under existing NEPA documentation, without the need for additional review.

In general, the smaller and less intrusive the trail project on federal lands, the quicker the environmental review. The public scoping process (by which issues and concerns are identified) may be more lengthy if a trail is perceived as controversial.

For more information, see NEPAnet at: http://ceq.eh.doe.gov/nepa/nepanet.htm

As early in the trail planning process as feasible, contact the owners of private lands in the general area of your proposed trail. Out of respect for private property, it is good to communicate with these community members from the beginning of the project.

Rules of Thumb

L.1 Existing plans. Propose trails on federal lands in areas identified as suitable in existing management plans.

L.2 Additional requirements. Be prepared to follow a more formal environmental review process if you are proposing a trail on federal land. You may want to start working with the responsible agency a year in advance of proposed construction.

L.3 Practical advice. Interview a person who already has been through the NEPA process for a trail project similar to yours. (Talk with the Bureau of Land Management or U.S. Forest Service, for example.)

Further Reading

Shipley Environmental, *Applying the NEPA Process.* Telephone: 801-298-7800.

USDA FOREST SERVICE TRAIL SYSTEM ANALYSIS

Typical information needed for trail system analysis on lands managed by the USDA Forest Service includes:

1. Is there an approved plan for the area?

2. What are the general goals of the Forest Plan as they relate to the area?

3. What specific Forest Plan management objectives and prescriptions have been designated for the area? What other resource activities are likely to take place?

4. Within those prescriptions, what standards and guidelines might affect trail system design, operation,and administration?

From: http://www.fs.fed.us/ im/directives/fsh/2309.18/2309.18_1

3. Wildlife and Trails Checklist

While the Wildlife and Trails Primer (Chapter 2) is a topical presentation of wildlife and trails issues, this chapter presents wildlife concepts in a sequence your might follow in planning a trail.

The checklist provides a broad framework for considering wildlife while planning trails. It also highlights important issues to consider at specific points in the planning process, raising questions rather than providing answers.

The checklist's organization is complementary to such trail planning processes as that developed by the Austin Metropolitan Trails Council with assistance from the Rivers, Trails, and Conservation Assistance Program of the National Park Service. (For more information, see the council's website: http://www.austin360.com/greenzone/amtc/build.htm)

Specific questions addressed

How well wildlife concerns are represented in a planning process depends on how well the following are understood:

1) the specific wildlife species and populations being affected,

2) their habitats, and

3) the proposed recreational activities affecting that population.

The steps outlined in the checklist should help trail planners become more familiar with these issues.

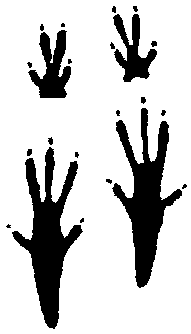
A generalized process

Every trail project is unique and not all of the detailed steps and questions in the checklist will be relevant to each project. Therefore it is important to adapt the checklist to your own situation.

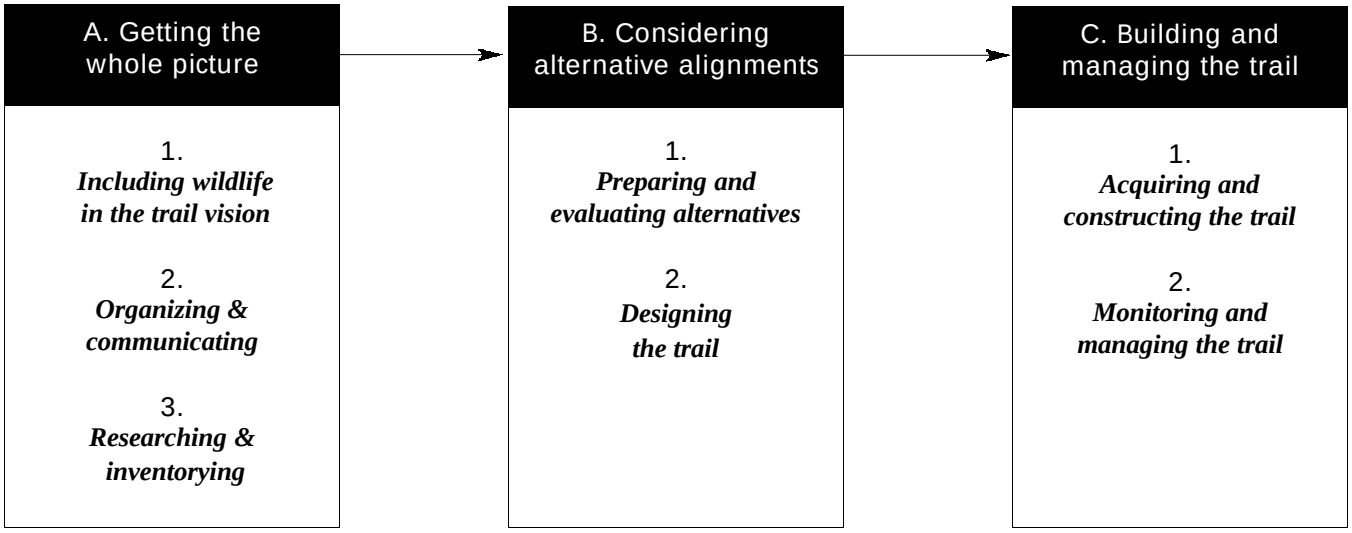
For example, in an urban setting it may not be possible to identify a range of options for a trail. The only possible alignments may be along drainages or other existing corridors not attractive to most kinds of development.

Similarly, many trail projects in Colorado improve existing roads or trails, rather than create new alignments. Developing wide-ranging alternatives may not make sense in such cases.

Also, users of the checklist from states other than Colorado will need to find substitutes for the Colorado-specific resources.



Wildlife and Trails Checklist



Comments welcomed

It would be very helpful to have your comments and suggestions on the Wildlife and Trails Checklist. Please send them to:

Stuart Macdonald, Colorado State Parks—Trails Program, 1313 Sherman Street, Room 618, Denver, CO 80203 or e-mail: MacTrail@aol.com.

A. Getting the whole picture

1.
Including wildlife in the trail vision

❑ Look at the broader landscape. What opportunities or constraints are there for trails and wildlife in the broader landscape? What plans are there for other trails or wildlife across the landscape? In general, what kinds of landscapes would the trail pass through? Would any be areas that currently have no trails and little human modification? Do you foresee any cumulative trail impacts by adding a new trail?

❑ Develop preliminary goals for the project. What activities do you foresee for the trail? What are your wildlife goals for the project?

❑ Develop initial trail concepts. What destinations, users, and activities do you foresee for the trail?

❑ Keep wildlife concerns within the focus of the project vision. Are there biologists or other professionals available to advise you on wildlife and trails concerns?

❑ Look for opportunities to coordinate your trail project with conservation and other complementary projects. Are there opportunities to coordinate habitat restoration, protection, or acquisition with the trail project? Where?

2.
Organizing & communicating

❑ Create a profile of the kinds of users who are likely to use the trail. What are likely levels and seasons of use? Are there organizations that would be interested in the trail project? Would any help monitor the trail area for wildlife issues?

❑ Identify the groups interested in wildlife in your trail area. What wildlife and conservation organizations would be interested to know of your trail project? Would any help monitor the trail area for wildlife issues?

❑ Share your ideas and findings with other community members, including both trails and wildlife enthusiasts, property owners, and land managers. Who are people and organizations that would feel strongly for or against the project? How can you inform and involve them?

❑ Meet with agency planners. Are there city or county land-use planners and federal or state resource planners who understand the broader context of the area where you are considering a trail? Is there an area-wide land-use, open space, or trails plan? If the trail might cross federal land, is there an existing management plan? Is your trail concept consistent with these plans?

❑ Start a public discussion of the trail and its implications for wildlife. What are the best ways to reach the various groups interested in your trail? Community meetings, field trips, a web site? What are the wildlife issues that must be addressed in planning the trail? Do the ideas you hear seem to complement or conflict?

A. Getting the whole picture, cont.

3.
Researching and inventorying

❑ Determine the physical extent of the project. Over what area might the trail extend? What elevational ranges?

❑ Conduct a preliminary biological inventory. What are the area's sensitive plants, animals, and wildlife habitats? Are there any special opportunities for wildlife education? How impacted already are wildlife in the area? How much modified is the area—is it urban, suburban, agricultural, pristine?

❑ Determine the habitat/ecosystem types present in the area of the proposed trail and the potential species or communities of special concern. What do the Colorado Natural Diversity Information Source (available online Fall 1998) and other sources indicate are likely species or communities of special interest in the area?

❑ Draw inferences from scientific studies done in similar habitats or with similar wildlife species. Does the Colorado State Parks wildlife/trails bibliographic data base include any such relevant references?

❑ Learn from others who have completed projects with similar wildlife issues. Are there case studies in Chapter 4 of this handbook with similar wildlife issues? Does the Trails Section of the Colorado State Parks website (www.dnr.state.co.us/parks/) include trails projects through similar environments? What lessons can you draw from the experiences of others?

❑ Review data found to date and conduct a site visit with a wildlife biologist or other scientists to identify potential wildlife opportunities and constraints. Are there areas to avoid because of resource sensitivity or areas to consider because of restoration potential or lower sensitivity? Which areas would provide the most interesting route and have the least impact on wildlife? Are there special opportunities for wildlife education?

❑ Identify seasons of special concern for the important wildlife species or communities. Are there times of year, such as elk calving or eagle nesting season, that are particular sensitive to disturbance from people? Are there alternatives for the trail away from such areas? Would seasonal closures of a trail near such areas be workable?

❑ Identify important plants in the area. Are there any sensitive plant species or communities in the area? Are there ways to present these communities to trail users without disturbing sensitive species?

❑ Evaluate the extent of existing impacts to wildlife and the landscape. What are the existing impacts to wildlife? How much have humans already modified the area? Is the area primarily natural, managed, cultivated, suburban, or urban? Will the trail provide access to backcountry or areas that have never had trails before? How can you minimize the trail's contribution to habitat fragmentation?

❑ Take a step back. Given what you have learned to this point, how well do you think this project will fit into its larger ecological context?

❑ Formalize the project goals. How would you revise the preliminary project goals based on what has been learned? What do members of the public and others think of the project goals?

B. Considering alternative alignments

1.
Preparing and evaluating alternatives

❑ Create distinctive alternative plans. With this handbook's rules of thumb as a guide, develop alternative plans that maximize the opportunities and minimize the constraints for wildlife. Especially look for opportunities to coordinate the restoration of degraded habitats. Get professional help preparing and evaluating alternatives, if possible. Where an existing trail is to be improved, alternatives might include different management strategies.

❑ Consider alternatives for trailheads and other support facilities. Sites for trailheads and parking areas are sometime overlooked in evaluating wildlife impacts of trails. They need careful design and review.

❑ Evaluate the alternatives. Conduct an internal evaluation of the alternatives using the goals set earlier.

❑ Ask others to help evaluate the alternatives. Conduct an external evaluation of the alternatives with wildlife biologists or other agency personnel, public, environmental groups, landowners, land managers, and others, as appropriate. Summarize the pros and cons of each alternative.

❑ Select a preferred plan. Review the comments made during the evaluation process and select one of the alternatives or create a hybrid plan incorporating the best qualities of two or more plans.

2.
Designing the trail

❑ Refine the selected plan. Develop site designs, budgets, and timetables.

❑ Develop management strategies. Consider how the trail will be managed, maintained, and monitored.

❑ Develop an environmental education/interpretation plan. The plan should explain how to communicate to trail users the specific wildlife issues of this trail.

❑ Develop a volunteer plan. Outline support tasks for involving volunteers in monitoring or managing wildlife.

❑ Conduct a final review of the plan and its components. Review the final plan with a wildlife biologist and other specialists to make certain all the parts went together in ways that support wildlife.

C. Building and managing the trail

1.
Acquiring and constructing the trail

❑ Look for opportunities for complementary conservation. In acquiring the land needed for the trail, look for additional areas that can be set aside for wildlife conservation at the same time and for the partners to implement such efforts.

❑ Implement the plan. Be careful to impact wildlife as little as possible during construction.

❑ Communicate to all interested parties. Share the progress about the trail and what is being learned about coexisting with wildlife.

2.
Monitoring and managing the trail

❑ Manage the trail. Implement the plan to manage the trail corridor and activities within it.

❑ Monitor. Using staff or volunteers, monitor the important plants and wildlife of the alignment, looking for impacts. Adjust management plans as appropriate.

❑ Communicate to all interested parties. Share the progress about the trail and what is being learned about coexisting with wildlife.

4. Case Studies

The following are case studies of trail projects that involved significant wildlife issues. In addition to a contact name for further information, cross-references are listed to topics in the Primer.

Sand Creek Regional Trail

Integrated trail/wildlife planning

Sand Creek has been one of Denver's forgotten streams. It flows from wide open spaces east of Denver, through Aurora, under runways at the former Stapleton International Airport, through intensive industrial development in Commerce City and into the South Platte River.

With the development of Stapleton's Bluff Lake and other sites along the Creek as natural areas has come more attention.

Systematic ecological study before trail planning

As part of planning a trail system along the creek, an ecological assessment was completed to evaluate the existing vegetation and wildlife habitat along the creek.

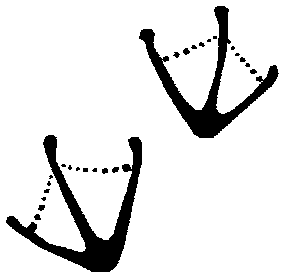
In order to evaluate the habitats, the 12-mile corridor was divided into 20 smaller segments, each about a half mile in length. Scientists estimated habitat quality in each of these segments based on overall plant and animal diversity.

Plant and animal diversity measured

Plant diversity was formulated based on the number of different types of vegetation that were present in the corridor. Also considered in the study of diversity were vegetation type, topsoil condition, soil texture, and abundance of noxious weeds.

Animal diversity was one of three components used to determine wildlife habitat quality. Animal diversity was based on the number of different species (species richness) in each segment.

Another component of the study was a rating of the corridors based on their ability to support a population of particular species of songbirds, water



birds, deer, medium-sized mammals, beaver, reptiles, and amphibians. Quantitative bird counts were particularly helpful in this portion of the study. Finally, the presence of rare animal species was taken into account.

Other habitat considerations

Other interesting factors used in assessing wildlife habitat included the degree of human disturbance, abundance of refuse, including piles of waste soil, asphalt or concrete, and abundance of transplantable vegetation. Evidence of human activity, grazing activity, and number of native species present were all used to determine a disturbance rating.

High quality areas avoided

Recommendations for trail alignments were evaluated based on this information. Areas of concern were established and avoided in trail planning, and existing trails or roads were used as much as possible for construction of new trails. Suggestions for habitat improvement were also included. The most important steps toward improvement included enhancing vegetation—restoration of native plant communities to provide a larger expanse and a greater diversity of habitat types; and stream and pond improvements—to provide additional open water.

For Information

Sand Creek Greenway; Stapleton Development Corp.
303-393-7700

Also see Primer topic: G. A site's existing impacts.

Chatfield Basin Conservation Network

Looking at the big picture

A group of over 35 public and private organizations and agencies is implementing an aggressive vision for wildlife and trails in the Chatfield Basin, on metro Denver's southwestern boundary.

Already the area has over three million visitors (in 1996), and the use and popularity of its trails, open spaces, 2,150 surface acres of water and 279 miles of streams will only grow with population increases.

Although approximately 39 percent of the Chatfield Basin is already conserved as a state or local park or some other kind of protected open space, the scattered conservation lands will not be enough to protect an interconnected open space system for wildlife and trails.

Their vision includes healthy protected areas that are sustainable and rich in indigenous species because these ecosystems are buffered and connected, with opportunities for hiking across the basin. The project vision is supported by five goals:

1. Conserve and enhance areas of significant wildlife habitat and protect a connected system in support of wildlife movement.

2. Conserve and enhance areas of significant vegetation.

3. Conserve open lands and wetlands to protect water quality and help reduce damage from flooding.

4. Create an interconnected, nonmotorized trail system for the Chatfield Basin.

5. Coordinate open space systems across jurisdictions in the basin.

Considerable cooperation

This is a complex conservation effort because it involves the cooperation of many people. Area parks and open space agencies will continue to manage and, as needed, expand core reserves, such as Roxborough State Park. These areas alone will not protect major wildlife movement corridors. The cooperation of private landowners and developers will be needed in planning housing developments and other uses in the buffer areas so that wildlife connections and important habitat areas are integrated into the larger system.

Trails are an integral part of the conservation plan

Trails planners were part of the Chatfield Network from the beginning and the proposed interconnected regional system of trails is fully integrated into the concept plan. By working together across the basin not only were trail planners able to cooperate across jurisdictions, but they were able to work directly with wildlife biologists to understand the wildlife sensitive areas to avoid.

For Information

Chatfield Basin Conservation Network, 303-660-7334

Also see Primer topic: C. Tools for a broader view.

Antelope Island State Park

Planning Backcountry trails in the midst of sensitive wildlife

Utah State Parks is in the process of implementing a backcountry trails plan that will add 40 miles of trail to Antelope Island State Park, near Salt Lake City, in the Great Salt Lake. To help with the process, the agency formed a wildlife advisory committee of experts from academia and other agencies.

The committee was created to bring a more scientific approach to park management, and to provide unbiased review of resource based programs and proposals. The wildlife committee was particularly interested in minimizing recreational impacts of trails in a setting that is home to both bighorn sheep and free-roaming bison.

The following are some of the important aspects of the trail program developed by the committee.

Identifying critical habitat a first step

A major first step was identifying critical wildlife habitat and the kinds of recreational activities that might impact it. Critical habitats for Antelope Island include areas where wildlife calve, lamb or fawn, critical winter range and habitat of threatened and endangered species.

To avoid wildlife conflicts in these area during sensitive times, motorized recreation is confined to park roads and excluded from the trail system.

Space and time limitations placed on recreation

In order to achieve the goal of providing access while protecting habitat, the park has developed a plan that limits recreation spatially and temporally.

The main spatial limitation on recreation is requiring trail users to remain on the trails. This part of the plan is based on the theory that wildlife may become accustomed to recreationists if their presence always occurs in the same area.

Temporal limitations in the park include seasonal closings. For example, Antelope Island's Frary Peak Trail is closed for six weeks while bighorn sheep are lambing.

Enforcement—staff and volunteer—is vital

Trail restrictions are enforced by park law enforcement staff. Rangers, who patrol the backcountry on bikes and horses, have the authority to issue citations.

In an effort to help the law enforcement staff, a volunteer trail patrol program also is being put into place. These volunteers are present primarily on weekends and other busy times to explain the program to park patrons. They are, in effect, salesmen for the entire management program at Antelope Island.

Tim Smith, manager of the park, says there have been few problems with off-trail use since the program's inception.

Interpretation used to encourage responsible trail use

As a way of encouraging responsible trail use, the park has introduced interpretive programs. These programs present the rationale behind the trail program and the opportunities and limits it places on recreationists. The park attempts to get the message across using a variety of means such as personal programs, interpretive signing and exhibits, publications, and other media outreach.

Trail impacts monitored

Antelope Island has a monitoring system in place that evaluates the impacts of the trail system on wildlife populations. Elements the park staff monitor on a (somewhat) regular basis include: habitat use; displacement; calving, lambing and fawning success; recruitment; causes of mortality; overall health of herds; and range conditions. Park staff conduct studies of the island's resources and encourage outside research.

For information

Utah State Parks, Antelope Island State Park; Tim Smith, Manager 801-322-4307

Also see Primer topic: H. How wildlife respond to trails.

Chatfield State Park

Visitors in a sensitive area

In creating a wildlife viewing area at Chatfield State Park, planners used three main strategies to avoid excessive disturbance of more than 90 active great blue heron nests and 135 active double-crested cormorant nests:

1. Controlling both the timing and location of visitors;

2. Educating visitors about the wildlife resources; and

3. Enforcing rules and regulations.

The first strategy—zoning—was crucial in protecting the birds. A recreational access schedule defines timing and types of human activities allowed within 150 meters of the waterbird colony.

From March 1 through April 30 the risk of human disturbance is high. During this period the birds return to the colony, court, build nests, lay eggs, and begin to incubate them. Therefore human access is limited to the viewing deck.

In this way the deck serves less as the only possible vantage point for visitors and more as a containment strategy to protect the water birds by concentrating the people.

For information

See Richard Larson, "Balancing Wildlife Viewing and Wildlife Impacts: A Case study," in R.L. Knight and K.J. Gutzwiller, *Wildlife and Recreationists*.

Crown Hill Park

Strong public support for wildlife management

Jefferson County (Colorado) Open Space Department's 250-acre Crown Hill Park is a neighborhood park in an urban setting. The park provides both important habitat for wildlife and recreation for a half million visitors each year.

The public has shown strong support for wildlife at Crown Hill Park, even when it has meant trail closures. A trail through a wetlands portion of the park is closed each year while waterfowl nest.

Recently there was support when a portion of the park was closed for two to three months due to the presence of nesting Swainson's hawks. Through interpretive efforts, the public was made aware of the situation.

In another situation, park-goers were initially outraged when coyotes arrived in the park, displacing resident foxes. Through education this has been turned around. Now park visitors are informally involved in coyote protection by making sure other visitors are not antagonizing the animals.

"Crown Hill is living proof that successful closures and good public compliance are possible with strong interpretive and volunteer efforts," says Jeffco's Colleen Gadd.

For information

Jefferson County Open Space, Colleen Gadd, 303-271-5995

Also see Primer topic: J. Managing trails with wildlife in mind.

Peron's Peak

The challenge of enforcing seasonal closures

Peron's Peak is a Colorado Division of Wildlife area purchased with hunter and angler dollars. The area is completely closed the day after hunting season ends through March 31 to make the area more attractive to animals and for deer fawning. The Division of Wildlife tries to make the animals feel that the area is secure. On April 1st, the area opens up west of the county road. The area east of the road remains closed due to peregrine falcon nesting. On July 15th the entire area is opened to the public.

Managers have faced ongoing problems enforcing the closures. Some cross-country skiers, hikers, and bikers ignore the signs and enter the area anyway. Some mountain bikers have ignored the signs at the east side closure and riden right up to the falcon eyries. This has the potential to cause falcons to abandon their nests.

For information

Colorado Division of Wildlife, Mike Zgainer, 970-247-0855

Also see Primer topics: H. How wildlife respond to trails, J. Managing trails with wildlife in mind, and L. Landownership.

Bay Trail Project

San Francisco Bay's proposed 400-mile trail develops creative designs for wildlife

California's Bay Trail Project, is a proposed 400-mile shoreline hiking and bicycling trail system around the San Francisco Bay. Project planners are looking for effective ways to provide access while preserving natural shoreline resources.

To date, 170 miles of trail have been completed. The Bay Trail Project is now working to implement the more difficult trail segments, many of which are near wetland and shoreline habitat areas.

As public access is proposed along undeveloped shoreline areas, concerns have been raised about the impact hikers, bicyclists, and pets may have on the adjacent wildlife. The Bay Trail Project personnel are studying the interaction of shoreline recreationists and wildlife and looking for ways to avoid harmful impacts.

A particularly good job of considering wildlife is evident in several projects.

San Rafael—Shoreline Park Trail

Included in the two-and-a-half mile San Rafael Shoreline Master plan are two parallel fences planted between with native vegetation. This wetland buffer, which is unobtrusive and still effective in keeping dogs and other pets away from the marsh, was built by the developer of an adjacent property.

Although the trail is heavily used, monitoring has shown an increase in the number and diversity of shorebirds.

Other features of the project include:

• A program was developed to remove invasive exotic plants, such as pampas grass and French broom.

• A secondary trail between wetland ponds and the improved main trail was removed.

• A task force developed the shoreline master plan over a period of three years.

See Primer topic: J. Managing trails with wildlife in mind.

E. Palo Alto—Ravenswood Landing

In this joint effort, the Midpeninsula Regional Open Space District (MSROD) and San Mateo County realigned a trail and built observation decks to reduce growing conflicts between recreational use and wildlife preservation.

MSROD and the County worked with the Audubon Society to locate wildlife observation decks. The decks are raised and have railings to further deter trespassing into sensitive wildlife areas. Interpretive signs explain that the decks act as dead ends to protect wildlife.

See Primer topics: H. How wildlife respond to trails, J. Managing trails with wildlife in mind, and K. Making informed decisions.

San Leandro—Shoreline Marsh Improvements and Public Access Corridor

In considering a new link to the Bay Trail through San Leandro, alternative trail alignments were considered to protect 175 acres of prime Bay wetland and sand dune habitat.

There was 15 years of input from the public and from technical experts. An interpretive signage program was planned to educate users about sensitive wetlands.

The wetlands were enhanced through the introduction of tidal action through excavation of channels, creation of elevated islands, and installation of culverts. Also, a sensitive sand dune area was preserved for the least tern, a shorebird.

See Primer topic: K. Making informed decisions.

San Jose Riparian Corridor Study

The City of San Jose developed a riparian corridor policy to help limit public access in potentially sensitive areas. They conducted an extensive inventory of 150 miles of creeks and biotic resources and met with residents, interest groups, and the building industry.

The policies and guidelines developed by the city aim to protect riparian corridors for environmental and recreational purposes. They:

• Require a 100-foot setback from the riparian corridor for all active land uses;

• Seek to limit trails to one side of the riparian corridor;

• Direct lighting away from the corridor to reduce the impact of such lighting on wildlife;

• Direct runoff away from the corridor and into filtration areas;

• Locate interpretive nodes at least 500 feet apart.

See Primer topics: C. Tools for a broader view and E. The importance of streamside areas.

Babbs Creek Canyon Drainage Project

In constructing a pedestrian trail along Babbs Creek Canyon, efforts were made to maintain and enhance sensitive oak riparian habitat.

The trail was located at the outer edge of the creek buffer zone, 100 feet from the top of creek bank. The area is being revegetated with native species, with the goal of a continuous canopy of oaks along the 100-foot wide buffer.

Habitat sensitive street lighting (which focuses light on the street) is being encouraged to reduce unnatural nighttime lighting. In addition, water drainages are being monitored for pollutants.

See Primer topics: H. How wildlife respond to trails and E. The importance of streamside areas.

For information

Bay Trail Project; Janet McBride, Manager; P.O. Box 2050, Oakland, CA 94694-2050

Appalachian Trail

Even with careful study, sensitive wildlife can be overlooked

The conflict between wildlife and recreation has become a prominent issue for the well-known Appalachian Trail. In several cases, despite every effort to be sensitive to wildlife, trails have had to be relocated.

In one case, wildlife studies were conducted prior to building a new trail, and a trail route was determined. But unfortunately, following construction biologists discovered that the trail alignment was impacting falcon hacking sites.

The hacking sites (ledges where falcon eggs were hatched) also were attractive to hikers because of the spectacular views they afforded. The falcons were being disturbed by hikers. A relocation of the trail was necessary to protect these breeding sites.

A second relocation of the Appalachian Trail was necessary when the trail was discovered to be threatening the habitat of the Eastern Timberback rattlesnake. Again, biological studies had been done beforehand, but somehow the Timberback got overlooked until after construction of a mile and a half of this segment. A biologist suggested a new route, to protect both the habitat and the public.

For information

Appalachian Trail, Bob Proudman, 304-535-6331

Also see Primer topic: F. Species and places of special interest.

Humboldt & Huron Peaks

Rerouting trails reduces impacts

Use by hikers had created a serious erosion problem on Humboldt Peak's southwest slope. A gully formed with some spots up to ten feet wide and four feet deep. All vegetation was trampled so there was nothing to hold the topsoil when it rained.

The Colorado Fourteeners Initiative organized a project to fix this trail in southcentral Colorado. They carefully imported rock from nearby quarries, plugging up the gulley with nearly 180 tons of rock.

The group cut a new trail around the gulley and transplanted the vegetation from the newly cut trail to the site of the old gulley.

At nearby Huron Peak, the Initiative moved an existing trail away from endangered plant species and from soils that were inappropriate for trails.

The Huron Peak trail was not well delineated at the top, and as a result, many social trails had been created on the climb down. Hence, trail consolidation was necessary to eliminate social trails.

For information

Colorado Fourteeners Initiative, Keith Desrosiers, 303-278-7525 x114

Also see Primer topic: F. Species and places of special interest.

Snowmass's Tom Blake Trail

Thinking of wildlife at every stage

Wildlife issues were taken into consideration throughout the construction of the Tom Blake Trail in Snowmass, Colorado. Because the nearby ski area had been required to complete an environmental impact study, trail planners were already aware of sensitive species and habitat in the area.

Project planners made certain to leave snags (dead trees) for nesting birds along the trail tread. Slash piles (small huts about 4-6 ft. wide) were also created in the same area to serve as shelter for small mammals.

Both snags and slash piles were left as a way of helping wildlife adjust to the intrusion of recreationists into their habitat. Twice a year—in the fall and spring—the trail is closed for a month during elk and deer calving and migration.

To date, monitoring has not detected any negative impacts to wildlife. The trail may be benefiting some local wildlife by providing a path for migration during heavy snow season. Future management of the trail will be by a local housing developer.

For information

Town of Snowmass (Colorado); Dawn Keating, Biologist, 970-923-5524

Also see Primer topics: J. Managing trails with wildlife in mind and F. Species and places of special interest.

St. Vrain Greenway

A trail project as midwife to river restoration

As part of the St. Vrain Greenway, residents of Longmont, Colorado, are reclaiming the river that flows through their community, The Greenway trail begins in Golden Ponds Park and runs along Main Street through heavily industrialized areas.

Large pieces of concrete, asphalt, and car parts—among other things—had been dumped along the banks of the river. To prepare the area for trail construction and river restoration, the Longmont Parks and Recreation Department removed this debris and eased the gradient next to the river.

The department also removed noxious weeds along the trail corridor and re-seeded, reintroducing native plants. They planted trees, and added benches and trash cans.

The restoration work was done to create a better trail setting, but was also effective in improving wildlife habitat. More foraging and shelter were provided.

Some sensitive species were thought to have migrated out of the area during construction, but have returned since the project was completed.

For information

Longmont Parks and Recreation Department, Paula Fitzgerald, 303-651-8448

Also see Primer topic: G. A site's existing impacts.

Wheat Ridge Greenbelt

Reconfiguring a riparian trail

At one time an 8-foot asphalt trail—narrow by urban standards—wound through the Wheat Ridge (Colorado) Greenbelt. In order to reduce congestion on the trail, a second paved trail was built for bicyclists and rollerbladers and the original asphalt path was replaced with crusher fines. Use of the original trail was then limited to equestrian and pedestrian traffic.

An environmental analysis was completed prior to construction of the trails. An endangered orchid, ute's ladies tresses was found in the area. Other endangered species thought to be present were not found.

Throughout construction, the city's park naturalist walked the alignment with the contractor to point out and have avoided such things as nesting trees and fox dens. The city moved the new "fast" trail as far away from the riparian corridor as possible, while still staying within the designated greenway.

The area with the "slower,"crusher fines path was designated as a conservation area, due to citizen request.

Enhancements to the habitat are being made through planting.

For information

City of Wheat Ridge, Margaret Paget, Park Naturalist, 303-423-1122

Also see Primer topic: E. The importance of streamside areas.

5. Sources of Information

Internet resources

Note: It may be convenient to access this list online and take advantage of the active links already established to the sites listed below. The list may be found at Colorado State Parks' website (www.dnr.state.co.us/parks/), where it will be kept updated.

GENERAL INFORMATION ABOUT TRAIL PLANNING, CONSTRUCTION, AND MANAGEMENT

Austin (Texas) Metropolitan Trails Council, How-to guide for neighborhood trail planning and development.
http://www.austin360.com/greenzone/amtc/build.htm

Austin (Texas) Metropolitan Trails Council: Sources of books on planning, building, maintaining, and managing trails, including volunteerism.
http://www.austin360.com/greenzone/amtc/resource.htm

Appalachian Trail Conference: Includes general information on management plans and other stewardship activities, as well as a land trust to protect their trail corridor.
http://www.atconf.org/programs.html

University of Idaho Extension Forestry: Building forest trails
http://www.ets.uidaho.edu/extforest/august97.htm

South Carolina Trails Program: Trails management, including searchable bibliographies and information on funding, construction, and greenways.
http://www.sctrails.net/trails/trails_mgmt.html

Purdue University Cooperative Extension Service: How to plan an interpretive trail
http://persephone.agcom.purdue.edu/~agcom/Pubs/FNR/FNR-124.html

North Carolina Cooperative Extension Service: "Recreational Forest Trails: Plan for Success," including types of trails, design, layout, construction, studying the land
http://www.ces.ncsu.edu/nreos/rrea/rectrailstoc.html

North Carolina State University: Recreational Forest Trails: "Top Ten Construction Tips" and sources of information
http://www.ces.ncsu.edu/nreos/rrea/topten.html

University of Minnesota Trail Planning, Construction, and Maintenance Bibliography
http://www.lib.umn.edu/for/bib/trls.html

FEDERAL LANDS AND AGENCIES

U.S. Fish and Wildlife Service
Threatened and Endangered Species Data Set:
http://www.fws.gov/pullenl/cais/tespec.html
Endangered Species Act:
http://www.fws.gov/r9endspp/esa.html#Lnk03

USDA Forest Service: Chapter 1.3 of Trails Management Handbook. Includes typical information needed for trail system analysis.
http://www.fs.fed.us/im/directives/fsh/2309.18/2309.18_1

Bureau of Land Management: General statement about stewardship activities, including trails.
http://www.blm.gov/budget/1998/98rec.html

USDA Forest Service: Newsletter about an Off-Highway Vehicle (OHV) proposal for Daniel Boone National Forest
http://www.atving.com/editor/trails/db.htm

National Park Service Planning Homepage
http://www.nps.gov/planning/

USDA Forest Service Homepage
http://www.fs.fed.us/

U.S. Forest Service Wildlife page
http://www.fs.fed.us/outdoors/wildlife/get.htm

U.S. Environmental Protection Agency Homepage
http://www.epa.gov/

USDA National Resource Conservation Service
http://www.nrcs.usda.gov/

NRCS Technical Resources, includes the National PLANTS database.
http://www.nrcs.usda.gov/TechRes.html

American Trails articles on trails in wetlands.
http://www.outdoorlink.com/amtrails/resources/trailbuilding/BuildTFWetlands.html

Council on Environmental Quality—NEPAnet,
http://ceq.eh.doe.gov/nepa/ nepanet.htm

NATURAL RESOURCE INFORMATION

Rocky Mountain Ecology: Wildlife links, ecological problems, trail links
http://www.afternet.com/~tnr/mountain/

clay.net® Environmental Professional's Homepage, designed specifically for environmental consultants and remediation professionals. Includes state and federal agencies and legislation.
http://www.clay.net/

Texas Agricultural Extension Service: Wildlife management information
http://leviathan.tamu.edu:70/1s/pubs/wildlife

Olympic National Forest: Ecology of Aquatic and Riparian Ecosystems: An Examination of Forest Management Alternatives
http://www.olympus.net/gov/onf/ecomgt/research/riparian.htm

Natural Resources Research Information Pages: Outdoor Recreation Research
http://sfbox.vt.edu:10021/Y/yfleung/recres.html

Colorado Division of Wildlife
http://www.dnr.state.co.us/wildlife/

Links to state wildlife agencies
http://www.ndsu.nodak.edu/instruct/devold/twrid/html/ gov.htm

Colorado Mountain Club
http://www.cmc.org/cmc/

Craighead Environmental Research Institute: Corridors and Reserve Design
http://www.avicom.net/ceri/col/reserve.html

Craighead Environmental Research Institute: Reserve Design--links to corridor analysis, habitat preservation, movement across landscapes
http://www.avicom.net/ceri/reserve/index.html

Bay Trail Project: Creative designs for conservation along trails
http://www.abag.ca.gov/bayarea/baytrail/innovsol.html

International Association for Landscape Ecology,
http://www.edc.uri.edu/iale/

Society for Conservation Biology
http://conbio.rice.edu/scb/

Wildlife Biology Information Page
http://members.aol.com/Bioweb98/thankyou.htm

RESTORATION

Colorado State Parks: Revegetation along trail corridors
http://www.outdoorlink.com/amtrails/resources/trailbuilding/BuildTFReveg.html

Army Corps of Engineers: Habitat Restoration Recommendations
http://www.swt.usace.army.mil/factbook/tc_71.htm

Bibliography of Literature describing riparian restoration and revegetation projects
http://www.habitat-restoration.com/rrrbib.htm

Ecological Restoration
http://wfscnet.tamu.edu/courses/wfsc406/restore.htm

Restoration and Management News
http://wiscinfo.doit.wisc.edu/arboretum/rmn/homepage.html

MISCELLANEOUS

Links to State Trail Programs
http://www.outdoorlink.com/amtrails/resources/statetrails/index.html

North Quimper Penninsula (Washington) Wildlife Corridor: Project to preserve wildlife corridor of native vegetation connecting habitat areas.
http://www.olympus.net/community/saveland/corridor.htm

FUNDING AND ASSISTANCE

Colorado State Trails Program
http://www.dnr.state.co.us/parks

Colorado Division of Wildlife—Fishing is Fun
http://www.dnr.state.co.us/wildlife/

USDA Natural Resources Conservation Service: Conservation Programs, including, incentive programs for wildlife, wetlands, soil, environmental quality.
http://www.nrcs.usda.gov/NRCSProg.html

Sources specific to Colorado Trail Projects

Boulder County Parks and Open Space, Michael Sanders, Senior Resource Specialist/Wildlife, 303-441-3952

City of Boulder Open Space Department, P.O. Box 791, Boulder, CO 80306

Bureau of Land Management, Jim McBrayer, Outdoor Recreation Planner, Little Snake Resource Center, Craig, CO, 970-826-5083

Continental Divide Trail Alliance, 303-838-3760

Colorado Division of Wildlife
Wildlife Habitat Biologists: Western Region: Bob Clark, 970-249-3431, Montrose; Northeast Region: Rick Moss, 970-484-2836, Ft. Collins; Southeast Region: Bruce Goforth, 719-539-3529, Salida
Natural Diversity Information Source (online, available Fall 1998): http://www.dnr.state.co.us/ wildlife/
Colorado List of Threatened and Endangered Species: http://www.dnr.state.co.us/wildlife/ T&E/list.html
Colorado State Wildlife Statute 33
http://web.intellinetusa.com/cgi-dos/statsrcf.exe?N

Colorado Dept. of Transportation, Gay Page, Bicycle/Pedestrian Program Manager, 303-757-9982J51

Colorado Natural Areas Program; E-mail: dnr.parksna@state.co.us;
website: http://elbert.state.co.us/cnap

Colorado Natural Heritage Program, John Armstrong, Environmental Review Coordinator, 254 General Services. Bldg., Colorado State University, Fort Collins, CO 80523, 970-491-7331

Colorado State Parks Trails Program, 1313 Sherman Street, Room 618, Denver, CO 80203 ; email: MacTrail@aol.com, website: www.dnr.state.co.us/parks/
Also see the Wildlife Bibliographic Data Base at this website.

Colorado Weed Management Association
http://linden.fortnet.org/CWMA/#index1

Jefferson County Open Space Department, Randall Frank, Natural Resources Supervisor, 700 Jefferson County Parkway, Suite 100, Golden, CO 80419, 303-271-5986

Summit County Open Space and Trails Department, Scott Hobson, P.O. Box 5660, Frisco, CO 80442; 970-668-4060.

U.S. Army Corps of Engineers,
Denver (Omaha District), 303-979-4120;
Pueblo (Albuquerque District), 719-543-6915;
Grand Junction (Sacramento District), 970-243-1199.

U.S.D.A. Forest Service, Rocky Mountain Region, Recreation and Public Service, 303-275-5045;
Melanie Woolever, Wildlife Biologist, 303-275-5007

General Trail References

Note: Also see the references listed in the Wildlife and Trails Primer.

Ashbaugh, B. L., and R. F. Holmes. 1967. Trail Planning and Layout. National Audobon Society. New York, NY. 104p.

Fogg, G. E. 1986. A Site Design Process. National Recreation and Park Assoc., Alexandria, VA. 185p.

Fogg, G. E. 1981. Park Planning Guidelines Revised. National Recreation and Park Assoc., Alexandria, VA. 202p.

Larsen, D. M., and W. R. Miles. Nature Trails. Agricultural Extension Service, University of Minnesota. Extension Bulletin Number 368. 15p.

PLAE, Inc. 1993. A Design Guide for Universal Access to Outdoor Recreation. Berkeley, CA. 240p.

USDA Forest Service 1985. Trails Management Handbook. (FSH 2309.18) 84p.

6. Glossary

Included here are terms used in the handbook or terms likely to be encountered in other sources of wildlife information.

ABIOTIC. Not living; often referring to the non-living components of the ecosystem such as water, rocks, and mineral soil.

AGE STRUCTURE (of a population). The percentage of the population at each age level, or the number of individuals of each sex at each age level.

BASELINE SURVEY. The initial set of measurements in an ongoing monitoring study, typically done before the system is changed by management

BIODIVERSITY. The variety of life and its processes; including the variety of living organisms, the genetic differences among them, the communities and ecosystems in which they occur, and the ecological and evolutionary processes that keep them functioning, yet ever changing and adapting.

BIOTIC. Life and living organisms, especially characteristics of entire populations or communities

CANDIDATE SPECIES. A species being considered for listing by the federal government as threatened or endangered.

CANOPY. Formed by the branches and leaves of trees in a wood or forest.

CARRYING CAPACITY. The number of recreationists that can be accommodated in a specific area based on ecological, physical, facility, and/or social factors.

CONNECTIVITY. The state of being functionally connected by movement of organisms, materials, or energy.

CORRIDOR. Narrow continuous areas of favorable habitat that allow the movement of animals, birds and plants along them.

CORVIDS. Birds of the Corvidae or crow family.

DETRITUS. Organic particles or other loose material that result directly from disintegration of leaves, stems, or other materials.

DISPERSAL. The managerial action of distributing a given amount of wilderness use over a larger area, such as through the construction of additional trails, with the intention of lessening impacts to wilderness areas.

DISTURBANCE. A discrete event, either natural or human-induced, that causes a change in the condition of an ecological system.

DIVERSITY (index). A measure of the biological diversity within an environment which can be used to detect stress on an environment.

ECOSYSTEM. A system formed by the interaction of living organisms, including people, with their environment. Spatially, ecosystems are described for areas in which it is meaningful to talk about these relationships.

ECOSYSTEM MANAGEMENT. The skillful, integrated use of ecological knowledge at various scales to produce desired resource values, product, services, and conditions in ways that also sustain the diversity and productivity of ecosystems. This approach blends physical, biological, and cultural/ social needs.

EDGE. A significant change in structure or composition caused by natural events such as fire and wind or human-caused events.

EDGE EFFECTS. Tendency to have greater variety and density of organisms in the boundary zone between communities.

EDGE SPECIES. Species living primarily or most frequently or numerously at junctions of communities.

ENDANGERED SPECIES. Any species listed under the Endangered Species Act which is in danger of or threatened with extinction throughout all or most of its range.

ENVIRONMENTAL IMPACT STATEMENT (EIS). An environmental analysis, as required by the National Environmental Policy Act (NEPA), for proposed federal actions that may have a significant effect on the quality of the human environment (40 CFR 1502.3).

EROSION. The detachment and movement of soil from the land by wind, water or gravity.

EXOTIC SPECIES. Species that occur in a given place, area, or region as the result of direct or indirect, deliberate or accidental introduction of the species by humans, and for which introduction has permitted the species to cross a natural barrier to dispersal.

FACULTATIVE. Having the capacity to live under different conditions; organisms that can live in a certain way but are not obliged to and may, under certain conditions, adopt another mode of life.

FLAGSHIP SPECIES. Species that are popular and charismatic and which therefore attract popular support for their conservation.

FLUSHING DISTANCE. The distance at which wildlife flee from a disturbance.

FORAGE. All browse and herbaceous plants that are available to feed livestock or wildlife.

FORBS. Seed plants with nonwoody, green stems (herbaceous plants); especially a plant other than a grass.

FOREST-INTERIOR SPECIES. Species living primarily or most frequently in the interiors of forests.

GUILD, SPECIES. Group of species having similar requirements and foraging habits and thus similar roles in the community.

HABITAT. The natural environment of a plant or animal.

HABITAT EVALUATION PROCESS (HEP). A process developed by the U.S. Fish and Wildlife Service as a structured and quantitative way of evaluating habitat before and after a project and determining how much mitigation is needed to compensate for damage.

HABITAT FRAGMENTATION. A process by which habitats are increasingly subdivided into smaller units, resulting in their increased insularity as well as an overall loss of habitat area.

HABITAT SECURITY. The condition of being safe from disturbance.

HABITAT SUITABILITY INDEX (HSI). A scale is created by rating the habitat for each species before and after a project on a scale from 0 (= totally unsuitable habitat) to 1.0 (= optimal habitat).

HARDENING. The manual, mechanical, or chemical compaction of the trail tread resulting in a hard, flat surface that sheets water effectively and resists the indentations that are created by use.

INDICATOR. A specific measurement used to gauge a resource or social condition.

INDIGENOUS SPECIES. Any species of flora or fauna that naturally occurs in wilderness areas that was not introduced by humans.

INDIRECT EFFECTS. Those effects occurring at a later time or at some distance from the triggering action.

LACUSTRINE. Living in or beside a lake.

LAND AND RESOURCE MANAGEMENT PLAN (LRMP) Programmatic level Forest-wide plan (required by NFMA) setting overall management direction, standards, and guidelines for a National Forest.

LANDSCAPE. Heterogeneous land area composed of a cluster of interacting ecosystems that is repeated in similar form throughout.

LEAVE NO TRACE (LNT). Educational program designed to instill behaviors in the wilderness that “leave no trace” of human activities or occupation.

LIMITS OF ACCEPTABLE CHANGE (LAC). A planning framework that establishes explicit measures

of the acceptable and appropriate resource and social conditions in wilderness settings as well as the appropriate management strategies for maintaining or achieving those desired conditions.

LANDSCAPE SCALE. At the broader scale of a landscape, i.e., several square kilometers.

LAYER. Horizontal stratum in a plant community, i.e., the tree layer comprising the canopy, the shrub layer comprising the shrubby understory, the herb layer comprising grass and herbaceous plants, and the ground (moss) layer comprising the ground surface, lichens and mosses.

MANAGEMENT INDICATOR SPECIES (MIS). A wildlife species whose population status and trend in a certain habitat type indicates the population and trend of other species that depend on the same habitat.

MANAGEMENT ZONES. Areas identified for different management techniques and/or uses.

MATRIX, LANDSCAPE. The most extensive and most connected habitat type in a landscape, which often plays the dominant role in landscape processes.

METAPOPULATION. A set of partially isolated populations belonging to the same species. The populations are able to exchange individuals and recolonize sites in which the species has recently become extinct.

MITIGATE. Actions to avoid, minimize, reduce, eliminate, or rectify the adverse impact of a management practice.

MONITORING. The collection of information to determine the effects of resource management and to identify changing resource conditions or needs.

MULTIHABITAT SPECIES. A species that uses more than one type of habitat over the course of the year or its life.

NATIONAL WILDERNESS PRESERVATION SYSTEM (NWPS). All lands covered by the Wilderness Act and all subsequent designations, irrespective of the department or agency having jurisdiction.

NATIONAL WILD AND SCENIC RIVER SYSTEM. Rivers with outstanding remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values designated by Congress under the Wild and Scenic Rivers Act for preservation of their free-flowing condition.

NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) Legislation declaring the productive harmony with nature, and protection of the environment, to be national policy. NEPA provides for analyzing the environmental consequences of proposed management actions on all National Forest System lands, including management actions taken in wilderness.

NATIVE SPECIES. Any species of flora or fauna that naturally occurs in an area and that was not introduced by humans.

NATURALIZED SPECIES. Any non-indigenous species of flora or fauna that is close genetically or resembles an indigenous species and that has become established in the ecosystem as if it were an indigenous species.

NEOTROPICAL MIGRANT. A bird that migrates to temperate North America from Central or South America and back over the course of the year.

NEST CAVITIES. Naturally occurring holes in trees, used by birds for nesting.

NEST PARASITES. Cowbirds and other birds that lay eggs in nests of other species of bird and leave their young to be raised by others.

NEST PREDATION. Jays and other birds that prey on eggs or nestlings.

NOXIOUS WEED. Plant that is invasive, displacing native species.

OBLIGATE. Obligatory; limited to one mode of life or action.

OFF-HIGHWAY VEHICLE (OHV). Any motorized vehicle used for travel in areas normally considered inaccessible to conventional highway vehicles. OHVs generally include dirt motorcycles, dune buggies, jeeps, 4-wheel drive vehicles, snowmobiles, and ATVs.

PALUSTRINE. Growing in marshes or swamps.

PASSERINES. Large order of birds, which includes small and medium-sized perching birds and songbirds such as crows, tits, warblers, thrushes, and finches

PATCH, LANDSCAPE. A nonlinear surface area differing in appearance from its surroundings, typically a small (less than 50 acres) portion of the landscape; small patches the size of an individual tree canopy are frequently called gaps.

PREDATION. When an organism catches and kills other organisms for food.

PUNCHEON. A log or timber structure built to cross a boggy area. Usually consists of sills, stringers, and a log deck.

RANGE. The geographic extent of habitat used by a species.

RAPTORS. Hawks, eagles, owls or other birds of prey.

RECORD OF DECISION (ROD). The portion of a Final Environmental Impact Statement that identifies the proposed action, signed by the appropriate deciding officer.

RECREATIONAL STOCK. Pack and saddle stock used primarily for transporting recreationist and their gear. Both commercial pack station and individual stock are included. Usually horses and mules but may also be llamas, or goats.

RECREATION OPPORTUNITY SPECTRUM (ROS). A means of classifying and managing recreational opportunities based on physical setting, social setting and managerial setting. Wildernesses, are normally managed entirely for the "primitive" ROS class.

RIPARIAN. The land and vegetation immediately adjacent to a body of water, such as a stream, lake, or river; such vegetation depends upon a perpetual source of water.

RIVERINE. Living in rivers.

SOCIAL TRAILS. Unplanned trails that developed informally.

SENSITIVE SPECIES. Those species on an official state list or recognized by another agency, needing special management to prevent them from becoming endangered or threatened.

SINGLE-TRACK TRAIL. A trail wide enough only for one user to travel and requires getting off the trail to allow another user to pass.

SNAGS. Standing dead trees.

SUCCESSION. The more or less predictable change in the composition of communities following a natural or human disturbance.

TAKE. Harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.

TREAD. The actual surface portion of a trail upon which users travel excluding backslope, ditch, and shoulder. Common tread surfaces are native material, soil cement, asphalt, concrete, or crushed rock.

UNTRAMMELED. An untrammeled area is which human influence does not impede the free play of natural forces or interfere with natural processes in the ecosystem.

WATERSHED. The entire area that contributes water to a drainage system or stream. Portion of the forest in which all surface waters drain to a common point.

WETLAND. Areas that are inundated by surface or ground water with a frequency sufficient to support a prevalence of vegetative or aquatic life dependent upon the water for growth and reproduction.

WILDERNESS. An area of wilderness is defined in sec. 2(c) of the Wilderness Act (16 U.S.C. 1131-1136).

WILDLIFE SIGN. Feathers, rubs, scraps, beds, and other evidence of wildlife use.

Index

Please send us your comments!

Use this form to suggest ways of improving this handbook or go on-line to tell us at: www.dnr.state.co.us/parks/
Send this form to: Stuart Macdonald, Colorado State Parks—Trails Program, 1313 Sherman Street, Room 618, Denver, CO 80203, email: MacTrail@aol.com, fax: 303-866-3206. Thank you.

CHAPTER 1. INTRODUCTION

CHAPTER 2. WILDLIFE AND TRAILS PRIMER

Any additional topics to cover? Rules of thumb to suggest? Additional reading to add for a topic?

CHAPTER 3. WILDLIFE AND TRAILS CHECKLIST

Any comments on the overall process? Additional steps to suggest?

CHAPTER 4. CASE STUDIES

Do you have other trail projects to recommend where important wildlife lessons were learned?

CHAPTER 5. SOURCES OF INFORMATION

Do you have other sources of information to recommend?

CHAPTER 6. GLOSSARY

Any other terms to include? Better defintions to suggest?