

**Partners in Flight
Land Bird Conservation Plan**

Colorado



Version 1.0

January 2000

Address comments to:
Carol A. Beidleman
Bird Conservation Plan Facilitator
Colorado Partners in Flight Chair
3245 Tunnel Road
Estes Park, Colorado 80517

970-586-3776

BeidlemanC@aol.com

EXECUTIVE SUMMARY

Justification

Continental and local declines in numerous bird populations have led to concern for the future of migratory and resident bird species. The reasons for declines are complex. Breeding habitat loss, modification and fragmentation, loss of wintering and migratory stopover habitat, brood parasitism, and pesticide use have been implicated. In 1990, the National Fish and Wildlife Foundation brought together federal, state, and local government agencies, private foundations, conservation groups, industry and the academic community to form a program to address the problem. Thus, Partners in Flight (PIF) was conceived as a voluntary, international coalition dedicated to “keeping common birds common” and “reversing the downward trends of declining species.”

Framework

The efforts to stem declines of both migratory and resident bird populations are guided by the “Flight Plan,” a national PIF document that provides a simple, effective framework for establishing regional and local conservation priorities for bird populations and the habitats upon which they depend. The Flight Plan identifies four steps which will result in biologically credible bird conservation that can be embraced by all partners: 1) identify priority species and habitats; 2) establish biological objectives; 3) identify actions to achieve objectives; and 4) implement bird conservation plans and monitor progress. These steps are being accomplished through the development of PIF Bird Conservation Plans for every state and physiographic area of the country. Thanks to funding from the National Fish and Wildlife Foundation and Colorado Division of Wildlife, Colorado PIF has been able to join in this effort, producing the Colorado Bird Conservation Plan.

Purpose

Effective and efficient ecological management involves determining which species and habitats are most in need of conservation. This plan identifies priority species and habitats, and establishes objectives for preserving or conserving bird populations and their habitats in Colorado. The plan not only focuses on microhabitat requirements of priority species, but also identifies landscape scale requirements. Conservation actions are recommended and partnerships are identified to accomplish the objectives.

Scope

Of the 278 breeding bird species in Colorado, 65 priority species in 15 major habitats and three physiographic areas are addressed in the Colorado Bird Conservation Plan. Coordinating conservation by habitat enables land managers to efficiently focus on a set of priority species and the specific habitat characteristics they need. Associate species that will benefit from management actions are listed in each priority species account.

Biological Objectives and Implementation Strategies

Biological objectives are identified for each priority species to provide a target for ecological planning and implementation, and a benchmark for measuring success. Preliminary

implementation strategies are identified to support the biological objectives, and will be further developed as the implementation phase proceeds. These strategies are organized by the statewide goals of the Colorado Bird Conservation Plan: to conserve and monitor all bird species in Colorado, monitor the quantity and quality of bird habitat, conserve unique representatives of and/or core areas in each major habitat, protect local sites that are important for conservation of priority species, promote management practices that benefit birds on all lands, conserve wintering grounds and migration habitat, develop outreach and educational programs, and identify and promote research priorities.

Evaluation of Progress

Research and monitoring needs are listed that relate directly to management questions. Research and monitoring are integral components of a feedback loop, supporting the plan as a dynamic document that will be updated and revised as new information becomes available. Thus, research and monitoring fulfill a critical link in the adaptive nature of this plan. The goals of the Colorado Bird Conservation Plan further provide a mechanism to evaluate the success of the Colorado PIF bird conservation implementation program on an annual basis.

Coordination

Many partners were instrumental in developing this document. However, coordination among existing and new partners is needed for the plan to succeed. Information in the plan can easily be linked with other landscape-level management programs; as implementation progresses, the plan can integrate with those other initiatives. Discussions regarding integration have already begun nationally with the North American Waterfowl Management Plan and Shorebird groups. International coordination is well under way with Canada and Mexico, and coordination of projects across international boundaries is planned for the implementation phase. Although this plan is specific to birds, coordination with other species groups will be a natural progression of implementation.

ACKNOWLEDGMENTS

We would like to extend appreciation and thanks to all of the partners who contributed their time and expertise to write this plan. Their hard work and dedication has made this very important endeavor possible. We thank all cooperating government agencies and organizations, including: Colorado Division of Wildlife, Colorado Bird Observatory, USGS Biological Resources Division, U.S. Forest Service, U.S. National Park Service, Bureau of Land Management, The Nature Conservancy, and Audubon of Colorado. We would like to especially thank the members of the Colorado Partners in Flight bird conservation planning team who contributed significantly to the development, writing, and editing of this plan: Carol Beidleman, Mike Carter, Jeff Connor, Beth Dillon, Ken Giesen, Scott Gillihan, Ron Lambeth, Rich Levad, Chris Pague, Dick Roth, Janet Ruth, and Chris Schultz. We would also like to thank the following individuals for their participation in manuscript review: Carol Beardmore, Bruce Baker, Doug Faulkner, Dave Hallock, Hugh Kingery, Fritz Knopf, Tony Leukering, Larry Norris, and Terri Skadeland.

TABLE OF CONTENTS

INTRODUCTION	8
Partners in Flight	8
The Flight Plan: Bird Conservation Planning	8
The Prioritization Process	9
Defining Status and Setting Biological Objectives	11
 OVERVIEW OF COLORADO	 13
Background	13
Physiographic Areas	13
Habitats	13
Conservation Issues	14
Conservation Opportunities	14
Avifaunal Analysis	16
State of Knowledge of Colorado's Birds	17
Statewide Implementation Goals and Objectives	17
 PHYSIOGRAPHIC AREA 36: CENTRAL SHORTGRASS PRAIRIE	 24
Background	24
Conservation Issues	25
Conservation Opportunities	26
Avifaunal Analysis	26
Habitats, Implementation Strategies, and Priority Species Accounts	27
Grassland	27
Swainson's Hawk	32
Ferruginous Hawk	34
Prairie Falcon	35
Plains Sharp-tailed Grouse	36
Greater Prairie-Chicken	37
Lesser Prairie-Chicken	38
Mountain Plover	40
Upland Sandpiper	41
Long-billed Curlew	42
Burrowing Owl	44
Cassin's Sparrow	45
Lark Bunting	47
Grasshopper Sparrow	48
McCown's Longspur	49
Lowland Riparian	51
Lewis's Woodpecker	55
Bell's Vireo	56
Shore/Bank	58

Snowy Plover	64
Piping Plover	65
Least Tern	66
Wetlands	68
Northern Harrier	75
Short-eared Owl	76
PHYSIOGRAPHIC AREA 62: SOUTHERN ROCKY MOUNTAINS	80
Background	80
Conservation Issues	81
Conservation Opportunities	82
Avifaunal Analysis	82
Habitats, Implementation Strategies, and Priority Species Accounts	84
Alpine Tundra	84
White-tailed Ptarmigan	86
American Pipit	87
Brown-capped Rosy-Finch	88
Aspen	90
Broad-tailed Hummingbird	96
Red-naped Sapsucker	97
Purple Martin	98
Violet-green Swallow	100
Cliff/Rock	102
Peregrine Falcon	106
Black Swift	108
High Elevation Riparian	110
Cordilleran Flycatcher	114
American Dipper	115
MacGillivray's Warbler	116
Wilson's Warbler	117
Lowland Riparian	119
Lewis's Woodpecker	123
Lazuli Bunting	124
Mixed Conifer	126
Blue Grouse	129
Williamson's Sapsucker	130
Mountain Shrubland	132
Virginia's Warbler	137
Green-tailed Towhee	138
Ponderosa Pine	140
Band-tailed Pigeon	144
Flammulated Owl	145
Mexican Spotted Owl	146

Lewis's Woodpecker	147
Grace's Warbler	148
Sagebrush Shrubland	150
Northern Sage Grouse	154
Brewer's Sparrow	155
Sage Sparrow	157
Spruce-Fir	159
Boreal Owl	163
Olive-sided Flycatcher	164
Hammond's Flycatcher	165
Wetlands	167
Willet	173
Short-eared Owl	174
PHYSIOGRAPHIC AREA 87: COLORADO PLATEAU	177
Background	177
Conservation Issues	179
Conservation Opportunities	180
Avifaunal Analysis	181
Habitats, Implementation Strategies, and Priority Species Accounts	182
Cliff/Rock	183
Peregrine Falcon	186
White-throated Swift	187
Lowland Riparian	189
Lewis's Woodpecker	193
Western Kingbird	194
Mountain Shrubland	196
Common Poorwill	200
Virginia's Warbler	201
Pinyon-Juniper	203
Black-chinned Hummingbird	210
Gray Flycatcher	212
Cassin's Kingbird	213
Gray Vireo	215
Pinyon Jay	216
Juniper Titmouse	217
Black-throated Gray Warbler	218
Scott's Oriole	220
Ponderosa Pine	222
Band-tailed Pigeon	226
Mexican Spotted Owl	227
Western Bluebird	228
Grace's Warbler	229

Sagebrush Shrubland	231
Northern Sage Grouse	235
Gunnison Sage Grouse	236
Brewer's Sparrow	237
Sage Sparrow	239
Semidesert Shrubland	241
Burrowing Owl	248
Loggerhead Shrike	249
Horned Lark	251
Wetlands	253
Northern Harrier	258
Short-eared Owl	260
 LITERATURE CITED	 262
 APPENDICES	
A: Scientific and Common Names of Plants and Animals	283
B: Habitat and Species Tables by Physiographic Area	287
Species of Selected Habitats within Physiographic Area 36	287
Species of Selected Habitats within Physiographic Area 62	292
Species of Selected Habitats within Physiographic Area 87	298
C: Partners in Flight Planning Unit Maps for Colorado	304
Partners in Flight Planning Units within Colorado	304
Partners in Flight Planning Units within Physiographic Area 36	305
Partners in Flight Planning Units within Physiographic Area 62	306
Partners in Flight Planning Units within Physiographic Area 87	307
D: Colorado GAP Vegetation Classification Map	308
E: Monitoring Colorado's Birds Program	309
F: Colorado Important Bird Areas Program	317

INTRODUCTION

Partners in Flight

Continental and local declines in numerous bird populations have led to concern for the future of migratory and resident bird species. The reasons for declines are complex. Loss, modification and fragmentation of breeding habitat, loss of wintering and migratory habitat, and brood parasitism have been implicated. Scientists and concerned citizens agreed that a coordinated, cooperative conservation initiative focusing on non-game land birds was needed. In late 1990, the National Fish and Wildlife Foundation brought together representatives from federal, state, and local government agencies, foundations, conservation groups, industry, and the academic community to form a program to address the problem. Thus, Partners in Flight (PIF) was conceived as a voluntary, international coalition of governmental agencies, conservation groups, academic institutions, private businesses, and everyday citizens dedicated to “keeping common birds common” and reversing the downward trends in bird populations. Partners in Flight’s primary goal is to direct resources to the conservation of non-game land birds and their habitats through cooperative efforts in monitoring, research, management, education, and international cooperation.

Colorado Partners in Flight, whose mission is to promote and enhance conservation and management efforts for Colorado birds, officially came into being in 1991. Participants include the Colorado Division of Wildlife, Colorado Bird Observatory, Bureau of Land Management, U.S. Fish and Wildlife Service, U.S. Forest Service, National Park Service, Department of Defense, USGS Biological Resources Division, Colorado State Parks, municipal government parks and open space departments, Audubon of Colorado and its chapters, The Nature Conservancy, Colorado Natural Heritage Program, American Birding Association, Denver Museum of Natural History, Denver Field Ornithologists, Colorado Field Ornithologists, university researchers, dedicated individuals, and many others.

The Flight Plan: Bird Conservation Planning

The “Flight Plan” is a national PIF document that defines the strategy for coordinating, developing and writing Partners in Flight Bird Conservation Plans. Much as the North American Waterfowl Management Plan does for waterfowl, PIF’s geographically based plans will direct efforts and prioritize funding for conserving non-game land birds.

Effective and efficient ecological management requires determining which species and habitats are most in need of conservation. The PIF plans identify priority species and habitats, and establish objectives for bird populations in physiographic areas (PIF planning units defined by biotic communities and bird distribution). The plans identify the type, quantity, and quality of habitats required by priority species on the local level and at the landscape scale. The plans also identify conservation opportunities and partnerships needed to accomplish their objectives. PIF bird conservation plans complement the long-established North American Waterfowl Management Plan and the more recently initiated Shorebird Conservation Plan and North American Colonial Waterbird Conservation Plan.

The first official step in developing a Bird Conservation Plan (BCP) in Colorado was to apply for a National Fish and Wildlife Foundation (NFWF) grant. This grant provided support for a Colorado PIF Bird Conservation Facilitator to coordinate the development of the Colorado Bird Conservation Plan. The grant agreement for \$32,000 in NFWF funds was signed in February 1998, requiring a match of \$48,000 in challenge funds. Prior to the grant's approval, the Colorado Division of Wildlife pledged a match of \$38,000, which demonstrated the Division's strong commitment to non-game bird conservation. These matching funds became available in May 1998, and work on the plan began. The remaining \$10,000 in challenge funds to complete the grant requirements were raised later.

Dozens of people have since participated in planning meetings, drafted language, and reviewed documents. State working groups and habitat working groups, functioning under the umbrella of the Western Working Group of the U.S. Partners in Flight program, have held numerous planning meetings. The meetings were open to anyone with an interest in bird conservation and were designed to solicit, discuss, and compile information into a document that forms the core of the plan. These meetings revealed significant data and observations unavailable in the scientific literature, information that highlighted the need for specific approaches and objectives to manage local variations in habitat use and ecosystem function.

The goals of the Colorado Bird Conservation Plan are to conserve and monitor all bird species in Colorado, monitor the quantity and quality of bird habitat, conserve unique representatives of and/or core areas in each major habitat, protect local sites that are important for conservation of priority species, promote management practices that benefit birds on all lands, conserve wintering grounds and migration habitat, develop outreach and educational programs, identify and promote research priorities, and evaluate the success of the Colorado PIF bird conservation implementation program on an annual basis.

Partners in Flight recognizes that significant gaps in our knowledge of Colorado's birds still exist. However, it intends to assemble the best and most current scientific information into a format that land managers and landowners can use to put ideas into action. As new information becomes available through the research and monitoring recommended in this plan and from the discovery of previously overlooked information, it will be incorporated into updated versions of the plan. Thus, the Colorado Bird Conservation Plan is to be considered a dynamic document.

The Prioritization Process

Rather than presenting information about all species, the Colorado Partners in Flight Bird Conservation Plan identifies species that have conservation priority in each of its planning units; it assumes that conservation measures focused on these priority species and their habitats will benefit the other species using these habitats as well.

The Partners in Flight Species Prioritization Process, first developed in 1991, has been continually reviewed and refined (Carter et al. 1999). This process ranks each species of North American

breeding bird based upon seven measures of conservation “vulnerability.” The rankings include global measures (breeding distribution, non-breeding distribution, and relative abundance) and measures specific to each physiographic area [area of importance (AI), population trend (PT), and threats to breeding (TB)]. For each category a species is given a score of 1–5, with 1 indicating the lowest vulnerability and 5 the greatest vulnerability. The sum of the scores produces a composite score ranging from 7–35. Species with high overall scores are most vulnerable to extinction (although they often are not listed as endangered at present) and need conservation measures or at least need to be carefully monitored through their ranges. The PIF prioritization process can be applied at the global, national, state, or physiographic area level.

Partners in Flight has generated scores for all breeding species in Colorado by physiographic area. Selected species scores are presented in Appendix B. A further analysis of these scores was used to identify priority species, by physiographic area, for Colorado. The criteria which define priority species are categorized into several “tiers,” entry levels into the priority species pool. No tier is more important than any other, and although each priority species may receive a single tier designation, it may also qualify for inclusion in other tiers. Furthermore, some species peripheral to Colorado are not included as priority species even though they may meet tier criteria. The tiers are defined as follows:

- I. *High overall (global) priority*—species scoring ≥ 22 in the PIF prioritization system. Indicates high vulnerability of populations throughout the species range, irrespective of specific status in the physiographic area. Peripheral species are omitted.
- II. *High physiographic area priority*—species scoring 19–21 in the PIF system, with AI + PT ≥ 8 . Indicates a species of moderately high global vulnerability and with both relatively high abundance and a declining or uncertain population trend in the physiographic area.
- III. *Additional Watch List*—species on PIF’s national Watch List that did not already meet criteria I or II. Watch List species score ≥ 20 (global scores only), or 18–19 with PT = 5.
- IV. *Abundant yet declining*—any additional species for which the score for AI = 5 and the score for PT = 5. May identify species or a habitat type in need of monitoring.
- V. *Area responsibility*—additional species with relatively high proportion of global population in the physiographic area [$>5\%$ for areas $< 200,000 \text{ km}^2$ ($77,200 \text{ mi}^2$); $\geq 10\%$ for areas $> 200,000 \text{ km}^2$]. Signifies that the area shares in responsibility for long-term conservation of species, even if not currently threatened.
- VI. *Additional listed*—species on federal or state endangered, threatened or special concern lists that did not meet any of the above criteria. These are often rare or peripheral populations.

VII. *Local concern*—species of justifiable local concern or interest. May represent geographically variable population or be representative of specific habitat of conservation concern.

In addition to the PIF scores, Appendix B includes scores from COVERS, the Colorado Vertebrate Ranking System developed for the Colorado Division of Wildlife. The COVERS categories listed for each species include: Stage 1 Biology (B1, indicating degree of biological imperilment); Stage 2 Biology (B2, sum of Stage 2 Biology variable scores); Stage 2 Importance of Colorado Populations (IMPORT, evaluates the “value” of individuals to the health of the global population and to the biotic community of the state of Colorado); and Total Biology (T.Bio, sum of all Stage 1 and Stage 2 Biology variable scores). Appendix B also indicates species having a special status designated by an agency within the State of Colorado.

Sorting the species in the priority pool by habitat identifies the highest priority habitats and associated species. A high priority habitat may have many priority species using it or a few priority species with high concern/vulnerability scores. Priority habitats are listed by physiographic area and are discussed in detail in the plan.

The highest priority species are listed by habitat within the appropriate physiographic area and a species account is provided. Priority species discussed in the plan are identified by tiers in Appendix B. A species may be discussed for any of the following reasons: 1) it represents a group or suite of species that will likely react similarly to management recommendations; 2) it utilizes a biotic component that is essential to a functioning habitat (e.g., a species using forest canopy or requiring a certain percentage of ground cover for nesting); 3) it is an area sensitive species or requires another landscape feature, such as a large territory; 4) it requires a certain successional stage; 5) the habitat is its primary or only breeding habitat; 6) monitoring it will permit ready assessment of the success of conservation efforts; 7) it is on either the federal endangered and threatened species list, or a watch list/species of concern list from a state agency or national conservation organization.

Defining Status and Setting Biological Objectives

Important steps in developing a bird conservation plan for the state include determining the current status of each priority species identified in the “tier process” and setting biological objectives that will enable us to evaluate our conservation efforts.

In defining the status of and setting biological objectives for each priority species in Colorado, many sources of information have been explored. In many cases the best source of information is the national Breeding Bird Survey (BBS). For this reason, it is important to define how we are using these BBS data, and to recognize the limitations of these data. The BBS employs trained volunteer observers who conduct roadside bird surveys along randomly distributed routes. The data obtained since its establishment in 1966 provide valuable information about bird distribution, population trends, and abundance across the country. However, for a number of reasons related to survey design or species life history (including geographic areas with limited road coverage, a

limited source of trained observers, species with clumped populations, nocturnal species, or habitats not easily surveyed from a roadside) BBS data for some species are limited and inadequate to estimate distribution and population trends. These limitations especially affect data from the sparsely populated West. In many cases, species inadequately sampled by BBS methods are not satisfactorily surveyed by alternative methods either. This issue is being addressed in Colorado by such programs as *Monitoring Colorado's Birds (MCB)*, and the plan identifies a number of specific needs for improved population surveys. The data available from BBS and any other sources will be presented in the "Status and Reasons for Concern" sections of the bird species accounts.

For this plan, we have adopted interpretations of BBS data that are consistent with BBS data analysis protocols and PIF uses (e.g., the prioritization process) of the data. Population trends (percent/year) are estimated by the BBS using the route-regression method described by Geissler and Sauer (1990). Regional trends are estimated as a weighted average of trends on individual routes. For further information about the analysis methods used, see the BBS website <http://www.mbr-pwrc.usgs.gov/bbs>.

For BBS population trend data, we will consider as statistically significant any trend with a P -value ≤ 0.10 and a sample size ≥ 14 . Based on this standard, a P -value larger than 0.10 indicates no statistical evidence of a trend, positive or negative (i.e., there is no evidence that the regression line is significantly different from zero). P -values larger than 0.10 may mean that there really is no trend, or that there is a trend that can't be detected due to low sample size, high variances, very small magnitude trends, or a combination of factors. For trend information, whether significant or not, we will provide the P -value and sample size to permit the readers to reach their own conclusions.

In addition, we frequently use BBS data to define the distribution of a species in the physiographic area. For this purpose we have calculated the following values for that portion of the physiographic area that lies within Colorado (i.e., not for the entire physiographic area) using data from 1988–1997: 1) mean percentage of routes run in the physiographic area on which the species was detected; 2) mean number of individuals detected per route; and 3) number of routes.

From the status and distribution information, biological objectives were developed. Biological objectives must be specific and measurable so that we can evaluate our progress toward the goals of keeping populations well-distributed throughout their natural range and reasonably common, stable, and self-sustaining.

Distribution is generally defined as the area in which a species is "present," and is distinguished from abundance. Due to lack of information about most species that would allow us to define or measure a biological objective as the number of $X \text{ km}^2$ in which the species is present, we have chosen a surrogate. For common and widespread species we set distribution objectives as the desired proportion of BBS routes (or other equivalent units) on which the species is to be recorded.

For rare species, or ones that occur in only a few areas (e.g., colonial species), the number of sites supporting the species is more meaningful and is used instead of BBS routes.

For many species, meeting a distribution objective will also ensure that the population is reasonably abundant, stable, and self-sustaining, and no additional objectives are needed. However, this is not always the case (e.g., for species with clumped distributions). In such cases, the total population could decline seriously, with each site still supporting some birds. Thus, an abundance component should be included in the objectives for these species. In most cases these biological abundance objectives are based on the BBS population trend data and call for maintaining a positive trend of X%, reversing a negative trend, or improving a current flat-line trend estimate until it is a positive trend. Another sort of abundance objective requires a mean of X individuals recorded per route.

OVERVIEW OF COLORADO

Background

Colorado is a land of contrasts, a place where rolling grasslands of the Great Plains in the east abruptly give way to a backbone of rugged mountains, which in turn give way to plateaus and canyons in the west. A day's drive can take travelers from semidesert all the way up to alpine tundra. Elevations range from a low of about 975 m (3,200 ft) in Prowers County on the eastern plains, to 4400 m (14,433 ft) on Mt. Elbert, near Leadville. Major rivers include the Yampa, White, Colorado, Gunnison, and Dolores in the west, and the North Platte, South Platte, Cache la Poudre, Arkansas, Arikaree, Republican, Big Sandy, Purgatoire, and Rio Grande in the east. Much of the prairie lands in the east are privately owned, and most of the mountainous western lands are federally owned.

Physiographic Areas

Partners in Flight physiographic areas found in Colorado include the Central Shortgrass Prairie (PA36), Southern Rocky Mountains (PA62), Colorado Plateau (PA87), and Wyoming Basin (PA86). Based on the percentage of the physiographic area within the state boundary, Colorado has the state lead for bird conservation planning in the Central Shortgrass Prairie and Southern Rocky Mountains physiographic areas, but will share responsibility for the Colorado Plateau Physiographic Area with New Mexico, Arizona, and Utah, and will defer responsibility for the Wyoming Basin Physiographic Area to Wyoming. Physiographic areas are discussed in detail later in the plan. Maps of Colorado's physiographic areas are included in Appendix C.

Habitats

The plan identifies 15 habitat types important to birds in Colorado. The habitat classifications and assignment of bird species to the habitats were developed by Colorado Bird Observatory (CBO) staff along with individuals who contributed to early development of the conservation prioritization scheme. Some adjustments were made by consensus of the BCP team. Bird species were

assigned to specific habitats based on their restriction to, or strong representation within, that habitat type. This habitat classification was designed to crosswalk with those of natural resource agencies, or at least be intuitively clear to agency staff. It identifies 13 vegetation-based categories (alpine tundra, aspen, grassland, high elevation riparian, lowland riparian, mixed conifer, mountain shrubland, pinyon-juniper, ponderosa pine, sagebrush shrubland, semidesert shrubland, spruce-fir, and wetlands), and two structural categories (cliff/rock and shore/bank). Because of its high number of priority bird species (14), grassland habitat in Physiographic Area 36 is the highest priority habitat in Colorado. Habitats are discussed in detail within the context of the physiographic areas. A Colorado GAP vegetation classification map is included in Appendix D.

Conservation Issues

Colorado's natural resources are under intense pressure from a burgeoning human population. The human population increased 16% between 1990 and 1997, with an accompanying 261% increase in building permits (from 1990 to 1996). Recent estimates place land development in Colorado at 17,600 ha (43,500 ac) per year (Hobbs and Theobald 1998). Land developed for housing and associated uses is largely unsuitable for birds, save those species that tolerate high levels of human activity and greatly altered habitats. Colorado's rapid growth has led to the decline of some of Colorado's bird species. Burrowing Owl populations, for example, are under intense pressure along the Front Range as urbanization claims suitable habitat.

Colorado's growth has been accompanied by geometric increases in recreational use of public lands where many of Colorado's bird species reside. The impact of recreationists on bird populations is only beginning to be examined, but it appears that even activities thought to be relatively benign, such as hiking on established trails, can negatively affect local bird populations by altering habitat, disrupting breeding activities, attracting native predators, and introducing domestic predators (Miller et al. 1998).

Conservation Opportunities

A list of some current projects that have profound implications for conservation of Colorado's avifauna follows. This list is by no means exhaustive but is intended to highlight innovative and broad-scale initiatives.

- In cooperation with the agencies charged with protecting and managing Colorado's birds, Colorado Bird Observatory has developed a program of bird monitoring for the state, *Monitoring Colorado's Birds* (hereafter referred to as *MCB*). *MCB* is designed to monitor all regularly-occurring breeding bird species in the state with annual habitat-based population surveys. Most species will be monitored through count-based techniques; species for which conventional count transects are inappropriate will be monitored through the use a variety of special, species- or group-specific techniques. A second phase of the program will gather demographic information to determine the possible reasons for known declines and to develop management information. Three agencies—Colorado Division of Wildlife, U.S. Forest Service, and Bureau of Land Management—are embarking on a five-year Memorandum of

Understanding to institutionalize this program. Two other agencies—National Park Service and U.S. Fish and Wildlife Service—are evaluating possible roles in the program. The *Monitoring Colorado's Birds* program plan is included in Appendix E.

- The Colorado *Important Bird Areas (IBA)* program began in March 1999 as a cooperative effort between the National Audubon Society and Colorado Bird Observatory, with support from Colorado Partners in Flight and Audubon of Colorado. A coordinator was appointed at Colorado Bird Observatory to head the program for the first year, and an 8-member technical committee comprised of some of the state's top bird experts was organized. This committee, using standardized categories for all state programs, identified specific criteria for each category based on the avifauna and habitat types representative of Colorado. The program is currently in the nomination phase and has received nominations for 57 sites (Jan 2000). These site nominations are being reviewed by the technical committee. Official *IBA* site recognition will occur in March 2000. An overview of the *IBA* program, with criteria for site selection in Colorado, is included in Appendix F.
- Colorado Bird Observatory has developed a cooperative program, *Prairie Partners*, to work with landowners, leaseholders, and land managers in the U.S. and Mexico to conserve shortgrass prairie and the birds that depend upon it. Participants draw upon information gathered in a Best Management Practices manual to facilitate their contributions to bird conservation. All participants receive a certificate of participation and an annual report detailing the contributions of all partners.
- The Nature Conservancy has adopted an ecoregional planning effort to identify and preserve important natural communities and species within the TNC ecoregions that include Colorado. The basis of the effort is the protection and management of suites of sites that include community types and species that are representative of the ecoregion.
- The Colorado Natural Heritage Program gathers and compiles data on the distribution and status of "rare and imperiled" organisms in the state, including birds, and provides the data to interested parties as a proactive land-planning and research tool.
- The Colorado Natural Areas Program identifies lands possessing significant elements of natural diversity in the state, negotiates with the landowners or custodians, and designates State Natural Areas. State Natural Area designation typically carries fraternal rather than legal protections for the highlighted natural elements.
- The Ponderosa Pine Forest Partnership in southwestern Colorado aims to restore ponderosa pine forests to presettlement conditions by thinning small trees, preserving large trees and snags, and applying prescribed burns to open the understory. Agencies and organizations involved in the undertaking include the San Juan National Forest, Montezuma County, Colorado Division of Wildlife, Fort Lewis College, and the Colorado Timber Industry

Association. This collaborative effort aims to develop a sound restoration prescription via adaptive management—attempting new management methods, analyzing the outcome, and modifying subsequent efforts so as to develop a restoration prescription that accomplishes the goals of the Partnership. After an experimentation and evaluation period, ponderosa restoration activities are scheduled to occur on 1620–2020 ha (4,000–5,000 ac) per year in Colorado, and restoration methods may be adopted by resource managers for implementation elsewhere in the West.

Avifaunal Analysis

Colorado's habitat diversity promotes avian diversity—in the last 100 years, 464 species have been seen in the state. Only California, Texas, Arizona, and Florida have higher state species counts. Of the 464 species that have visited Colorado, 278 have bred at some point; the *Colorado Breeding Bird Atlas* documented 264 breeding in the state during the period of the Atlas (1987–1995). Many of these species reach their highest abundance in the state; 22 reach or exceed 50% of their maximum abundance in any state (based on BBS data through 1996).

In general, monitoring information from the BBS is poor, with only 63 (23%) species being well monitored. Data for 216 (77%) species are so sparse that those species are virtually unmonitored in the state. Of those that are well monitored, eight are declining and 55 are increasing or stable. (It should be noted, however, that common species are more easily monitored, and declines are statistically more difficult to detect.) The main message regarding bird monitoring within the state is that many species may be falling through the cracks due to inadequate monitoring, and declining populations may be going unnoticed.

A number of Colorado species have small distributions (occupying <5% of North America) on either their breeding ($n = 16$; 6%) or wintering ($n = 16$; 6%) grounds. The number of species threatened by impacts to breeding or winter grounds is moderate; sixteen species (16%) score 4 or 5 for Threats on Winter grounds in the PIF Priority System, and 23 (8%) score 4 or 5 for Threats on Breeding grounds.

Together, these statistics indicate that Colorado has a unique and important avifauna. The populations of a few species show documented declines and many show documented increases, but the vast majority are unmonitored. While individual threats are probably extensive, the number of species documented to be suffering from any single threat or from combinations of threats is moderate, both in the breeding and non-breeding seasons. Many species inhabit very small ranges and may be at risk from events occurring within these small ranges. Only one of the state's species has gone extinct in recorded history (Carolina Parakeet), but others may have been extirpated and many are currently listed by natural resource agencies as either endangered, threatened, of concern, or sensitive. The generally positive picture is compromised by the known declines and the fact that some species exhibit small ranges, others are experiencing habitat loss on their breeding and/or wintering grounds, and most are virtually unmonitored.

State of Knowledge of Colorado's Birds

Colorado's history of ornithological study extends back to the days of frontier exploration. A fine recounting of that history can be found in Bailey and Niedrach (1965), but several landmark accomplishments deserve mention. One of the first zoologists afield in Colorado was Thomas Say, who collected bird specimens while accompanying the Long Expedition in the early 1820s. Later ornithologists added to the species list and expanded our knowledge of natural history through the collecting of specimens and eggs, and careful recording of observations. Cooke (1897) published the first extensive collection of information on Colorado's birds, followed later by Sclater (1912) and Bergtold (1928). The two-volume set by Bailey and Niedrach (1965) was, for many years, the standard reference to Colorado ornithology, and is still widely used. The *Colorado Bird Distribution Latilong Study* (Chase et al. 1982, Kingery 1988) included schematic distribution maps, and estimates of abundance. Andrews and Righter (1992) has replaced Bailey and Niedrach as the standard reference on distribution and abundance of birds in Colorado. The *Colorado Breeding Bird Atlas* (Kingery 1998) provides more extensive information on the natural history and distribution of the state's breeding birds. Yanishevsky and Petring-Rupp (1998) offers detailed life history information and management recommendations for some Colorado species.

Recently completed projects have collected extensive data on distribution and abundance of Colorado birds. The CDOW's COVERS project compiled information on population status, ecology, and management for all vertebrate species in Colorado, including birds. The *Colorado Breeding Bird Atlas* project collected data from nearly 1300 field workers over eight years (1987–1994), compiling over 80,000 records (Kingery 1998). Those data have been deposited with several agencies and organizations in Colorado, with the raw data on file at the Denver Museum of Natural History.

Several bird monitoring programs in the state are ongoing. The Audubon Society's Christmas Bird Count inventories wintering birds, currently in 35 locations. The Hawkwatch, conducted under the direction of the Denver Museum of Natural History and the Colorado Bird Observatory, counts raptors during their spring migration along the Dakota Hogback west of the Denver metropolitan area. The Colorado Natural Heritage Program compiles information on the distribution of rare species in Colorado for use in setting conservation priorities and assisting in land-use planning activities. The Breeding Bird Survey initiated in 1966 and jointly coordinated by the USGS Patuxent Wildlife Research Center and the Canadian Wildlife Service, conducts roadside surveys each spring. The BBS data have been basic to determining priority species in this plan. Colorado Bird Observatory's *MCB* project is conducting count-based surveys in a large number of habitats, surveying nesting colonies, and conducting species-specific surveys to document habitat associations, distributions, and population trends. This project will greatly increase the data available on Colorado's bird populations.

Statewide Implementation Goals and Objectives

Based on the key concepts identified by the Colorado Partners in Flight bird conservation planning team, we have identified the following statewide goals and objectives which must be met to

achieve our overall goals of “keeping common birds common” and “reversing the downward trends of declining species” in Colorado. These statewide goals and objectives will be fleshed out and expanded within the habitat writeups.

1. Bird Monitoring

Goal: All breeding birds in Colorado will be monitored or tracked to document distribution, population trends, and abundance in a statistically acceptable manner.

Objective: All species with an area importance (AI) score > 2 will be monitored with count-based methods. We will continue to use BBS data, but will incorporate *Monitoring Colorado's Birds* data as they become available.

Objective: Species with AI scores ≥ 2 will be tracked through count-based methods or their presence or absence noted in the state.

Objective: Some species such as colonial nesters and nocturnally-active species will be monitored or tracked using special techniques such as colony counts and nocturnal transects.

Objective: All species with a population trend (PT) score of 4 or 5 will be tracked with demographic monitoring methods.

2. Habitat Monitoring

Goal: To monitor all major habitats in Colorado in order to document amount, condition, and ownership. This goal is crucial to the implementation of all parts of the bird conservation plan since it will allow us to determine the current state of things and the potential partners available to implement activities on any particular habitat.

Objective: Develop collaborative efforts (potential partners include Colorado DOW, Colorado Natural Heritage Program, Colorado Bird Observatory, The Nature Conservancy, USGS) to use GIS in mapping all major habitat types in the state, documenting amount, condition, ownership, etc.

3. Habitat Core Areas

Goal: To conserve unique representatives and/or core areas in each major habitat in Colorado. Specific candidates or foci may be identified in the habitat writeups. This goal considers the importance of such areas to birds during breeding, migration, and winter.

Objective: Identify unique representatives and/or core areas in each major habitat type in Colorado that should be conserved.

Objective: Identify any of these core areas that are appropriate for designation as *IBAs*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Objective: Identify additional means of designating and conserving unique representatives and/or core areas in each major habitat type in Colorado.

Objective: Identify agency- or organization-specific means of designating and conserving unique representatives and/or core areas (e.g., state management areas, refuges, wilderness areas, and possible purchase by private or public entities, etc.). Identify areas that are appropriate for such designations, work with the appropriate agency or organization to designate them, and promote conservation activities.

Objective: Promote collaboration/cooperation between agencies, organizations, and individuals in conserving unique representatives and/or core areas with multiple ownership.

4. Site-based Conservation

Goal: To conserve local sites that are important for the conservation of priority species. These sites may include key nesting spots (e.g., cliffs, nest colonies, individual nest sites for rare species, etc.), lek sites, migration staging or stopover spots, or concentration sites. This goal considers the importance of such areas to birds during breeding, migration, and winter.

Objective: Identify key local sites that are appropriate for designation as *IBAs*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Objective: Identify additional means of designating and conserving key local sites.

Objective: Identify agency- or organization-specific means of designating and conserving key local sites (e.g., exclosures, protocols in management plans, exclusion of certain activities during important times of the year, and possible purchase by private or public entities, etc.). Identify areas that are appropriate for such designations, work with the appropriate agency or organization to designate them, and promote conservation activities.

5. Management Practices

Goal: To promote management practices that benefit birds on all lands. This goal is not meant to encourage the impression that someone can manage a single piece of land to benefit all birds, but rather to encourage all land managers to understand that there is something they can do on any piece of land to benefit birds.

Objective: Best Management Practices (BMPs) manuals will be produced and distributed for each priority habitat in Colorado. In some cases, existing documents such as *Birds in a Sagebrush Sea* (Paige and Ritter 1998) will be used to avoid duplication of effort. The focus

on priority habitats rather than priority species is meant to promote management using a community approach, recognizing the range of needs expressed by the suite of species using a particular habitat.

Objective: Identify key landowners and/or land managers and ask them to incorporate best management practices to conserve priority species and their habitat in Colorado. Work with land managers to develop practices that meet their needs and those of the birds, and evaluate effectiveness.

Objective: Monitor the quantity and quality of acres managed under each BMP.

6. Interstate/International Wintering Grounds

Goal: To conserve the wintering ground habitat used by Colorado migratory birds outside of the state and the country.

Objective: Identify the wintering distribution and key habitat associations of all priority Colorado species. Some of this information is already available and presented in the habitat and species writeups.

Objective: Monitor all major wintering habitats for priority species in order to document amount, condition, and ownership.

Objective: Develop collaborative efforts with other states and countries to monitor wintering habitats and conserve them for wintering migrants and resident species.

Objective: Develop collaborative efforts with other states and countries on projects (e.g., education, research, fund-raising, donations, etc.) which benefit species on their winter grounds.

7. Migration Concerns

Goal: To conserve the migration habitat used by priority Colorado species, and to conserve those species themselves as they migrate. This goal focuses particularly on migration corridors, concentration areas, and staging areas.

Objective: Identify key migration habitats of priority Colorado species.

Objective: Monitor key migration habitats for priority species in order to document amount, condition, and ownership.

Objective: Develop collaborative efforts with other states and countries to monitor migration habitats and conserve them for migrants and resident species.

Objective: Develop collaborative efforts with other states and countries on projects (e.g., education, research, fund-raising, donations, etc.) which benefit species on their migration grounds.

8. Outreach and Education

Goal: To provide information about priority species (conservation, habitat needs, natural history, etc.) and habitats to the public, resource managers, and other interested parties with emphasis on school children, teachers, naturalists, landowners, and natural resource professionals. The habitat writeups may identify priority species and habitats on which to focus.

Objective: Develop and make educational materials and information booklets about priority species or habitats available to local nature centers and organizations, landowners, natural resource agency offices, and teachers. This might include producing materials for the agricultural extension service, the Natural Resources Conservation Service, or the timber industry.

Objective: Integrate information on priority species or habitats into existing education programs (Project Wild, Balarat, other programs for children and adults).

Objective: Hold workshops and field programs for teachers, natural resource professionals, and landowners.

Objective: Present information at education, natural resource professional, and land manager (timber and ranching) association meetings and conferences.

Objective: Submit manuscripts to popular magazines for children and adults, and also those targeting landowners and managers.

Objective: Use the annual International Migratory Bird Day (IMBD) to supply local media outlets with information on priority species and habitats, organize informational activities for school children and the public, provide guided natural history viewing opportunities, and promote local conservation activities in which people can become involved.

Objective: Collaborate with Mexican and Central American colleagues in translating and/or developing informational and educational materials on priority species and habitats in Spanish.

9. Research Priorities

Goal: To fill the voids in scientific information needed to conserve Colorado's birds.

Objective: Identify the top ten research needs in each major habitat in Colorado. See the habitat writeups for these developing lists.

Objective: Facilitate investigations to answer these questions by providing information about priority needs to universities, and public and private research entities, identifying funding sources, promoting collaboration between management and research agencies, etc.

10. Adaptive Management

Goal: To evaluate the success of the Partners in Flight bird conservation program and to incorporate the lessons learned and the new information produced into an improved program for the conservation of Colorado's birds.

Objective: Convene an annual meeting where progress on the above goals and objectives is presented. This may be accomplished with a sort of "score card" based on the previous nine categories of goals and objectives.

Objective: Based on the results of the score card and annual meeting, redraft objectives to reflect progress or what has been learned in the previous year.

PHYSIOGRAPHIC AREA 36: CENTRAL SHORTGRASS PRAIRIE	24
Background	24
Conservation Issues	25
Conservation Opportunities	26
Avifaunal Analysis	26
Habitats, Implementation Strategies, and Priority Species Accounts	27
Grassland	27
Swainson's Hawk	32
Ferruginous Hawk	34
Prairie Falcon	35
Plains Sharp-tailed Grouse	36
Greater Prairie-Chicken	37
Lesser Prairie-Chicken	38
Mountain Plover	40
Upland Sandpiper	41
Long-billed Curlew	42
Burrowing Owl	44
Cassin's Sparrow	45
Lark Bunting	47
Grasshopper Sparrow	48
McCown's Longspur	49
Lowland Riparian	52
Lewis's Woodpecker	56
Bell's Vireo	57
Shore/Bank	59
Snowy Plover	65
Piping Plover	66
Least Tern	67
Wetlands	69
Northern Harrier	75
Short-eared Owl	77

PHYSIOGRAPHIC AREA 36: CENTRAL SHORTGRASS PRAIRIE

Background

The Central Shortgrass Prairie Physiographic Area covers much of eastern Colorado and smaller portions of western Kansas, southwestern Nebraska, and southeastern Wyoming. Most of the land (70%) is privately owned; the remainder is under the jurisdiction of the states (22%) and the federal government (7%). Principal federal holdings are U.S. Forest Service National Grasslands: Thunder Basin in Wyoming (231,485 ha; 572,000 ac), Pawnee (78,100 ha; 193,000 ac) and Comanche (169,570 ha; 419,000 ac) in Colorado, Ogallala in Nebraska (37,800 ha; 93,400 ac), and Cimarron in Kansas (43,700 ha; 108,000 ac).

The region contains flat to gently rolling topography, with occasional canyons and bluffs. Elevations within Colorado range from about 975 m (3,200 ft) in Prowers County to about 1800 m (6,000 ft) around Limon and near the foothills of the Rockies. Principal rivers include the South Platte, Arikaree, Big Sandy, Republican, and Arkansas. Precipitation is low, less than 50 cm (20 in) per year with most of that falling in spring and summer; total precipitation varies greatly between years at a given location and varies significantly more than in mixed grass or tallgrass systems (Wiens 1972). Mean monthly temperatures range from -12°C (10°F) in winter to 38°C (100°F) in summer. Localized severe weather is not uncommon, and blizzards, hailstorms, and tornadoes occur in most years.

The dominant habitat in this physiographic area is shortgrass prairie. Shortgrass is dominated by two low-growing warm-season grasses, blue grama and buffalo grass; western wheatgrass is also present, along with taller vegetation including widespread prickly-pear cactus and yucca, and cholla in the south. Sandsage prairie is found where sandy soils occur, and is dominated by sand sagebrush and the grasses sand bluestem and prairie sand-reed. Mixed grass (needle-and-thread, side-oats grama) and tallgrass (big bluestem, little bluestem, switchgrass) communities occur locally.

Ecological forces that shape the shortgrass prairie landscape include fire, grazing, and climate. Little is known about the ecological role of fire in shortgrass, although before the advent of fire suppression by humans, fire was probably less frequent than in either mixed grass or tallgrass prairie (Weaver et al. 1996). Prescribed burns have been used in shortgrass to remove woody vegetation, cacti, and accumulated litter and to improve grazing conditions for livestock, but the grasses recover slowly, requiring 2–3 years with normal precipitation (Wright and Bailey 1980). Before widespread settlement by European-Americans, grazing regimes consisted of native ungulates wandering widely across the shortgrass prairie—spreading over the landscape the impact of their grazing and trampling—and prairie dog colonies expanding, contracting, and moving in response to climatic influences on vegetation so that, at any given time, they grazed some areas intensively and others not at all (Knopf 1996*b*). The severity of the semi-arid climate and the sharp differences over relatively short distances in precipitation produced contrasts in vegetation and advanced the formation of a variegated landscape. Grassland birds thus evolved in a shifting

landscape mosaic, with access to patches of vegetation in a variety of successional stages and conditions.

A second habitat in this physiographic area is lowland riparian. In the shortgrass prairie, lowland riparian habitats occur along the few stream and river courses. Riparian vegetation is dominated by plains cottonwood, willow shrubs, and introduced species such as Russian-olive and Chinese elm. Trees were uncommon features of the shortgrass prairie before European settlement (Hart and Hart 1997); development of woody vegetation has been facilitated in historical times by alteration of natural river flow regimes, a result of irrigation drawdown and reservoir construction for flood control. Animal species of eastern deciduous forests, including birds, have capitalized on the recent development of wooded corridors, and many of the species now found in this habitat in the shortgrass region are actually eastern natives (Knopf 1986). Their impact on indigenous species is largely unknown.

Additional habitats in this physiographic area that support priority bird species are shore/bank (a habitat type found along watercourses, reservoirs, and playas) and wetlands (including marshes, wet meadows, lakes, and ponds).

Conservation Issues

The driving conservation issues in the Central Shortgrass Prairie are habitat loss and habitat alteration. Colorado's rapid population growth and accompanying land development are responsible for much of the habitat conversion and degradation. Within the shortgrass area, much of that development is concentrated along the Front Range in Denver, Boulder, Jefferson, Arapahoe, Larimer, and Douglas counties, where population densities are as high as 1,180 people/km² (3,050/mi²). Human population densities in counties within the physiographic area but away from the Front Range corridor range from as high as 6.6 people/km² (17.1/mi²) in Morgan County to as low as 0.4 people/km² (1.0/mi²) in Kiowa County (U.S. Department of Commerce 1991).

Because much of the shortgrass prairie is too dry to farm without irrigation, the proportion of plowed land is not high and much of the region is still grassland (Weaver et al. 1996). In Colorado, approximately 67% of the historical shortgrass prairie still exists (Knopf 1994), although some sources suggest that only 20% of the original shortgrass prairie exists in an unaltered state—the rest having been converted to cropland and urban development or degraded by overgrazing. Conversion to agriculture results in an absolute loss of grassland habitat, but much of the area is managed for grazing, which maintains grassland habitat but often with changes in plant height, vigor, and community composition.

Ideally, modern management would replicate the timing, intensity, and landscape distribution of the natural disturbances that shaped the shortgrass prairie (unfortunately, detailed information about presettlement conditions is lacking). In practice, however, modern grazing tends to spread grazing intensity evenly, producing a comparatively homogeneous landscape. Shortgrass birds are

left with few options if grazed prairie does not meet their habitat needs. “There is no shortage of grazed and hayed lands for those species that benefit from these activities. By comparison, habitat for species with breeding requirements that are not compatible with grazing and haying is exceedingly rare and continues to diminish” (Dobkin 1994).

Habitat loss and alteration have contributed to population declines among shortgrass bird species. These declines have been largely overlooked by the conservation community until recently, due at least in part to widespread concern about population declines in Neotropical migrant bird species of the eastern deciduous forest. The result of newly redirected focus is that grassland habitat is now arguably the highest conservation priority in the U.S. “As a group, grassland species have shown steeper, more consistent, and more geographically widespread declines than any other behavioral or ecological grouping of North American species,” including Neotropical migrants (Knopf 1996b).

Conservation Opportunities

Colorado Bird Observatory has developed *Prairie Partners*, a cooperative and voluntary program to work with landowners, leaseholders, and land managers in the U.S. and Mexico to conserve shortgrass prairie and the birds that depend upon it. Participants can draw upon information gathered in a Best Management Practices manual to facilitate their contributions to bird conservation, and each participant receives a certificate of participation and an annual report detailing the overall contributions of all partners.

The USDA Natural Resources Conservation Service oversees a number of private landowner programs stemming from the 1996 Farm Bill, the Federal Agriculture Improvement and Reform Act. These programs provide a number of conservation opportunities in Physiographic Area 36. They include the Environmental Quality Incentives Program (EQIP), Wetlands Reserve Program (WRP), Conservation Reserve Program (CRP), and Wildlife Habitat Incentives Program (WHIP).

Avifaunal Analysis

The shortgrass prairie bird community is comparatively depauperate, possibly as a result of the limited vegetation structure available for nesting and foraging, or as a result of the unpredictable and highly variable weather (Wiens 1974). In spite of the extent of prairie habitats in North America (comprising 17% of the land area), only 10 bird species are endemic to upland grassland areas (Knopf 1994). Other species that are present are only secondarily associated with grasslands. As examples of this species paucity, a study on 14 sites throughout the shortgrass region recorded only eight breeding species (Wiens 1974), and a study on the Pawnee National Grassland recorded only 14 bird species on 112 point-count surveys (Knopf 1996b).

Habitats, Implementation Strategies, and Priority Species Accounts

Grassland

Description and Ecology: Shortgrass is dominated by two low-growing warm-season grasses, blue grama and buffalo grass; western wheatgrass is also present, along with taller vegetation, including widespread prickly-pear cactus and yucca, and cholla in the south. Sandsage prairie is found where sandy soils occur, and is dominated by sand sagebrush and the grasses sand bluestem and prairie sand-reed. Mixed grass (needle-and-thread, side-oats grama) and tallgrass (big bluestem, little bluestem, switchgrass) communities occur locally.

Ecological forces that shape the shortgrass prairie landscape include fire, grazing, and climate. Little is known about the ecological role of fire in shortgrass, although even before the advent of fire suppression by humans, fire was probably less frequent than in either mixed grass or tallgrass prairie (Weaver et al. 1996). Prescribed burns have been used in shortgrass to remove woody vegetation, cacti, and accumulated litter and to improve grazing conditions for livestock, but the grasses recover slowly, requiring 2–3 years with normal precipitation (Wright and Bailey 1980). Before widespread settlement by European-Americans, grazing regimes consisted of native ungulates wandering widely across the shortgrass prairie—spreading over the landscape the impact of their grazing and trampling—and prairie dog colonies expanding, contracting, and moving in response to climatic influences on vegetation so that, at any given time, they grazed some areas intensively and others not at all (Knopf 1996*b*). The severity of the semi-arid climate and sharp differences in precipitation over relatively short distances produced contrasts in vegetation and advanced the formation of a variegated landscape. Grassland birds thus evolved in a shifting landscape mosaic, with access to patches of vegetation in a variety of successional stages and conditions.

Importance and Conservation Status: The driving conservation issues in the Central Shortgrass Prairie are habitat loss and habitat alteration. Colorado's rapid population growth and accompanying land development are responsible for much of the habitat conversion and degradation. Within the shortgrass area much of that development is concentrated along the Front Range in Denver, Boulder, Jefferson, Arapahoe, Larimer, and Douglas counties, where population densities are as high as 1,180 people/km² (3,050/mi²). Human population densities in counties within the physiographic area but away from the Front Range corridor range from as high as 6.6 people/km² (17.1/mi²) in Morgan County to as low as 0.4 people/km² (1.0/mi²) in Kiowa County (U.S. Department of Commerce 1991).

Because much of the shortgrass prairie is too dry to farm without irrigation, the proportion of plowed land is not high and much of the region is still grassland (Weaver et al. 1996). In Colorado, approximately 67% of the historical shortgrass prairie still exists (Knopf 1994), although some sources suggest that only 20% of the original shortgrass prairie exists in an unaltered state—the rest having been converted to cropland and urban development or degraded by

overgrazing. Conversion to agriculture results in an absolute loss of grassland habitat, but much of the area is managed for grazing, which maintains grassland habitat but often with changes in plant height, vigor, and community composition.

Ideally, modern management would replicate the timing, intensity, and landscape distribution of the natural disturbances that shaped the shortgrass prairie (unfortunately, detailed information about presettlement conditions is lacking). In practice, however, modern grazing tends to spread grazing intensity evenly, producing a comparatively homogeneous landscape. Shortgrass birds are left with few options if grazed prairie does not meet their habitat needs. "There is no shortage of grazed and hayed lands for those species that benefit from these activities. By comparison, habitat for species with breeding requirements that are not compatible with grazing and haying is exceedingly rare and continues to diminish" (Dobkin 1994).

Habitat loss and alteration have contributed to population declines among shortgrass bird species. These declines have been largely overlooked by the conservation community until recently, due at least in part to widespread concern about population declines in Neotropical migrant bird species of the eastern deciduous forest. The result of newly redirected focus is that grassland habitat is now arguably the highest conservation priority in the U.S. "As a group, grassland species have shown steeper, more consistent, and more geographically widespread declines than any other behavioral or ecological grouping of North American species," including Neotropical migrants (Knopf 1996b).

Implementation Strategies:

Bird Monitoring

Goal: To monitor or track all breeding birds in the shortgrass prairie habitat and document distribution, population trends, and abundance in a statistically acceptable manner.

Objective: All species with AI > 2 will be monitored with count-based methods.

Strategy: Monitoring will be accomplished through the combined efforts of agencies with primary responsibility for managing this habitat.

Strategy: Monitoring will continue to rely on BBS data, with data from CBO's *Monitoring Colorado's Birds (MCB)* program incorporated as it becomes available.

Status: MCB implemented grassland habitat transects in 1999 and ran a total of 30 transects; trend data should be available for most species within 5–12 years.

Objective: All species with AI # 2 will be tracked through count-based methods or their presence/absence noted in the state.

Strategy: CBO's MCB monitoring program will address this.

Status: MCB monitoring was implemented on grassland habitat beginning in 1999.

Objective: Population demographic monitoring will be instituted for all species in grassland habitats with PT of 4 or 5.

Strategy: CBO's MCB will address this objective.

Status: MCB demographic monitoring will begin in 2001.

Habitat Monitoring

Goal: To monitor shortgrass prairie habitat in Colorado in order to document amount, condition, and ownership.

Objective: Develop collaborative efforts to use GIS in mapping shortgrass, documenting amount, condition, ownership. Potential collaborators include CDOW, CNHP, CBO, NRCS, and TNC.

Strategy: CBO's *Prairie Partners* Registry will track amount of shortgrass and its condition on the private lands of cooperators.

Habitat Core Areas

Goal: To conserve unique representatives and/or large, ecologically-functioning examples of shortgrass prairie habitat in Colorado used by birds during the breeding season, during migration, or during the winter.

Objective: Obtain special designations for core areas that will serve to protect them.

Strategy: Identify agency- or organization-specific means of designating and conserving core areas, and work with the appropriate agency or organization to promote conservation activities.

Status: Appropriate areas that have been identified include the U.S. Forest Service Comanche and Pawnee National Grasslands, Colorado Natural Areas Program sites (Bonny Prairie in Yuma County), the 34,800 ha (86,000 ac) Chico Basin Ranch (El Paso and Pueblo counties), TNC's 16,200 ha (40,000 ac) Bohart Ranch (El Paso County), and the Arikaree Ranch (Yuma County).

Status: Appropriate areas that have been identified as important during migration include playa lakes in southeastern Colorado, including the Neenoshe and Neesopah complex (Kiowa County).

Strategy: Nominate appropriate core areas as *Important Bird Areas (IBAs)* and promote involvement of local groups in conserving these areas once they are designated.

Status: Pawnee National Grassland was nominated in 1999; the *IBA* committee will make final selections in 2000.

Objective: To maintain or increase the quantity and quality of shortgrass habitat on private lands.

Strategy: Encourage landowners to take advantage of funding opportunities for creating, restoring, and maintaining shortgrass habitat on their properties. Suitable opportunities include NRCS's WHIP and EQIP, USFWS's Partners for Wildlife program, and the *Conservation of Private Grazing Land* and *Voluntary Debt-for-Nature Contract* provisions of the 1996 Farm Bill.

Strategy: Encourage landowner enrollment in CBO's *Prairie Partners* program.

Objective: To maintain or increase the quantity and quality of shortgrass habitat on public lands.

Strategy: Integrate the BCP into management plans for public lands in the physiographic area.

Strategy: Promote collaboration/cooperation between agencies, organizations, and individuals in conserving unique representatives/core areas with multiple ownership.

Objective: To recreate the heterogeneous landscape mosaic of prehistory so that breeding birds are always offered a patchwork of large grassland parcels in a variety of structural stages and with varying amounts of forbs and shrubs.

Strategy: Incorporate landscape-scale habitat management into management plans for public and private lands.

Strategy: Use livestock, prescribed burns, and other management tools to create a mosaic of habitat patches of \$ 50 ha (125 ac) each across the shortgrass landscape.

Strategy: Encourage managers of public and private lands to remove some grassland areas from grazing for at least 25–50 years to provide habitat for species intolerant of grazing (Bock et al. 1992). On private lands, such long-term rest could be accomplished through conservation easements.

Site-based Conservation

Goal: To conserve local breeding, migratory stopover, and wintering sites that are important for the conservation of shortgrass prairie priority species.

Objective: Identify agency- or organization-specific means of designating and conserving key local sites. Work with appropriate agencies and organizations to designate such sites, and promote conservation activities.

Strategy: Within the historical breeding range of Greater and Lesser Prairie-Chicken, protect and/or recreate suitable lek site habitat.

Objective: Identify key local sites that are appropriate for designation as *IBAs*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites within the shortgrass prairie ecosystem were nominated in 1999, and the *IBA* committee will make final selections in 2000.

Management Practices

Goal: To promote management practices that benefit birds on shortgrass prairie.

Objective: Best Management Practices (BMPs) manuals will be produced and distributed.

Status: In 1999, CBO completed BMPs for four species (Long-billed Curlew, Loggerhead Shrike, Cassin's Sparrow, and Grasshopper Sparrow) for use by land managers at the Comanche National Grassland. An additional set of BMPs for 13 species is under development by CBO; these will be presented in nontechnical language (with landowners as the target audience) as part of the *Prairie Partners* program and will be available from CBO in early 2000.

Objective: Identify key landowners and land managers and encourage them to incorporate best management practices to conserve shortgrass species and their habitat.

Status: CBO's *Prairie Partners* program contacted more than 125 landowners in 1999 to invite them to join the program. Interested landowners will be provided copies of the shortgrass BMP manual in 2000.

Interstate/International Wintering Grounds

Goal: To conserve the wintering ground habitat used by Colorado's migratory shortgrass prairie birds outside of the state.

Objective: Identify the wintering distribution and key habitat associations of priority species.

Status: Currently being addressed by field work in northern Mexico by CBO (see Leukering and Bradley 1997), and in southeastern Arizona by the Biological Resources Division of USGS.

Objective: Track amount of available habitat on the wintering grounds.

Strategy: Utilize GIS (state GAP projects, Heritage Program, and/or CBO).

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to obtain data.

Objective: To protect wintering habitat of priority species.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect wintering habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Migration Concerns

Goal: To protect migratory stopover habitat used by priority species that breed in Colorado shortgrass prairie.

Objective: Identify important migratory stopover areas for priority species that breed in Colorado, and key sites for priority species that breed elsewhere.

Objective: Track amount, condition, and ownership of key migratory stopover sites.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect migratory habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Outreach and Education

Goal: To provide information on shortgrass birds (conservation, habitat needs, natural history, etc.) to children, teachers, naturalists, landowners, natural resource professionals, and other interested parties.

Strategy: CBO will produce a booklet for distribution in elementary schools as part of its *Prairie Partners* program.

Status: The booklet ("The Shortgrass Prairie: Activities for Learning about North America's Grassland Ecosystems") was completed in 1999 and is available from CBO.

Strategy: Produce an agricultural extension bulletin on conservation of shortgrass prairie and its birds.

Strategy: Make educational materials available at local nature centers and natural resource agency offices.

Strategy: Hold workshops and field programs for teachers.

Strategy: Hold workshops and field programs for natural resource professionals (CDOW, BLM, and USFS staff).

Strategy: Present information at Teacher Association meetings, conferences, and other annual meetings.

Strategy: Submit manuscripts to popular magazines for children and adults.

Research Priorities

Goal: To identify and facilitate research that will aid in understanding and managing grassland habitats for Colorado's birds.

Objective: To identify the top ten research needs in shortgrass prairie habitat in Colorado.

Strategy: Update the list of research needs annually to reflect shifting conservation priorities and to remove research needs from the list as they are investigated.

Strategy: Solicit input from researchers and managers on research needs and accomplishments.

Status: The following needs have been identified:

1. The interplay of precipitation, habitat condition, and population distributions at the landscape level, especially of species that exhibit nomadism and shift their breeding grounds each year (e.g., Cassin's Sparrow and Lark Bunting).
2. The effects on bird populations of prescribed burning in shortgrass.
3. The effects on bird populations of different grazing regimes.
4. Identification of key migratory stopover and wintering areas and habitats.
5. Effects of prairie dog control operations and sport hunting on bird populations.
6. Patch size effects—are shortgrass birds area-sensitive?

Objective: Facilitate investigations to answer these questions.

Strategy: Provide information about priority needs to universities, public and private research entities, identify funding sources, and promote collaboration between management and research agencies.

Priority Species Accounts: This habitat is represented by 14 priority species—more than any other habitat in Colorado. These species are Swainson's Hawk, Ferruginous Hawk, Prairie Falcon, Plains Sharp-tailed Grouse, Greater Prairie-Chicken, Lesser Prairie-Chicken, Mountain Plover, Upland Sandpiper, Long-billed Curlew, Burrowing Owl, Cassin's Sparrow, Lark Bunting, Grasshopper Sparrow, and McCown's Longspur.

SWAINSON'S HAWK (*Buteo swainsoni*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Red-tailed Hawk, Ferruginous Hawk, Rough-legged Hawk, Golden Eagle, American Kestrel, Mourning Dove, Great Horned Owl, and Loggerhead Shrike.

Distribution: Swainson's Hawks breed from central Alberta east to southern Manitoba and western Minnesota, south through Texas to the Mexican states of Sonora and Durango, and west to southern California. In Colorado, they breed throughout the eastern plains in the grassland and

lowland riparian habitat types. They are also found in North and South Parks, the San Luis Valley, and sparsely in western valleys and grassland parks. Swainson's Hawks winter in southern South America.

Habitat Requirements: Swainson's Hawks nest in riparian areas adjacent to grasslands and in trees or large shrubs standing in open shrublands or croplands. They also nest in trees planted in shelterbelts or farmyards. The adjacent open habitats are used for foraging.

Ecology: Swainson's Hawks reside in Colorado from April into October. Nest construction takes place during the latter half of April through May, and young fledge during June and July. The breeding season diet consists primarily of small mammals such as ground squirrels, pocket gophers, mice, and voles, but also includes reptiles and large invertebrates such as grasshoppers and beetles.

Management Issues and Conservation Recommendations: Populations of this species may have benefitted from human settlement of the Great Plains as trees planted as windbreaks and around homesteads provide nesting substrate. Many of these trees are being lost through senescence and through active removal as small farms are consolidated into larger farms and homesteads are removed. Also, government incentives to plant trees for windbreaks have largely disappeared. As a result, the Great Plains are probably experiencing a net loss of trees. *Preserve trees in shelterbelts, windbreaks, and around homesteads, especially those trees that already contain nests.*

Programs to control the principal prey species are probably detrimental to Swainson's Hawk populations, as a declining prey base has been linked to diminished reproductive success. *Retain populations of the principal prey species (rodents and grasshoppers) at levels compatible with economic activities on the land.*

In Argentina, agricultural use of organophosphate insecticides has resulted in deaths of large numbers of wintering birds due to direct exposure and consumption of poisoned grasshoppers. Although the most notorious of the insecticides (monocrotophos) has been banned, other organophosphate insecticides remain in use. *Encourage adoption of alternatives to organophosphates on the wintering grounds.*

Status and Reasons for Concern: This species has a high conservation need locally and throughout its range. Within the shortgrass physiographic area, BBS data do not show a statistically significant annual rate of change between 1966 and 1996 ($P = 0.40$; $n = 56$ routes). Swainson's Hawks were present on an average of 85.38% (SE = 0.98) of the BBS routes run in Physiographic Area 36 in Colorado during 1988–1997, at an average abundance of 3.69 (SE = 0.21) individuals per route. The mean number of routes run each year was 29.2 (SE = 2.28). This species is monitored by *MCB* with point transects.

Biological Objective: Increase the species' distribution and abundance, based upon results from the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Bechard 1983, England et al. 1997, Kingery 1998.

FERRUGINOUS HAWK (*Buteo regalis*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Swainson's Hawk, American Kestrel, Mourning Dove, Great Horned Owl, and Loggerhead Shrike.

Distribution: Ferruginous Hawks breed from eastern Washington east to southern Saskatchewan, south to northern Texas, south and west through central New Mexico and central Arizona, and as far west as southeastern Nevada. In Colorado, they are found primarily on the eastern plains, in the grassland and lowland riparian habitat types. Small numbers of these hawks nest in northwestern Colorado and the San Luis Valley.

Habitat Requirements: Ferruginous Hawks nest in isolated trees or small groves of trees, and on other elevated sites such as rock outcrops, buttes, large shrubs, haystacks, and low cliffs. Nests are situated adjacent to open areas such as grassland or shrubsteppe. These hawks are closely associated with prairie dog colonies, especially in winter.

Ecology: In Colorado, nesting is initiated as early as mid March, and young fledge during late June and July. Although they do breed in Colorado, Ferruginous Hawks are more common during winter (November to March). Rabbits and hares are the most important prey items by biomass, but prairie dogs and ground squirrels are the most important numerically.

Management Issues and Conservation Recommendations: Conversion of native grassland to agricultural land has led to population declines. Management of grasslands for grazing is considered compatible with healthy Ferruginous Hawk populations. *Encourage public land managers and private landowners to preserve native prairie.*

Control of prey species (ground squirrels and prairie dogs) reduces Ferruginous Hawk populations. *Retain populations of the primary prey species at the highest levels compatible with economic uses of the land.*

Ferruginous Hawks are sensitive to disturbance at the nest; activities such as mineral extraction near nests result in lower nest success or abandonment. *Restrict activities within 0.8 km (0.5 mi) of active nests.*

Some birds are shot on the breeding and wintering grounds. *Encourage strict enforcement of extant game laws that protect this species.*

Some nest trees are in shelterbelts or windbreaks or around abandoned homesteads; as those trees are lost, suitable nest sites become scarcer. *Preserve nest trees.*

Status and Reasons for Concern: This species has a high conservation need locally and throughout its range. The Ferruginous Hawk is a USFS Sensitive Species in Region 2, and a CDOW Species of Special Concern. Within Physiographic Area 36, BBS data do not show a statistically significant annual rate of change between 1966 and 1996 ($P = 0.69$; $n = 25$ routes). Ferruginous Hawks were present on an average of 34.58% (SE = 3.53) of the BBS routes run in Physiographic Area 36 in Colorado during 1988–1997, at an average abundance of 0.69 (SE = 0.09) individuals per route. The mean number of routes run each year was 29.2 (SE = 2.28). This species is monitored by *MCB* with tracking transects.

Biological Objective: Maintain or increase the species' distribution and abundance, based upon results from the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Bechard and Schmutz 1995, Harmata 1981, Kingery 1998.

PRAIRIE FALCON (*Falco mexicanus*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Golden Eagle, Peregrine Falcon, Great Horned Owl, and Common Raven.

Distribution: Prairie Falcons breed throughout the western U.S., from southern British Columbia east to southern Saskatchewan, then in a broad band south through southern California, Arizona, and New Mexico. In Colorado, they nest in scattered locations throughout the state, with concentrations in Douglas County and southeastern Colorado, where they inhabit the grassland and cliff/rock habitat types.

Habitat Requirements: These falcons breed on cliffs and rock outcrops, and hunt in adjacent open areas such as grasslands and shrubsteppe.

Ecology: Adults arrive on the breeding grounds in February or March and initiate nesting in late April; young fledge in June and July. Many birds that breed to the north of Colorado spend the winters here; others winter as far south as central Mexico. Their diet during the breeding season is a mix of passerines and small mammals. Birds wintering in Colorado prey on passerines, especially Horned Larks.

Management Issues and Conservation Recommendations: Urbanization has encroached on feeding territories, resulting in abandonment of traditional breeding sites. Management of feeding territories for grazing probably has little impact on their value to falcons, provided habitat still exists for prey species. Disturbance from recreational activities (rock climbing and hiking) can cause nest failure. *Identify nest sites; discourage development in the area and restrict recreational activities during the nesting period.*

Status and Reasons for Concern: Prairie Falcons occupy a unique habitat type (cliff/rock) in this physiographic area. They are not adequately sampled by BBS surveys within the shortgrass physiographic area, and data collected between 1969 and 1996 are too sparse to allow analysis of trend data ($n = 7$ routes). Prairie Falcons were present on an average of 6.90% (SE = 1.23) of the BBS routes run in Physiographic Area 36 in Colorado during 1988–1997, at an average abundance of 0.08 (SE = 0.02) individuals per route. The mean number of routes run each year was 29.2 (SE = 2.28). This species is monitored by *MCB* with a statewide census.

Biological Objective: Maintain or increase the species' distribution and abundance, based upon results from the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Beauvais et al. 1992, Kingery 1998, Steenhof 1998.

PLAINS SHARP-TAILED GROUSE (*Tympanuchus phasianellus jamesi*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Virginia's Warbler, Indigo and Lazuli Buntings.

Distribution: Sharp-tailed Grouse currently reside in an area that forms a triangle from east-central British Columbia southeast to southwestern Manitoba, and south in a narrowing band to eastern Colorado. In Colorado, birds of the subspecies *jamesi* reside in Douglas County, northern Weld County, and Logan County.

Habitat Requirements: Plains Sharp-tailed Grouse inhabit a mix of tall and short grasses interspersed with stands of shrubs, including Gambel oak, threeleaf sumac, willows, and sand sagebrush, especially where the shrubs form a dense cover with a relatively open understory. The woody cover is especially important for brood cover. The Weld County population occupies CRP lands where tall grasses mix with shorter native species and agricultural fields.

Ecology: Sharp-tailed Grouse migrate short distances to wintering grounds. Males begin frequenting leks in March, and nesting occurs soon after the females arrive in the area during the second half of April. Fledged young are present from late May through mid August. The diet

consists of leaves, buds, and fruits of woody plants, and cultivated grains. Young birds consume significant amounts of animal matter, primarily insects, including grasshoppers, beetles, and ants.

Management Issues and Conservation Recommendations: The overriding factor affecting populations in Colorado is habitat loss due to conversion to housing developments and, to a lesser extent, conversion to agriculture. Heavy grazing reduces cover used for nesting. Residual cover is especially critical, given the early nesting season. *Identify and protect leks and surrounding vegetation; protected habitat should encompass 125 to 530 ha (315–1300 ac) or more. Management should follow the guidelines spelled out in the state recovery plan (Braun et al. 1992).*

Status and Reasons for Concern: The Plains Sharp-tailed Grouse is listed as Endangered in Colorado. BBS surveys do not adequately monitor this subspecies within the shortgrass physiographic area, and BBS data are too sparse for meaningful analysis of trends. This species is monitored by CDOW.

Biological Objective: Increase the species' distribution and abundance, based upon results from CDOW monitoring programs.

Selected References: Andrews and Righter 1992, Braun et al. 1992, Connelly et al. 1998, Kingery 1998, Prose 1987.

GREATER PRAIRIE-CHICKEN (*Tympanuchus cupido*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Upland Sandpiper, Grasshopper Sparrow, and Western Meadowlark.

Distribution: Greater Prairie-Chickens reside from eastern North Dakota east to northern Michigan, south to southeastern Texas, and west as far as northeastern Colorado, where they inhabit only parts of Yuma, Washington, and Phillips counties, also Sedgwick, Logan, and Morgan counties, where they were introduced. This species' expansion into Colorado in historical times may have been facilitated by planting of grain: shortgrass prairie offers too few seeds for an adequate winter food supply.

Habitat Requirements: They mainly reside in mixed-grass and tallgrass prairies, but they will accept some agricultural land. Historically, the habitat included oak. In Colorado, this species frequents areas with sand sagebrush. They nest in areas with dense vertical and horizontal grass cover, where grass height averages 25 to 70 cm (10–28 in).

Ecology: Courtship activity on the leks begins in April, with young fledging by mid July. Individuals migrate only a short distance for wintering (about 40 km; 25 mi). The diet includes

leaves, seeds, buds, and fruits from a variety of plants, also cultivated grains, and insects. They will eat acorns where available.

Management Issues and Conservation Recommendations: Insecticide use may limit availability of insect prey, which is critical to chick survival. *Postpone the use of insecticides until after young have fledged.*

Conversion of native grassland to intensive agriculture can reduce Greater Prairie-Chicken populations due to direct (e.g., nest destruction by farm machinery) and indirect (loss of preferred food sources) effects. *Native and exotic grasslands provide more suitable habitat than croplands; grasslands should be retained in the largest contiguous blocks possible, with the 65-ha (160-ac) minimum size recommended for southwestern Missouri birds (Ryan et al. 1998) utilized in Colorado, unless future research suggests otherwise.*

The exotic Ring-necked Pheasant competes directly with prairie-chickens, and sometimes parasitizes their nests. *Remove existing pheasant populations and introduce no additional pheasants where management goals include protection of prairie-chicken populations.*

Status and Reasons for Concern: This species has a high conservation need locally and throughout its range. This is a USFS Sensitive Species in Region 2. Within the shortgrass physiographic area, this species is not adequately monitored by BBS surveys, and data collected during 1969–1996 are too sparse for meaningful analysis. Greater Prairie-Chickens were present on an average of 4.69% (SE = 1.40) of BBS routes run in Physiographic Area 36 in Colorado during 1988–1997, at an average abundance of 0.62 (SE = 0.30) individuals per route. The mean number of routes run each year was 29.2 (SE = 2.28). CDOW surveys indicate that Colorado populations are stable or increasing. This species is monitored by CDOW.

Biological Objective: Increase the species' distribution and abundance, based upon results from the BBS and CDOW monitoring programs.

Selected References: Andrews and Righter 1992, Flickinger and Swineford 1983, Kingery 1998, Prose 1985, Schroeder and Robb 1993, Van Sant and Braun 1990, Vance and Westemeier 1979.

LESSER PRAIRIE-CHICKEN (*Tympanuchus pallidicinctus*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Cassin's Sparrow, Grasshopper Sparrow, Lark Bunting, and Western Meadowlark.

Distribution: Lesser Prairie-Chickens reside from southeastern Colorado east to southwestern Kansas south of the Arkansas River, south through western Oklahoma and the Texas panhandle,

and west to southeastern New Mexico. Within Colorado, they occupy the grassland habitat type, primarily in Baca County, with some birds residing in Kiowa and Prowers counties.

Habitat Requirements: Lesser Prairie-Chickens prefer grasslands with some shrubs; they will also use CRP land. Vegetation found in a suitable habitat includes sand sagebrush and shinnery oak with bluestem (historically) or mixed grass, including sand dropseed, side-oats grama, three-awn, blue grama, or bluestem. Leks are located in areas of sparse vegetation, typically on knolls or ridges. The birds usually nest within 3 km (2 mi) of the lek, usually in grasses and forbs of comparatively high density and height, often on north- or northeast-facing slopes (<6% slope), presumably for protection from sunlight. Taller, woody vegetation provides shade for nests and for adults and broods in summer.

Ecology: Lesser Prairie-Chickens do not migrate; males visit leks from January to June and from September to November; females visit leks from late March through May. They initiate nesting during mid April through late May; hatching occurs about 25 days later, and the precocial young leaving the nest within 24 hours of hatching. They feed on invertebrates (especially grasshoppers and leafhoppers), leaves, flowers, seeds (especially shinnery oak acorns, where available), and cultivated grains.

Management Issues and Conservation Recommendations: The historical distribution has declined by an estimated 78% between 1963 and 1980 due to droughts, habitat conversion to cropland (including chemical and other control of sand sagebrush and shinnery oak), and overgrazing. So far, efforts to transplant birds have not succeeded. *Protect and restore sand sagebrush and shinnery oak habitats within the species' historical range. Continue attempts to transplant birds to areas with suitable habitat.*

Status and Reasons for Concern: This species has a high conservation need locally and throughout its range. A petition has been filed for listing it under the Endangered Species Act. This is a USFS Sensitive Species in Region 2. Over its entire known historical range, the population has declined an estimated 97% since the 1800s. This species is not monitored by the BBS. Surveys by CDOW show a substantial increase in the Colorado population between 1970 and 1990; however, the total population is still perilously low. This species is monitored by CDOW.

Biological Objective: Maintain or increase the species' distribution and abundance, based upon results of CDOW monitoring.

Selected References: Andrews and Righter 1992; Giesen 1994*a,b*, 1998; Kingery 1998; Taylor and Guthery 1980.

MOUNTAIN PLOVER (*Charadrius montanus*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Long-billed Curlew, Burrowing Owl, Horned Lark, and McCown's Longspur.

Distribution: Mountain Plovers breed from southern Alberta south through western Oklahoma and western Texas, and west through central New Mexico. In Colorado, populations are concentrated in and around the Pawnee and Comanche National Grasslands and in South Park. Small numbers of plovers nest in North Park and the San Luis Valley.

Habitat Requirements: Mountain Plovers will breed in shortgrass prairie where the topography is fairly flat (slopes $<5^\circ$) with very short (#5 cm; 2 in) and sparse vegetation. They are often found where vegetation height and density have been reduced through grazing by livestock or prairie dogs. Average bare ground cover in studies of plover territories ranged from 17% to 100%. They will also nest in areas with low, sparse shrubs. Plovers will forage and nest in agricultural fields that are bare or contain short vegetation, but will abandon the nests if the vegetation grows too tall (i.e., above about 5 cm; 2 in).

Ecology: Birds arrive in Colorado in March, and young fledge in June and July; most birds have left the state by the end of September. Plovers winter in southern California, and southern Texas into northern Mexico. The breeding season diet consists largely of beetles, but also includes grasshoppers, crickets, and ants. Although plovers often nest near water sources, they may be attracted to the low vegetation structure created by concentrations of livestock rather than to the water itself.

Management Issues and Conservation Recommendations: Having evolved in the company of grazing ungulates and prairie dogs, this species benefits from the bare ground and sparse vegetation conditions created by prairie dogs, grazing cattle, or prescribed burns. *Encourage public land managers and private landowners to retain populations of prairie dogs at levels compatible with economic activities on the land. Graze at moderate to heavy levels in summer or late winter, or implement prescribed burns, to produce suitable habitat. Recreate the landscape mosaic historically produced by wandering herds of bison by interspersing areas of varying grazing intensities, including areas where no grazing occurs, and rotating rested pastures. Avoid planting taller grasses, as on CRP land, which precludes plover use of those areas.*

Disturbance due to oil and gas exploration, water well development, and other similar activities is detrimental to plovers during the nesting season; such activities are restricted in certain areas during April through June in Colorado, Wyoming, and Utah. Some individuals will reuse nest sites in subsequent years. *Protect known nest sites from disturbance.*

Status and Reasons for Concern: This species has a high conservation need locally and throughout its range. It is on the national Watch List. A petition has been filed to list Mountain Plovers for protection under the Endangered Species Act. It is a USFS Sensitive Species in Region 2, and a CDOW Species of Special Concern. Most (55.4%) of this species' total population occurs within this physiographic area, indicating that this area has the highest responsibility for the species' conservation. Within the Central Shortgrass Prairie, BBS data do not show a statistically significant annual rate of change between 1969 and 1996 ($P = 0.93$; $n = 16$ routes). However, BBS data from 1966–1996 demonstrate a significant survey-wide annual rate of decline (-2.7% ; $P = 0.02$; $n = 33$ routes). Mountain Plovers were present on an average of 21.82% (SE = 1.96) of the BBS routes run in Physiographic Area 36 in Colorado during 1988–1997, at an average abundance of 0.84 (SE = 0.15) individuals per route. The mean number of routes run each year was 29.2 (SE = 2.28). This species is monitored by *MCB* with point transects.

Biological Objective: Increase the species' distribution and abundance, based upon results from the BBS, *MCB*, and other monitoring programs.

Selected References: Andrews and Righter 1992; Graul 1973, 1975; Johnson et al. 1998; Kingery 1998; Knopf 1996a; Knopf and Rupert 1996; Knowles et al. 1982.

UPLAND SANDPIPER (*Bartramia longicauda*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Grasshopper Sparrow and Western Meadowlark.

Distribution: Upland Sandpipers breed from north-central Alaska east to southern New Brunswick, south to central Virginia, and west to northeastern Colorado. Within Colorado, they nest only in the northeastern corner of the state.

Habitat Requirements: Upland Sandpipers prefer meadows, croplands, and mixed-grass and tallgrass prairies. In Colorado, they find suitable nesting habitat in grassy riparian zones. Upland Sandpipers avoid nesting in vegetation taller than about 62 cm (24 in) and often nest in much shorter vegetation—less than 6 cm (2.4 in). They also avoid nesting in croplands. They use open areas, such as grazed pasture, cut hayfields, and croplands with vegetation shorter than about 27 cm (10.5 in), for foraging (Bolster 1990).

Ecology: Upland Sandpipers arrive in Colorado in April and nest in May. The young fledge in June. They depart for their wintering grounds in the grasslands of southern South America by late July. The diet consists primarily of insects, especially grasshoppers, locusts, and weevils; they also eat some seeds and grains.

Management Issues and Conservation Recommendations: The primary causes of population declines are probably the loss of breeding and wintering habitat by conversion to agriculture and the removal of taller vegetation by intensive grazing. Colorado populations are at the periphery of the species' range, and suitable habitat is scarce even without loss due to human activities. *Protect mixed-grass and tallgrass habitats in riparian zones.*

Many broods are lost when hay is cut in the second half of July, before young birds have fledged. *To protect these birds, cut hay 7–10 days later, cut hay several inches taller, or leave islands of uncut hay in each field as refugia* (Bolster 1990).

Status and Reasons for Concern: This species is representative of an uncommon habitat type (midgrass and tallgrass riparian zones) within this physiographic area. This is a USFS Sensitive Species in Region 2. Within the Central Shortgrass Prairie, BBS data do not show a statistically significant annual rate of change between 1966 and 1996 ($P = 0.54$; $n = 29$ routes). Upland Sandpipers were present on an average of 9.76% (SE = 1.66) of the BBS routes run in Physiographic Area 36 in Colorado during 1988–1997, at an average abundance of 0.28 (SE = 0.09) individuals per route. The mean number of routes run each year was 29.2 (SE = 2.28). This species is monitored by *MCB* with tracking transects.

Biological Objective: Maintain or increase the species' distribution and abundance, based upon results from the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Kingery 1998, Kirsch and Higgins 1976.

LONG-BILLED CURLEW (*Numenius americanus*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Mountain Plover and Horned Lark.

Distribution: The breeding range extends from south-central British Columbia east to southern Manitoba, south to northern Texas, and west through central New Mexico to as far as central Nevada. In Colorado, the birds breed throughout the eastern plains, with the population concentrated in the southeast.

Habitat Requirements: Curlews breed in shortgrass and mixed-grass habitats, and occasionally in idle cropland. They prefer short vegetation, generally <30 cm (12 in) and often <10 cm (4 in). After hatching, the adults move the chicks to areas of taller grasses and scattered forbs and shrubs for protection from predators and weather extremes; dense forbs or shrubs are avoided, due to low visibility and difficulty of travel for chicks.

Proximity to standing water seems to be a necessary feature, even though the birds are rarely seen actually using the water. Birds are often found <400 m (0.25 mi) from standing water, and often

much closer. The water is often from human sources (windmill overflow, stock ponds, etc.). As with Mountain Plovers, curlews may be attracted to the low vegetation profile and high insect population associated with livestock near such water sources, rather than an attraction to the water itself. Additionally, the birds frequent areas of moist soils, where prey populations are higher.

Although curlews prefer to nest close to water, the nest sites must be dry. Some nest sites far from water may have been established when water was present, and the birds return out of site fidelity. Nests are located in areas of low grass height and low grass height diversity. In a Colorado study, average height of the tallest vegetation at nest sites was 11.0 cm (4.3 in), and vegetation cover averaged 72.1% (range 50–95%) (King 1978). They occasionally nest in idle croplands such as wheat stubble.

Ecology: Curlews arrive in Colorado in April, lay eggs in May, and fledge young by mid June. Most of Colorado's adult birds have left the state by 15 July, leaving only the young-of-the-year birds and migrants from the north, which leave by the end of August. Curlews winter along the California coast, the Baja peninsula, central and southern Texas, and throughout Mexico. They feed on insects (especially grasshoppers, but also beetles and butterflies) and other invertebrates (especially worms, crustaceans, and mollusks), but also take small vertebrates including the eggs and young of other birds. Territory size reported across their range varies from 6 to 14 ha (15–35 ac). Many territories are reused in subsequent years, perhaps by the same individuals.

Management Issues and Conservation Recommendations: Grasshopper control is detrimental, given the species' dependence on grasshoppers and other invertebrate prey. *Adopt Integrated Pest Management practices to retain some populations of the prey species.*

Curlews will not renest if the nest is destroyed. Grazing by sheep in shortgrass reportedly is more detrimental than grazing by cattle, as sheep graze an area more completely and to a shorter height, and their habits of grazing across a broad front and traveling in tight herds results more often in nest destruction. *Maintain a landscape mosaic of grassland parcels of different heights and densities to provide habitat for foraging, nesting, and brood-rearing. Protect the area around known nest sites, because birds often reuse the same territories.*

Status and Reasons for Concern: This species has a high conservation need locally and throughout its range. This species is on the national Watch List, indicating a high conservation need throughout its range. This is a CDOW Species of Special Concern, and a Sensitive Species in USFS Region 2. Within the Central Shortgrass Prairie, BBS data show a statistically significant annual rate of decline between 1966 and 1996 (-10.00%; $P = 0.02$; $n = 25$ routes). This species is arguably the highest conservation priority in this physiographic area. Long-billed Curlews were present on an average of 15.49% (SE = 2.10) of the BBS routes run in Physiographic Area 36 in Colorado during 1988–1997, at an average abundance of 1.68 (SE = 0.21) individuals per route. The mean number of routes run each year was 29.2 (SE = 2.28). This species is monitored by MCB with point transects.

Biological Objective: Increase the species' distribution and abundance, based upon results from the BBS and *MCB* monitoring programs.

Selected References: Allen 1980, Andrews and Righter 1992, Cochran and Anderson 1987, Kingery 1998, McCallum et al. 1977.

BURROWING OWL (*Athene cunicularia*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Ferruginous Hawk, Rough-legged Hawk, Swainson's Hawk, Golden Eagle, Mountain Plover, and Horned Lark.

Distribution: Burrowing Owls nest from southern British Columbia east to southern Manitoba, south to central Mexico, and west to Baja California; a disjunct population occurs in Florida. In Colorado, Burrowing Owls breed throughout the eastern plains and in river valleys and mountain parks elsewhere.

Habitat Requirements: These owls reside in treeless areas with short vegetation (<10 cm; 4 in), usually in association with prairie dog colonies. They nest in burrows dug by prairie dogs, badgers, coyotes, or foxes. Some evidence suggests that they prefer larger prairie dog colonies, perhaps because of decreased threat of predation.

Ecology: Some uncertainty surrounds the timing of specific breeding events by this species, due to the relative difficulty of studying their underground nests. The owls arrive in Colorado at the end of March and early April, and probably initiate nesting by early May. Fledged young appear at the burrow opening from May through July. The birds leave for their wintering grounds in the Southwest, Mexico, and Central America by mid October. The breeding season diet consists primarily of insects, but small mammals are also taken.

Management Issues and Conservation Recommendations: Loss of native grassland by conversion to agriculture results in loss of foraging and nesting habitat; urbanization also destroys habitat and elevates levels of disturbance by humans (noise, harassment by pets, collisions with vehicles). *Maintain a 100 to 300 m (300–1,000 ft) buffer zone around Burrowing Owl nest burrows and prohibit pesticide applications, rodent control, and other human disturbances within this zone. Protect all colonies in Colorado's Front Range counties, where populations have declined most precipitously.*

Burrowing Owls in Physiographic Area 36 are heavily dependent on prairie dogs for burrows, for burrow maintenance, and for the preferred low vegetation profile. Programs to control prairie dogs are detrimental to owl populations because they lead to loss of breeding habitat, and because some chemical controls are harmful to owls. Prairie dog management on private land should aim to control rather than eradicate. *Encourage private landowners to retain prairie dog populations at*

the highest level compatible with economic activities on the land, to employ nonlethal means of control (trapping and relocating, barrier fences), to treat only active prairie dog burrows, to avoid burrows that show evidence of use by Burrowing Owls (presence of feathers or white droppings, or entrances lined with livestock manure), and to fumigate burrows in the spring before the owls arrive or bait in the fall after the owls have left.

Control of the principal prey species (grasshoppers, crickets, beetles) can also harm populations because insecticides have direct (toxic) and indirect (loss of prey) effects on the birds. *Postpone the use of insecticides until after young owls have fledged (i.e., after the end of July).*

Because these owls habitually perch on the ground outside of a burrow entrance, “varmint” hunters occasionally mistake them for prairie dogs or ground squirrels and shoot them. *Educate hunters on the ecological importance of the owls and provide information on identification.*

Status and Reasons for Concern: This species has a high conservation need locally and throughout its range. A high proportion (estimated at 24.7%) of this species’ total population occurs within this physiographic area, indicating that this area has high responsibility for the species’ conservation. This is a USFS Sensitive Species in Region 2. Within Physiographic Area 36, BBS data do not show a statistically significant annual rate of change between 1966 and 1996 ($P = 0.41$; $n = 45$ routes). Burrowing Owls were present on an average of 54.02% (SE = 2.24) of the BBS routes run in Physiographic Area 36 in Colorado during 1988–1997, at an average abundance of 2.88 (SE = 0.30) individuals per route. The mean number of routes run each year was 29.2 (SE = 2.28). This species is monitored by *MCB* with nocturnal surveys.

Biological Objective: Increase the species’ distribution and abundance, based upon results from the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Haug et al. 1993, Kingery 1998, Pezolesi 1994.

CASSIN’S SPARROW (*Aimophila cassinii*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Scaled Quail, Loggerhead Shrike, and Lark Sparrow.

Distribution: Cassin’s Sparrows breed in areas from northeastern Colorado and southeastern Wyoming east to west-central Kansas, south through Texas to northern Tamaulipas, and northwest to southeastern Arizona. Within Colorado, they nest throughout the eastern plains with highest concentrations in the southeast. They winter in southern Arizona, New Mexico, and southern Texas, south to central Mexico.

Habitat Requirements: These sparrows inhabit shortgrass prairie with scattered shrubs (including sand sagebrush, yucca, and rabbitbrush), which they use for song perches and nest cover. Breeding birds will accept a wide range of shrub densities as long as grass cover exists.

Ecology: Cassin's Sparrows arrive in Colorado in early to mid April, but most do not initiate nesting until late May. Incubation and brooding take place in June, and most young fledge by mid July. Most birds have left for their wintering grounds by late September. The diet consists of invertebrates (beetles, grasshoppers, crickets) and seeds.

Management Issues and Conservation Recommendations: Local populations of Cassin's Sparrows exhibit extreme annual fluctuations, especially in peripheral areas of the range such as Colorado. Populations appear to move around in response to precipitation patterns, most likely because they affect vegetation growth, grass seed production, and invertebrate populations. *Public land managers and private landowners should be encouraged to create a landscape mosaic of grassland parcels of different heights and densities to provide Cassin's Sparrow populations options for establishing breeding sites each year.*

Heavy grazing can remove grass cover needed by breeding Cassin's Sparrows, especially in arid regions where grasses are naturally short and sparse. However, in less arid parts of its range, this species regularly utilizes grazed areas. This topic needs further study. Fire can also remove grass cover and shrubs, and render the habitat unsuitable for Cassin's Sparrows until the vegetation recovers—up to two growing seasons in arid regions. *Graze lightly (or avoid grazing) in areas of short, sparse grasses. Where prescribed burns are used as a management tool, burn habitat blocks in rotation, so that unburned blocks are always available.*

Status and Reasons for Concern: This species is on the national Watch List, indicating a high conservation need throughout its range. A high proportion (estimated at 17.0%) of its total population occurs within this physiographic area, indicating that this area has high responsibility for the species' conservation. Within the Central Shortgrass Prairie, BBS data do not show a statistically significant annual rate of change between 1966 and 1996 ($P = 0.15$; $n = 31$ routes). However, for the same period, BBS data reveal a significant survey-wide decline (-2.5% per year; $P < 0.01$; $n = 203$ routes). Cassin's Sparrows were present on an average of 72.36% (SE = 3.07) of the BBS routes run in Physiographic Area 36 in Colorado during 1988–1997, at an average abundance of 33.54 (SE = 3.18) individuals per route. The mean number of routes run each year was 29.2 (SE = 2.28). This species is monitored by *MCB* with point transects.

Biological Objective: Increase the distribution and abundance of the species, based upon results of the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Bock and Webb 1984, Dorn and Dorn 1995, Faanes et al. 1979, Hubbard 1977, Kingery 1998.

LARK BUNTING (*Calamospiza melanocorys*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Chestnut-collared Longspur and Western Meadowlark.

Distribution: Lark Buntings breed throughout the Great Plains region, from southern Alberta east to southwestern Manitoba, south through the Texas panhandle, and west to eastern New Mexico. In Colorado, they breed on the eastern plains, with smaller numbers breeding in northwestern Colorado, North Park, the San Luis Valley, and scattered grassland basins in western Colorado.

Habitat Requirements: These birds breed in open grasslands with a mixture of short to tall grasses and scattered shrubs, also sagebrush steppe. They prefer total vegetative cover of 70–90%, with 60–70% shortgrass cover, 5–15% sedge and forb cover, and 10–15% bare ground; shrubs and taller grass and forbs (necessary for shading nests) should total 10–30% (Finch et al. 1987).

Ecology: Birds arrive on the eastern plains in late April-early May, with nesting initiated during mid May to June and young fledged during June and July. Migration from Colorado to the winter grounds occurs by late September although some birds may overwinter; they winter in the southern U.S. and Mexico. They feed on grasshoppers and other invertebrates and on grass and forb seeds.

Management Issues and Conservation Recommendations: Heavy grazing renders shortgrass habitats unsuitable by increasing the percentage of bare ground, and removing grass cover needed by invertebrate prey (especially grasshoppers) and taller vegetation needed for nest shading. *Graze lightly in summer or heavily in winter to maintain the preferred vegetation structure. Retain shrubs, cacti, and other tall vegetation.*

Grasshopper control is detrimental, given the species' dependence on grasshoppers and other invertebrate prey. *Adopt Integrated Pest Management practices to retain some populations of the prey species.*

Status and Reasons for Concern: This species has a high conservation need locally and throughout its range. This species is on the national Watch List, indicating a high conservation need throughout its range. This is the Colorado state bird, making it a good flagship species for conservation action. A very high proportion (estimated at 28.8%) of this species' total population occurs within this physiographic area, indicating that this area has high responsibility for the species' conservation. Within the Central Shortgrass Prairie, BBS data show a statistically significant annual rate of decline between 1966 and 1996 (-1.7%; $P = 0.01$; $n = 62$ routes). Data for Colorado for the same period show a similar trend (-1.9%; $P = 0.01$; $n = 43$ routes). Lark Buntings were present on an average of 85.27% (SE = 2.05) of the BBS routes run in Physiographic Area 36 in Colorado during 1988–1997, at an average abundance of 129.91 (SE =

15.80) individuals per route. The mean number of routes run each year was 29.2 (SE = 2.28). This species is monitored by *MCB* with point transects.

Biological Objective: Increase the species' distribution and abundance, based upon results of the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Creighton 1974, Finch et al. 1987, Kingery 1998, Wiens 1970.

GRASSHOPPER SPARROW (*Ammodramus savannarum*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Vesper Sparrows in migration and Upland Sandpiper and Western Meadowlark during the nesting season.

Distribution: Grasshopper Sparrows breed in grasslands from southern British Columbia east to southern Maine, south to central Florida, and west to northern Sonora. In Colorado, they nest throughout the eastern plains, with highest concentrations in the northeast and near the South Platte and Arkansas rivers.

Habitat Requirements: These sparrows use most types of grassland, especially tallgrass and midgrass, but also shortgrass where shrubs or tall forbs are present. In addition to native grasslands, they will nest in CRP lands planted to taller grasses and may be heavily reliant on these in the shortgrass region. Grasshopper Sparrows require some areas of bare ground since they forage on the ground; however, it is unclear how much they need, as studies have described bare ground cover in territories as ranging from 2% to 34%. In general, they prefer sites where much of the vegetation is >10 cm (4 in) high. They are highly territorial, and require the presence of tall forbs, scattered trees, or shrubs for singing perches; however, they avoid areas with more than 35% shrub cover.

Ecology: Grasshopper Sparrows arrive in Colorado in mid May and remain through September. They initiate nesting in early June, and most young fledge by the end of July. They winter across the southern tier of states, south into Central America. They eat mostly insects, especially grasshoppers, but also other invertebrates and seeds.

Management Issues and Conservation Recommendations: Grasshopper Sparrow populations in a particular location can vary widely from year to year, as the birds move around in response to changes in their habitat. This tendency is reinforced by its semi-colonial nesting habits.

Encourage public land managers and private landowners to provide a landscape mosaic of grassland parcels of different structural stages to provide Grasshopper Sparrow populations with options for establishing breeding grounds in any given year.

Grasshopper Sparrows are considered a grassland-interior species. In several studies, including some in Colorado, breeding populations were more abundant in areas distanced from other land-use types, such as suburban developments, recreational trails, and cropland (Vickery 1996). *Provide suitable habitat in patches large enough—at least 12 ha (30 ac)—to accommodate breeding birds.*

Grasshopper Sparrow populations usually respond negatively to grazing or burning in areas where grasses are already comparatively short and sparse (Saab et al. 1995), due to loss of needed nest cover and song perches. In some areas, vegetation requires several growing seasons to recover to conditions suitable to this species. *Graze lightly or not at all in areas of short, sparse grasses. Burn grassland parcels in rotation, such that some unburned habitat is always available.*

Mowing operations in hayfields often destroy nests or exposes them to predators. *Delay mowing until after the completion of nesting, i.e., until late July.*

Status and Reasons for Concern: This species has a moderately high conservation need throughout its range, high representation in the physiographic area (14.8% of the total population), and a declining population trend. Within the shortgrass physiographic area, BBS data show a statistically significant annual rate of decline between 1966 and 1996 (-2.6%; $P = 0.09$; $n = 54$ routes). BBS data also show a significant annual rate of decline survey-wide for the same period (-3.6%; $P < 0.01$; $n = 1404$ routes). Grasshopper Sparrows were present on an average of 70.98% (SE = 1.88) of the BBS routes run in Physiographic Area 36 in Colorado during 1988–1997, at an average abundance of 21.05 (SE = 1.31) individuals per route. The mean number of routes run each year was 29.2 (SE = 2.28). This species is monitored by *MCB* with point transects.

Biological Objective: Maintain or increase the species' distribution and abundance, based upon results of the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992; Bock and Webb 1984; Bock et al. 1992, 1993; Kingery 1998; Vickery 1996.

McCOWN'S LONGSPUR (*Calcarius mccownii*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Mountain Plover and Horned Lark.

Distribution: McCown's Longspurs inhabit grasslands from southeastern Alberta east to southern Saskatchewan, south through central North Dakota to northeastern Colorado. Within Colorado, they breed primarily in northern Weld and northeastern Larimer counties.

Habitat Requirements: These birds breed in shortgrass, especially where vegetation cover is sparse due to low soil moisture or grazing, or is interspersed with shrubs or taller grasses. They

also nest in grazed mixed-grass prairies. Individuals often use sparsely-vegetated hilltops for displaying and nesting. They require areas of bare soil and often place nests on barren hillsides. Territories in Colorado averaged 45–79% shortgrass and 13–23% bare ground, with little or no forb or cactus cover and few woody plants (although nests initiated late in the season are more likely to be near shrub cover, perhaps for protection from solar radiation). Longspurs breed in loose colonies.

Ecology: Longspurs arrive in Colorado in late March, and often linger into November. They initiate nesting by mid May, and most young fledge by mid July. Attempts to produce second broods may account for their extended residence in Colorado. They winter in the southern U.S. and northern Mexico. Their diet consists primarily of grass and forb seeds, but also includes grasshoppers, moths, beetles, and ants.

Management Issues and Conservation Recommendations: Conversion of native prairie to cropland or other land cover types can reduce longspur populations. *Preserve native shortgrass prairie, especially in areas of sparsely-vegetated hills, a favored nesting site for this species.*

Cattle grazing and prescribed burning may help create the short vegetation profile favored by longspurs. *Graze shortgrass at moderate intensity in summer, and graze taller grasses at moderate to heavy intensity.*

Tall, exotic grass species do not provide suitable habitat for this species. *Avoid planting taller grasses on CRP and other lands.*

Status and Reasons for Concern: This species has a high conservation need locally and throughout its range; it is on the national Watch List. This species is not adequately sampled by BBS surveys within the shortgrass physiographic area, and the data collected between 1966 and 1996 are too sparse to allow meaningful analysis of trends. McCown's Longspurs were present on an average of 9.71% (SE = 1.39) of the BBS routes run in Physiographic Area 36 in Colorado during 1988–1997, at an average abundance of 2.88 (SE = 0.74) individuals per route. The mean number of routes run each year was 29.2 (SE = 2.28). This species is monitored by *MCB* with tracking transects.

Biological Objective: Maintain or increase the species' distribution and abundance, based upon results of the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Creighton 1974, Creighton and Baldwin 1974, Dechant et al. 1999, Graul 1980, Kingery 1998, With 1994.

Lowland Riparian

Description and Ecology: Lowland riparian forests border streams as they flow out of the foothills onto the eastern plains. Plains cottonwoods interspersed with thickets of willows and other shrubs such as wild plums, hackberries, hawthorns, chokecherries, and box elder generally line these streams in eastern Colorado. Many of these lowland riparian areas have been substantially altered by humans to create residential, industrial, and recreational developments and to create highways and gravel mines.

Various sources report that riparian forests comprise less than 3% of the total landscape, but up to 80% of the resident bird species use them for some part of their life cycle. Birds use this habitat for nesting, cover, resting, migration stopover areas, and migration corridors. This system has the richest avian species component of any of Colorado's habitats. Common species in lowland riparian forests in Physiographic Area 36 include American Kestrel, Eastern and Western Screech-Owls, Great Horned Owl, Mourning Dove, Northern Flicker, Western Wood-Pewee, Western Kingbird, Eastern Kingbird, House Wren, Black-billed Magpie, American Robin, Yellow Warbler, Blue Grosbeak, and Bullock's Oriole (Andrews and Righter 1992, Krueper 1995, Howe 1996, Kingery 1998).

Importance and Conservation Status: Lowland riparian systems provide dispersal corridors for woodland birds across otherwise treeless terrain. Well-defined, unique, and highly productive, riparian areas are sensitive to disturbance (Melton et al. 1984).

Riparian ecosystems are important for both humans and wildlife. During historic times, humans have used riparian zones intensively and have substantially altered much of this habitat to create highways, gravel mines, and residential, industrial, and recreational developments. Riparian zones are convenient locations for those activities. They are also productive areas for domestic livestock grazing. However, the impacts of domestic livestock are not as dominant as in high elevation riparian zones (Melton et al. 1984, Wozniak 1995).

Unlike the high elevation riparian habitat in Colorado, much of the lowland riparian ecosystem is in private ownership; consequently, it is much more susceptible to loss and degradation by urban and industrial development, mining, road and trail development, and recreational development.

Implementation Strategies:

Bird Monitoring

Goal: To monitor or track all breeding birds in the lowland riparian habitat and document distribution, population trends, and abundance in a statistically acceptable manner.

Objective: All species with AI > 2 will be monitored with count-based methods.

Strategy: Monitoring will be accomplished through the combined efforts of agencies with primary responsibility for managing this habitat.

Strategy: Monitoring will continue to rely on BBS data, with data from CBO's *Monitoring Colorado's Birds (MCB)* program incorporated as it becomes available.

Status: MCB implemented lowland riparian habitat transects in 1999 and ran a total of 25 transects; trend data should be available for most species within 5–12 years.

Objective: All species with AI # 2 will be tracked through count-based methods or their presence/absence noted in the state.

Strategy: CBO's MCB monitoring program will address this.

Status: MCB monitoring was implemented on lowland riparian habitat beginning in 1999.

Objective: All colonial-nesting species will be monitored or tracked with colony counts.

Strategy: MCB will census all known colonies of Double-crested Cormorant, Great Blue Heron, Black-crowned Night-Heron, and Snowy Egret.

Status: MCB demographic monitoring of colonial-nesters began in 1999.

Objective: Population demographic monitoring will be instituted for all species in lowland riparian habitats with PT of 4 or 5.

Strategy: CBO's MCB will address this objective.

Status: MCB demographic monitoring will begin in 2001.

Habitat Monitoring

Goal: To document the amount, condition, and ownership of lowland riparian habitat in Colorado.

Objective: Develop collaborative efforts to use GIS in mapping lowland riparian habitat, documenting amount, condition, and ownership.

Status: This effort has not been initiated to date. Potential collaborators include CDOW, CNHP, CBO, USGS, and TNC.

Habitat Core Areas

Goal: To conserve unique representatives and/or large, ecologically-functioning examples of lowland riparian habitat in Colorado used by birds during the breeding season, during migration, or during the winter.

Objective: Identify such areas, use agency- or organization-specific means of designating and conserving them, and work with the appropriate agency or organization to promote conservation activities.

Status: None have been identified to date.

Objective: Identify riparian core areas that are appropriate for designation as *Important Bird Areas (IBAs)*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with lowland riparian habitat were nominated in 1999, and the *IBA* committee will make final selections in 2000.

Objective: To maintain or increase the quantity and quality of lowland riparian habitat on private lands.

Strategy: Promote collaboration/cooperation between agencies, organizations, and individuals in conserving unique representatives/core areas with multiple ownership.

Strategy: Encourage landowners to take advantage of funding opportunities for creating, restoring, and maintaining lowland riparian habitat on their properties. Suitable opportunities include NRCS's WHIP and EQIP, USFWS's Partners for Wildlife program, and the *Conservation of Private Grazing Land* and *Voluntary Debt-for-Nature Contract* provisions of the 1996 Farm Bill.

Strategy: Encourage private owners of existing mature and late-successional cottonwood-riparian communities along Colorado's lowland river systems to adopt grazing systems and other management practices that maintain and enhance stand conditions and ecosystem integrity.

Strategy: Encourage private owners of Colorado's lowland riparian lands to replant native cottonwoods and willows along stream reaches that have become degraded.

Objective: To maintain or increase the quantity and quality of lowland riparian habitat on public lands.

Strategy: Integrate the BCP into management plans for public lands in the physiographic area.

Strategy: Encourage public managers of existing mature and late-successional cottonwood-riparian communities along Colorado's lowland river systems to adopt grazing systems and other management practices that maintain and enhance stand conditions and ecosystem integrity.

Strategy: Encourage public managers of Colorado's lowland riparian lands to replant native cottonwoods and willows along stream reaches that have become degraded.

Site-based Conservation

Goal: To conserve local breeding sites, wintering sites, and migration stopover sites that are important for the conservation of lowland riparian priority species.

Objective: Identify agency- or organization-specific means of designating and conserving key local sites. Work with appropriate agencies and organizations to designate such sites, and promote conservation activities.

Objective: Identify key local sites that are appropriate for designation as *IBAs*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with lowland riparian habitat were nominated in 1999, and the *IBA* committee will make final selections in 2000.

Management Practices

Goal: To promote management practices that benefit birds in lowland riparian habitat.

Objective: Produce Best Management Practices manual for lowland riparian habitat.

Objective: Identify key landowners and land managers and encourage them to incorporate BMPs into management plans for public and private lands.

Interstate/International Wintering Grounds

Goal: To conserve the wintering ground habitat used by Colorado's migratory lowland riparian birds outside of the state.

Objective: Identify the wintering distribution and key habitat associations of priority species.

Objective: Track amount of available habitat on the wintering grounds.

Strategy: Utilize GIS (state GAP projects, Heritage Program, and/or CBO).

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to obtain data.

Objective: To protect wintering habitat for lowland riparian birds.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect wintering habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Migration Concerns

Goal: To protect migratory stopover habitat for lowland riparian birds.

Objective: Identify important migratory stopover areas for priority species that breed in Colorado, and key sites for priority species that breed elsewhere.

Objective: Track amount, condition, and ownership of key migratory stopover sites.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect migratory habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Outreach and Education

Goal: To provide information on lowland riparian habitat birds (conservation, habitat needs, natural history, etc.) to children, teachers, naturalists, landowners, natural resource professionals, and other interested parties.

Strategy: Make educational materials available at local nature centers and natural resource agency offices.

Strategy: Hold workshops and field programs for teachers.

Strategy: Hold workshops and field programs for natural resource professionals (CDOW, BLM, NRCS, and USFS staff).

Strategy: Present information at Teacher Association meetings, conferences, other annual meetings.

Strategy: Submit manuscripts to popular magazines for children and adults.

Research Priorities

Goal: To identify and facilitate research that will aid in understanding and managing riparian habitats for Colorado's birds.

Objective: To identify the top ten research needs in lowland riparian habitat in Colorado.

Strategy: Update the list of research needs annually to reflect shifting conservation priorities and to remove research needs from the list as they are investigated.

Strategy: Solicit input from researchers and managers on research needs and accomplishments.

Status: The following research needs have been identified:

1. The impact of Brown-headed Cowbird nest parasitism on the reproductive success of Bell's Vireo and other riparian species.
2. The impact of competition for nest cavities with European Starlings on Lewis's Woodpecker reproductive success.
3. The impact of westward expansion of birds of the eastern deciduous forest.
4. The influence of exotic plant species (especially Russian-olive and tamarisk) on habitat suitability during breeding, wintering, and migration periods.
5. The impact on habitat suitability during breeding, wintering, and migration periods of livestock grazing in lowland riparian habitat.

Objective: Facilitate investigations to answer these questions.

Strategy: Provide information about priority needs to universities, public and private research entities, identify funding sources, and promote collaboration between management and research agencies.

Priority Species Accounts: Two species are identified as high priority in lowland riparian habitat in Physiographic Area 36: Lewis's Woodpecker and Bell's Vireo.

LEWIS'S WOODPECKER (*Melanerpes lewis*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include American Kestrel, Great Horned Owl, Northern Flicker, Western Kingbird, Eastern Kingbird, Yellow Warbler, and Bullock's Oriole.

Distribution: Lewis's Woodpeckers breed from central British Columbia and western Alberta south to northern Mexico, and as far east as eastern Wyoming. In Colorado, Lewis's Woodpeckers reside in the valleys, plains, and foothills from 1100 to 2400 m (3,500–8,000 ft) in elevation. In Physiographic Area 87 in western Colorado, Lewis's Woodpeckers are fairly common summer residents in central and southwestern valleys, but rare north of the Colorado River.

Habitat Requirements: Lewis's Woodpeckers breed in riparian forests, agricultural areas, and urban areas when they contain scattered, mature cottonwoods adjacent to areas of low vegetation, such as ungrazed or lightly grazed grasslands, mowed hayfields, or fallow fields. In southeastern Colorado, mean dbh of nest trees was 112.6 cm (44.3 in), significantly greater than that of unused trees (Vierling 1997). These woodpeckers avoid dense riparian forests, and those which contain Red-headed Woodpeckers. They excavate their nesting and roosting cavities in the soft wood of dead or decaying trees, or rely on natural cavities or cavities excavated by other woodpeckers; they have relatively weak bills and skulls and cannot excavate cavities in sound wood.

Ecology: Lewis's Woodpeckers initiate nesting by late April, and most young leave the nest by the end of July. Their diet during the warmer months consists largely of flying insects caught on the wing. During colder months, the diet shifts to nuts, grains, and berries.

Management Issues and Conservation Recommendations: Lewis's Woodpeckers depend upon large trees and snags and are sensitive to disturbance at the nest. *Reduce or eliminate activities that degrade the structure and quality of the overstory or understory of riparian systems. Do not permit timber cutting within 30 m (100 ft) of the riparian area. Locate recreational facilities such as roads, trails and campgrounds up, out of riparian areas.*

Competition with European Starlings for limited nest cavities may limit breeding success of this species in some areas. *Research ways to reduce competition from these unprotected, introduced birds.*

Status and Reasons for Concern: This species has a high conservation need locally and throughout its range. It is on the national Watch List and is a USFS Sensitive Species in Region 2. Lewis's Woodpeckers are not adequately monitored by the BBS in Physiographic Area 36, and data are too sparse to permit meaningful analysis of trends. This species was present on an average of 6.40% (SE = 1.46) of BBS routes run in Physiographic Area 36 in Colorado, 1988–1997, at an average abundance of 0.13 (SE = 0.04) individuals per route. The mean number of routes run each year was 29.2 (SE = 2.28). This species is monitored by *MCB* with tracking transects.

Biological Objective: Increase the species' distribution and abundance, based upon results of BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Hadow 1973, Kingery 1998, Tobalske 1997, Vierling 1997.

BELL'S VIREO (*Vireo bellii*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Brown Thrasher, Common Yellowthroat, Yellow-breasted Chat, and Blue Grosbeak.

Distribution: Bell's Vireos breed in Northern Mexico and Central and Southwest U.S. In Colorado they nest on the northeastern plains along the South Platte, Arikaree, and Republican rivers, and very rarely in riparian areas elsewhere on the eastern plains.

Habitat Requirements: Bell's Vireos require dense lowland riparian shrubs for nesting and foraging habitat.

Ecology: In April and early May, these vireos return to their breeding grounds from wintering in western Mexico and Central America. The breeding season begins in late May. Nesting is completed by early August, and fall migration begins in early September. Their diet consists almost exclusively of insects, but they eat some berries late in the summer.

Management Issues and Conservation Recommendations: Bell's Vireos have experienced significant declines in the central U.S. in recent years, for reasons not clearly understood. They were probably never abundant in Colorado because of a paucity of suitable habitat. *Protect shrubby riparian zones from activities that degrade them, such as channelization, aggregate mining, grazing, urbanization, and development of roads and recreational facilities.*

Brown-headed Cowbird nest parasitism causes substantial declines in nesting success in some areas. *Reduce or eliminate livestock grazing in areas with Bell's Vireo breeding populations. Plant suitable shrubby vegetation in riparian zones in northeastern Colorado to expand habitat patches for vireos and to deter cowbirds.*

Status and Reasons for Concern: This species has a high conservation need locally and throughout its range, and is on the national Watch List. Bell's Vireos are not adequately monitored by BBS in the shortgrass physiographic area, and the data are too sparse for meaningful analysis of trends. However, BBS data from 1966 to 1996 reveal a statistically significant, survey-wide annual rate of decline (-3.4%; $P < 0.01$; $n = 248$). This species is monitored by *MCB* with statewide census.

Biological Objectives: Increase the species' distribution and abundance, with progress toward meeting this objective measured by returns from BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Brown 1993, Kingery 1998.

Shore/Bank

Description and Ecology: On the Great Plains, shore and bank habitats historically were restricted largely to rivers (Licht 1997). Descriptions of a very wide South Platte River flood plain bordered by only a few trees and laced with sandbars are common (Knopf and Scott 1990, Kingery 1998). The flood plain geomorphology of the Arkansas River suggests that, although not as wide as the South Platte, it also was marked with numerous sandbars. This habitat is formed by two ecological processes, erosion and flooding (Busch and Scott 1995). The former continues today while the latter is highly altered. Islands, beaches, and sandbars are greatly diminished in number and extent, resulting in declines of birds that utilize these habitats (Andrews and Righter 1992). Simply put, these land forms are not being created as large or as often as historical records indicate they once were.

The current extent of beaches and shorelines is greatly diminished along rivers, but man has created a new source of these habitats—reservoirs. The excavation and water management of reservoirs creates shoreline and beach. Such beaches are now the key remaining breeding sites for two priority bird species. The persistence of these habitats depends upon water levels remaining below capacity during the breeding season and/or upon adequate windblown deposits, usually from reservoir bottoms, creating active beach and dune ecosystems.

Bank habitat results from erosion. The habitat generally occurs along stream or valley corridors, but can occur in other areas where slope is excessive relative to the soils it is supporting. Banks are also a common feature of man-made habitats, e.g., mines, highway embankments, and borrow pits. There is likely a decrease in the natural bank formations along many stream courses; however, there is also an increase in the same due to manmade features.

Although shore/bank habitats support some vegetative growth, they are most notable for their lack of vegetation. The actions of inundation, waves, and wind greatly inhibit vegetative growth. In fact, relatively small increases in plant density and height make the habitat unsuitable for most shore/bank bird species.

In addition to providing breeding habitat for a few species, the shore/bank habitat provides foraging habitat for many other species. Even in the winter, these habitats are often occupied by Horned Larks, pipits, and various sparrows.

Importance and Conservation Status: Thirteen of Colorado's breeding bird species are dependent on shore/bank habitats. This is 5% of the breeding species on less than 1% of the state's surface area. Shore/bank obligates have specialized adaptations necessary to achieve breeding success in these harsh habitats. As so often happens in nature, these specialized adaptations, combined with the small areas that the birds occupy, make shore/bank species highly susceptible to human-caused changes in the environment. Such changes are almost certain because these habitats are associated

with water; in the arid West, the association of an important habitat type with water is reason for concern.

Two of the three high priority species, Piping Plover and Least Tern, no longer breed in native habitat in Colorado; all of their reproduction takes place on the shores and islands of reservoirs. The third, the Snowy Plover, has its largest populations associated with reservoirs. It is ironic that the sources that altered the native habitats to water management have also created the last nesting areas for these birds. Reservoir management has become the key to successfully conserving these birds in Colorado (Nelson 1998a,b).

Although people have created an abundance of shore and beach around reservoirs, only a few reservoir sites meet the requirements of these specialized birds. Key threats to birds in this habitat include flooding, trampling by livestock, predation, overheating of eggs and young, off-road vehicle traffic, and vegetation encroachment (Gaines and Ryan 1988; Haig et al. 1992; Nelson 1998a,b). The rarity of existing breeding sites necessitates a site-specific approach to management, and raising the numbers of sites and birds should be a key strategy.

Least Terns and Piping Plovers are critically imperiled in Colorado. Each species has fewer than 25 pairs breeding in Colorado. Where they occur on state-managed land, the sites receive intensive management. But the control of water levels is critical to success and dependent upon private water users.

Shore and bank habitat suitable for reproduction of the high priority species has always been rare, and natural occurrences of these habitats have all but disappeared. The development and maintenance of reservoirs has created surrogate patches of habitat, however, and these are now the only sites used by these species. Treating water as a property and managing it for a variety of purposes has presented significant challenges to conservation success and has resulted in urgent conservation needs for the high priority species.

Implementation Strategies:

Bird Monitoring

Goal: To monitor or track all breeding birds in the shore/bank habitat and document distribution, population trends, and abundance in a statistically acceptable manner.

Objective: All species with AI > 2 will be monitored with count-based methods.

Strategy: Monitoring will be accomplished through the combined efforts of agencies with primary responsibility for managing this habitat.

Strategy: Monitoring will continue to rely on BBS data, with data from CBO's *Monitoring Colorado's Birds (MCB)* program incorporated as it becomes available.

Objective: All species with AI # 2 will be tracked through count-based methods or their presence/absence noted in the state.

Strategy: CBO's *MCB* monitoring program will address this.

Objective: Population demographic monitoring will be instituted for all species in shore/bank habitats with PT of 4 or 5.

Status: In 1999 there are no species known to have PT scores of 4 or 5.

Objective: Monitor all priority birds in shore/bank habitats in Colorado. Monitor the Least Tern, Snowy Plover, and the Piping Plover.

Strategy: Monitor Snowy Plover breeding activity at documented sites.

Strategy: Monitor Least Tern breeding numbers at documented sites using direct count methods.

Strategy: Monitor Piping Plover breeding numbers at documented sites using direct count methods.

Strategy: Establish a volunteer “nest guardian” program, to monitor and protect active nests.

Habitat Monitoring

Goal: To document the amount, condition, and ownership of shore/bank habitat in Colorado and the extent and quality of breeding sites for priority species.

Objective: Develop collaborative efforts to use GIS in mapping shore/bank habitat, documenting amount, condition, and ownership.

Status: This effort has not been initiated to date. Potential collaborators include CDOW, CNHP, CBO, USGS, and TNC.

Objective: Monitor known breeding habitat of priority species annually for condition and need for updated conservation strategies. The quality of occupied sites should be monitored as determined in applicable management plans. However, due to the high speed of change, annual monitoring is likely to be required.

Habitat Core Areas

Goal: To conserve unique representatives and/or large, ecologically-functioning examples of shore/bank habitat in Colorado used during the breeding season, during migration, and/or during the winter.

Objective: Identify at least three landscapes with suitable conditions for conservation of priority species and seek conservation status for appropriate breeding habitats.

Strategy: Coordinate activities with the conservation activities of state agencies, NGOs, local governments, private landowners, and federal agencies currently working in the areas.

Objective: Identify areas where Snowy Plovers and Piping Plovers are known to stage prior to migration. Seek conservation status that will preserve the landscape functions of identified areas.

Site-based Conservation

Goal: To conserve local breeding sites, migratory stopover sites, and wintering sites in shore/bank habitats that are important for the conservation of priority species. Due to the discrete

and relatively small areas in this habitat category, site-specific strategies are likely to be highly efficient.

Objective: Seek conservation status for those known breeding sites of priority species that are regularly occupied.

Objective: Identify reservoirs or other potentially suitable breeding habitat and develop conservation strategies that are compatible with long term conservation needs of priority birds, e.g., the management of the John Martin Reservoir provides opportunities to create and maintain habitat below the dam in the Arkansas River.

Objective: Develop land protection strategies to ensure that critical sites are not threatened with incompatible land use changes. The future of lakeside property is uncertain in the plains counties. However, if adjacent states are an example, our reservoirs may become highly popular recreation sites, followed soon by residential expansion. Notably, this is not simply a threat, but creates opportunities for conservation as well.

Management Practices

Goal: To promote management practices that benefit birds in shore/bank habitats.

Objective: Implement site-specific management strategies for known existing breeding sites of Least Tern and Piping Plover as developed by the CDOW (Slater 1994).

Objective: A Best Management Practices (BMP) manual will be produced and distributed.

The manual will include the following recommendations:

1. Maintain reservoir levels that support reproduction of the terns and plovers. Develop incentives for water users to free up shoreline for birds when they have adequate water to store.
2. Maintain high habitat quality on islands that are currently occupied breeding habitat. Water levels need to be low enough to expose the island, but high enough to prevent the creation of a land bridge. Such bridges invite predators and livestock.
3. Exclude livestock from nesting areas during the nesting period; use livestock for post-breeding vegetation reduction. Dense vegetation may preclude nesting. Vegetation removal is often the goal in these habitats. Effective grazing intensities can be attained with cattle, but can also be attained with other species, e.g., goats.
4. Develop recreation plans at known breeding sites that support the persistence of breeding activity. Recreational disturbance can be a critical stress for priority species. This is especially the case where nesting occurs on recreational destination points: high dunes, islands, and spits. In the searing heat of summer, it only takes a few minutes of exposure to kill the eggs or chicks. Habitat management should include appropriate people management as well.
5. Wherever possible use ecological processes to maintain vegetation within the range of suitable variation for priority species. Where flooding and/or grazing are not available it may be critical to manually manipulate vegetation.
6. Manage predators at each site in a manner dictated by local conditions. Predators can have severe impacts on the small populations of high priority species. The maintenance

of water barriers will exclude most terrestrial predators. However, in reservoirs, gulls have increased in numbers and now present predation problems for the smaller species.

7. Create spits and islands. While management is still required, these areas are the most isolated and permit easier monitoring.

Status: Production has not yet been initiated.

Objective: Identify key landowners and land managers and encourage them to incorporate best management practices to conserve shore/bank birds and their habitat. The needs of priority bird species of the shore/bank habitat should be considered in public reservoir management plans. Work with private landowners and irrigation companies to gain voluntary cooperation.

Objective: Promote the creation of habitat for plovers and terns in protected areas with adequate management (e.g., a state park or state wildlife area) (Nelson 1998b).

Interstate/International Wintering Grounds

Goal: To conserve the wintering ground habitat used by birds of shore/bank habitats.

Objective: Track the amount of habitat available on the wintering grounds.

Strategy: Utilize GIS (state GAP projects, Heritage Program, and/or CBO).

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to obtain data.

Objective: Protect key tracts of wintering habitat.

Strategy: Identify the wintering distribution and key habitat associations of priority species.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect wintering habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Migration Concerns

Goal: To protect migratory stopover habitat of birds of shore/bank habitats as they migrate outside of the state.

Objective: Identify important migratory stopover areas for priority species that breed in Colorado, and key sites for priority species that breed elsewhere.

Objective: Track amount, condition, and ownership of key migratory stopover sites.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect migratory habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Outreach and Education

Goal: To provide information on shore/bank birds (conservation, habitat needs, natural history, etc.) to children, teachers, naturalists, landowners, natural resource professionals, and other interested parties.

Strategy: Make educational materials available at local nature centers and natural resource agency offices.

Strategy: Hold workshops and field programs for teachers.

Strategy: Hold workshops and field programs for natural resource professionals (CDOW, BLM, and USFS staff).

Strategy: Present information at Teacher Association meetings, conferences, other annual meetings.

Strategy: Submit manuscripts to popular magazines for children and adults.

Strategy: Provide landowners with information on the needs of shore/bank species and the role of private lands in conservation.

Strategy: Each spring, supply local media outlets with general information on the natural history and conservation needs of priority species and on current conservation efforts.

Strategy: Provide guided viewing opportunities for persons interested in seeing priority species.

Research Priorities

Goal: To identify and facilitate research that will aid in understanding and managing shore/bank habitats for Colorado's birds.

Objective: To identify the top ten research needs in shore/bank habitat in Colorado.

Strategy: Update the list of research needs annually to reflect shifting conservation priorities and to remove research needs from the list as they are investigated.

Strategy: Solicit input from researchers and managers on research needs and accomplishments.

Status: The following research needs have been identified:

1. Determine the status, variability, and locations of existing and potential breeding habitat.
2. Determine the most effective ways to design and manage reservoirs to maximally benefit the high priority birds.
3. Determine methods to manage instream impoundments to create riverine sandbar habitat.
4. Determine the hydrological regime that would restore adequate sandbar habitat in the Arkansas River below John Martin Reservoir. The management of reservoirs to restore more natural flow regimes downstream is being investigated throughout the West. Most of the research impetus is to benefit endangered fishes in the respective rivers. However, a similar need is present on the South Platte and Arkansas rivers of eastern Colorado with respect to the shore/bank birds identified herein. With only small reservoirs on the South Platte, it is likely that the greatest benefits for the birds could be attained in the Arkansas drainage.

Strategy: Facilitate investigations to answer these questions by providing information about priority needs to universities, public and private research entities, identifying funding sources, and promoting collaboration between management and research agencies.

Priority Species Accounts: Three species are identified as high priority birds for shore/bank habitats in Physiographic Area 36: Snowy Plover, Piping Plover, and Least Tern. Fewer than 25 pairs each of Piping Plovers and Least Terns are known to breed in Colorado.

SNOWY PLOVER (*Charadrius alexandrinus*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Piping Plover, Killdeer, Spotted Sandpiper, American Avocet, Black-necked Stilt, and Least Tern.

Distribution: Snowy Plovers breed along the West and Gulf coasts, throughout much of Nevada, southern Washington, northern Utah, southeastern Kansas, the Oklahoma and Texas panhandles, and southeastern New Mexico. Within the Central Shortgrass Prairie in Colorado, they breed on the shores of reservoirs near the Arkansas River between La Junta and Lamar.

Habitat Requirements: Snowy Plovers nest on sandy beaches or alkaline flats with little or no vegetation; nests are located within 150 m (500 ft) of water.

Ecology: Snowy Plovers arrive in Colorado in mid April. They initiate nests as early as mid April and as late as early July; the later dates are probably renesting attempts after failed nests rather than second clutches after successful nests. Most birds have left the state by the end of September. The diet consists of terrestrial and aquatic invertebrates.

Management Issues and Conservation Recommendations: Snowy Plovers' nest sites and breeding success are sensitive to water levels, which are subject to management for irrigation and other uses. *Integrate Snowy Plover nesting habitat needs into reservoir management plans.*

Nest depredation hampers productivity, but experimental predator exclosures failed to improve nest success rates, probably because they did not exclude smaller predators such as snakes and rodents. Humans and domestic animals can destroy nests. *Establish area closures with fences and signs to restrict access within 150 m (500 ft) of known nest sites.*

Status and Reasons for Concern: This species has a high conservation need locally and throughout its range; fewer than 100 pairs nest in Colorado. This species is on the national Watch List, indicating a high conservation need throughout its range. Due to its small numbers and limited range, this species is not monitored by the BBS within Physiographic Area 36. This species is monitored by CDOW.

Biological Objective: Increase the species' distribution and abundance, based on results of the CDOW or other monitoring programs.

Selected References: Andrews and Righter 1992; Estelle and Mabee 1994, 1995; Kingery 1998; Page et al. 1995.

PIPING PLOVER (*Charadrius melodus*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Snowy Plover, Killdeer, Spotted Sandpiper, American Avocet, Black-necked Stilt, and Least Tern.

Distribution: Piping Plovers breed in southern Alberta, Saskatchewan, and Manitoba, northern Montana, North and South Dakota, Nebraska, northern Michigan, and along the Atlantic coast from Newfoundland to North Carolina. In Physiographic Area 36 in Colorado, they nest only on reservoirs in the vicinity of the Arkansas River, between Las Animas and Lamar.

Habitat Requirements: These plovers require sandy beaches (mainland or islands) or alkaline flats with little or no vegetation; nests are located within 250 m (275 yd) of water.

Ecology: Piping Plovers arrive in Colorado in late April, and initiate nesting in early May, although they may renest after failed nests through July. Most birds have left the state by the end of September to spend the winter in the southern and southeastern states along the Atlantic and Gulf coasts.

Management Issues and Conservation Recommendations: Nest site availability and breeding success are sensitive to water levels, which are subject to management for irrigation and other uses. Nest depredation hampers productivity, but experimental predator exclosures failed to improve nest success rates, probably because they did not exclude smaller predators such as snakes and rodents (Estelle and Mabee 1994, 1995). Area closures can protect known nest sites from disturbance or destruction by humans and domestic animals; the boundaries of such closures should be situated at least 150 m (500 ft) from known nests. Attempts to relocate nests away from rising waters or human activity rarely succeed. Vegetation encroachment into suitable habitat restricts nesting opportunities; vegetation should be removed from nesting sites by mechanical means or by flooding outside of the late April to late August nesting season. *Management efforts, including alteration of water management schemes and habitat manipulation, should follow the guidelines of the state and federal recovery plans (Slater 1994, U.S. Fish and Wildlife Service 1996).*

Status and Reasons for Concern: This species has a high conservation need locally and throughout its range. The Piping Plover is listed as Threatened at the federal and state (Colorado) levels. Fewer than 6,000 birds were tallied during an extensive North American breeding census in 1996; fewer than 20 birds were found in Colorado, and many of them were unpaired males. Due to its small numbers and limited range, this species is not monitored by the BBS. Results of the International Piping Plover Census indicated that the continental population increased 7.8%

between 1991 and 1996, although the total population is still perilously low; in Colorado, the 1991 census recorded 19 birds, while the next census in 1996 found 13 birds. This species is monitored by CDOW and USFWS.

Biological Objective: Increase the species' distribution and abundance, based upon results of CDOW censuses, the International Piping Plover Census, and other monitoring programs.

Selected References: Andrews and Righter 1992, Haig 1992, Kingery 1998.

LEAST TERN (*Sterna antillarum*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Snowy Plover, Piping Plover, Killdeer, American Avocet, Black-necked Stilt, and Spotted Sandpiper.

Distribution: Least Terns nest along the East, West, and Gulf coasts, and inland along the Missouri and Mississippi river drainages. In Physiographic Area 36 in Colorado, they nest only on reservoirs in the vicinity of the Arkansas River, between Las Animas and Lamar.

Habitat Requirements: Least Terns nest on sandbars, islands, beaches, and alkali flats with little or no vegetation, although they will tolerate more vegetation than the plover species. Vegetation provides thermal and hiding cover for chicks later in the season. Nests are often located within 20 m (65 ft) of water. Nesting success is higher on islands than on the mainland, probably due to restricted access by terrestrial predators.

Ecology: These semi-colonial terns place their nests from a few meters to hundreds of meters apart from one another. Adults arrive in Colorado in mid May and initiate nesting between late May and early July. Most young leave the nest by mid August, and most birds leave the state by mid September. Least Terns winter in Central and South America. They feed primarily on fish, but may also take terrestrial and aquatic invertebrates.

Management Issues and Conservation Recommendations: Disturbance or destruction by humans and domestic animals often leads to nest failure. Least Terns will accept artificial islands for nesting, but they will not use freshly made islands until the soils have settled and become stable. *Management efforts, including alteration of water management schemes and habitat manipulation, should follow the guidelines of the federal and state recovery plans (Sidle and Harrison 1990, Slater 1994).*

Status and Reasons for Concern: This species is listed as Endangered at the federal and state (Colorado) levels. Fewer than 50 pairs breed in Colorado. Due to its small numbers and limited range, this species is not monitored by the BBS. This species is monitored by CDOW and USFWS.

Biological Objective: Increase the species' distribution and abundance, based on results of CDOW censuses or other monitoring programs.

Selected References: Andrews and Righter 1992, Kingery 1998, Thompson et al. 1997.

Wetlands

Description and Ecology: The habitat category of wetlands encompasses a large variety of ecosystems of large and small proportions. The state of Colorado has numerous representatives of this variety: marshes, wet meadows, seeps, springs, rivers, lakes, ponds, swamps, fens, bogs, hanging gardens, and playas (Windell et al. 1986, Benedict 1991). Many of Colorado's wetlands, including some that support priority species, are artificial. Such wetlands include irrigated meadows and man-made reservoirs, lakes, and ponds with their associated marshes. Less than 3% of the surface area of Colorado originally occurred as wetlands (Dahl 1990). Approximately 40% to 60% (0.4–1.2 million ha; 1–3 million ac) of the original wetlands area has been lost (Dahl 1990, Wilen 1995). Losses are greater proportionately in wetlands than in other habitat types in Colorado.

Wetlands in Colorado range in size from a few square meters (e.g., springs and splash pools) to large areas of wet meadows and riparian wet forests. They also include wetlands along riparian corridors that may continue for many kilometers, yet are quite narrow. (Discussion of riparian habitats will be found in the appropriate section: lowland riparian or high elevation riparian habitats.) What all wetlands have in common is water. The water occurs in sufficient quantities and in such patterns that the soils, geomorphology, and vegetation respond characteristically, forming repeated patterns on the landscape. The repeated patterns are categorized as types of wetlands.

All wetlands likely play a role in the lives of birds, at least as sources of water. But many wetland types are very small and unlikely to make a large contribution to Colorado's avifauna. (Although any wetlands may be important to local conservation.) Wetlands that support high priority bird species include lakes, ponds, reservoirs, wet meadows, playas, and marshes. The remaining, smaller wetlands are perhaps best considered as patch types and important habitat components within a larger habitat matrix.

Importance and Conservation Status: Thirty-seven of Colorado's breeding bird species are dependent on wetlands. That means that 14% of the breeding species depend on less than 3% of the state's area. Many of the species are common and are presently of little current conservation concern (e.g., Red-winged Blackbird). However two species are in need of special conservation attention in Colorado: Northern Harrier and Short-eared Owl.

In the water-restricted western United States, water resources are necessary for life, and control of water has become a most lucrative asset. Water law in Colorado, as in most western states, recognizes water as one of a bundle of property rights. As such, water is owned, bought and sold, as property. For mining operations, agricultural irrigation, and drinking water for a growing population, water has been harnessed, moved, stored, slowed, and spread. Wetlands have often been considered impediments to efficient water use, slowing its downstream progress to areas of human use. Many wetlands have been drained and others heavily altered. Dahl (1990) estimated

wetland losses in Colorado to be approximately 50%. More specific estimates for wetland losses in the Central Shortgrass Prairie are not available, and interpretations are very complicated because of the large number of created wetlands.

Many wetland manipulations resulted in the addition of many acres of wetlands (Kingery 1998). For example, large irrigation canals move water from mountain rivers or streams into the prairie. Some of the water escapes the confines of ditches and leaks into the surrounding landscape; this escaped water often creates artificial springs. Vegetation changes around such seepages create wetlands such as wet prairie, wet meadows, small standing waters, shrub thickets, and woody groves. Such areas are often rich with birds, and where trees and shrubs occur, the associated birds may represent those found in riparian habitats.

The largest changes in the wetlands of Colorado's prairies came from the creation of water storage facilities, reservoirs and ponds (Kingery 1998). These reservoirs are often placed on top of existing wetlands where they may greatly expand the total wetland acres. (This does not imply good or bad since there may be a significant change in wetlands or habitat type with the creation of these wetlands. It is important to remember that different wetland types are not equivalent in biodiversity terms.) The extensive patchwork of reservoirs in the Denver metropolitan area—from Fort Collins to Pueblo—has greatly changed the regional avifauna. Birds that were undoubtedly rare or absent prior to European advancement are now common (e.g., some gulls, many waterfowl, and some wading birds). Outside of the metropolitan area, large reservoirs such as Jackson Reservoir, Bonny Reservoir, John Martin Reservoir, Neenoshe Reservoir, and many others have created large areas of wetlands, open water, shore/bank, and riparian habitats that are novel in the physiographic area.

The wetlands that support high priority bird species in Colorado have shown variable changes over the past 150 years. Shallow lakes and ponds that supported large populations of breeding waterfowl have declined in many areas. Instead, reservoirs are often maintained with little vegetation. A common goal of water users is to provide the smallest surface area of water to limit evaporation losses; this goal often creates wetlands habitats that are relatively sterile.

It is difficult to assess the status of marshes since agricultural practices have created numerous marshes. However, it is clear that native graminoid-dominated marshes have clearly suffered extensive losses, even more when the condition of the landscape in which they occur is considered (J. Sanderson, personal communication). For example, a marsh may have adequate breeding habitat for Northern Harriers, but a landscape that is inadequate or ecologically dysfunctional.

Playas deserve special mention. Playas are variably sized depressions in the prairie that are usually dry. However, during wet periods, especially after heavy thunderstorms, these depressions are often filled with water and teeming with birds. In much of the physiographic area, 1998 and 1999 were wet years, and the playas provided nesting, feeding, or resting grounds for an abundance of

waterfowl, wading birds, and shorebirds. The playas vary in size from hundreds of square feet to several square miles.

The unpredictability of playas as a wetlands resource may be one factor that has led to a lack of attention from Colorado's conservation community; some playas have been filled for many years (e.g., in Huerfano County near the Spanish Peaks), but most have been filled only 2–3 years in a decade. Livestock producers often try to increase the capacity of playas in an attempt to maintain surface water for longer periods, and wildlife managers have long sought means of increasing the time that water is available in larger and deeper playas; however, other playas have been lost in the conversion of prairie to croplands. In the wettest years, these playas are visible as ponds within a sea of crops (C. A. Pague, The Nature Conservancy, personal observation).

Current threats to wetlands include water diversions, draining, manipulation, intensive use by livestock, conversion to cropland, and conversion to residential uses in the metropolitan area (Windell 1986). Threats include direct losses—conversion of wetland types—and contextual changes. Interestingly, the pressure to provide water to urban populations has stimulated the acquisition of water rights by municipalities from large areas of the plains (e.g., Rocky Ford Ditch 1999). Such acquisitions have resulted in large areas of prairie having their local hydrology returned to a more natural state.

The concept of no net loss of wetlands appears to be adequate for protecting the associated birds in Colorado. However, existing guidelines for wetlands mitigation, i.e., the focus on jurisdictional wetlands, rarely give adequate attention to bird communities or high priority species that are not given legal status. Cumulative changes of wetland types and loss of ecosystem-level biological attributes continue to reduce the amounts of wetlands habitats that are suitable for the more sensitive wetlands species. Recommendations for making wetlands mitigation more suitable for birds are laudable but may not adequately address the concerns for the most sensitive species.

In summary, wetlands habitats are diverse and widespread in Colorado's Central Shortgrass Prairie. The wetland types that support most wetlands bird species are playas, marshes, wet meadows, lakes, and ponds. The status of these wetland communities is checkered, with an increase in lakes, ponds, and seeps. Losses of springs, wet meadows, and playas are notable. Marshes have probably declined somewhat, but mostly have changed from native condition to altered and scattered patches.

Implementation Strategies:

Bird Monitoring

Goal: To monitor or track all breeding birds in wetlands habitat and document distribution, population trends, and abundance in a statistically acceptable manner.

Objective: All species with AI > 2 will be monitored with count-based methods.

Strategy: Monitoring will be accomplished through the combined efforts of agencies with primary responsibility for managing this habitat.

Strategy: Monitoring efforts will continue to rely on BBS data, with CBO's *Monitoring Colorado's Birds (MCB)* data incorporated as it becomes available.

Status: MCB implemented wetlands transects in 1999 and ran a total of nine transects; trend data should be available for most species within 5–12 years.

Objective: All species with AI # 2 will be tracked through count-based methods or their presence/absence noted in the state.

Strategy: The MCB monitoring program will address this.

Status: MCB was implemented in wetlands habitat in 1999.

Objective: All species with PT of 4 or 5 will be tracked with demographic monitoring.

Strategy: CBO's MCB monitoring program will address this.

Status: MCB demographic monitoring will begin in 2001.

Objective: Establish breeding bird survey protocols that more precisely monitor specific populations of priority birds.

Strategy: The MCB monitoring program will address this.

Habitat Monitoring

Goal: To document the amount, condition, and ownership of wetlands habitat in Colorado.

Objective: Develop collaborative efforts to use GIS in mapping wetlands habitat, documenting amount, condition, and ownership. (Mapping of important examples of wetlands is needed as a first step in a monitoring program. Subsequent monitoring of the areas should include size, ecological composition, and landscape context. State, federal, and non-government organizations should be encouraged to focus on prairie wetlands because of their disproportionate contribution to bird conservation in that region.)

Strategy: Support the wetlands programs of the Colorado Natural Heritage Program and the Colorado Division of Wildlife and their initiatives to identify high priority wetlands, including playas, that support native natural communities or high priority species.

Status: This effort has not been initiated to date. Potential collaborators include CDOW, CNHP, CBO, USGS, and TNC.

Objective: Identify and protect the ecological processes that support specific wetlands and their associated bird communities. This is particularly important where wetlands are supported by groundwater.

Habitat Core Areas

Goal: To conserve unique representatives and/or large, ecologically-functioning examples of wetlands habitat in Colorado used during the breeding season and/or during migration.

Objective: Identify such areas, use agency- or organization-specific means of designating and conserving them, and work with the appropriate agency or organization to promote conservation activities.

Objective: Identify any of these areas that are appropriate for designation as *Important Bird Areas (IBAs)*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with wetlands habitat were nominated in 1999 (including Barr Lake State Park, Glenmere Park, and Chatfield Basin Conservation Network), and the *IBA* committee will make final selections in 2000.

Objective: To maintain or increase the quantity and quality of wetlands habitat on private lands.

Strategy: Encourage landowners to take advantage of funding opportunities and expertise for creating, restoring, and maintaining wetlands habitat on their properties.

Strategy: Promote collaboration/cooperation between agencies, organizations, and individuals in conserving unique representatives/core areas with multiple ownership.

Objective: To maintain or increase the quantity and quality of wetlands habitat on public lands.

Strategy: Integrate the BCP into management plans for public lands in the physiographic area.

Site-based Conservation

Goal: To conserve local breeding sites, migratory stopover sites, and wintering sites in wetlands that are important for the conservation of priority species.

Objective: Identify agency- or organization-specific means of designating and conserving key local sites. Work with appropriate agencies and organizations to designate such sites, and promote conservation activities. Work with the State Wetlands Initiative to ensure that funded conservation projects support the goals of this plan.

Strategy: Work with waterfowl management interests to conserve regionally significant areas, insuring that non-game interests are maintained.

Strategy: Identify areas with high numbers of breeding priority birds and determine if they are appropriate as site-based conservation projects.

Objective: Identify key local sites that are appropriate for designation as *IBAs*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with wetlands habitat were nominated in 1999, and the *IBA* committee will make final selections in 2000.

Management Practices

Goal: To promote management practices that benefit birds in wetlands habitats.

Objective: A Best Management Practices (BMP) manual specific to wetlands birds will be produced and distributed. (A more general wetlands BMP manual is available: Peale 1996.) The manual should include the following topics and recommendations:

1. Conservation activities in wetlands should enhance the current legal protection of wetland functions by emphasizing the protection of natural wetland structure, composition, and the ecological processes that support them and their bird residents. The current focus on protecting jurisdictional wetlands is insufficient to conserve many

wetlands associated species, particularly the more sensitive bird species (Buhlmann et al. 1996).

2. Include bird conservationists in the process of planning and approving new reservoirs to produce more bird-friendly projects.
3. Develop grazing plans for wetlands that support wetlands bird conservation. Grazing is a natural, perhaps even essential, ecological process in the shortgrass prairie. However, large numbers of livestock (cattle) permitted to graze in wetlands during the breeding season may accidentally trample nests or young and significantly alter habitat.
4. Impose limits on free-ranging dogs.
5. Guidance on landscape context, particularly with respect to buffers against incompatible land uses (e.g., some urbanization).
6. Man-made wetlands (e.g., reservoirs surrounded by extensive marshes, return flows from ditches and canals, agricultural return flows, etc.) that provide habitat for birds, including high priority species, should be managed to protect the supported bird communities. This includes best management practices centered on water level management, recreation, and maintenance.

Status: Not yet initiated.

Objective: Identify key landowners and land managers and encourage them to incorporate best management practices to conserve wetlands birds and their habitat.

Objective: Integrate wetlands bird BMPs into waterfowl management plans as appropriate, insuring conservation of the entire avian community.

Interstate/International Wintering Grounds

Goal: To conserve the wintering ground habitat used by birds of wetlands habitats.

Objective: Track the amount of habitat available on the wintering grounds.

Strategy: Utilize GIS (state GAP projects, Heritage Program, and/or CBO).

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to obtain data.

Objective: Protect key tracts of wintering habitat.

Strategy: Identify the wintering distribution and key habitat associations of priority species.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect wintering habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Migration Concerns

Goal: To protect migratory stopover habitat of birds of wetlands habitats as they migrate outside of the state.

Objective: Identify important migratory stopover areas for priority species that breed in Colorado, and key sites for priority species that breed elsewhere.

Objective: Track amount, condition, and ownership of key migratory stopover sites.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect migratory habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Outreach and Education

Goal: To provide information on wetlands birds (conservation, habitat needs, ecological processes, natural history, etc.) to children, teachers, naturalists, landowners, natural resource professionals, and other interested parties.

Strategy: Make educational materials available at local nature centers and natural resource agency offices.

Strategy: Hold workshops and field programs for teachers.

Strategy: Hold workshops and field programs for natural resource professionals (CDOW, BLM, and USFS staff).

Strategy: Present information at Teacher Association meetings, conferences, other annual meetings.

Strategy: Submit manuscripts to popular magazines for children and adults.

Research Priorities

Goal: To identify and facilitate research that will aid in understanding and managing wetlands habitats for Colorado's birds.

Objective: To identify the top ten research needs in wetlands habitat in Colorado.

Strategy: Update the list of research needs annually to reflect shifting conservation priorities and to remove research needs from the list as they are investigated.

Strategy: Solicit input from researchers and managers on research needs and accomplishments.

Status: The following research needs have been identified:

1. The status, variability, and locations of playas and playa complexes. Specific attention should be paid to the identification of playa complexes and their local and regional roles.
2. The habitat requirements, including landscape context, of wetlands birds. This is particularly important where the wetlands area is small and surrounded by dissimilar vegetation types.
3. The relative significance of tallgrass prairie vegetation to high priority species.
4. The actual locations of nesting habitat for Northern Harriers and Short-eared Owls.
5. The criteria for successful reserve design. Some examples exist relative to human disturbance (Klein et al. 1995), but little is known about the more comprehensive needs of wetland avian communities.

Strategy: Facilitate investigations to answer these questions by providing information about priority needs to universities, public and private research entities, identifying funding sources, and promoting collaboration between management and research agencies.

Priority Species Accounts: Two species are identified as high priority birds for wetlands habitat in Physiographic Area 36: Northern Harrier and Short-eared Owl.

NORTHERN HARRIER (*Circus cyaneus*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Virginia Rail, Sora, Common Snipe, Short-eared Owl, Marsh Wren, Red-winged Blackbird, and Yellow-headed Blackbird.

Distribution: Northern Harriers breed in North America and Eurasia. They breed throughout North America except for the South and Southeast, with their highest densities occurring in the northern prairie regions (Price et al. 1995). They reside throughout Colorado, with highest densities on the eastern plains, mountain parks, and western valleys.

Habitat Requirements: Northern Harriers breed in a wide array of habitats, but they typically prefer large tracts (100 ha; 250 ac) of wetlands with dense vegetation. Actual breeding habitat preferences may be fairly broad, and include wet meadows, grasslands, sandsage prairie, and croplands, but little information is available. This species has a large home range (Craighead and Craighead 1956), which makes the researcher's task of locating nests difficult.

Ecology: In Colorado Northern Harriers initiate breeding in late April, and young leave the nest by August. These hawks feed on small mammals, birds, reptiles, and amphibians. They hunt by flying low over wetlands, grasslands, shrublands, and croplands. Their keen sense of hearing and sight make this low altitude strategy successful.

Management Issues and Conservation Recommendations: The population of Northern Harriers has declined due to wetlands habitat losses. Large feeding areas are needed. *Identify and protect larger wetlands used by this species. Erect buffers to incompatible land uses such as urban development.*

In wetlands where water levels are regulated, nests become flooded by sudden rises in water levels. *Do not allow water levels to rise more than 15 cm (6 in) during the nesting season.*

Large numbers of livestock permitted to graze in wetlands during the breeding season may accidentally trample nests or young. *Stock wet meadows and wetland pastures at low levels.*

Habitat management schemes for waterfowl and upland game birds generally benefit harriers. *Managers should continue to consider the potential benefits and impacts of such management to Northern Harriers.*

Loss of prey species, either through direct control or through habitat loss, reduces populations. *Maintain populations of voles at levels compatible with economic uses of the land.*

Some nests are destroyed by agricultural equipment. *Postpone haying until after the end of nesting, or avoid the area immediately around harrier nests.*

Status and Reasons for Concern: This species has a moderately high conservation need throughout its range, along with high representation in the physiographic area and a declining population trend. BBS data from Physiographic Area 36 during 1966–1996 reveal a statistically significant annual rate of decline (-4.6%; $P = 0.07$; $n = 35$ routes). The Northern Harrier was present on an average of 32.94% (SE = 2.60) of BBS routes run in Physiographic Area 36 in Colorado during 1988–1997, at an average abundance of 0.65 (SE = 0.08) individuals per route. The mean number of routes run each year was 29.2 (SE = 2.28). This species is monitored by *MCB* with point transects.

Biological Objective: Increase the species' distribution and abundance, based upon results of the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Kingery 1998, MacWhirter and Bildstein 1996.

SHORT-EARED OWL (*Asio flammeus*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Northern Harrier, Barn Owl, and Western Meadowlark.

Distribution: Short-eared Owls are sparsely and widely distributed in Colorado, with more birds present in winter than in summer. Breeding birds are most common on the plains, with additional populations in the San Luis Valley and North Park. Records indicate that they have never been common breeders in Colorado (Boyle 1998).

Habitat Requirements: These owls breed and forage in grasslands, prairies, wetlands, and croplands. Large blocks of suitable habitat (100 ha; 250 ac) seem necessary to support breeding pairs. The birds nest on the ground, usually on a dry site, often elevated on a small hummock.

Ecology: They lay eggs in April or May, and young leave the nest by June. Fall migrants arrive in September-October and leave in March. Short-eared Owls eat small mammals (especially voles, *Microtus* spp.) and occasionally small birds.

Management Issues and Conservation Recommendations: Loss of suitable habitat is the most pressing issue, with losses coming from conversion of land to uses such as urbanization that are incompatible with the owls' nesting and foraging. *Conservation efforts should focus on landscapes of prairie with suitable habitat for Short-eared Owls. Current breeding sites can be used as one layer of information in selecting these sites; however, any single effort appears likely*

to have a relatively small impact if current population and distribution records are accurate. Assure that large areas of habitat are available for the species. This approach may be most successful in North Park and the San Luis Valley.

Habitat management schemes for nesting waterfowl and upland gamebirds generally benefit Short-eared Owls. *Consider the needs of this species when managing for game species. Populations of the principal prey species (voles) should be maintained at levels compatible with economic activities on the land.*

Status and Reasons for Concern: This species is on the national Watch List, indicating a high conservation need throughout its range. The Short-eared Owl is not adequately monitored by the BBS within Physiographic Area 36, and the data are too sparse to allow meaningful analysis of trends. This species is monitored by *MCB* with nocturnal surveys.

Biological Objective: Increase the species' distribution and abundance, as measured by results of *MCB* and other monitoring programs.

Selected References: Andrews and Righter 1992, Clark 1975, Holt and Leasure 1993, Kingery 1998.

PHYSIOGRAPHIC AREA 62: SOUTHERN ROCKY MOUNTAINS	81
Background	81
Conservation Issues	82
Conservation Opportunities	83
Avifaunal Analysis	83
Habitats, Implementation Strategies, and Priority Species Accounts	85
Alpine Tundra	85
White-tailed Ptarmigan	87
American Pipit	88
Brown-capped Rosy-Finch	89
Aspen	91
Broad-tailed Hummingbird	97
Red-naped Sapsucker	98
Purple Martin	99
Violet-green Swallow	101
Cliff/Rock	103
Peregrine Falcon	107
Black Swift	109
High Elevation Riparian	111
Cordilleran Flycatcher	115
American Dipper	116
MacGillivray's Warbler	117
Wilson's Warbler	118
Lowland Riparian	120
Lewis's Woodpecker	124
Lazuli Bunting	125
Mixed Conifer	127
Blue Grouse	130
Williamson's Sapsucker	131
Mountain Shrubland	133
Virginia's Warbler	138
Green-tailed Towhee	139
Ponderosa Pine	141
Band-tailed Pigeon	145
Flammulated Owl	146
Mexican Spotted Owl	147
Lewis's Woodpecker	148
Grace's Warbler	149
Sagebrush Shrubland	151
Northern Sage Grouse	155
Brewer's Sparrow	156
Sage Sparrow	158

Spruce-Fir	160
Boreal Owl	164
Olive-sided Flycatcher	165
Hammond's Flycatcher	166
Wetlands	168
Willet	174
Short-eared Owl	175

PHYSIOGRAPHIC AREA 62: SOUTHERN ROCKY MOUNTAINS

Background

The Southern Rocky Mountains Physiographic Area (62) covers much of the central region of Colorado, with small extensions into southern Wyoming and northern New Mexico. This physiographic area encompasses the majority of the forested lands in Colorado, except for pinyon-juniper woodlands (most of which occur in Physiographic Area 87, the Colorado Plateau). The topography is rugged, with more than 50 mountain peaks rising above 4270 m (14,000 ft) elevation. The mountainous terrain is interrupted by very large, flat, open, mountain basins, or parks.

Annual precipitation varies from 25 to 100 cm (10–40 in), much of it occurring as snowfall during the winter months. Some permanent snowfields and remnant glaciers are found at higher elevations. Local precipitation is heavily influenced by elevation. Elevation and exposure, and their effects on soil moisture, also strongly influence plant communities. Interdigitation of forest types occurs as soil moisture varies with topography. In mixed-conifer forests, for example, aspen stands often occur in moist drainages while dry, south-facing slopes may be primarily ponderosa pine, and cooler, north-facing slopes may be primarily Douglas-fir. Understory vegetation is sparse in most forest types except for aspen.

Forests in the Southern Rocky Mountains may be naturally “patchier” than most other forest types in North America, due to the severity of the weather and topography and to the effects of forces such as avalanches, snow accumulation, fire, insects, and disease. The resulting landscape pattern is a complex mosaic of open meadows and forest stands of varying age and species composition. This naturally patchy landscape has implications for forest fragmentation issues: birds in the Southern Rocky Mountains may not respond to forest patch size and shape in the same ways as birds of eastern deciduous forests (Carter and Gillihan, in press).

The primary large-scale-disturbance agents shaping the landscape are fire and insect outbreaks. Other agents may act on a smaller scale. In some areas, dwarf mistletoe is common. This parasite affects the growth form of some conifers. Long considered a destructive pest by timber managers, its presence has been correlated with higher bird abundance because the witch’s brooms (clusters of small branches) that result provide nesting platforms for some species, and the weakening of trees by mistletoe encourages attacks by insects, providing prey for birds (Bennetts et al. 1996).

A breakdown of Colorado timber types and ownership demonstrates that much of the forested land in this physiographic area is publicly-owned (Benson and Green 1987).

Timber Type	Acres	Hectares	Publicly-owned
Douglas-fir	1,805,600	730,726	76%
Ponderosa pine	2,771,900	112,178	54%
Lodgepole pine	2,244,200	908,227	87%
Limber pine	65,600	26,548	52%
Spruce-fir	347,000	14,043	60%
White fir	121,300	49,090	24%
Spruce (primarily Engelmann spruce)	4,431,800	1,793,549	95%
Aspen	3,556,800	1,439,437	78%

Significant federal holdings (and approximate areas) include the Arapaho (415,000 ha; 1,024,000 ac), Grand Mesa (140,000 ha; 346,000 ac), Gunnison (674,000 ha; 1,665,000 ac), Pike (449,000 ha; 1,110,000 ac), Rio Grande (752,000 ha; 1,859,000 ac), Roosevelt (327,000 ha; 808,000 ac), Routt (455,000 ha; 1,126,000 ac), San Isabel (452,000 ha; 1,117,000 ac), San Juan (760,000 ha; 1,878,000 ac), Uncompahgre (382,000 ha; 945,000 ac), and White River (794,000 ha; 1,962,000 ac) National Forests, and Rocky Mountain National Park (108,000 ha; 266,00 ac). Lands managed by the BLM comprise 810,000 ha (2 million ac).

Important bird habitats in Physiographic Area 62 include ponderosa pine, mixed-conifer, aspen, and spruce-fir forests, mountain shrubland, cliff/rock, sagebrush shrubland, lowland riparian, high elevation riparian, wetlands, and alpine tundra.

Conservation Issues

Hejl (1994) identified six ways that western coniferous forests have been altered by humans over the past 100 years: fire exclusion, timber harvesting, grazing, residential development, chemical applications, and introduction of exotic diseases, plants, and animals. The effects on bird populations of these actions are understudied and poorly understood, although more is known about the first two than the others.

Fire exclusion has resulted in stands overstocked with small trees or heavy fuel loads of dead and down trees, especially in ponderosa pine habitats, where the forest evolved with frequent (low-intensity) fires. Overstocked stands and heavy fuel loads have altered fire intensity, leading to larger and hotter catastrophic fires. Increases in road density have resulted in fragmented habitats, with unknown impacts on bird populations. Even-aged timber harvest techniques move the forest toward homogeneity, rather than the more natural landscape mosaic of uneven-aged stands.

Timber harvesting probably has reduced the density of snags, especially large snags, to the detriment of cavity-nesting species. For many years, harvesting was driven by economics and expedience, with little thought given to ecological consequences. Southern Rocky Mountain forests were harvested with even-age management techniques such as clearcuts, which simplify harvesting but result in unnatural, homogeneous forests. Compared to some other physiographic areas that are strongholds for industrial forestry, this area is drier and the forests experience shorter growing seasons due to the elevation. As a result, Southern Rocky Mountain forests do not regenerate quickly after harvesting and rotations must be longer.

Conservation Opportunities

Many bird species in this physiographic area are not adequately monitored by the BBS. Its limitations include its restriction to roads which, in mountainous areas, often parallel streams or rivers. This emphasizes riparian birds and edge species, and under-samples forest interior species. Also, routes that run along streams climb (or descend) in elevation, so routes often sample different forest habitat types. CBO's *MCB* program avoids these problems by utilizing habitat-based surveys, with point count transects oriented randomly through those habitats. Once this program is in place for several years, it should provide valuable data on trends in bird populations.

The U.S. Forest Service is shifting its emphasis away from timber production to genuine multiple use of forests (including wildlife habitat), and adopting a more holistic management strategy (for example, use of prescribed burns). This is partly a result of growing public pressure to change forest management practices, and the Forest Service and other agencies have responded by adjusting their policies on clearcuts, forest fragmentation, and other practices.

New tools and techniques are available for measuring and analyzing landscape patterns and bird distribution (Geographic Information Systems, Global Positioning Systems, remote sensing, computer models in landscape ecology, etc.), and their application can do much for forest bird conservation. With these advances, forest managers can manage forests to mimic landscape patterns that result from natural disturbance regimes. While forest management practices do not exactly replicate natural disturbance agents, the possibilities are promising and, from a conservation standpoint, more desirable than working without any sense of natural patterns.

Avifaunal Analysis

Of the 123 species that regularly breed in this physiographic area, populations of three are strongly represented in alpine tundra, 10 in aspen, 13 in cliff/rock, 13 in high elevation riparian, 11 in mixed-conifer, nine in mountain shrubland, 11 in ponderosa pine, four in sagebrush shrubland, 17 in spruce-fir, and 32 in wetlands. Because they are adapted to a complex forest mosaic, few species use only a single habitat type, but shift between several habitats. Aspen forests support the most bird species and the most individual birds of any of the forest types in the Southern Rocky Mountains.

Species for which this area has high responsibility (20% of the global population within the physiographic area) include Broad-tailed Hummingbird, Brown-capped Rosy-Finch, and Dark-eyed (Gray-headed) Junco. Other species that have a significant presence in the Southern Rocky Mountains (10% of the global population) include Williamson's Sapsucker, Virginia's Warbler, Green-tailed Towhee, and Cordilleran Flycatcher.

Habitats, Implementation Strategies, and Priority Species Accounts

Alpine Tundra

Description and Ecology: Alpine tundra habitats occur in the western United States in Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. Alpine tundra occurs in most mountain ranges above treeline, which lies at higher elevations at southern latitudes, and lower elevations at northern latitudes. In Colorado, treeline varies with slope and aspect but is generally at 3500 m (11,500 ft) elevation. There are an estimated 3 million ha (7.4 million ac) of alpine tundra in the western United States, south of Canada (Brown et al. 1978). Nearly one third of that lies in Colorado, which contains approximately 970,000 ha (2.4 million ac) of alpine tundra. Nearly all of Colorado's alpine tundra occurs in Physiographic Area 62, the Southern Rocky Mountains.

Alpine tundra is comprised of a variety of vegetative communities adapted to specific soils, slope, aspect, moisture, and other environmental influences at high elevations. Tundra habitats are a complex mosaic of boulder fields, fell fields, cliff/rock, wet and dry meadows, and snowfields. Alpine tundra habitats are characterized by shallow soils, short growing seasons, low temperatures, high solar radiation, and high winds. Most precipitation in Rocky Mountain alpine areas falls as snow, often in late winter or early spring, and is distributed non-uniformly because of winds. Because of the severe climate, few vertebrate species, including birds, are able to breed in this habitat.

Importance and Conservation Status: Historically, livestock grazing, mining, reservoir development, and recreation have impacted alpine tundra habitats, and these disturbances have resulted in long-term changes in alpine vegetation. Global warming threatens to reduce the extent of alpine tundra through encroachment of forested communities. Although the avifauna of alpine tundra is small compared to other habitats, these species are typically specialized and endemic, and are not found in other habitats during the breeding season. Further, alpine habitats are fragile; disturbances may take decades or centuries to recover and have long-term impacts on these species.

Implementation Strategies:

Bird Monitoring

Goal: To monitor or track all breeding birds in alpine tundra and document distribution, population trends, and abundance in a statistically acceptable manner.

Objective: All species with AI > 2 will be monitored with count-based methods.

Strategy: Monitoring will be accomplished through the combined efforts of agencies with primary responsibility for managing this habitat.

Strategy: Monitoring will continue to rely on BBS data, with data from CBO's *Monitoring Colorado's Birds (MCB)* monitoring program incorporated as it becomes available.

Status: MCB implemented alpine tundra habitat transects in 1999 and ran a total of 25 transects; trend data should be available for most species within 5–12 years.

Objective: Brown-capped Rosy-Finches will be monitored using flock counts at wintering areas or other special techniques.

Status: Techniques and protocols need to be developed.

Habitat Monitoring

Goal: To document the amount, condition, and ownership of alpine tundra habitat in Colorado.

Objective: Develop collaborative efforts to use GIS in mapping alpine tundra habitat, documenting amount, condition, and ownership.

Status: This effort has not been initiated to date. Potential collaborators include CDOW, CNHP, CBO, USGS, USFS, Rocky Mountain National Park, and TNC.

Habitat Core Areas

Goal: To conserve unique representatives or core areas of alpine tundra in Colorado.

Objective: Identify and preserve representative or core areas of alpine tundra in Colorado in collaboration with the USFS, NPS, and CDOW.

Status: The alpine tundra in Rocky Mountain National Park has been identified as one core area. Other representative areas need to be identified.

Site-based Conservation

Goal: To identify and preserve local sites that are important for the conservation of priority species breeding in alpine tundra.

Objective: Identify sites that are appropriate for designation as IBAs, nominate them, and promote involvement of key agencies and personnel for conserving these areas.

Status: In progress.

Objective: Identify sites within alpine tundra habitats used by wintering White-tailed Ptarmigan, and protect them from disturbance.

Status: Completed (CDOW Spec. Rep. No. 38).

Management Practices

Goal: To promote management practices that benefit birds using alpine tundra habitats.

Objective: Produce a Best Management Practices (BMPs) manual for alpine tundra and distribute it to appropriate agencies and other interested parties.

Status: To be developed.

Outreach and Education

Goal: To provide information about alpine tundra and birds breeding in this habitat to the public, natural resource managers, and other interested parties.

Objective: Develop and make available educational materials including pamphlets, videos, and other materials and make them available to local nature centers, schools, natural resource agency personnel, and teachers.

Status: To be developed.

Objective: Hold workshops, symposia, and field trips on alpine tundra and birds breeding in these habitats.

Status: To be developed.

Research Priorities

Goal: To fill the voids in scientific information needed to conserve birds using alpine habitats.

Objective: Identify the top ten research needs for conserving birds breeding in alpine tundra.

Status: The following research priorities have been identified:

1. Develop methods for inventory of Brown-capped Rosy-Finches.
2. Investigate population limiting factors for Brown-capped Rosy-Finches.
3. Investigate seasonal movements and habitat needs of Brown-capped Rosy-Finches.
4. Identify wintering grounds of American Pipits breeding in Colorado.
5. Investigate impacts of global warming on alpine ecosystems.

Priority Species Accounts: Three species are identified as high priority in alpine tundra habitat in Physiographic Area 62: White-tailed Ptarmigan, American Pipit, and Brown-capped Rosy-Finch.

WHITE-TAILED PTARMIGAN (*Lagopus leucurus*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Horned Lark, American Pipit, and Brown-capped Rosy-Finch.

Distribution: White-tailed Ptarmigan inhabit alpine areas from the Southern Rocky Mountains in New Mexico north to Alaska and the Northwest Territories (Braun et al. 1993). They have been introduced into the Sierra Nevada mountains in California, Uinta Mountains in Utah, and Wallowa Mountains in Oregon (Braun et al. 1993). In Colorado, White-tailed Ptarmigan inhabit all mountain ranges with suitable alpine habitats, including Pikes Peak, where they were introduced in 1975 (Braun 1971, Hoffman and Giesen 1983).

Habitat Requirements: White-tailed Ptarmigan breed in alpine habitats at or above treelimit. (Braun et al. 1993). They nest in snow free, rocky areas or near willow or spruce krummholz. In summer, males and broods often forage near receding snowfields and rocky areas at higher elevations. In winter, ptarmigan occupy willow-dominated basins or riparian areas at or below treeline where snow is available for roosting.

Ecology: White-tailed Ptarmigan arrive on breeding territories in late April or May and initiate nesting in June. Breeding densities are typically 1–5 pairs/km². Dispersal of juveniles and migration to wintering sites occurs in September-October. Adults are long-lived and have high philopatry to breeding and wintering areas (Giesen and Braun 1992, Braun et al. 1993). The diet

of ptarmigan consists primarily of vegetation, especially leaves, buds, and twigs of willow (May and Braun 1972).

Management Issues and Conservation Recommendations: Excessive grazing by domestic livestock and wildlife, mining, reservoir development, winter recreation, and road building have all negatively impacted alpine habitats, especially critical wintering areas (Braun et al. 1976). Recreational use of alpine areas and manipulation of alpine watersheds for water development can be expected to increase as Colorado's population increases. *Emphasize light grazing by both domestic livestock and wild ungulates, total exclusion of off-road vehicles and snowmobiles except on maintained roads, proper engineering of mine sites, and careful evaluation of proposed roads, water storage reservoirs, ski developments, and other recreational and commercial developments for potential impacts on ptarmigan (Braun 1980). Identify and protect wintering habitats from disturbance or destruction (Braun et al. 1976).*

Status and Reasons for Concern: White-tailed Ptarmigan occupy a unique habitat and are representative of many other species in this habitat type. This species is not monitored by the BBS nor sampled adequately by alternative methods. This species is monitored by CDOW.

Biological Objective: Maintain current population levels and distribution of White-tailed Ptarmigan in alpine areas of Colorado, as based on results of CDOW and other monitoring programs.

Selected References: Andrews and Righter 1992; Braun 1980; Braun et al. 1976, 1993; Giesen and Braun 1992; Kingery 1998; May and Braun 1972.

AMERICAN PIPIT (*Anthus rubescens*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include White-tailed Ptarmigan, Horned Lark, and Brown-capped Rosy-Finch.

Distribution: American Pipits breed above treeline in alpine habitats from California (Sierra and Cascade Mountains), Arizona and New Mexico (Rocky Mountains) north into Canada and Alaska, and east throughout arctic tundra habitats into Newfoundland and Greenland (Verbeek and Hendricks 1994). In Colorado, American Pipits are fairly common breeders in all mountain ranges having suitable alpine habitats. In migration they pass through the western valleys, the mountain parks, and the eastern plains (Andrews and Righter 1992).

Habitat Requirements: In Colorado, American Pipits nest in alpine meadows dominated by grass and sedge vegetation and in fell fields with lush vegetation or cushion plants. They typically establish territories on gentle slopes that become snow free early in the breeding season (June) and have suitable topographic features (tussocks, tilted rocks, eroded turf) for nest sites (Braun 1980).

Ecology: Pipits arrive in alpine breeding habitats in late April or early May, but may move down slope during inclement spring weather. They initiate nests in mid June and typically hatch young in late June or July. They remain on summering areas above tree limit into September-October. Pipits winters in southern U.S. and Mexico, typically on barren shorelines, agricultural fields and shortgrass habitats. Their diet consists primarily of insects in summer (Verbeek 1970, Conry 1978), and insects and vegetation in winter (Verbeek and Hendricks 1994).

Management Issues and Conservation Recommendations: Livestock grazing, mining, recreation, water storage reservoirs, and road construction have damaged alpine tundra habitats in Colorado in the past, and they remain concerns. *Emphasize light grazing by both domestic and wild ungulates, totally exclude off-road vehicles and snowmobiles except on maintained roads, properly engineer mine sites, and carefully evaluate proposed roads, water storage reservoirs, ski developments, and other recreational or commercial facilities for potential impacts on American Pipits (Braun 1980).*

Status and Reasons for Concern: American Pipits occupy a unique habitat and are representative of other species in this habitat type. Current programs (BBS) do not adequately monitor this species. The few intensive studies of this species suggests that breeding densities range from 0.2 to 2.1 pairs/km in suitable breeding habitat (Verbeek and Hendricks 1994). This species is monitored by *MCB* with point transects.

Biological Objective: Maintain current distribution and breeding densities on all alpine areas currently having populations of American Pipits, based on results from *MCB* and other monitoring programs.

Selected References: Andrews and Righter 1992, Braun 1980, Conry 1978, Kingery 1998, Verbeek 1970, Verbeek and Hendricks 1994.

BROWN-CAPPED ROSY-FINCH (*Leucosticte australis*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include White-tailed Ptarmigan, Horned Lark, and American Pipit.

Distribution: Brown-capped Rosy-Finches breed in alpine tundra in Colorado, south into northern New Mexico, and north into southeastern Wyoming. They winter at lower elevations in mountain valleys, foothills, and eastern plains. Breeding and winter distributions are very local. Colorado is the center of their distribution.

Habitat Requirements: Brown-capped Rosy-Finches nest above treelimit in cliffs, cirques, talus slopes, and rock slides (Bailey and Niedrach 1965). Some nesting occurs in abandoned mines or buildings. Rosy-Finches frequently forage at the edges of snowfields.

Ecology: Brown-capped Rosy-Finches arrive on breeding areas in April-May, but they delay nesting until late June or July. They remain in alpine habitat until winter snows force them to migrate to lower elevations. Their diet consists primarily of vegetative material, especially seeds of grasses, sedges, and forbs (Braun 1980). These finches frequent feeders in mountain or foothill urban areas in winter, and they are often nomadic outside the breeding season. Knowledge of many aspects of their ecology is lacking.

Management Issues and Conservation Recommendations: The small number of suitable nesting sites limits the population of Brown-capped Rosy-Finches. Grazing, mining, recreation, road building, and water storage development have damaged alpine habitats. Because breeding areas are very localized, this species is vulnerable to environmental and human disturbances. *Exclude off-road vehicles and snowmobiles except on maintained roads, properly engineer mine sites, and carefully evaluate proposed roads, water storage reservoirs, ski developments, and other recreational or commercial facilities for potential impacts on Brown-capped Rosy-Finches.*

Status and Reasons for Concern: Because of their isolated breeding range, Brown-capped Rosy-Finches are not monitored by the BBS or other monitoring programs. This species has a high conservation need locally and throughout its range. Also, a very high proportion of this species' total population (estimated at 100%) occurs within this physiographic area, indicating that this area has the highest (and perhaps sole) responsibility for the conservation of this species. This species is not adequately monitored by BBS or other monitoring programs. This species is monitored by *MCB* with tracking transects.

Biological Objective: Maintain current populations and breeding distribution of this species in alpine habitats of Colorado, New Mexico, and Wyoming, as based on results from the *MCB* and other monitoring programs.

Habitat Objectives: Protect cliffs, talus slopes, and cirques known to have breeding populations of Brown-capped Rosy-Finches.

Selected References: Andrews and Righter 1992, Bailey and Niedrach 1965, Braun 1980, Kingery 1998.

Aspen

Description and Ecology: Aspen is the most widely distributed tree species in North America, found from northern Mexico north to Alaska and east to the Atlantic coast (Eyre 1980). It occurs from sea-level to 600 m (2,000 ft) at its northern limit and at increasing elevations to the south. At its southern limit it occurs from 2000 to 3000 m (7,000–10,000 ft). Aspen-dominated woodlands are best developed and most abundant in Colorado, northern New Mexico and southern Utah at 2000 to 3000 m elevation (Eyre 1980, Mueggler 1989). There are about 2.8 million ha (7 million ac) of aspen-dominated woodlands across the western United States, of which about 1.4 million ha (3.5 million ac, 50%) occur in Colorado. On National Forests in the Rocky Mountain Region, aspen forests comprise almost 20% of the tree-covered woodlands (Torrence 1984).

Aspen grows under a wide variety of environmental conditions and upland sites. Required site conditions include long growing seasons, deep snow, and annual precipitation exceeding 40 to 50 cm (16–20 in) (Jones and DeByle 1985). In the Southern Rockies, the best stand development occurs on well-drained, sandy to silt-loam soils (Eyre 1980), and on southerly to easterly exposures (Mueggler 1989). Aspen-dominated woodlands are highly valued for summer forage for livestock grazing, watershed protective cover, timber harvest, firewood, and scenic beauty. Most aspen in Colorado occurs in Physiographic Area 62, the Southern Rocky Mountains.

Aspen occurs primarily as an early seral species, eventually being replaced by surrounding shade-tolerant late-seral conifers (Mueggler 1989). In Colorado, it is a major seral constituent of Englemann spruce-subalpine fir, Douglas-fir, white fir, blue spruce, and ponderosa pine forests. At lower elevations, it is often found as stringers along riparian corridors, or in small mesic islands surrounded by drier pine uplands. At higher elevations, it functions primarily as a seral dominant species within the spruce-fir ecotone. At intermediate elevations and on deep soils, aspen can occur as pure stands of successional stable woodlands dispersed within a matrix of coniferous forest types. Mueggler (1989) states "the most valid general indicator of seral aspen is the presence of conifers either in the overstory or as reproduction, suggesting active replacement by the more shade tolerant [conifer] species. A lack of conifers might indicate either a true late-seral aspen situation, or merely the absence of a nearby conifer seed source."

Following severe disturbance, such as stand-replacement fires or clear cutting, aspen usually dominates sites for many decades. On some sites, conversion back to a conifer-dominated stand occurs very quickly (<100 years), while on other sites, conversion may take many aspen generations and extend 300–400 years (Eyre 1980, Mueggler 1989). The rate of stand conversion is determined by site conditions, proximity to conifer seed sources, and rate of conifer seedling growth into the stand canopy.

Most aspen regeneration occurs as root-suckering with little occurring from seed. Therefore, aspen stands are usually a mosaic of clones, within which individual trees are genetically identical and have strong structural uniformity (Eyre 1980). Despite uniformity within clones, multi-clone

stands often exhibit wide structural variation due to genetic and site differences among adjacent clones (Johnston and Hendzel 1985). Clone size averages 0.2 ha (0.5 ac) across the species range (Eyre 1980). In Colorado, clone size averages 0.8 to 1.2 ha (2–3 ac) but can exceed 20 ha (50 ac) (Johnston and Hendzel 1985). Aspen stems are typically short-lived, with average stem age being 50–60 years across the species range. An extensive study in Colorado examined 64 aspen stands and found the oldest stem was 137 yrs old, and it was also the largest diameter stem and measured 21.8 cm (8.6 in) dbh (Johnston and Hendzel 1985). The tallest stem found in this study was 26 m (86 ft). Because stem diameter and height are not strongly correlated with stem age, it is difficult to clearly define a structurally distinct mature stage.

Most aspen stands have well-defined overstory layers of relatively uniform height produced by the rapid regeneration of suckers following stand-replacement events (Mueggler 1989). The majority of stems are produced during the first 4–6 years after disturbance; thus, stands with an equal representation of multiple age and size classes are rare (Johnston and Hendzel 1985). Multiple age classes develop when older stands begin to disintegrate or when disease or insects open up the canopy and apical dominance declines, releasing understory suckers.

Because of the ecological amplitude of aspen, overstory and understory vegetation composition varies widely across its range, resulting in equally diverse breeding bird assemblages. The value of aspen habitats to wildlife is directly related to the structural diversity of the canopy and undergrowth (Mueggler 1989). Stands with a predominantly aspen overstory allow sufficient light to reach the forest floor to support multilayered herb and shrub understories, and are often more lush than adjacent conifer stands (Eyre 1980). As aspen dominance gives way to conifer dominance, less light reaches the forest floor, and understory diversity and abundance declines. In Colorado, the most common understory shrubs are snowberry, western serviceberry, chokecherry, and rose. The most common forbs include geranium, valerian, yarrow, and dandelion.

Importance and Conservation Status: Because aspen is seral to and is usually mixed with adjacent conifer types, the importance of aspen-dominated woodlands to birds and other wildlife far exceeds the aerial extent of the stands themselves. DeByle (1985) listed 134 species of birds that use aspen-dominated habitats. This list includes 34 cavity nesters, 7 canopy nesters, 10 shrub nesters, and 10 ground nesters. Few species are limited to aspen, but some reach their highest breeding densities within this habitat type. Bird communities within aspen stands are often composites of aspen-associated species along with many species found in the surrounding conifer habitats. However, the exact species mix depends on the relative amounts of aspen and conifer in the stand.

Perhaps the most important contribution of aspen-dominated woodlands to avian nesting habitat is as a structural substrate for primary cavity excavators and secondary cavity nesters. False tinder rot is a major source of heartwood decay in live aspens; it produces a hard sapwood shell surrounding a soft interior that is ideal for cavity excavation (Kalcounis and Brigham 1998). In conifers, sapwood and heartwood decay at equal rates, precluding the formation of a hard outer

shell. Aspen stems with heartrot can be readily detected by the presence of shelf fungi or conks on the trunk. Habitat preferences of primary cavity excavators and the decay characteristics of aspen combine to produce much higher cavity densities in aspen than in surrounding conifer habitats.

Most of today's seral aspen woodlands were produced by stand-replacement fires that occurred within the previous 150 years. Fire suppression during the past 75 years has dramatically reduced the rate of conversion of conifer stands back to early-seral aspen. As a result of continuing fire suppression and successional processes, the extent of aspen across the Colorado landscape is probably declining and will continue to do so unless direct management actions are taken. Controlled burning of aspen stands is difficult and expensive, and currently encompasses less than 0.009% of aspen woodlands in the interior west (DeByle et al. 1987). Although loss of aspen woodlands to conifer succession at the landscape scale has yet to be conclusively demonstrated, most land managers agree that it is occurring and that management actions are insufficient to maintain current aspen dominance in many areas.

Wood fiber production is becoming increasingly important as a tool for stand regeneration of aspen woodlands in western Colorado. Clearcut harvesting is the most common harvest mechanism. Significant production of aspen chipboard, indoor paneling, and excelsior has recently developed in western Colorado. This production may provide a viable economic tool for small-scale aspen stand regeneration. There have been few studies on the effects of aspen harvesting on breeding bird communities. Scott and Crouch (1987) found that breeding bird density and species composition did not change significantly following small patch clearcutting of 25% of an aspen analysis area in Colorado, and made specific recommendations for harvest patch size and rotation age. These results concurred with an earlier study by DeByle (1981) in Utah. However, in a Minnesota study, Merrill et al. (1998) found significant differences in bird species composition between clearcuts with residual patches and clearcuts without patches.

Grazing by both domestic livestock and native ungulates, particularly elk, can have significant impacts on aspen regeneration and shrub-forb structure of aspen-dominated woodlands (Shepperd and Fairweather 1994). Because of the comparatively high production of grass and forbs in aspen understories compared to surrounding conifer stands, aspen woodlands frequently provide excellent summer range for domestic livestock, and in some cases they have been severely overgrazed, especially in the early 1900s. Aspen-dominated woodlands continue to provide a significant amount of the available forage for domestic livestock on public land grazing allotments. Grazing on vegetative structure of aspen stands may change the composition and relative abundance of understory vegetative species and change the structure of shrub and forb communities; intense repeated browsing on apical stems can severely damage aspen suckers and halt regeneration. Fire suppression has allowed dense conifer regeneration to survive, reducing available forage in some conifer types such as ponderosa pine and increasing browsing pressure in adjacent aspen stands where forage is more readily available (Shepperd and Fairweather 1994). Browsing by elk is thought to be partly responsible for an estimated 50% loss of aspen in Yellowstone National Park (Mueggler 1989).

Implementation Strategies:

Bird Monitoring

Goal: To monitor or track all breeding birds in aspen-dominated woodlands and document distribution, population trends, and abundance in a statistically acceptable manner.

Objective: All species with AI > 2 will be monitored with count-based methods.

Strategy: Monitoring will be accomplished through the combined efforts of agencies with primary responsibility for managing this habitat.

Strategy: Monitoring will continue to rely on BBS data, with data from CBO's *Monitoring Colorado's Birds (MCB)* program incorporated as it becomes available.

Status: MCB program implemented aspen transects in 1998 and ran a total of 26 transects in 1999; trend data should be available for most species within 5–12 years.

Objective: All priority birds in aspen-dominated habitats in Colorado will be monitored.

Strategy: MCB will monitor Broad-tailed Hummingbird and Violet-green Swallow using point transects.

Status: Analysis of 1999 MCB transects show that they will adequately monitor the trend of Broad-tailed Hummingbird and Violet-green Swallow.

Strategy: MCB will monitor trend of Red-naped Sapsucker using continuous-count transects.

Status: Analysis of 1999 MCB transects show that they will adequately monitor the trend of Red-naped Sapsucker.

Strategy: MCB will census all known Purple Martin nesting sites in Colorado.

Status: 81 nesting sites were censused in 1999.

Objective: Population demographic monitoring will be instituted for all species in aspen-dominated woodlands with PT of 4 or 5.

Status: As of 1999, no aspen species were known to have PT of 4 or 5.

Habitat Monitoring

Goal: To monitor aspen habitat in Colorado in order to document amount, condition, and ownership.

Objective: Develop collaborative efforts to use GIS in mapping aspen habitat, documenting amount, condition, and ownership. Potential collaborators include CDOW, CNHP, CBO, USGS, Rocky Mountain National Park, and TNC.

Status: CDOW's current statewide GAP coverage adequately identifies pure aspen stands statewide, but mixed aspen-conifer stands are not adequately identified.

Objective: Use GIS to map and monitor all natural and prescribed fires in aspen-dominated woodlands state wide.

Status: No statewide system has been developed yet to monitor fire occurrence in aspen-dominated woodlands.

Objective: Use GIS to map and monitor all harvest activities in aspen-dominated woodlands statewide.

Status: No statewide system has been developed yet to monitor harvest activities in aspen-dominated woodlands. However, most National Forest units in Colorado have GIS activity layers that delineate recent harvest areas.

Habitat Core Areas

Goal: To conserve unique representative and/or large, ecologically-functioning examples of aspen habitat in Colorado.

Objective: Identify and nominate at least three *IBAs* in aspen-dominated woodlands. These stands should have significant populations of all aspen priority birds. At least two should include mature stands that are not grazed by domestic livestock. At least one should be a stand in southwest Colorado that incorporates extensive aspen clones.

Status: No *IBAs* have been identified yet in aspen-dominated woodlands.

Site-based Conservation

Goal: To identify and preserve local sites that are important for the conservation of priority species breeding in aspen habitat.

Objective: Identify sites that are appropriate for designation as *IBAs*, nominate them, and promote involvement of key agencies and personnel for conserving these areas.

Status: No *IBAs* have been identified yet in aspen-dominated woodlands.

Management Practices

Goal: To promote management practices that benefit birds in aspen habitat.

Objective: Reintroduce and maintain natural disturbance regimes at the landscape level.

Strategy: Encourage public land management agencies to designate areas where natural fires will be allowed to burn with minimal human intervention and to consider allowing stand-replacement fires to burn in areas where private property or significant natural or cultural resources are not threatened.

Status: Most National Forest units in Colorado have plans in place that identify specific areas where natural fires can be allowed to burn, or where only minimal control actions will be undertaken following natural ignitions.

Objective: In commercial harvest areas, design aspen patch cuts to closely mimic natural disturbance patch size and landscape distribution and to maintain bird diversity and relative abundance on the planning unit.

Strategy: Distribute aspen patch cuts of 2 to 8 ha (5–20 ac) across the planning area to maintain bird diversity and abundance on the planning unit and to minimize effects of ungulate browsing on regeneration.

Status: Most National Forest units in Colorado include aspen patch cuts of 2 to 8 ha (5–20 ac) in size in commercial aspen timber sales.

Objective: Manage domestic livestock grazing in aspen-dominated woodlands to ensure maintenance of nesting cover and structure for ground-nesting birds.

Strategy: Replace season-long livestock grazing in aspen habitats with rest-rotation grazing systems.

Strategy: Monitor livestock use in aspen grazing allotments to ensure livestock effects are within standards and guidelines.

Strategy: Use results of grazing monitoring to ensure maintenance or improvement of habitat structure for ground-nesting birds.

Interstate/International Wintering Grounds

Goal: To conserve the wintering ground habitat used by Colorado's migratory aspen birds outside the state.

Objective: Identify and map key wintering sites, habitats, and habitat components for all four aspen priority birds.

Strategy: Coordinate with appropriate state, federal, and foreign governments and agencies to identify, map and conserve key wintering sites, habitats, and habitat components for aspen priority birds.

Status: Key wintering sites, habitats, and habitat components for aspen priority birds have not yet been identified.

Migration Concerns

Goal: To protect migratory stopover habitat for aspen birds.

Objective: Identify important migratory stopover areas for priority species that breed in Colorado.

Objective: Track amount, condition, and ownership of key migratory stopover sites.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect migratory habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Outreach and Education

Goal: To provide information on aspen habitat birds, aspen ecology, habitat management techniques and wildlife values to children, teachers, naturalists, landowners, natural resource professionals, and other interested parties.

Strategy: Make educational materials available at local nature centers and natural resource agency offices.

Strategy: Hold workshops and field programs for teachers.

Strategy: Hold workshops and field programs for natural resource professionals (CDOW, BLM, and USFS staff).

Strategy: Present information at Teacher Association meetings, conferences, other annual meetings.

Strategy: Submit manuscripts to popular magazines for children and adults.

Research Priorities

Goal: To identify and facilitate research that will aid in understanding and managing aspen habitats for Colorado's birds.

Objective: To identify the top ten research needs in aspen habitat in Colorado.

Status: The following research needs have been identified:

1. Test the effect of livestock grazing intensity on ground-nesting bird abundance, productivity and habitat selection.
2. Test the effect of harvest patch size and rotation age on breeding bird diversity and relative abundance.
3. Locate all possible Purple Martin colonies in Colorado and study habitat selection in relation to land management activities.

Objective: Facilitate investigations to answer these questions.

Strategy: Provide information about priority needs to universities, public and private research entities, identify funding sources, and promote collaboration between management and research agencies.

Priority Species Accounts: Priority birds in aspen-dominated habitats in Colorado include Broad-tailed Hummingbird, Red-naped Sapsucker, Purple Martin, and Violet-green Swallow.

BROAD-TAILED HUMMINGBIRD (*Selaphorus platycercus*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include House Wren, Lincoln's Sparrow, White-crowned Sparrow, and Dark-eyed Junco.

Distribution: Broad-tailed Hummingbirds breed in the Intermountain West from western Montana south to southern Mexico, and from western Nevada east to the Rocky Mountain front. They winter from the highlands of northern Mexico southward to Guatemala. In Colorado they are common breeding birds in forested mountains at lower and middle elevations, and uncommon at higher elevations and above timberline. They can be an abundant late-summer visitor to bird feeders in western valleys and mountain parks and are rare migrants on the eastern plains.

Habitat Requirements: These hummingbirds breed in open ponderosa pine, mixed conifer, aspen, and riparian woodlands. They nest in trees, frequently near or over mountain streams and less commonly in pinyon-juniper and mountain shrublands. They build their nests of plant down, lichens, bark fiber, and bound with cocoons and spider's silk.

Ecology: They arrive in Colorado mid-April to early May, and most autumn migrants depart by mid September. Broad-tails are a lek displaying species with males strongly territorial and females highly faithful to breeding sites, especially if successful the previous year. Incubation and feeding of young is exclusively by females. They are mostly single-brooded, but in some years may be double-brooded. Their diet includes flower nectar, insects, spiders, tree sap. They also feed on insects gleaned from vegetation and taken in flight. Their complex, U-shaped courtship flights are instrumental to pair formation and male territorial defense. They frequently bathe in shallow pools of mountain creeks.

Management Issues and Conservation Recommendations: Grazing by domestic livestock should be carefully managed to assure that standards of forb and shrub utilization, trampling of vegetation, and soil compaction are not exceeded. Creation of small forest openings that stimulate forb and shrub development will benefit this species. Aspen stand invasion by seral conifers will result in long-term declines in habitat quality by reducing abundance and diversity of flowering plants, and reducing density of low shrubs and forbs.

Status and Reasons for Concern: A very high proportion of this species' total population occurs within this physiographic area, indicating that this area has high responsibility for the conservation of this species. BBS population trends from Colorado and the western U.S. appear to be stable or slightly increasing. It is most abundant in Physiographic Area 62. It reaches its highest national abundance on BBS routes in central Colorado, averaging 52.8 individuals per year in Gunnison County. They were present on an average of 97.5% (SE = 1.30) of the BBS routes run in Physiographic Area 62 in Colorado, 1988–1998, at an average abundance of 15.69 (SE = 0.90) individuals per route. The mean number of routes run each year was 21.1 (SE = 3.06). This species is monitored by *MCB* with point transects.

Biological Objective: Maintain or increase the species' distribution and abundance, based upon results of the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Baicich and Harrison 1997, Dobkin 1994, Ehrlich et al. 1988, Kingery 1998, Price et al. 1995.

RED-NAPED SAPSUCKER (*Sphyrapicus nuchalis*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Violet-green Swallow, Purple Martin, and Mountain Bluebird. Other species associated with mature aspen stands include Cooper's Hawk, Broad-tailed Hummingbird, Western Wood-Pewee, Warbling Vireo, and House Wren.

Distribution: Red-naped Sapsuckers breed from southern British Columbia and Alberta south in the Rocky Mountains to central Arizona and New Mexico, and from eastern Washington, Oregon and California east to the Rocky Mountain front. In Colorado, they are fairly common breeders in the foothills and lower mountains, especially aspen forests. They are rare spring and fall migrants and very rare winters resident in the Four Corners area.

Habitat Requirements: Breeding habitat for Red-naped Sapsuckers in Colorado is aspen forests or conifer forests mixed with aspen. They are most strongly associated with mature aspen woodlands. Aspen and other hardwoods may be important for successful reproduction and foraging, especially in close proximity to small openings and riparian zones with abundant willows. They will preferentially nest in aspen, even when conifer snags are available.

Ecology: These sapsuckers arrive in breeding habitats by mid April and begin nesting in early May. They raise only one brood each season. Their nests are placed almost exclusively in aspen or other deciduous trees, and they construct new cavities each year, frequently in the same tree. Nest trees are either green with heartrot, or dead. The abandoned nest cavities are important nesting substrate for many secondary cavity nesters, and may be a critical habitat feature for some bats. Their territory size is 2 to 5 ha (5–12 ac). In Colorado, nest trees average 23.3 cm (9.2 in) dbh and 1 to 10 m (3–35 ft) in height. Orientation of nest cavities is generally southward. Their diet consists of insects, tree sap from sap wells, and some fruit; they also hawk flying insects.

Management Issues and Conservation Recommendations: These birds respond well to partial harvesting with small to moderate sized patch clear-cuts. *Maintain at least 50% of management areas in uncut patches. Retain aspen snags greater than 25.4 cm (10 in) dbh, especially near riparian zones, water sources, and habitat edges. Snag densities in mature stands should exceed 15 per 4 ha (10 ac). Maintain disturbance regimes, natural and mechanical, and the dynamic nature of aspen communities at the landscape scale. Where natural disturbance mechanisms cannot be reintroduced, mechanical disturbance events should mimic, as closely as possible, the disturbance history of the local area and surrounding habitats.*

Decay-infected green trees are preferred for cavity construction and are often reused for several consecutive seasons; individuals may show strong site fidelity. *Maintain sufficient snag and live cavity-tree densities within commercial harvest areas.*

Status and Reasons for Concern: Population trends of this species are not adequately monitored by the BBS in Colorado, but populations appear to be stable or slightly increasing at the continental scale. Breeding densities of 5–10 pairs per 40 ha (100 ac), and 14 nests per 1.4 km² have been reported. They were present on an average of 49.86% (SE = 4.44) of the BBS routes run in Physiographic Area 62 in Colorado, 1988–1998, at an average abundance of 1.11 (SE = 0.17) individuals per route. The mean number of routes run each year was 21.1 (SE = 3.06). This species is monitored by *MCB* with point transects.

Biological Objective: Maintain the species' distribution and abundance, based upon results of the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Baicich and Harrison 1997, Dobkin 1994, Ehrlich et al. 1988, Kalcounis and Brigham 1998, Kingery 1998, Price et al. 1995, Yanishevsky and Petring-Rupp 1998.

PURPLE MARTIN (*Progne subis*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Violet-green Swallow, Mountain Chickadee, White-breasted Nuthatch, House Wren, and Mountain Bluebird.

Distribution: Purple Martins breed across the eastern half of North America from southern Canada south to south Florida, and from the east coast west to the central Canadian Provinces, western Dakotas, Kansas, Oklahoma, and Texas. They are local and scattered breeders in the Intermountain West and along the Pacific coast from Washington south to southern California. Winters in South America east of the Andes Mountains south from Venezuela to northern Bolivia and southeastern Brazil. In Colorado, they are an uncommon breeding species in the western mountains and accidental east of the Continental Divide and on eastern plains. They are rare spring and fall migrants in western valleys and on eastern plains.

Habitat Requirements: Purple Martins breed primarily along the edges of late-seral, aspen-dominated woodlands, usually near water. They are obligate secondary cavity nesters, using abandoned woodpecker cavities in isolated live aspen or aspen snags and rarely in ponderosa pine or Douglas-fir. Key habitat features include live aspen trees or snags containing cavities and averaging 36 cm (14 in) dbh, located within 50 m (175 ft) of the edge of mountain parks, and within 300 m (1,000 ft) of surface water. The height of nest cavities in live aspen averages 35% of tree height and are usually well below the tree crown.

Ecology: Purple Martins arrive in Colorado by early June and depart on autumn migration by late August. They are loosely colonial, nesting in small, isolated colonies of one to three pairs. They defend only the nest cavity, and a single tree may contain two or three nests. Nests are primarily in abandoned Northern Flicker cavities. Mud is required for the nests. Their diet consists almost entirely of insects captured in flight as they forage over mountain parks, riparian zones, reservoirs, moderate-sized forest openings, and within open forest canopies. Martins are single-brooded. Breeding site fidelity is high.

Management Issues and Conservation Recommendations: Preferred nesting trees are live and located in parks, along forest edges, or in open-structured stands. Martin use of artificial nest boxes is limited in the western U.S. *Retain all live cavity-bearing trees and large diameter snags. Retain a minimum of 8–12 snags or live cavity-bearing trees per 4 ha (10 ac), and all snags greater than 48 cm (19 in) dbh, especially those near water, riparian corridors, or stand edges. Retain broken and spike-topped trees.*

Purple Martins have a very high fidelity to a limited number of nesting sites, which have rather precise specifications. These number and general location of these sites appear to have remained relatively stable over time. *Maintain natural disturbance regimes and the dynamic nature of aspen communities at the landscape scale. Where natural disturbance mechanisms cannot be reintroduced, mechanical disturbance events should mimic, as closely as possible, the disturbance history of the local area and surrounding habitats. Maintain sufficient live cavity-tree and snag densities within and adjacent to commercial harvest areas.*

Status and Reasons for Concern: Purple Martin is classified as a Sensitive Species in U.S. Forest Service Region 2. Population trends of this species in Colorado are not adequately

monitored by the BBS. Population trends appear to be stable or increasing in the western U.S., but have declined significantly in recent years in the eastern portion of the species range. They were present on an average of 5.18% (SE = 1.54) of the BBS routes run in Physiographic Area 62 in Colorado, 1988–1998, at an average abundance of 0.15 (SE = 0.05) individuals per route. The mean number of routes run each year was 21.1 (SE = 3.06). CBO initiated a statewide monitoring program in 1999, visiting known and likely nesting sites and initiating a database of colony sites. They counted 174 birds at 31 active colonies. No birds were found at six historical sites that were visited. The database contains 81 sites of reported martin use. This species is monitored by *MCB* with a statewide census.

Biological Objective: Maintain current breeding densities at all known nest sites. Maintain or increase the current number of colonies. Continue to monitor known breeding sites and survey other potential nest sites within the state.

Selected References: Andrews and Righter 1992, Baicich and Harrison 1997, Dobkin 1994, Ehrlich et al. 1988, Kingery 1998, Price et al. 1995, Reynolds et al. 1991, Svoboda et al. 1980, Yanishevsky and Petring-Rupp 1998.

VIOLET-GREEN SWALLOW (*Tachycineta thalassina*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Purple Martins, Mountain Chickadees, Pygmy and White-breasted Nuthatches, House Wrens, Mountain Bluebirds, and Western Bluebirds.

Distribution: Violet-green Swallows breed from central Alaska south through the western Canadian provinces and Rocky Mountain chain to southern Mexico, and from the Rocky Mountain front west to the Pacific Ocean. In Colorado, they are fairly common breeding birds in foothills, mountains, and mountain parks. They are common spring and fall migrants in western valleys, and on eastern plains near foothills. They winter in central and southern coastal California and southern Mexico.

Habitat Requirements: These swallows breed along the edges of aspen-dominated woodlands or within open stands, on cliffs, and in cavities in riparian embankments. They also breed in lesser numbers in open ponderosa pine and spruce-fir stands. They are obligate secondary cavity nesters, using abandoned woodpecker cavities in snags, and natural cavities in cliffs and banks. Breeding densities are directly related to snag density. Key habitat features are snags or live trees containing cavities located near water or mountain parks.

Ecology: Violet-green Swallows arrive in Colorado in early March and begin breeding from mid April through early May. They nest primarily in abandoned Red-naped Sapsucker and Downy Woodpecker cavities, either singly or in small loose colonies; breeding site fidelity is high.

Breeding densities of 10–30 pairs per 40 ha (100 ac) have been reported, but densities are dependent on availability of nesting cavities, which may vary widely across the landscape. Their diet consists almost entirely of insects captured in flight as they forage over mountain parks, riparian zones, reservoirs, moderate-sized forest openings, and within open forest canopies. Little else is known about their behavior.

Management Issues and Conservation Recommendations: Populations of these swallows depend directly upon the availability of appropriate nest cavities. Preferred nesting snags are of decay class III, and located in open areas, along forest edges, or in open-structured stands. Response to small aspen patch clearcuts within a matrix of uncut forest is either neutral or positive. This species will readily accept artificial nest boxes, but House Wren predation may reduce productivity in some habitats. *Retain all live cavity-bearing trees and all large diameter snags. Retain a minimum of 8–12 snags or live cavity-bearing trees per 4 ha (10 ac), and all snags greater than 48 cm (19 in) dbh, especially those near water, riparian corridors, or stand edges. Broken and spike-topped trees are also valuable retention trees. Maintain natural disturbance regimes and the dynamic nature of aspen communities at the landscape scale. Where natural disturbance mechanisms cannot be reintroduced, mechanical disturbance events should mimic, as closely as possible, the disturbance history of the local area and surrounding habitats. Sufficient snag and live cavity-tree densities should be maintained within commercial harvest areas.*

Status and Reasons for Concern: This species has a moderately high conservation need throughout its range, along with high representation in the physiographic area and an uncertain population trend. Population trends of this species in Colorado are not adequately monitored by the BBS, but populations appear to be stable at the continental scale. Abundance on BBS routes in Colorado equals that of anywhere in the species range. They were present on an average of 89.64% (SE = 2.28) of the BBS routes run in Physiographic Area 62 in Colorado, 1988–1998, at an average abundance of 22.57 (SE = 3.64) individuals per route. The mean number of routes run each year was 21.1 (SE = 3.06). This species is monitored by *MCB* with point transects.

Biological Objective: Maintain or increase the species' distribution and abundance, based upon results of the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Baicich and Harrison 1997, Dobkin 1994, Ehrlich et al. 1988, Price et al. 1995, Yanishevsky and Petring-Rupp 1998.

Cliff/Rock

Description and Ecology: Cliff/rock habitats are ecologically typical and exceptionally scenic features of the mountainous West. Across Colorado this habitat appears as high cliffs, rocky ledges, small rocky out thrusts, talus, stream cut-banks, bluffs, rim rock, and a few cliff buttes. Cliff/rock habitat occurs throughout the Southern Rocky Mountains in Colorado. On the east slope of the Southern Rockies, cliff/rock habitats start in the plains at an elevation of 1650 m (5,400 ft) and extend up to the Continental Divide generally up to 3650 m (12,000 ft) but on some higher mountains up to 4270 m (14,000 plus ft). Steep cliffs on either side of the Continental Divide are primarily unglaciated with glaciated U-shaped valleys below. The rough granite, crystalline cracks and rounded structures make many cliffs popular for technical rock climbing. The activities of rock climbers sometimes come into conflict with birds that nest on cliff/rock habitat.

Importance and Conservation Status: Although the avifauna of cliff/rock habitat is small compared to other habitats, these species are highly specialized. Birds that use cliffs for nesting may be more susceptible to loss of nesting habitat than many other species because they rely completely on cliffs as nest sites. Thus, the number of suitable nest sites is finite and essentially non-renewable. All suitable nest sites in some areas may be used, making every usurpation of a nest site by humans result in a direct reduction in the population.

Conflicts related to nesting birds that use cliffs, rocky ledges, and small rocky out thrusts include rock climbing, mining, road construction, hiking, bicycle and horseback trails, and housing development. All these activities can have a negative impact whether they are conducted at the base or the top of a cliff, rocky ledge, or small rocky out thrust. Probably the greatest disturbance factor in cliff/rock habitat is rock climbing.

Habitat protection can be enhanced by making land managers and the general public more aware of the importance of protecting this habitat and by controlling use and development wherever necessary and possible. Cliff/rock habitat can be protected by various means including establishing buffer zones, temporary closures, and designation of special areas (Research Natural Areas, Areas of Critical Environmental Concern, Special Management areas, or sanctuaries).

It is important to protect not only nesting habitat, but also foraging habitat and a prey base. Many birds that nest on cliff/rock habitat forage in or above other habitat types. Prey abundance and appropriate nesting sites are both key factors in determining the success of any nesting birds on cliff/rock habitat.

Disturbance to birds can be caused by the presence of humans, noise, or erosion. Any one of these components, or a combination, may be sufficient to discourage many birds from using an area or causing an active nest to fail. Such disturbance may gradually reduce the number of total sites available.

Implementation Strategies:

Bird Monitoring

Goal: To monitor or track all priority birds in cliff/rock habitats and document distribution, population trends, and abundance in a statistically acceptable manner.

Objective: Monitor all known Black Swift colonies and survey potential habitat for new nest sites.

Strategy: The U.S. Forest Service and CBO's *Monitoring Colorado's Birds (MCB)* will take the lead in developing a statewide monitoring program for the Black Swift.

Status: The *MCB* program for monitoring the Black Swift is partially implemented. It has developed a data base of historical sites, and in 1999 visited 65% of them and found four new sites.

Objective: Continue with long-term statewide monitoring of Peregrine Falcon.

Strategy: The Colorado Division of Wildlife will take the lead in a statewide monitoring program for the Peregrine Falcon, with continued reliance on USFS, CDOW, NPS, BLM, and others to monitor known nest sites.

Status: Monitoring for the Peregrine Falcon is fully implemented.

Habitat Monitoring.

Goal: To document the amount, condition, and ownership of cliff/rock habitats in Colorado.

Objective: Develop collaborative efforts to use GIS in mapping cliff/rock habitats, documenting amount, condition, and ownership.

Status: This effort has not been initiated to date. Potential collaborators include CDOW, CNHP, CBO, USGS, NPS, BLM, and TNC.

Habitat Core Areas

Goal: To conserve unique representatives and/or core areas of Black Swift nesting colonies and a high concentration of breeding Peregrine Falcons in Colorado.

Objective: Identify unique representative and/or core areas.

Objective: Identify agency- or organization-specific means of designating and conserving unique representatives and/or core areas (e.g., state management areas, refuges, wilderness areas, etc.).

Objective: Identify any of these core areas that are appropriate for designation as *Important Bird Areas (IBAs)*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with cliff/rock habitat were nominated in 1999, and the *IBA* committee will make final selections in 2000.

Objective: Promote collaboration/cooperation between agencies, organizations, and individuals in conserving unique representatives and/or core areas with multiple ownership.

Site-based Conservation

Goal: To conserve local sites that are important for the conservation of the Black Swift and Peregrine Falcon in Colorado. These sites may include key nesting spots (e.g., cliffs, nest colonies, individual nest sites, historic sites etc.).

Objective: Identify agency- or organization-specific means of designating and conserving key local sites, work with the appropriate agency or organization to designate them, and promote conservation activities (e.g., temporary closures on nest sites, protocols in management plans, exclusion of certain activities such as rock climbing during important times of the year).

Objective: Identify key local sites that are appropriate for designation as *IBAs*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: The Box Canyon Black Swift nesting site was nominated in 1999, and the *IBA* committee will make final selections in 2000.

Management Practices

Goal: To promote management practices that benefit birds in cliff/rock habitat.

Objective: Develop a BMP manual for the Black Swifts.

Status: Not yet initiated.

Objective: Identify key landowners and/or land managers and ask them to incorporate best management practices to conserve the Black Swifts and Peregrine Falcons and their habitat in Colorado.

Objective: Maintain or increase the quality of Black Swift colonies.

Strategy: Some potential nest sites may currently be unsuitable for Black Swift nesting due to encroachment by trees. Prescribed burns or tree thinning should be encouraged around known or potential nest sites to improve access. Encourage land managers to take advantage of funding opportunities for creating/restoring/maintaining Black Swift nest sites on the lands they manage.

Objective: Maintain nesting habitat for the Peregrine Falcon, which would include foraging areas around nest sites.

Interstate/International Wintering Grounds

Goal: To conserve the wintering ground habitat used by the Black Swift and Peregrine Falcon outside of Colorado.

Objective: Identify the wintering distribution and key habitat associations for the Black Swift and Peregrine Falcon (Mexico, Central and South America).

Objective: Document the amount, condition, and ownership of key wintering habitats.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, NGOs.

Strategy: Develop collaborative efforts with other states and countries on projects (e.g., education, research, fund-raising, donations, etc.) which benefit the Black Swift and Peregrine Falcon on their winter grounds.

Migration Concerns

Goal: To protect high priority birds for cliff/rock habitat in migration.

Objective: Determine if there are migration concerns for the Black Swift.

Status: Presently migration concerns for the Black Swift are unknown.

Objective: Document amount, condition, and ownership of key migration habitats for the Black Swift and Peregrine Falcon.

Strategy: Develop collaborative efforts with other states and countries on projects (e.g., education, research, fund-raising, donations, etc.) which benefit the Black Swift and Peregrine Falcon on their migration grounds.

Outreach and Education

Goal: Provide information on Black Swifts and Peregrine Falcons (conservation, habitat needs, natural history, etc.) to children, teachers, naturalists, landowners, natural resource professionals, rock climbing organizations, and other interested parties.

Objective: Prepare a booklet about Black Swifts. Information on the Peregrine Falcon is currently available.

Strategy: Make educational materials available at local nature centers and natural resource agency offices.

Strategy: Hold workshops and field programs for teachers.

Strategy: Hold workshops and field programs for natural resource professionals.

Strategy: Use the annual International Migratory Bird Day (IMBD) to supply local media outlets with information on priority species and habitats, organize informational activities for school children and the public, provide guided natural history viewing opportunities, and promote local conservation activities in which people can become involved.

Strategy: Integrate information materials into existing education programs (Project Wild, Balarat, other programs for children and adults).

Strategy: Present information at Teacher Association meetings, conferences, other annual meetings.

Strategy: Submit manuscripts to popular magazines for children and adults, also those targeted at rock climbers and landowners.

Research Priorities

Goal: To identify and facilitate research that will aid in understanding and managing cliff/rock habitats for their high priority bird species.

Objective: To identify the top ten research needs in cliff/rock habitat in Colorado.

Strategy: Update the list of research needs annually to reflect shifting conservation priorities and to remove research needs from the list as they are investigated.

Strategy: Solicit input from researchers and managers on research needs and accomplishments.

Status: The following research needs have been identified:

1. Determine the effects on Black Swift populations of large-scale wildland fires and prescribed fires in foraging habitat and restoration efforts by land managers.

2. Identify the key migratory stopover and wintering areas and habitats of Black Swifts.
3. Test and evaluate monitoring protocols for the Black Swift (breeding only).
4. Conduct demographic studies of Black Swifts.
5. Determine what impacts may be occurring due to rock climbing during the summer and ice climbing during the winter (Black Swift colonies) and due to hikers or other disturbances during the breeding season (Black Swift and Peregrine Falcon).
6. Identify Black Swift and Peregrine Falcon nesting habitat most susceptible to disturbance.
7. Determine whether habitat around colonies and/or nest sites is adequate for foraging Black Swifts and Peregrine Falcons.
9. Identify principal wintering areas for Black Swifts and Peregrine Falcons in Mexico, Central or South America.

Priority Species Accounts: Two species, the Peregrine Falcon and Black Swift are identified as high priority birds for cliff/rock habitat in Physiographic Area 62.

PEREGRINE FALCON (*Falco peregrinus*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Golden Eagle, Prairie Falcon, Great Horned Owl, Black Swift, and Common Raven.

Distribution: Peregrine Falcons have a more extensive worldwide range than any other bird: they occur on all continents except Antarctica (Kingery 1998). They breed across the North American Arctic and southward along the Pacific Coast, through the Rocky Mountains, and in scattered locations in the eastern U.S. Peregrines breed along the foothills in Physiographic Area 62 and at scattered locations in the higher mountains. About one-fourth of Colorado's peregrines nest in the region. Statewide in 1998, CDOW personnel found peregrines occupying 90 of 107 known nesting sites and located six new sites. Seventy-six of the sites were occupied by adult breeding pairs which produced 157 young.

Habitat Requirements: In Colorado, Peregrine Falcons breed on cliffs and rock outcrops from 1370 m to more than 2740 m (4,500–9000 ft) in elevation. They most commonly choose cliffs that lie within pinyon-juniper and ponderosa pine zones, but this choice probably depends on the nature and location of the cliffs rather than an attraction to these habitats. They select a ledge that has a wide view and plentiful prey in the area. Most eyries (nest sites) are within a mile of water. The falcons hunt in adjacent open meadows, forested tree top areas, around lakes and rivers, and shrubsteppe. Early records suggest that they once nested in somewhat more accessible spots, but now they tend choose cliffs higher than 60 m (200 ft) in undisturbed areas. Recovery efforts have also succeeded in coaxing them to nest on tall buildings in urban areas where they subsist largely on Rock Doves.

Ecology: Some Peregrine Falcons reside in their territories in Colorado throughout the year, but most winter south of Colorado and arrive on the breeding grounds in March. They immediately begin courtship activities and are laying eggs in April. The eyrie is a level ledge beneath an overhang where they can scrape a depression in debris. Eggs hatch after a 32–35 day incubation period and the young remain on the nest for another 39–46 days. The young remain dependent on the parents for another period of 30 days or more until dispersing in August and September. They winter in Mexico, Central and South America. These falcons feed on smaller birds almost exclusively, with White-throated Swifts and Rock Doves being among their favored prey. They have been known to take bats in the early morning or late in the day when bats become active.

Management Issues and Conservation Recommendations: Disturbance from recreational activities (rock climbing and hiking) can cause nest failure. *Identify nest sites and restrict recreational activities during the nesting period. This may require seasonal closures or rerouting of some hiking trails around the base or top of some cliffs during the breeding season. Establish buffer zones to minimize conflicts around nesting sites, especially if the cliff is a popular destination point for hikers or rock climbers. Establish Research Natural Areas, Areas of Critical Environmental Concern, Special Management areas, Important Bird Areas, or sanctuaries where appropriate to protect eyries.*

Urbanization has encroached on some feeding territories, resulting in abandonment of traditional breeding sites. *Determine if roads, housing developments, or other human related activities have a negative impact on nesting or foraging habitat.*

Most of the known nest sites in Colorado are on public lands administered by the Bureau of Land Management, U.S. Forest Service, and National Park Service. *Coordination with land managers is imperative in protecting nest sites.*

In the 1980s there were still occasionally White-throated Swift and swallow die-offs in western Colorado and eastern Utah due to pesticide poisoning (J. Connor, National Park Service, personal observation). Many birds that migrate are still subjected to chemical exposure especially around agricultural fields. In the United States, DDT caused the near extinction of the Peregrine Falcon in the 1950s and 1960s, and pesticides are still a serious threat to birds in the late 1990s. *Monitor Peregrine Falcons and their habitat for herbicides, pesticides, and other chemicals that would have a direct or indirect impact on them. Research Peregrine Falcon food sources for pesticide and herbicide poisoning. Research threats to food in Peregrine Falcon winter habitat.*

Status and Reasons for Concern: This species occupies a unique habitat type (cliff/rock) in this physiographic area. It was delisted from the Federal Threatened and Endangered Species list in 1999. Monitoring protocols call for the peregrines to be monitored for at least the next 13 years (2012) to ensure that 100 to 120 breeding pairs are maintained in Colorado (Gray 1995). Within the cliff/rock habitat in Physiographic Area 62, BBS data collected between 1969 and 1996 are too sparse to allow analysis of trend data. This species is monitored by CDOW.

Biological Objective: Maintain or increase the species' distribution and abundance, based upon results from the CDOW monitoring program. Maintain current breeding densities at all known nest sites, and improve breeding densities by protecting these sites from human disturbance. Continue to monitor known breeding sites and survey other potential nest sites with the state.

Selected References: Andrews and Righter 1992, Gray 1995, Kingery 1998.

BLACK SWIFT (*Cypseloides niger*)

Associated Species: Black Swift habitat is very specialized and there are no associated species.

Distribution: Black Swifts breed in scattered colonies in North America, from southeast Alaska to central Mexico (Kingery 1998). They tend to be more common along the west coast states from Mexico north into Canada. Their range extends into Arizona and Colorado. In Colorado the species is an uncommon summer resident in the San Juan Mountains and is very local in most other mountain ranges in the state. Breeding was first confirmed in the state in 1949 (Knorr and Baily 1950).

Habitat Requirements: Due to their exacting nesting requirements, Black Swifts probably never have been numerous in Colorado (Knorr 1961). They nest on precipitous cliffs near or behind high waterfalls. They tend to congregate in nesting colonies, usually fewer than ten pairs (Knorr 1961). Knorr outlined six specific habitat requirements for breeding Black Swifts in Colorado:

1. Black Swifts nest within close proximity to falling water on a cliff. They place nests in small cavities within the spray zone or directly behind sheets of falling water.
2. Nest sites have a commanding view from the nest colony over the surrounding terrain, enabling swifts to fly straight out from the nest colony and very quickly be hundreds of feet above the valley floor.
3. The cliff face should be free of obstructions such as dense forest that would inhibit access to nests.
4. Black Swift nest ledges are in deep shade the majority of the day, sunlit only late in the day as ambient air temperatures decline.
5. The nest niche often has water flowing around or in front of the opening, but the nest cup itself is usually dry. Nest niches are often covered with moss and other hydrophilic plants.
6. Occupied nest niches are always inaccessible to ground predators.

Ecology: Black Swifts arrive in Colorado in late May and begin nesting in June. They have extremely long incubation (24–27 days) and nestling (45–49 days) periods, and young do not fledge until September. All reports of Black Swift clutch sizes are of one egg only. Foraging birds range widely at high elevations over most montane and adjacent lowland habitats, seeking widely scattered “blooms” of aerial insects, particularly flying ants. Nestlings spend the day alone without food: typically adults return only in the evening with a meal of partly digested insects. Faced with day-long fasts, young grow extremely slowly, and may even exhibit torpor, a slowing

of metabolism that could explain why Black Swifts choose cold, damp nest sites even when dry ledges exist nearby (Holroyd 1993). Another theory postulates that two other factors dictate the choice of nest sites: constant temperatures to ameliorate outside changes and high humidity to aid in attaching the nest to the cliff.

Management Issues and Conservation Recommendations: Conflicts related to nesting Black Swifts could include rock climbing, spelunking, mining, road construction, hiking, bicycling, horseback trails, water diversions, and housing developments. Probably the greatest disturbance to Black Swift nesting habitat is hiking trails to the base or top of waterfalls and any rock or ice climbing. The effect that ice climbing may have on nesting habitat needs research. Rock climbing can remove lichens, mosses and other hydrophilic plants needed in the building of nests, and climbing at waterfalls could disturb incubation, brooding, and foraging of swifts. *Protect known nest sites and potential nest sites from disturbance, rerouting hiking trails or enforcing seasonal closures around the base or top of some cliffs during the breeding season. Establish buffer zones to minimize conflicts around important Black Swift nesting sites. Identify and designate sites as special areas (Research Natural Areas, Areas of Critical Environmental Concern, Special Management areas, Important Bird Areas, or sanctuaries). Determine whether winter ice climbing has any negative effects on nesting habitat (e.g., removal of hydrophilic plants). Determine whether roads, housing developments, or other human related activities have a negative impact on nesting or foraging habitat. Research Black Swift food sources particularly flying ants for threats such as herbicides or pesticides that would have a direct or indirect impact on those aerial insects.*

Status and Reasons for Concern: This species has a high conservation need locally and throughout its range. Although the statewide total probably does not exceed a few hundred pair breeding at fewer than 50 known sites, at least 20% of all Black Swifts breed in Colorado (Kingery 1998). The 1998 Partners in Flight Watch List ranked Black Swifts nationally as a High Priority species (Carter et al. 1999). The Colorado Natural Heritage Program for rare and imperiled species ranks the Black Swift as vulnerable in the state. The Black Swift is classified as a Sensitive Species in U.S. Forest Service Region 2. BBS data are not adequate for meaningful analysis. CBO initiated a statewide monitoring program in 1998, and previously unknown breeding sites have been documented in 1998 and 1999. This species is monitored by *MCB* with a statewide census.

Biological Objective: Maintain current breeding densities at all known nest sites. Continue to monitor known breeding sites and survey other potential nest sites within the state. There is a high probability that there are unknown nest sites in Colorado.

Selected References: Andrews and Righter 1992, Bent 1940, Carter et al. 1999, Holroyd 1993, Kingery 1998, Knorr 1961, Knorr and Baily 1950.

High Elevation Riparian

Description and Ecology:

A) Subalpine Riparian Shrubland

These ecosystems may be extensive in broad, glacial valleys, along stream systems and other wetlands from 2450 to 3650 m (8,000–12,000 ft) elevation. They have relatively low plant diversity—comprised mostly of willows, shrubby cinquefoil, and bog birch. The low plant diversity along with the short growing season usually results in low avian species diversity as well. However the dense willow thickets provide many protected nest sites and an abundance of insects. This results in a high density of nesting birds in a given area. Species most commonly found in these areas are Broad-tailed Hummingbird, Dusky Flycatcher, Yellow Warbler, MacGillivray's Warbler, Wilson's Warbler, Lincoln's Sparrow, Song Sparrow, White-crowned Sparrow, and Fox Sparrow.

B) Foothills Riparian Forest

Foothills riparian forests are distributed along stream systems in the foothills, lower mountains and mountain parks from 1700 to 3050 m (5,500–10,000 ft) elevation. In some areas the riparian forest is dominated by a deciduous component, especially narrowleaf cottonwood, a variety of willow species, box elder, mountain alder and river birch. In other areas Colorado blue spruce and other coniferous trees dominate, and conifers often form a mixture with cottonwoods. The understory of these systems is typically rich, with a wide variety of shrubs and herbaceous plants.

The *Colorado Breeding Bird Atlas* (Kingery 1998) reported that foothills riparian forests dominated by deciduous trees comprised nearly 85% of all foothills riparian forests, while conifer-dominated systems comprised just over 15%. These two systems also exhibited somewhat different avian communities. In deciduous systems, Yellow Warbler was the species most frequently detected, followed by American Robin, Northern Flicker, House Wren, Warbling Vireo, Song Sparrow, Western Wood-Pewee, and Broad-tailed Hummingbird. In coniferous systems, Cordilleran Flycatcher was the most frequently detected species, followed by Broad-tailed Hummingbird, Ruby-crowned Kinglet, American Robin, Golden-crowned Kinglet, Swainson's Thrush, Mountain Chickadee, Yellow-rumped Warbler, and Western Tanager.

Importance and Conservation Status: Riparian ecosystems are highly important areas for both humans and wildlife. They are convenient locations for roads and trails, mining activities, and dams and water diversions. They are also productive areas for domestic livestock grazing. Riparian areas are under constant assault from these and other activities which cause habitat loss and degradation, disturbance, dewatering, and pollution (Melton et al. 1984, Wozniak 1995).

Riparian areas represent a transition zone between the aquatic ecosystem and the drier uplands. The riparian zones are well defined, unique, and highly productive areas which are sensitive to disturbance (Melton et al. 1984). Riparian systems occupy no more than 3% of the Colorado

landscape (Kingery 1998); however, 75% of the bird species in the West use riparian areas during some part of their life cycle (Howe 1996).

Perhaps one of the most dramatic and widespread impacts on riparian areas in the West comes from domestic livestock use. Domestic livestock are disproportionately attracted to riparian areas during the summer months when uplands are hot and upland vegetation is drying out. The high moisture and nutrient content of riparian forbs and shrubs during the summer months are irresistible to domestic livestock. As a result of grazing and trampling, many riparian areas are devoid of understory vegetation at a time when it is most critical as cover and food source for avian species (Krueper 1995).

Much of the high elevation riparian habitat in Colorado is controlled by federal land managers. Better control of domestic livestock use on these Federal lands could make a substantial difference in the health of the riparian communities in the state. In many cases, total removal of domestic livestock is not needed to make a substantial improvement in riparian vegetation condition; simply a change in the season of use and or change in the length of use of the riparian pastures could make a substantial difference (Myers 1991).

Implementation Strategies:

Bird Monitoring

Goal: To monitor or track all breeding birds in the high elevation riparian habitat and document distribution, population trends, and abundance in a statistically acceptable manner.

Objective: All species with AI > 2 will be monitored with count-based methods.

Strategy: Monitoring will be accomplished through the combined efforts of agencies with primary responsibility for managing this habitat.

Strategy: Monitoring will continue to rely on BBS data, with data from CBO's *Monitoring Colorado's Birds (MCB)* program incorporated as it becomes available.

Status: MCB implemented high elevation riparian habitat transects in 1999 and ran a total of 25 transects; trend data should be available for most species within 5–12 years.

Objective: All species with AI # 2 will be tracked through count-based methods or their presence/absence noted in the state.

Strategy: CBO's MCB monitoring program will address this.

Status: MCB was implemented on high elevation riparian habitat in 1999.

Objective: All Great Blue Heron colonies in foothills riparian habitats will be monitored or tracked with colony counts.

Status: MCB began cataloguing and censusing Great Blue Heron colonies in 1999 and will census all colonies in 2000.

Objective: Population demographic monitoring will be instituted for all species in high elevation riparian habitats with PT of 4 or 5.

Strategy: CBO's MCB will address this objective.

Status: MCB demographic monitoring will begin in 2001.

Habitat Monitoring

Goal: To document the amount, condition, and ownership of high elevation riparian habitat in Colorado.

Objective: Develop collaborative efforts to use GIS in mapping high elevation riparian habitat, documenting amount, condition, and ownership.

Status: This effort has not been initiated to date. Potential collaborators include CDOW, CNHP, CBO, USGS, USFS, and TNC.

Habitat Core Areas

Goal: To conserve unique representatives and/or large, ecologically-functioning examples of high elevation riparian habitat in Colorado used by birds during the breeding season, during migration, or during the winter.

Objective: Identify such areas, use agency- or organization-specific means of designating and conserving them, and work with the appropriate agency or organization to promote conservation activities.

Status: Appropriate areas that have been identified include USFS Research Natural Areas, USFS Wilderness Areas, and Colorado Natural Areas Program sites (West Creek Natural Area in Larimer County).

Objective: Identify high elevation riparian core areas that are appropriate for designation as *Important Bird Areas (IBAs)*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with high elevation riparian habitat were nominated in 1999, including Carpenter Ranch on the Yampa River, and the *IBA* committee will make final selections in 2000.

Objective: To maintain or increase the quantity and quality of high elevation riparian habitat on private lands.

Strategy: Encourage municipalities to incorporate preservation of high elevation riparian habitat into planning.

Objective: To maintain or increase the quantity and quality of high elevation riparian habitat on public lands.

Strategy: Integrate the BCP into management plans for public lands in the physiographic area.

Site-based Conservation

Goal: To conserve local breeding sites, local migratory stopover sites, and local wintering sites that are important for the conservation of priority species of high elevation riparian habitats.

Objective: Identify agency- or organization-specific means of designating and conserving key local sites. Work with appropriate agencies and organizations to designate such sites, and promote conservation activities.

Objective: Identify key local sites that are appropriate for designation as IBAs, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with high elevation riparian habitat were nominated in 1999, and the IBA committee will make final selections in 2000.

Management Practices

Goal: To promote management practices that benefit birds in high elevation riparian habitat.

Objective: A Best Management Practices (BMP) manual will be produced and distributed.

Status: Not yet initiated.

Objective: Identify key landowners and land managers and encourage them to incorporate best management practices to conserve high elevation riparian birds and their habitat.

Interstate/International Wintering Grounds

Goal: To conserve the wintering ground habitat used by Colorado's high elevation riparian birds that migrate outside of the state.

Objective: Track amount of available habitat on the wintering grounds.

Strategy: Utilize GIS (state GAP projects, Heritage Program, and/or CBO).

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to obtain data.

Objective: Protect key tracts of wintering habitat.

Strategy: Identify the wintering distribution and key habitat associations of priority species.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect wintering habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Migration Concerns

Goal: To protect migratory stopover habitat used by high elevation riparian birds.

Objective: Identify important migratory stopover areas for priority species that breed in Colorado, and key sites for priority species that breed elsewhere.

Objective: Track amount, condition, and ownership of key migratory stopover sites.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect migratory habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Outreach and Education

Goal: To provide information on high elevation riparian habitat birds (conservation, habitat needs, natural history, etc.) to children, teachers, naturalists, landowners, natural resource professionals, and other interested parties.

Strategy: Make educational materials available at local nature centers and natural resource agency offices.

Strategy: Hold workshops and field programs for teachers.

Strategy: Hold workshops and field programs for natural resource professionals (CDOW, BLM, and USFS staff).

Strategy: Present information at Teacher Association meetings, conferences, other annual meetings.

Strategy: Submit manuscripts to popular magazines for children and adults.

Research Priorities

Goal: To identify and facilitate research that will aid in understanding and managing high elevation riparian habitats for Colorado's birds.

Objective: To identify the top ten research needs in high elevation riparian habitat in Colorado.

Strategy: Update the list of research needs annually to reflect shifting conservation priorities and to remove research needs from the list as they are investigated.

Strategy: Solicit input from researchers and managers on research needs and accomplishments.

Status: The following research needs have been identified:

1. The effect of livestock grazing on habitat suitability during the breeding, wintering, and migration periods.
2. The impact of Brown-headed Cowbird nest parasitism on breeding success of high elevation riparian birds.
3. The effect on habitat suitability of residential and other development in high elevation riparian habitats.

Strategy: Facilitate investigations to answer these questions by providing information about priority needs to universities, public and private research entities, identifying funding sources, and promoting collaboration between management and research agencies.

Priority Species Accounts: Four species are identified as high priority in high elevation riparian habitat: Cordilleran Flycatcher, American Dipper, MacGillivray's Warbler, and Wilson's Warbler.

CORDILLERAN FLYCATCHER (*Empidonax occidentalis*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities in coniferous riparian forests include Broad-tailed Hummingbird, Ruby-crowned Kinglet, Golden-crowned Kinglet and Swainson's Thrush. In deciduous riparian forests, associates include Western Wood-Pewee, Warbling Vireo, Yellow Warbler, and Song Sparrow.

Distribution: Cordilleran Flycatchers breed throughout the Rocky Mountains, from Oaxaca, Mexico, north to southeastern Alaska. In Colorado they are uncommon to fairly common summer residents in the foothills and lower mountains from 1800 to 3000 m (6,000–10,000 ft) elevation. They winter in Mexico and Central America.

Habitat Requirements: These flycatchers nest in shady coniferous and deciduous forests, usually near streams or moist ravines. They place their nest in roots of upturned trees and forked branches; small cavities in rock ledges, dirt banks, trees, and snags; and occasionally in niches in cabins and other structures.

Ecology: Cordilleran Flycatchers arrive on their breeding grounds in early to mid May. Nest building occurs from mid May to mid July, with young present from mid June to mid August. Fall migration begins in mid August.

Management Issues and Conservation Recommendations: As is the case with most species, the most pressing conservation issue is habitat loss. Timber cutting, livestock grazing, and recreational developments contribute to this loss. *Reduce or eliminate any activities that degrade the structure and quality of the overstory or understory of riparian systems, i.e., maintain riparian vegetation with a closed canopy, shrubby understory, snags, and downed trees. Do not permit timber cutting within 30 m (100 ft) of the riparian area. Tightly control or eliminate domestic livestock grazing in these areas. Summer grazing should not be permitted. Locate recreational facilities such as roads, trails, and campgrounds away from riparian areas (Myers 1991).*

Status and Reasons for Concern: A high proportion (estimated at 11.3%) of these flycatchers' total population occurs within this physiographic area, indicating that this area has high responsibility for the conservation of this species. BBS data for Physiographic Area 62 did not demonstrate a statistically significant trend for the period 1966–1996 ($P = 0.57$; $n = 29$ routes). Cordilleran Flycatchers were present on an average of 53.79% of BBS routes run in Physiographic Area 62 in Colorado, 1988–1997, at an average abundance of 3.03 (SE = 0.35) individuals per route. The mean number of routes run each year was 21.1 (SE = 3.06). This species is monitored by *MCB* with point transects.

Biological Objective: Maintain or increase the species' distribution and abundance, based upon results from the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Beaver and Baldwin 1975, Kingery 1998.

AMERICAN DIPPER (*Cinclus mexicanus*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include the Spotted Sandpiper.

Distribution: American Dippers reside from western Alaska and Canada south to western Panama. In Colorado, they are uncommon summer residents in foothills and mountains from 1800 to 3500 m (6,000–11,500 ft) elevation. In winter, most birds withdraw to lower elevations.

Habitat Requirements: Dippers reside along clear mountain streams and rivers with sand and rubble on the bottom and little or no aquatic vegetation. Selected streams are usually less than 15 m (50 ft) wide and 2 m (6.5 ft) deep. They require exposed rocks in the stream for perching. Dippers place their nests 2 to 3 m (6–10 ft) above fast or deep water, on cliff ledges, boulders, and bridges (which have replaced natural nesting substrates in some areas).

Ecology: Dippers move upstream to nesting areas as ice leaves. The beginning of breeding varies from March to May depending upon ice and snow melt, with nestlings sometimes present as late as August. Birds move downstream as freeze-up closes their habitat for the winter. Dippers eat mainly aquatic insects but also occasionally small fish, fish eggs, and tadpoles.

Management Issues and Conservation Recommendations: American Dippers benefit from some human activities, such as construction of bridges. However, they are hurt by others, such as drawing down streams to supply agricultural or municipal needs, damming and flooding streams, mining (can contribute toxins to streams), and logging (can increase sedimentation); these activities are detrimental to dippers because they eliminate nesting habitat and aquatic insect prey. *Reduce or eliminate activities that pollute streams with added sedimentation or mine and chemical waste.*

Dippers exhibit high between-year fidelity to nesting sites. *Protect known sites from habitat degradation. Preserve streamside logs and upturned roots, which can serve as cover and as nest substrate.*

Status and Reasons for Concern: Because they rely on aquatic insects, which only flourish in clear, unpolluted streams, American Dippers are excellent indicators of stream quality. They are not adequately monitored by the BBS within Physiographic Area 62, and data are too sparse for meaningful analysis of trends. Dippers were present on an average of 16.63% (SE = 3.19) of BBS routes run in Physiographic Area 62 in Colorado, 1988–1997, at an average abundance of 0.20 (SE = 0.03) individuals per route. The mean number of routes run each year was 21.1 (SE = 3.06). This species is monitored by *MCB* with point transects.

Biological Objective: Maintain or increase the species' distribution and abundance, based upon results of BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992; Kingery 1996, 1998; Price and Bock 1983.

MACGILLIVRAY'S WARBLER (*Oporornis tolmiei*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities in foothills shrublands include Broad-tailed Hummingbird, Virginia's Warbler, Spotted Towhee, and Green-tailed Towhee. In willow carr ecosystems, associated species include Broad-tailed Hummingbird, Dusky Flycatcher, Yellow Warbler, Wilson's Warbler, Fox Sparrow, Lincoln's Sparrow, and White-crowned Sparrow.

Distribution: MacGillivray's Warblers breed throughout western North America. In Colorado MacGillivray's Warblers are uncommon to fairly common summer residents in the foothills and lower mountains from 1800 to 3400 m (6,000–11,000 ft) in elevation. They are most numerous in the lower mountains. They winter from west and central Mexico to Central America.

Habitat Requirements: MacGillivray's Warblers nest in foothills and mountain shrubland and willow carrs. They also breed in moist aspen forests with shrubby understory, in shrubby forest openings, and in Gambel oak in moist ravines.

Ecology: These warblers arrive on their breeding grounds in early to late May. They lay eggs in early to late June, and most young leave the nest by late July. Fall migration begins in mid September. The diet consists exclusively of insects.

Management Issues and Conservation Recommendations: *Reduce or eliminate any activities that degrade the structure and quality of the overstory or understory of these riparian systems. Timber cutting should not be permitted within 30 m (100 ft) of the riparian area. Domestic livestock grazing should be tightly controlled or eliminated in these areas. Summer grazing should not be permitted. Recreational facilities such as roads, trails and campgrounds should be located up, out of riparian areas (Myers 1991).*

Status and Reasons for Concern: MacGillivray's Warblers are representative of many other species in the montane riparian habitat type because they occupy habitat typically used by other species. Data for BBS Physiographic Area 62 during 1966–1996 do not show a statistically significant annual rate of change ($P = 0.41$; $n = 27$ routes). This species was present on an average of 52.08% (SE = 3.91) of routes run in Physiographic Area 62 in Colorado, 1988–1997, at an average abundance of 2.43 (SE = 0.34) individuals per route. The mean number of routes runs each year was 21.1 (SE = 3.06). This species is monitored by *MCB* with point transects.

Biological Objective: Maintain or increase the species' distribution and abundance, based upon results of the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Kingery 1998, Pitocchelli 1995.

WILSON'S WARBLER (*Wilsonia pusilla*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Broad-tailed Hummingbird, MacGillivray's Warbler, Fox Sparrow, Song Sparrow, Lincoln's Sparrow, and White-crowned Sparrow.

Distribution: Wilson's Warblers breed throughout the Rocky Mountain West, and in a broad band across Canada and Alaska. In Colorado they are fairly common summer residents in

mountain parks and higher mountains from 3000 to 4000 m (10,000–13,000 ft) in elevation. Winter range includes northern Mexico south to Panama.

Habitat Requirements: These warblers nest in willow and alder thickets of stream banks, lake shores, and wet meadows. They may be the most common breeding birds in Colorado's montane and subalpine willow habitats (Andrews and Righter 1992).

Ecology: Wilson's Warblers arrive on breeding the breeding grounds in late May and lay eggs soon after. Most young leave their nests by mid July. Fall migration begins in mid August.

Management Issues and Conservation Recommendations: *Reduce or eliminate any activities that degrade the structure and quality of willow shrub riparian systems. Do not permit timber cutting within 30 m (100 ft) of the riparian area. Locate recreational facilities such as roads, trails, and campgrounds away from riparian areas (Myers 1991).*

Drawing down streams for agricultural, municipal, or other uses may degrade willow habitats. *Limit dewatering in areas where it could affect dense, extensive willow carrs.*

Livestock grazing may remove ground cover, alter willow structure, and facilitate Brown-headed Cowbird nest parasitism. *Tightly control or eliminate livestock grazing in high elevation riparian areas.*

Status and Reasons for Concern: Wilson's Warblers have a moderately high conservation need throughout their range, and they have high representation in the physiographic area. Data for BBS Physiographic Area 62 during 1966–1996 do not show a statistically significant annual rate of change ($P = 0.51$; $n = 22$ routes). Wilson's Warblers were present on an average of 51.20% (SE = 2.57) of BBS routes run in Physiographic Area 62 in Colorado, 1988–1997, at an average abundance of 4.31 (SE = 0.37) individuals per route. The mean number of routes run each year was 21.1 (SE = 3.06). This species is monitored by *MCB* with point transects.

Biological Objective: Maintain or increase Wilson's Warblers' distribution and abundance, with progress toward meeting this objective based upon results of BBS and *MCB* monitoring programs.

Selected References: Ammon 1995, Andrews and Righter 1992, Kingery 1998, Morrison 1981, Stewart 1973.

Lowland Riparian

Description and Ecology: Lowland riparian forests border streams as they flow out of the foothills onto the eastern plains, into the San Luis Valley, and into the valleys of the Western Slope. Narrowleaf and plains cottonwoods generally line these streams in eastern Colorado, interspersed with thickets of willows and other shrubs such as wild plums, hackberries, hawthorns, chokecherries, and box elder. The lowland riparian forests in the San Luis Valley and on the Western Slope generally consist of narrowleaf and Rio Grande cottonwoods with an understory of willows and other shrubs, including red-osier dogwood, buffaloberry, skunkbrush, and greasewood (Andrews and Righter 1992, Kingery 1998).

Various sources report that riparian forests comprise less than 3% of the total landscape, but up to 80% of the resident bird species use them for some part of their life cycle. Birds use this habitat for nesting, cover, resting, migration stopover areas, and migration corridors. This system has the richest avian species component of any of Colorado's habitats. The most frequently detected species in lowland riparian forests in Physiographic Area 62 include American Kestrel, Great Horned Owl, Mourning Dove, Northern Flicker, Western Wood-Pewee, Western Kingbird, Eastern Kingbird, House Wren, Black-billed Magpie, American Robin, Yellow Warbler, Blue Grosbeak, and Bullock's Oriole (Andrews and Righter 1992, Krueper 1995, Howe 1996, Kingery 1998).

Importance and Conservation Status: Lowland riparian systems provide dispersal corridors for woodland birds across otherwise treeless terrain. Well-defined, unique, and highly productive, riparian zones areas are sensitive to disturbance (Melton et al. 1984).

Riparian ecosystems are important for both humans and wildlife. During historic times, humans have used riparian zones intensively and have substantially altered much of this habitat to create highways, gravel mines, and residential, industrial, and recreational developments. Riparian zones are convenient locations for those activities. They are also productive areas for domestic livestock grazing. However, the impacts of domestic livestock are not as dominant as in high elevation riparian zones (Melton et al. 1984, Wozniak 1995).

Unlike the high elevation riparian habitat in Colorado, much of the lowland riparian ecosystem is in private ownership. Consequently it is much more susceptible to loss and degradation by urban and industrial development, mining, road and trail development, and recreational development.

Implementation Strategies:

Bird Monitoring

Goal: To monitor or track all breeding birds in the lowland riparian habitat and document distribution, population trends, and abundance in a statistically acceptable manner.

Objective: All species with AI > 2 will be monitored with count-based methods.

Strategy: Monitoring will be accomplished through the combined efforts of agencies with primary responsibility for managing this habitat.

Strategy: Monitoring will continue to rely on BBS data, with data from CBO's *Monitoring Colorado's Birds (MCB)* program incorporated as it becomes available.

Status: MCB implemented lowland riparian habitat transects in 1999 and ran a total of 25 transects; trend data should be available for most species within 5–12 years.

Objective: All species with AI # 2 will be tracked through count-based methods or their presence/absence noted in the state.

Strategy: CBO's MCB monitoring program will address this.

Status: MCB implemented lowland riparian habitat transects in 1999 and ran a total of 25 transects; trend data should be available for most species within 5–12 years.

Objective: All colonial-nesting species will be monitored or tracked with colony counts.

Strategy: MCB will census all known colonies of Double-crested Cormorant, Great Blue Heron, Black-crowned Night-Heron, and Snowy Egret.

Status: MCB demographic monitoring of colonial-nesters began in 1999.

Objective: Population demographic monitoring will be instituted for all species in lowland riparian habitats with PT of 4 or 5.

Strategy: CBO's MCB will address this objective.

Status: MCB demographic monitoring will begin in 2001.

Habitat Monitoring

Goal: To document the amount, condition, and ownership of lowland riparian habitat in Colorado.

Objective: Develop collaborative efforts to use GIS in mapping lowland riparian habitat, documenting amount, condition, and ownership.

Status: This effort has not been initiated to date. Potential collaborators include CDOW, CNHP, CBO, USGS, USFS, and TNC.

Habitat Core Areas

Goal: To conserve unique representatives and/or large, ecologically-functioning examples of lowland riparian habitat in Colorado used by birds during the breeding season, during migration, or during the winter.

Objective: Identify such areas, use agency- or organization-specific means of designating and conserving them, and work with the appropriate agency or organization to promote conservation activities.

Status: None have been identified to date.

Objective: Identify riparian core areas that are appropriate for designation as *Important Bird Areas (IBAs)*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with lowland riparian habitat were nominated in 1999, and the *IBA* committee will make final selections in 2000.

Objective: To maintain or increase the quantity and quality of lowland riparian habitat on private lands.

Strategy: Promote collaboration/cooperation between agencies, organizations, and individuals in conserving unique representatives/core areas with multiple ownership

Strategy: Encourage landowners to take advantage of funding opportunities for creating, restoring, and maintaining lowland riparian habitat on their properties. Suitable opportunities may include NRCS's WHIP and EQIP, USFWS's Partners for Wildlife program, and the *Conservation of Private Grazing Land* and *Voluntary Debt-for-Nature Contract* provisions of the 1996 Farm Bill.

Strategy: Encourage private owners of existing mature and late-successional cottonwood-riparian communities along Colorado's lowland river systems to adopt grazing systems and other management practices that maintain and enhance stand conditions and ecosystem integrity.

Strategy: Encourage private owners of Colorado's lowland riparian lands to replant native cottonwoods and willows along stream reaches that have become degraded.

Objective: To maintain or increase the quantity and quality of lowland riparian habitat on public lands.

Strategy: Integrate the BCP into management plans for public lands in the physiographic area.

Strategy: Encourage public managers of existing mature and late-successional cottonwood-riparian communities along Colorado's lowland river systems to adopt grazing systems and other management practices that maintain and enhance stand conditions and ecosystem integrity.

Strategy: Encourage public managers of Colorado's lowland riparian lands to replant native cottonwoods and willows along stream reaches that have become degraded.

Site-based Conservation

Goal: To conserve local breeding sites, wintering sites, and migration stopover sites that are important for the conservation of priority species of lowland riparian habitats.

Objective: Identify agency- or organization-specific means of designating and conserving key local sites. Work with appropriate agencies and organizations to designate such sites, and promote conservation activities.

Objective: Identify key local sites that are appropriate for designation as *IBAs*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with lowland riparian habitat were nominated in 1999, and the *IBA* committee will make final selections in 2000.

Management Practices

Goal: To promote management practices that benefit birds in lowland riparian habitat.

Objective: Produce Best Management Practices manual for lowland riparian habitat.

Status: Not yet implemented.

Objective: Identify key landowners and land managers and encourage them to incorporate BMPs into management plans for public and private lands.

Interstate/International Wintering Grounds

Goal: To conserve the wintering ground habitat used by Colorado's lowland riparian birds that migrate outside of the state.

Objective: Identify the wintering distribution and key habitat associations of priority species.

Objective: Track amount of available habitat on the wintering grounds.

Strategy: Utilize GIS (state GAP projects, Heritage Program, and/or CBO).

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to obtain data.

Objective: To protect wintering habitat for lowland riparian birds.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect wintering habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Migration Concerns

Goal: To protect migratory stopover habitat for lowland riparian birds.

Objective: Identify important migratory stopover areas for priority species that breed in Colorado, and key sites for priority species that breed elsewhere.

Objective: Track amount, condition, and ownership of key migratory stopover sites.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect migratory habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Outreach and Education

Goal: To provide information on lowland riparian habitat birds (conservation, habitat needs, natural history, etc.) to children, teachers, naturalists, landowners, natural resource professionals, and other interested parties.

Strategy: Make educational materials available at local nature centers and natural resource agency offices.

Strategy: Hold workshops and field programs for teachers.

Strategy: Hold workshops and field programs for natural resource professionals (CDOW, BLM, and USFS staff).

Strategy: Present information at Teacher Association meetings, conferences, other annual meetings.

Strategy: Submit manuscripts to popular magazines for children and adults.

Research Priorities

Goal: To identify and facilitate research that will aid in understanding and managing riparian habitats for Colorado's birds.

Objective: To identify the top ten research needs in lowland riparian habitat in Colorado.

Strategy: Update the list of research needs annually to reflect shifting conservation priorities and to remove research needs from the list as they are investigated.

Strategy: Solicit input from researchers and managers on research needs and accomplishments.

Status: The following research needs have been identified:

1. The impact of Brown-headed Cowbird nest parasitism on the reproductive success of riparian species.
2. The impact on Lewis's Woodpecker reproductive success of competition for nest cavities with European Starlings.
3. The influence of exotic plant species (especially Russian-olive and tamarisk) on habitat suitability during breeding, wintering, and migration periods.
4. The impact on habitat suitability during breeding, wintering, and migration periods of livestock grazing in lowland riparian habitat.

Objective: Facilitate investigations to answer these questions.

Strategy: Provide information about priority needs to universities, public and private research entities, identify funding sources, and promote collaboration between management and research agencies.

Priority Species Accounts: Two species are identified as high priority in lowland riparian habitat in Physiographic Area 62: Lewis's Woodpecker and Lazuli Bunting.

LEWIS'S WOODPECKER (*Melanerpes lewis*)

Associated Species: Other species that may use this habitat in a similar way and/or respond similarly to threats, management, and conservation activities include American Kestrel, Great Horned Owl, Northern Flicker, Western Kingbird, Eastern Kingbird, Yellow Warbler, and Bullock's Oriole.

Distribution: Lewis's Woodpeckers breed from central British Columbia and western Alberta south to northern Mexico, and as far east as eastern Wyoming. In Colorado, Lewis's Woodpeckers reside in the valleys, plains and foothills from 1100 to 2400 m (3,500–8,000 ft) in elevation. The Arkansas River watershed, the pinyon-juniper country of Las Animas and Huerfano counties, and the San Juan Basin hold the largest concentrations. Smaller numbers reside in west-central valleys and plateaus, the edge of the Front Range from Denver to Wyoming, and the Black Forest northeast of Colorado Springs. Many birds that nest at higher elevations and latitudes withdraw to lower elevations and latitudes during the winter.

Habitat Requirements: Lewis's Woodpeckers breed in riparian forests, agricultural areas and urban areas with scattered, mature cottonwoods, adjacent to areas of low vegetation, such as ungrazed or lightly grazed grasslands, mowed hayfields, or fallow fields.

Ecology: Lewis's Woodpeckers initiate nesting by late April, and most young leave the nest by the end of July. The diet during the warmer months is largely flying insects, caught on the wing. During colder months, the diet shifts to nuts, grains, and berries.

Management Issues and Conservation Recommendations: Lewis's Woodpeckers depend upon large trees and snags and are sensitive to disturbance at the nest. *Reduce or eliminate activities that degrade the structure and quality of the overstory or understory of riparian systems. Do not permit timber cutting within 30 m (100 ft) of the riparian area. Locate recreational facilities such as roads, trails and campgrounds up, out of riparian areas.*

European Starlings compete for limited nest cavities and limit breeding success of this species in some areas. *Research ways to reduce competition from these unprotected, introduced birds.*

Status and Reasons for Concern: Lewis's Woodpeckers are on the national Watch List, indicating a high conservation need throughout their range. They are classified as a Sensitive Species in U.S. Forest Service Region 2. This species is not adequately monitored by the BBS within Physiographic Area 62, and BBS data collected between 1969 and 1996 are too sparse to allow analysis of trend data ($n = 10$ routes). Lewis's Woodpeckers were present on an average of 4.60% (SE = 1.47) of routes run in Physiographic Area 62 in Colorado, 1988–1997, at an average abundance of 0.16 (SE = 0.06) individuals per route. The mean number of routes run each year was 21.1 (SE = 3.06). This species is monitored by *MCB* with tracking transects.

Biological Objective: Maintain or increase the species' distribution and abundance, based upon results of the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Kingery 1998, Tobalske 1997, Vierling 1997.

LAZULI BUNTING (*Passerina amoena*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Mourning Dove, Western Kingbird, Black-billed Magpie, House Wren, Yellow Warbler, and Bullock's Oriole.

Distribution: Lazuli Buntings nest in southwestern Canada and the western United States. In Colorado, they are common summer residents, mostly in the foothills and less frequently in the lowlands, from 1100 to 2900 m (3,500–9,500 ft) elevation. They winter along the west coast of Mexico.

Habitat Requirements: Favored habitats of Lazuli Buntings include Gambel oak, hillside shrublands, lowland and foothill riparian shrubland. In all habitats they require low shrubs.

Ecology: Lazuli Buntings begin to arrive in the breeding areas as early as late April. Nesting begins in May, and young leave the nest by August. They begin fall migration as early as August, with most birds out of the state by mid September.

Management Issues and Conservation Recommendations: Habitat loss/conversion is the most critical issue. Some populations are heavily parasitized by Brown-headed Cowbirds. *Reduce or eliminate any activities that degrade the structure and quality of the shrublands of these riparian systems. Do not permit brush removal within 30 m (100 ft) of the riparian area. Tightly control or eliminate domestic livestock grazing in these areas; do not permit summer grazing. Locate recreational facilities such as roads, trails, and campgrounds away from riparian areas (Myers 1991, Wozinak 1995).*

Status and Reasons for Concern: Lazuli Buntings are representative of many other species in the lowland riparian habitat type because they occupy habitat typically used by other species. BBS data for Physiographic Area 62 during 1966–1996 do not show a statistically significant annual rate of change ($P = 0.58$; $n = 16$ routes). Lazuli Buntings were present on an average of 23.16% (SE = 3.79) of the BBS routes run in Physiographic Area 62 in Colorado, 1988–1998, at an average abundance of 0.59 (SE = 0.09) individuals per route. The mean number of routes run each year was 21.1 (SE = 3.06). This species is monitored by *MCB* with point transects.

Biological Objective: Increase the species' distribution and abundance, based upon results of the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Greene et al. 1996, Kingery 1998.

Mixed Conifer

Description and Ecology: This forest type is found at elevations of 1700 to 3050 m (5,600–10,000 ft), where it is transitional between ponderosa pine and spruce-fir forests. At lower elevations, ponderosa pines are common, with Douglas-fir on north-facing slopes and in drainages. Mixed conifer gives way to spruce-fir at higher elevations. Aspen stands are an important component, and so pervasive as to be considered an integral part of the mixed conifer forest. Other tree species present include blue spruce, white fir, lodgepole pine, limber pine, and bristlecone pine. The stand- and landscape-level structure of mixed conifer forests is shaped by fire, blowdown, and insect infestations (western spruce budworm, Douglas-fir bark beetle, and Douglas-fir tussock moth).

Importance and Conservation Status: No bird species is restricted to this forest type. Species commonly found in mixed conifer include the Yellow-rumped Warbler, Western Tanager, Dark-eyed Junco, and Evening Grosbeak. Insect outbreaks are a regular feature of this forest type, and can provide a superabundant food source for insectivorous birds. In southwestern Colorado, the legacy of decades of forest fire suppression includes invasion by fire-intolerant white fir, which often forms stands with high densities of small trees.

Implementation Strategies:

Bird Monitoring

Goal: To monitor or track all breeding birds in mixed conifer habitat to document distribution, population trends, and abundance in a statistically acceptable manner.

Objective: All species with AI > 2 will be monitored with count-based methods.

Strategy: Monitoring will be accomplished through the combined efforts of agencies with primary responsibility for managing this habitat.

Strategy: Monitoring efforts will continue to rely on BBS data, with CBO's *Monitoring Colorado's Birds (MCB)* data incorporated as it becomes available.

Status: *MCB* implemented mixed conifer habitat transects in 1999 and ran a total of 25 transects; trend data should be available for most species within 5–12 years.

Objective: All species with AI # 2 will be tracked through count-based methods or their presence/absence noted in the state.

Strategy: The *MCB* monitoring program will address this.

Status: *MCB* was implemented in mixed conifer habitat in 1999.

Objective: All species with PT of 4 or 5 will be tracked with demographic monitoring.

Strategy: CBO's *MCB* monitoring program will address this.

Status: *MCB* demographic monitoring will begin in 2001.

Habitat Monitoring

Goal: To document the amount, condition, and ownership of mixed conifer habitat in Colorado.

Objective: Develop collaborative efforts to use GIS in mapping mixed conifer habitat, documenting amount, condition, and ownership.

Status: This effort has not been initiated to date. Potential collaborators include CDOW, CNHP, CBO, USGS, USFS, and TNC.

Habitat Core Areas

Goal: To conserve unique representatives and/or large, ecologically-functioning examples of mixed conifer habitat in Colorado used during the breeding season, during migration, and/or during the winter.

Objective: Identify such areas, use agency- or organization-specific means of designating and conserving them, and work with the appropriate agency or organization to promote conservation activities.

Status: Appropriate areas that have been identified include USFS Research Natural Areas, USFS Wilderness Areas, and Colorado Natural Areas Program sites.

Objective: Identify any of these areas that are appropriate for designation as *Important Bird Areas (IBAs)*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with mixed conifer habitat were nominated in 1999, and the *IBA* committee will make final selections in 2000.

Objective: To maintain or increase the quantity and quality of mixed conifer habitat on private lands.

Strategy: Encourage landowners to take advantage of funding opportunities and expertise for creating, restoring, and maintaining mixed conifer habitat on their properties.

Strategy: Integrate bird habitat conservation goals and objectives into Colorado State Forest Service materials for landowners.

Strategy: Promote collaboration/cooperation between agencies, organizations, and individuals in conserving unique representatives/core areas with multiple ownership.

Objective: To maintain or increase the quantity and quality of mixed conifer habitat on public lands.

Strategy: Integrate the BCP into management plans for public lands in the physiographic area.

Objective: To recreate the heterogeneous landscape mosaic of prehistory so that breeding birds are always offered a patchwork of forested parcels in a variety of structural stages and densities.

Strategy: Incorporate landscape-scale habitat management into management plans for public and private lands.

Strategy: Allow wildfires to burn and allow insect outbreaks to run their courses.

Site-based Conservation

Goal: To conserve local breeding sites, migratory stopover sites, and wintering sites that are important for the conservation of priority species of mixed conifer habitats.

Objective: Identify agency- or organization-specific means of designating and conserving key local sites. Work with appropriate agencies and organizations to designate such sites, and promote conservation activities.

Objective: Identify key local sites that are appropriate for designation as *IBAs*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with mixed conifer habitat were nominated in 1999, and the *IBA* committee will make final selections in 2000.

Management Practices

Goal: To promote management practices that benefit birds in mixed conifer habitats.

Objective: A Best Management Practices (BMP) manual will be produced and distributed.

Status: Not yet initiated.

Objective: Identify key landowners and land managers and encourage them to incorporate best management practices to conserve mixed conifer birds and their habitat.

Interstate/International Wintering Grounds

Goal: To conserve the wintering ground habitat used by birds of mixed conifer forests.

Objective: Track the amount of available habitat on the wintering grounds.

Strategy: Utilize GIS (state GAP projects, Heritage Program, and/or CBO).

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to obtain data.

Objective: Protect key tracts of wintering habitat.

Strategy: Identify the wintering distribution and key habitat associations of priority species.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect wintering habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Migration Concerns

Goal: To protect migratory stopover habitat of birds of mixed conifer forests as they migrate outside of the state.

Objective: Identify important migratory stopover areas for priority species that breed in Colorado, and key sites for priority species that breed elsewhere.

Objective: Track amount, condition, and ownership of key migratory stopover sites.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect migratory habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Outreach and Education

Goal: To provide information on mixed conifer birds (conservation, habitat needs, natural history, etc.) to children, teachers, naturalists, landowners, natural resource professionals, and other interested parties.

Strategy: Make educational materials available at local nature centers and natural resource agency offices.

Strategy: Hold workshops and field programs for teachers.

Strategy: Hold workshops and field programs for natural resource professionals (CDOW, BLM, and USFS staff).

Strategy: Present information at Teacher Association meetings, conferences, other annual meetings.

Strategy: Submit manuscripts to popular magazines for children and adults.

Research Priorities

Goal: To identify and facilitate research that will aid in understanding and managing mixed conifer habitats for Colorado's birds.

Objective: To identify the top ten research needs in mixed conifer habitat in Colorado.

Strategy: Update the list of research needs annually to reflect shifting conservation priorities and to remove research needs from the list as they are investigated.

Strategy: Solicit input from researchers and managers on research needs and accomplishments.

Status: The following research needs have been identified:

1. Determine the numerical and spatial distribution of disturbance-caused patches, by size and structural stages, across the pre-settlement landscape.
2. Identify management practices (prescribed burns, timber harvesting) that may be used to mimic the outcome of natural disturbances.

Strategy: Facilitate investigations to answer these questions by providing information about priority needs to universities, public and private research entities, identifying funding sources, and promoting collaboration between management and research agencies.

Priority Species Accounts: Two priority species inhabit mixed conifer habitat: Blue Grouse and Williamson's Sapsucker.

BLUE GROUSE (*Dendragapus obscurus*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include American Robin and Hermit Thrush.

Distribution: Blue Grouse reside year-round throughout the Southern and Northern Rocky Mountains, western Canada, Oregon, and Washington, and northern California.

Habitat Requirements: Blue Grouse inhabit upper elevation shrub habitats, including subalpine krummholz, and open forests with shrub understory, including mixed-conifer where aspen is present. Young broods appear to favor mesic areas with lush vegetation and high concentrations

of invertebrate prey. In winter they spend most of their time in conifer trees, especially Douglas-fir.

Ecology: Blue Grouse begin courtship activities in mid April and continue to late May. The peak of hatching in Colorado is mid June to early July. Young leave the nest within 24 hours after the last egg has hatched. Their diet consists of leaves, flowers, the berries of a wide variety of herbs and shrubs (including *Arctostaphylos uva-ursi*, *Vaccinium*, *Fragaria*, *Amelanchier*, *Ribes*, *Rubus*, *Rosa*), conifer needles (including Douglas-fir and lodgepole pine, primarily in winter), and invertebrates (principally ants, beetles, and grasshoppers).

Management Issues and Conservation Recommendations: In dense forests of the Pacific Northwest, logging often boosts local populations by creating open areas; similar results would not be expected in Colorado except where forests are very dense, given its generally more open forests. Logging could reduce thermal cover and food supply (conifer needles). Blue Grouse are hunted in Colorado; the numbers harvested have dropped steadily since 1979. The decline could result from fewer birds or from fewer hunters; a lack of research has hampered identifying the causes of the reported decline.

Status and Reasons for Concern: Blue Grouse are not adequately monitored by the BBS within Physiographic Area 62, and sample sizes are too small to permit analysis of trends. However, BBS data for 1966–1996 reveal a statistically significant, survey-wide annual rate of decline (-3.6%; $P = 0.02$; $n = 73$ routes). Blue Grouse were present on an average of 6.51% (SE = 1.71) of the BBS routes run in Physiographic Area 62 in Colorado during 1988–1997, at an average abundance of 0.07 (SE = 0.02) individuals per route. The mean number of routes run each year was 21.1 (SE = 3.06). This species is monitored by CDOW.

Biological Objective: Maintain or increase the species' distribution and abundance based on results of CDOW and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Kingery 1998, Schroeder 1984, Zwickel 1992.

WILLIAMSON'S SAPSUCKER (*Sphyrapicus thyroideus*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Red-naped Sapsucker, House Wren, and Western Bluebird.

Distribution: Williamson's Sapsuckers breed in forested regions throughout the western United States, except for the coastal areas and Southwest. In Physiographic Area 62, populations are concentrated along the eastern edge of the Rockies and in the San Juan Mountains in southwestern Colorado, with smaller numbers in appropriate habitat throughout the area. They winter from northern Arizona and northern New Mexico south into central Mexico.

Habitat Requirements: Williamson's Sapsuckers nest primarily in ponderosa pine and in aspen components of mixed-conifer. They often place nest cavities in aspen trees, and often choose nest trees in aspen stands adjacent to open ponderosa pine or mixed-conifer forest. Nest substrate preferences appear to be live aspen (with some decay) or aspen snags, followed by conifer snags.

Ecology: Birds generally arrive in Colorado in early to mid April, and nest cavity excavation begins within three weeks of the females' arrival and lasts 3–4 weeks. They lay eggs in May to early June, and young leave the nest about mid July. Birds leave for wintering grounds in September to mid October. They feed on conifer sap and phloem during the pre-nesting phase, and shift to invertebrates (principally ants, but also beetles, flies, and aphids) after the young have hatched.

Management Issues and Conservation Recommendations: These sapsuckers require large-diameter trees for nesting: in Colorado, mean dbh of ponderosa pine nest trees was 50.8 cm (20 in; Crockett and Hadow 1975). They apparently tolerate some timber harvesting activities, provided aspens and snags are retained for nesting substrate, especially if clusters of large snags are preserved. Fire can create snags for nesting. *Large snags created by fire should be retained rather than "salvaged."* Retain at least 6 snags per 40 ha (100 ac), each at least 46 cm (18 in) dbh if ponderosa pine or 30 cm (12 in) dbh if aspen or other conifer species (Crockett and Hadow 1975, Raphael and White 1984).

Status and Reasons for Concern: Williamson's Sapsuckers have a high conservation need locally and throughout their range. Also, a high proportion (17.6%) of this species' total population occurs within this physiographic area, indicating that this area has high responsibility for the conservation of this species. Williamson's Sapsuckers are not adequately monitored by the BBS within Physiographic Area 62, and data collected between 1969 and 1996 are too sparse to allow analysis of trends ($n = 13$ routes). Williamson's Sapsuckers were present on an average of 23.22% (SE = 4.39) of the BBS routes run in Physiographic Area 62 in Colorado during 1988–1997, at an average abundance of 0.46 (SE = 0.13) individuals per route. The mean number of routes run each year was 21.1 (SE = 3.06). This species is monitored by *MCB* with point transects.

Biological Objective: Maintain or increase the species' distribution and abundance, with progress toward meeting this objective based upon results of the BBS, *MCB*, or other monitoring programs.

Selected References: Andrews and Righter 1992, Crockett and Hadow 1975, Dobbs et al. 1997, Kingery 1998, Sousa 1983.

Mountain Shrubland

Description and Ecology: Mountain shrubland is one of the several manifestations ecologists identify for the Transition Zone between semi-arid pinyon-juniper woodlands and the subalpine forest above. Mountain shrubland consists primarily of Gambel oak and other associated shrubs, including serviceberry, mountain mahogany, chokecherry, antelope bitterbrush, and snowberry.

Gambel oak is a large shrub or small tree and is probably the best known of the mountain shrubs in Colorado. Gambel oak is widely distributed throughout the Southern and Central Rocky Mountains. It occupies about 3.76 million ha (9.3 million ac) of land in Colorado. Gambel oak has been described as a climax indicator in a number of habitat types. It reproduces by suckering, and very large areas—whole mountainsides—can be populated by clones. Gambel oak is extremely fire tolerant, vigorously re-sprouting from stem bases or from underground tubers and rhizomes following fire. It can recover to original heights from a fire in 30 to 40 years. A healthy stand of Gambel oak contains shrubs of varying heights and has robust native bunchgrasses and forbs growing between them and relatively little bare ground.

Serviceberry is a large mountain shrub that increases in abundance in Colorado from south to north. Mottes of this species make extremely dense cover. Mountain mahogany has a structure similar to that of serviceberry, but in Colorado it does not create thickets as dense as serviceberry. It grows with and adjacent to oak and serviceberry, but on drier sites. Chokecherry is a large shrub common to mountain shrublands, but it rarely dominates large areas. Snowberry and antelope bitterbrush are lower stature species that often grow intermixed with sagebrush and Gambel oak. They are about the same height as sagebrush. Other shrubs occurring in mountain shrubland communities (e.g., Squaw apple, curl-leaf mountain mahogany, buckbrush, and mountain spray) do not become widespread dominants. Three species of Neotropical migrants—Dusky Flycatcher, Virginia's Warbler, and Green-tailed Towhee—are associated with Gambel oak and other shrub habitat.

Importance and Conservation Status: Mountain shrubland habitat provides valuable food and cover for many wildlife species. Many shrub species produce edible fruits, and they provide a large selection of forage types. Often the soil moisture is enough for shrubs to grow densely, particularly on elk winter ranges.

Gambel oak acorns are an important mast crop in many areas. Birds such as Band-tailed Pigeon, Wild Turkey, Lewis's Woodpecker, Steller's Jay, Western Scrub-Jay, and Green-tailed Towhee feed on the acorns. Other birds such as the Virginia's Warbler utilize mountain shrub habitat for resting, feeding, and nesting. At least 24 species of birds use Gambel oak habitat.

In Colorado, bird populations in mountain shrubland habitat are probably meeting their requirements fairly well at this time, and impacts do not seem very serious. For Gambel oak this status could change if firewood harvesting resumes importance or if chip plants discover the fiber

resource in Gambel oak. There is also a growing perception that something must be done to increase the western mule deer population. Vegetation conversion projects in mountain shrublands are being proposed and funds to implement them are being raised. Many acres of bird habitat could be changed. In localized areas in Colorado, mountain shrubland habitat is being altered, sometimes severely. These local alterations' cumulative impact can be detrimental to birds over the long-term.

Implementation Strategies:

Bird Monitoring

Goal: To monitor or track all breeding birds in mountain shrubland habitat and document distribution, population trends, and abundance in a statistically acceptable manner.

Objective: All species with AI > 2 will be monitored with count-based methods.

Strategy: Monitoring will be accomplished through the combined efforts of agencies with primary responsibility for managing this habitat.

Strategy: Monitoring efforts will continue to rely on BBS data, with CBO's *Monitoring Colorado's Birds (MCB)* data incorporated as it becomes available.

Status: *MCB* implemented mountain shrubland habitat transects in 1999 and ran a total of 22 transects. Thirty transects will be run in 2000; trend data will be available for most species within 5–12 years.

Objective: Species with AI # 2 will be tracked through count-based methods or their presence/absence in the state will be noted.

Strategy: The *MCB* monitoring program will address this.

Status: *MCB* was implemented in mountain shrubland habitat in 1999.

Objective: All species with PT of 4 or 5 will be tracked with demographic monitoring.

Strategy: CBO's *MCB* monitoring program will address this.

Status: *MCB* demographic monitoring will begin in 2001.

Habitat Monitoring

Goal: To document the amount, condition, and ownership of mountain shrubland habitat in Colorado.

Objective: Develop collaborative efforts to use GIS in mapping mountain shrubland habitat, documenting amount, condition, and ownership.

Status: This effort has not been initiated to date. Potential collaborators include CDOW, CNHP, CBO, USGS, BLM, and TNC.

Habitat Core Areas

Goal: To conserve unique representatives and/or large, ecologically-functioning examples of mountain shrubland habitat in Colorado used during the breeding season, during migration, and/or during the winter.

Objective: Identify such areas, use agency- or organization-specific means of designating and conserving them, and work with the appropriate agency or organization to promote conservation activities.

Status: Appropriate areas that have been identified include USFS Research Natural Areas, USFS or BLM Wilderness Areas, and Colorado Natural Areas Program sites.

Objective: Identify any of these areas that are appropriate for designation as *Important Bird Areas (IBAs)*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with mountain shrubland habitat were nominated in 1999, and the *IBA* committee will make final selections in 2000.

Objective: To maintain or increase the quantity and quality of mountain shrubland habitat on private lands.

Strategy: Encourage landowners to take advantage of funding opportunities for creating/restoring/maintaining mountain shrubland habitat on their properties.

Strategy: Promote collaboration/cooperation between agencies, organizations, and individuals in conserving unique representatives/core areas with multiple ownership.

Objective: To maintain or increase the quantity and quality of mountain shrubland habitat on public lands.

Strategy: Integrate the BCP into management plans for public lands in the physiographic area.

Site-based Conservation

Goal: To conserve local breeding sites, migratory stopover sites, and wintering sites in mountain shrublands that are important for the conservation of priority species.

Objective: Identify agency- or organization-specific means of designating and conserving key local sites. Work with appropriate agencies and organizations to designate such sites, and promote conservation activities.

Objective: Identify key local sites that are appropriate for designation as *IBAs*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with mountain shrubland habitat were nominated in 1999, and the *IBA* committee will make final selections in 2000.

Management Practices

Goal: To promote management practices that benefit birds in mountain shrubland habitats.

Objective: A Best Management Practices (BMP) manual will be produced and distributed.

Status: Not yet initiated.

Objective: Identify key landowners and land managers and encourage them to incorporate best management practices to conserve mountain shrubland birds and their habitat.

Strategy: Each land manager will be asked to monitor the quantity and quality of mountain shrubland habitat. These land managers include USFS, BLM, and NPS.

Objective: Reestablish fire to recreate a heterogeneous landscape mosaic. Fire has to be carefully implemented so that it will not establish large areas of the same age and structure but leave healthy mosaic patterns of various aged stands. Fires should not remove all shrubs but leave pockets of unburned shrubs. Concerns about cheatgrass and other exotic plants invading this habitat have to be addressed. Land managers should strive for a no net loss of mountain shrubland. There is nothing wrong with burning this habitat type as long as it is not lost—it has just become part of the natural mosaic of habitats within the landscape.

Objective: Remove some mountain shrubland habitat from livestock grazing or reduce livestock grazing to improve the habitat and to recreate a heterogeneous landscape mosaic.

Strategy: Encourage managers of public lands to set aside pastures for permanent or long-term rest (at least 25–50 years).

Objective: Increase the conservation value of mountain shrubland habitat.

Strategy: Work with land managers to encourage planting of native species that include appropriate native shrubs when revegetating disturbed habitat. The tendency is to revegetate with only grasses and forbs leaving out the landscape structure (i.e., shrubs) important to nesting birds.

Interstate/International Wintering Grounds

Goal: To conserve the wintering ground habitat used by birds of mountain shrubland.

Objective: Document amount, condition, and ownership of available habitat on the wintering grounds.

Strategy: Utilize GIS (state GAP projects, Heritage Program, and/or CBO).

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to obtain data.

Objective: Conserve wintering habitat used by the Green-tailed Towhee and Virginia's Warbler. This includes dense scrub habitat in northern Mexico and the Baja Peninsula for the Green-tailed Towhee and dense scrub of Mexico's semi-arid west-central highlands for the Virginia's Warbler. Track amount of available habitat on the wintering grounds to determine if habitat is shrinking, remaining stable or increasing

Objective: Develop collaborative efforts with other states and countries on projects (e.g., education, research, fund-raising, donations, etc.) which benefit the Green-tailed Towhee and Virginia's Warbler on their winter habitat.

Migration Concerns

Goal: To protect migratory stopover habitat of priority birds of mountain shrublands as they migrate outside of the state.

Objective: Identify important migratory stopover areas for priority species that breed in Colorado, and key sites for priority species that breed elsewhere.

Objective: Track amount, condition, and ownership of key migratory stopover sites.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect migratory habitat of Green-tailed Towhee and Virginia's Warbler.

Outreach and Education

Goal: To provide information on mountain shrubland priority species (conservation, habitat needs, natural history, etc.) to children, teachers, naturalists, landowners, natural resource professionals, and other interested parties.

Strategy: Make educational materials available at local nature centers and natural resource agency offices.

Strategy: Hold workshops and field programs for teachers.

Strategy: Hold workshops and field programs for natural resource professionals (CDOW, BLM, and USFS staff).

Strategy: Develop materials for county commissioners and local planning boards.

Strategy: Present information at Teacher Association meetings, conferences, other annual meetings.

Strategy: Submit manuscripts to popular magazines for children and adults.

Research Priorities

Goal: To identify and facilitate research that will aid in understanding and managing mountain shrubland habitats for Colorado's birds.

Objective: To identify the top ten research needs in mountain shrubland habitat in Colorado.

Strategy: Update the list of research needs annually to reflect shifting conservation priorities and to remove research needs from the list as they are investigated.

Strategy: Solicit input from researchers and managers on research needs and accomplishments.

Status: The following research needs have been identified:

1. Determine the relationships of precipitation, habitat condition, and population distributions at the landscape level.
2. Determine the effects of prescribed burning in mountain shrubland habitats on bird populations, with an emphasis on Green-tailed Towhees and Virginia's Warblers.
3. Determine the effects on bird populations of different grazing regimes.
4. Identify key migratory stopover and wintering areas and habitats.
5. Conduct demographic studies for Virginia's Warbler and Green-tailed Towhee.
6. Determine minimum shrub canopy cover (threshold level) needed to support viable populations of Virginia's Warbler and Green-tailed Towhee.
7. Identify areas of concern in the state where impacts from humans have a negative impact on these two species.
8. Identify principal wintering areas for Virginia's Warbler and Green-tailed Towhee in Mexico.

Strategy: Facilitate investigations to answer these questions by providing information about priority needs to universities, public and private research entities, identifying

funding sources, and promoting collaboration between management and research agencies.

Priority Species Accounts: Two species have been identified as being of high conservation priority in this habitat in Physiographic Area 62: Virginia's Warbler and Green-tailed Towhee.

VIRGINIA'S WARBLER (*Vermivora virginiae*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Common Poorwill, Broad-tailed Hummingbird, House Wren, Blue-gray Gnatcatcher, Green-tailed Towhee, Spotted Towhee, and Black-headed Grosbeak.

Distribution: Virginia's Warblers breed in the Four Corners states of Colorado, Utah, New Mexico, and Arizona, with extensions into Nevada and extreme eastern California. A few occupy the Guadalupe Mountains of western Texas. In Colorado, these warblers nest primarily between 1500 and 2700 m (5,000–9,000 ft) in elevation. They breed most abundantly in the western quarter of the state, along the eastern slope foothills, and in the Upper Arkansas River drainage. They winter in the dense scrub of Mexico's semi-arid west-central highlands.

Habitat Requirements: Virginia's Warblers nest in dense shrublands and on scrub-adorned slopes of mesas, foothills, open ravines, and mountain valleys in semiarid country. They use scrubby brush, pinyon-juniper woodland with a well-developed shrubby understory, ravines covered with scrub oak, and dense shrublands—especially Gambel oak. They also breed in open ponderosa pine savannahs that have a dense understory of tall shrubs.

Ecology: Virginia's Warblers begin to arrive in Colorado in late April. They lay eggs in late May, and hatch young in June. Young fledge in late June and early July. These warblers build their nests on the ground in dense vegetation usually beneath shrubs. The males usually use song posts such as the top of a shrub, scrub oak, and tree, but also sing while feeding in the middle of shrubs. Virginia's Warblers are entirely insectivorous, foraging for insects and spiders near the ground.

Management Issues and Conservation Recommendations: Mining, road construction, hiking trails, hiking trails in ravines and streamsides, fire, conversion of rural areas to urban subdivisions (ski resorts), and intentional alteration of habitat to enhance livestock grazing disturb nesting, resting, and foraging habitat for the Virginia's Warbler. *Survey areas for breeding Virginia's Warblers before considering altering mountain shrubland by herbicide treatment, mechanical alteration, or burning. Strive to produce landscape-scale mosaics of altered and unaltered habitat, and to prevent invasion of exotic plants such as cheatgrass or noxious weeds. Conduct prescribed burns in early spring before birds arrive, leaving adequate amounts of unburned shrubs to provide breeding habitat. Identify historic mountain shrub habitat. Identify areas where*

Virginia's Warbler habitat may be threatened due to urban or rural development. Research threshold levels below which Virginia's Warblers drop in significant breeding numbers to determine where the critical loss of shrub cover occurs. Rotate livestock grazing to provide rested pastures during the nesting season to give this warbler respite from cowbird parasitism.

Status and Reasons for Concern: Virginia's Warblers have a small breeding range, and in places their habitat has been severely altered. They are vulnerable to Brown-headed Cowbird parasitism and the rate of parasitism on Virginia's Warbler may be on the rise (Kingery 1998). Due to its small breeding range, Colorado has a moderate responsibility in protecting this species. BBS trend data indicate a slight decrease in Colorado but no indication of decline on the continent. Virginia's Warblers are on the national Partners in Flight 1998 Watch List, indicating a high conservation need throughout their range. Within Physiographic Area 62 in Colorado, BBS returns are too sparse for meaningful analysis; however, Virginia's Warblers were present on an average of 22.92 (SE = 1.47) of BBS routes, 1988–1997, at an average abundance of 1.21 (SE = 0.17) individuals per route. The mean number of routes run each year was 21.1 (SE = 3.06). This species is monitored by *MCB* with point transects.

Biological Objective: Maintain or increase the species' distribution and abundance, based upon results of the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992; Kingery 1998; Paige and Ritter 1999; Stholgren et al. 1995, 1997; Udvardy 1977.

GREEN-TAILED TOWHEE (*Pipilo chlorurus*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Dusky Flycatcher, House Wren, Sage Thrasher, Virginia's Warbler, and Spotted Towhee.

Distribution: Green-tailed Towhees breed in the montane and plateau interior of the western United States at an average elevation of 2200 m (7,300 ft). In Colorado, they breed from the eastern foothills through the western part of the state and are absent only in Intermountain parks. However, they are locally rare in higher mountain shrublands particularly where upland shrub density is lower or absent (Andrews and Righter 1992). Green-tailed Towhees winter from central Arizona, New Mexico, and Texas south into Mexico.

Habitat Requirements: Green-tailed Towhees breed in dry shrubby hillsides (Gambel oak, mountain mahogany, serviceberry, sagebrush, snowberry, chokecherry, and antelope bitterbrush), in sagebrush flats, and on slightly moister soils within hillside shrublands around rock outcrops where *Ribes* is found. They are also found in ponderosa pine savannah habitat with shrub understory. They also use hillsides in scattered aspen trees intermixed with shrubs. Additionally, these towhees reside on hillsides covered with pinyon and junipers, as well as in riparian

shrublands. They avoid dense forests except in openings and where conditions allow shrubs to form (Bent 1968). They are most often seen at altitudes between 1830 to 2750 m (about 6,000–9,000 ft).

Ecology: Green-tailed Towhees' nesting season extends from the first of May through mid August.

Management Issues and Conservation Recommendations: Conflicts related to the nesting, resting, and foraging of Green-tailed Towhees include mining, road construction, hiking trails, fire, conversion of rural areas to urban subdivisions (ski resorts), and intentional alteration of habitat to enhance livestock grazing. Large scale prescribed fires that eliminate the shrub component would be detrimental to this species. *Survey areas for breeding Green-tailed Towhees before considering altering mountain shrubland by herbicide treatment, mechanical alteration, or burning. Strive to produce landscape-scale mosaics of altered and unaltered habitat, and to prevent invasion of exotic plants such as cheatgrass or noxious weeds. Schedule prescribed burning in early spring before birds arrive and not during the bird's breeding and nesting season. Ensure that prescribed fires leave adequate amounts of unburned shrubs to provide breeding habitat.*

Identify historic habitat (e.g., agriculture zones, urban areas) that once was or may have been mountain shrub habitat. Identify areas of the state where Green-tailed Towhee habitat may be threatened due to urban or rural development. Research threshold levels below which Green-tailed Towhees drop in significant breeding numbers to determine where the critical loss of shrub cover occurs. Rotate livestock grazing to provide rested pastures during the nesting season to respite from cowbird parasitism.

Status and Reasons for Concern: Colorado contains between 20% and 40% of the entire breeding population of Green-tailed Towhees (Kingery 1998); therefore, Colorado has high responsibility for the conservation of this species. *Colorado Breeding Bird Atlas* abundance calculations rank this towhee as the thirteenth most numerous species in Colorado, with almost a million breeding pairs (Kingery 1998). Mountain shrubland habitat in Physiographic Area 62 is one of the most important breeding habitat types for Green-tailed Towhees. Despite high counts on BBS routes, the BBS data proved inadequate to provide accurate population trends for either Colorado or North America (Kingery 1998). Within Physiographic Area 62, Green-tailed Towhees were present on an average of 87.48 (SE = 2.56) of BBS routes, 1988–1997, at an average abundance of 12.20 (SE = 1.10) individuals per route. The mean number of routes run each year was 21.1 (SE = 3.06). This species is monitored by *MCB* with point transects.

Biological Objective: Maintain or increase Green-tailed Towhees' distribution and abundance, based upon results of the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Bent 1968, Dobbs et al. 1997, Kingery 1998, Paige and Ritter 1999, Udvardy 1977.

Ponderosa Pine

Description and Ecology: In Colorado, ponderosa pine is found at 1700 to 2700 m (5,600–9,000 ft). It is a very dry and warm forest, with less than 65 cm (25 in) of precipitation annually. Mature ponderosa pine forests on dry sites are open and park-like; mature trees achieve wide separation as they compete for limited soil moisture, and a luxuriant grassy ground cover is maintained by frequent low-intensity fires. On more mesic sites, ponderosa stands are denser, and closed-canopy stands are common. Ponderosa pines are the largest conifers in Colorado, with mature specimens reaching 120 cm (4 ft) dbh and 45 m (150 ft) tall. Gambel oak is a common component of the understory, typically in a shrubby form in central Colorado and reaching tree form in the southwest. Gambel oak is important for insectivorous birds, since it supports higher insect populations than other vegetation types in the region. Other common understory shrubs include mountain mahogany and wax currant. Tree species sometimes found mixed with ponderosa pine are junipers, pinyon pine, aspen, lodgepole pine, and Douglas-fir.

Ponderosa pine distribution at local and landscape scales is influenced by soil moisture and fire. Ponderosa forests are shaped primarily by fire, which affects species composition and forest structure. Ponderosa forests evolved with frequent, low-intensity fires that cleared understory vegetation and other tree species with lower fire tolerance, but left unharmed the large ponderosa pines with their thick bark (Moir et al. 1997). Heavy grazing in the 1800s and early 1900s reduced and made discontinuous the grass fuels that fed the low-intensity ground fires. As a result, fires have become far less frequent and shrubs and saplings have crowded the once open stands. Another natural disturbance agent shaping ponderosa pine forests is the mountain pine beetle, which kills many ponderosa pines.

Importance and Conservation Status: Birds typical of the ponderosa pine forest type include Wild Turkey, Pygmy Nuthatch, Western Bluebird, and Chipping Sparrow. More bird species are found in ponderosa pine forests than any other coniferous forest habitat in Physiographic Area 62. This abundant bird life reflects in part the prevalence of Gambel oak in many ponderosa stands. Oak adds structure, acorns, and prey—insect densities are higher in oak than in nearby conifers.

Their large size and low-elevation distribution make ponderosa pines popular for timber harvesting. They were the first timber species extensively harvested in the 1800s, when they were cut for railroad ties, mining timbers, firewood, and construction lumber. They remain a favored timber type for commercial logging and residential firewood collecting. Much of the old-growth ponderosa has been lost to logging, and the structure of many of the old-growth stands that remain have been compromised by dense growth of young trees. Many of the ponderosa pine snags have also been removed, removing a valuable resource for cavity-nesting bird species.

Implementation Strategies:

Bird Monitoring

Goal: To monitor or track all breeding birds in ponderosa pine habitat to document distribution, population trends, and abundance in a statistically acceptable manner.

Objective: All species with AI > 2 will be monitored with count-based methods.

Strategy: Monitoring will be accomplished through the combined efforts of agencies with primary responsibility for managing this habitat.

Strategy: Monitoring efforts will continue to rely on BBS data, with CBO's *Monitoring Colorado's Birds (MCB)* data incorporated as it becomes available.

Status: *MCB* implemented ponderosa pine habitat transects in 1998 and ran a total of 29 transects in 1999; trend data should be available for most species within 5–12 years.

Objective: All species with AI # 2 will be tracked through count-based methods or their presence/absence noted in the state.

Strategy: The *MCB* monitoring program will address this.

Status: *MCB* was implemented in ponderosa pine habitat in 1999.

Objective: All species with PT of 4 or 5 will be tracked with demographic monitoring.

Strategy: CBO's *MCB* monitoring program will address this.

Status: *MCB* demographic monitoring will begin in 2001.

Habitat Monitoring

Goal: To document the amount, condition, and ownership of ponderosa pine habitat in Colorado.

Objective: Develop collaborative efforts to use GIS in mapping ponderosa pine habitat, documenting amount, condition, and ownership.

Status: This effort has not been initiated to date. Potential collaborators include CDOW, CNHP, CBO, USGS, USFS, and TNC.

Habitat Core Areas

Goal: To conserve unique representatives and/or large, ecologically-functioning examples of ponderosa pine habitat in Colorado used during the breeding season, during migration, and/or during the winter.

Objective: Identify such areas, use agency- or organization-specific means of designating and conserving them, and work with the appropriate agency or organization to promote conservation activities.

Status: Appropriate areas that have been identified include USFS Research Natural Areas (Hurricane Canyon in El Paso County), USFS Wilderness Areas, Colorado Natural Areas Program sites (Rajadero Canyon Natural Area in Conejos County, Cottonwood Canyon State Park in Douglas County).

Objective: Identify any of these areas that are appropriate for designation as *Important Bird Areas (IBAs)*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with ponderosa pine habitat were nominated in 1999, and the *IBA* committee will make final selections in 2000.

Objective: To maintain or increase the quantity and quality of ponderosa pine habitat on private lands.

Strategy: Encourage landowners to take advantage of funding opportunities and expertise for creating, restoring, and maintaining ponderosa pine habitat on their properties.

Strategy: Integrate bird habitat conservation goals and objectives into Colorado State Forest Service materials for landowners.

Strategy: Promote collaboration/cooperation between agencies, organizations, and individuals in conserving unique representatives/core areas with multiple ownership.

Objective: To maintain or increase the quantity and quality of ponderosa pine habitat on public lands.

Strategy: Integrate the BCP into management plans for public lands in the physiographic area.

Objective: To recreate the heterogeneous landscape mosaic of prehistory so that breeding birds are always offered a patchwork of forested parcels in a variety of structural stages and densities.

Strategy: Incorporate landscape-scale habitat management into management plans for public and private lands.

Strategy: Allow wildfires to burn and allow insect outbreaks to run their courses.

Site-based Conservation

Goal: To conserve local breeding sites, migratory stopover sites, and wintering sites in ponderosa pine that are important for the conservation of priority species.

Objective: Identify agency- or organization-specific means of designating and conserving key local sites. Work with appropriate agencies and organizations to designate such sites, and promote conservation activities.

Objective: Identify key local sites that are appropriate for designation as *IBAs*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with ponderosa pine habitat were nominated in 1999, and the *IBA* committee will make final selections in 2000.

Management Practices

Goal: To promote management practices that benefit birds in ponderosa pine habitats.

Objective: A Best Management Practices (BMP) manual will be produced and distributed.

Status: Not yet initiated.

Objective: Identify key landowners and land managers and encourage them to incorporate best management practices to conserve ponderosa pine birds and their habitat.

Interstate/International Wintering Grounds

Goal: To conserve the wintering ground habitat used by birds of ponderosa pine forests.

Objective: Track the amount of habitat available on the wintering grounds.

Strategy: Utilize GIS (state GAP projects, Heritage Program, and/or CBO).

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to obtain data.

Objective: Protect key tracts of wintering habitat.

Strategy: Identify the wintering distribution and key habitat associations of priority species.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect wintering habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Migration Concerns

Goal: To protect migratory stopover habitat of birds of ponderosa pine forests as they migrate outside of the state.

Objective: Identify important migratory stopover areas for priority species that breed in Colorado, and key sites for priority species that breed elsewhere.

Objective: Track amount, condition, and ownership of key migratory stopover sites.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect migratory habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Outreach and Education

Goal: To provide information on ponderosa pine birds (conservation, habitat needs, natural history, etc.) to children, teachers, naturalists, landowners, natural resource professionals, and other interested parties.

Strategy: Make educational materials available at local nature centers and natural resource agency offices.

Strategy: Hold workshops and field programs for teachers.

Strategy: Hold workshops and field programs for natural resource professionals (CDOW, BLM, and USFS staff).

Strategy: Present information at Teacher Association meetings, conferences, other annual meetings.

Strategy: Submit manuscripts to popular magazines for children and adults.

Research Priorities

Goal: To identify and facilitate research that will aid in understanding and managing ponderosa pine habitats for Colorado's birds.

Objective: To identify the top ten research needs in ponderosa pine habitat in Colorado.

Strategy: Update the list of research needs annually to reflect shifting conservation priorities and to remove research needs from the list as they are investigated.

Strategy: Solicit input from researchers and managers on research needs and accomplishments.

Status: The following research needs have been identified:

1. The effects on bird populations of using thinning and burning to restore ponderosa pine forests to presettlement conditions.
2. The numerical and spatial distribution of disturbance-caused patches, by size and structural stages, across the pre-settlement landscape.
3. Management practices (prescribed burns, timber harvesting) that may be used to mimic the outcome of natural disturbances.

Strategy: Facilitate investigations to answer these questions by providing information about priority needs to universities, public and private research entities, identifying funding sources, and promoting collaboration between management and research agencies.

Priority Species Accounts: Ponderosa pine habitat in Physiographic Area 62 is represented by five priority species: Band-tailed Pigeon, Flammulated Owl, Mexican Spotted Owl, Lewis's Woodpecker, and Grace's Warbler.

BAND-TAILED PIGEON (*Columba fasciata*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Virginia's Warbler and Black-headed Grosbeak.

Distribution: Two separate populations exist: a coastal population along the West Coast from west-central British Columbia south to northern Baja California, and an interior population from southeastern Wyoming to north-central Utah south to west-central Mexico. In Physiographic Area 62, populations are concentrated along the eastern edge of the Rockies and in southwestern Colorado, with lower numbers throughout Physiographic Area 62 in appropriate habitat. Birds in this area are of the interior subspecies (*C. f. fasciata*).

Habitat Requirements: In Colorado, these birds breed primarily in ponderosa pine forests and Gambel oak shrublands, but also occasionally in pinyon pine, lodgepole pine, and spruce-fir forests.

Ecology: Birds arrive in the region as early as late March; by mid October, most have left for wintering areas in the southern U.S. south to Central America. The diet consists of Gambel oak acorns, pinyon nuts, seeds, and cultivated grains.

Management Issues and Conservation Recommendations: This is a game species in Colorado, although hunter activity and harvest are low. Detailed information on the preferred habitat of the birds inhabiting Colorado is lacking, hampering conservation efforts and precluding formulation of management recommendations as related to timber harvest and prescribed burns. Obvious needs of the species include good mast and fruit crops. *The most productive oak,*

serviceberry, and chokecherry stands should be identified and removed from big game and livestock range conversion projects. Retain large pines for nesting and roosting.

Status and Reasons for Concern: This species is on the national Watch List, indicating a high conservation need throughout its range. Band-tailed Pigeons are not adequately monitored by the BBS within Physiographic Area 62, and data collected between 1969 and 1996 are too sparse to allow analysis of trend data ($n = 5$ routes). However, BBS data from 1966 to 1996 reveal a statistically significant, survey-wide annual rate of decline (-2.7%; $P = 0.01$; $n = 191$ routes). Band-tailed Pigeons were present on an average of 6.27% (SE = 3.01) of the BBS routes run in Physiographic Area 62 in Colorado during 1989–1997, at an average abundance of 0.14 (SE = 0.06) individuals per route. The mean number of routes run each year was 21.1 (SE = 3.06). This species is monitored by CDOW.

Biological Objective: Maintain or increase the species' distribution and abundance, based on results of BBS, CDOW, or other monitoring programs.

Selected References: Andrews and Righter 1992, Braun 1994, Gutiérrez et al. 1975, Kingery 1998.

FLAMMULATED OWL (*Otus flammeolus*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Northern Flicker, Pygmy Nuthatch, and Western Bluebird.

Distribution: Flammulated Owls have a scattered, disjunct distribution from southern British Columbia south through the Rocky Mountains into western Mexico, and as far west as southern California. They are found in suitable habitat throughout Physiographic Area 62, with concentrations in the ponderosa pine belts along the Front Range, the Uncompahgre Plateau, and the San Juan Mountains.

Habitat Requirements: Flammulated Owls prefer old-growth or mature ponderosa pine, apparently due to the presence of large broken-top and lightning-damaged snags and trees for nesting cavities, large cavities excavated by Northern Flickers and other woodpeckers, open structure of trees and understory for foraging, and high prey availability. They will utilize other habitats with similar structure, such as open mixed-conifer and aspen forests. Key habitat features seem to be the presence of large trees and snags, scattered clusters of shrubs or saplings, clearings, and a high abundance of nocturnal arthropod prey. Territories are often on ridges or dry mid-slope areas.

Ecology: These birds arrive in Colorado in late April to early May and lay eggs in May and June; young hatch in June and early July, and most young fledge by the end of July. Most owls leave

Colorado by early October; the winter grounds are poorly known, but are believed to be southern Mexico into Central America. The diet consists of invertebrates, including moths, beetles, crickets, and grasshoppers.

Management Issues and Conservation Recommendations: Given the commercial value of the large trees favored by Flammulated Owls for nesting, roosting, and as hunting perches, the greatest threat to this species is the loss of habitat. *Preserve stands of mature and old-growth ponderosa pine forest within the species' range, in stands of at least 40 ha (100 ac); specifically, protect stands with large [46 cm (18 in) dbh] trees and snags. Efforts to restore ponderosa pine forests to pre-settlement conditions should be of great benefit.*

Status and Reasons for Concern: Flammulated Owls have a high conservation need locally and throughout their range. The U.S. Forest Service classifies this as a Sensitive Species in Region 2. Because of their nocturnal habits, neither the BBS nor any other long-term monitoring program adequately monitors these owls. These owls are present in all of their historical range, so no apparent changes in distribution have occurred. No information is available on changes in abundance. This species is monitored by *MCB* with nocturnal surveys.

Biological Objective: Maintain or increase the species' distribution and abundance based on results of *MCB* nocturnal surveys or other monitoring programs.

Selected References: Andrews and Righter 1992, Hayward and Verner 1994, Kingery 1998, McCallum 1994, Reynolds 1992, Reynolds and Linkhart 1987.

MEXICAN SPOTTED OWL (*Strix occidentalis lucida*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Flammulated Owl and Red-breasted Nuthatch.

Distribution: Mexican Spotted Owls inhabit local areas from southern Utah and southern Colorado south into central Mexico. Recent nesting in Colorado has been confirmed in only three areas: Mesa Verde, the Wet Mountains, and near Pikes Peak.

Habitat Requirements: Mexican Spotted Owls nest in steep canyons with dense stands of large ponderosa pine or pinyon-juniper with Douglas-fir, and in mature to old-growth mixed-conifer forest with high canopy closure and open understory. Favored stands generally are multi-storied, with snags and downed logs. They nest in tree cavities or on cliff ledges.

Ecology: Pair bonding probably occurs in February and March, and eggs are laid in March and April. Young birds fledge in June. Members of this subspecies are nonmigratory, although individuals sometimes move to lower elevations in winter. Their diet primarily consists of small- to

medium-sized mammals, especially woodrats and white-footed mice (*Peromyscus* spp.); they also take voles, rabbits, and some birds.

Management Issues and Conservation Recommendations: The primary threat is the loss of mature trees to timber harvesting, and stand-replacement fires, especially in steep canyons and riparian zones. Even-aged management in particular is detrimental as it not only eliminates habitat but eventually results in stands that lack the multi-storied structure the owls prefer. Prescribed burns outside of the breeding season can reduce the fuel load and lessen the potential for catastrophic fires. The Mexican Spotted Owl Recovery Team recommendations include protecting 240 ha (600 ac) of habitat around each nest (U.S. Fish and Wildlife Service 1995). *Management activities should follow recommendations in the recovery plan.*

Status and Reasons for Concern: This species has a high conservation need locally and throughout its range. The Mexican Spotted Owl is listed as a Threatened Species at both the federal and state (Colorado) levels. Because of its rarity and nocturnal habits, this species is not monitored by the BBS, and no data are available from any other long-term monitoring programs. The USFS and NPS monitor their known nest sites. This species is monitored by *MCB* with nocturnal surveys.

Biological Objective: Increase the species' distribution and abundance based on results of USFS surveys and *MCB* or other monitoring programs.

Selected References: Andrews and Righter 1992, Gutiérrez et al. 1995, Kingery 1998.

LEWIS'S WOODPECKER (*Melanerpes lewis*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Northern Flicker, Pygmy Nuthatch, House Wren, and Western Bluebird.

Distribution: Lewis's Woodpeckers breed from central British Columbia and western Alberta south to northern Mexico, and as far east as eastern Wyoming. In Colorado, Lewis's Woodpeckers reside in the valleys, plains and foothills from 1100 to 2400 m (3,500–8,000 ft) in elevation. The Arkansas River watershed, the pinyon-juniper country of Las Animas and Huerfano counties, and the San Juan Basin hold the largest concentrations. Smaller numbers reside in west-central valleys and plateaus, the edge of the Front Range from Denver to Wyoming, and the Black Forest northeast of Colorado Springs. Many birds that nest at higher elevations and latitudes withdraw to lower elevations and latitudes during the winter. In Physiographic Area 62 in Colorado, this species occupies low-elevation ponderosa pine forests, especially in riparian areas.

Habitat Requirements: Lewis's Woodpeckers breed in open ponderosa pine forests with large trees and snags and in burned forest with abundant snags. Compared to other woodpeckers, Lewis's Woodpeckers have weak bills and skulls and are largely incapable of excavating cavities in sound wood. Instead, they excavate their nesting and roosting cavities in soft wood, or rely on natural cavities or cavities excavated by other woodpeckers.

Ecology: These woodpeckers are residents in Colorado, although individuals may wander after the breeding season. They initiate nesting by late April, and most young leave the nest by the end of July. Their diet during the warmer months consists largely of flying insects, caught on the wing. During colder months, their diet shifts to nuts, grains, and berries.

Management Issues and Conservation Recommendations: Lewis's Woodpeckers depend on commercially-valuable large trees and snags and an open stand structure for aerial pursuit of insects. Fire suppression policies contribute to a closed stand structure. *Retain stands of mature and old-growth ponderosa pine forest, restored to presettlement conditions (open stand structure with clusters of large trees and a grassy understory).*

These woodpeckers are sensitive to human disturbance at the nest. *Restrict commercial and recreational timber cutting and recreation development (roads, trails, campgrounds) in areas with known Lewis's Woodpecker nest cavities.*

Status and Reasons for Concern: This species is on the national Watch List, indicating a high conservation need throughout its range. It is classified as a Sensitive Species in U.S. Forest Service Region 2. This species is not adequately monitored by the BBS within Physiographic Area 62, and BBS data collected between 1969 and 1996 are too sparse to allow analysis of trend data ($n = 10$ routes). Lewis's Woodpeckers were present on an average of 4.60% (SE = 1.47) of routes run in Physiographic Area 62 in Colorado, 1988–1997, at an average abundance of 0.16 (SE = 0.06) individuals per route. The mean number of routes run each year was 21.1 (SE = 3.06). This species is monitored by *MCB* with tracking transects.

Biological Objective: Maintain or increase the species' distribution and abundance, based upon results of the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Kingery 1998, Tobalske 1997, Vierling 1997.

GRACE'S WARBLER (*Dendroica graciae*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Flammulated Owl, Olive-sided Flycatcher, Violet-green Swallow, Pygmy Nuthatch, and Western Tanager.

Distribution: Grace's Warblers breed from southwest Colorado and southern Utah, south through central Arizona, western New Mexico, and into north-central Mexico. Wintering areas extend from northern Mexico to Central America.

Habitat Requirements: Grace's Warblers inhabit open ponderosa pine forests with pines 5 m (16 ft) tall, especially stands with a Gambel oak understory.

Ecology: Birds arrive in Colorado in early May and lay eggs in late May and early June; the young fledge by late June and early July. Nearly four decades after Webster (1961) declared this "one of the least known of North American parulids," little new information has been published about its ecology.

Management Issues and Conservation Recommendations: Threats to Grace's Warblers include the loss of mature ponderosa pines due to timber harvest, and the closing of ponderosa stands by dense young trees, a result of fire suppression. *Restore ponderosa pine forests to presettlement conditions of large trees, in clusters, with an open understory of grasses.*

Status and Reasons for Concern: Grace's Warblers have a high conservation need locally and throughout their range. They are not adequately monitored by the BBS within Physiographic Area 62, and sample sizes are too small to permit analysis of trends. Continent-wide results do not show a statistically significant annual rate of change ($P = 0.42$; $n = 32$) between 1966 and 1996, although the results for the same period in New Mexico approach statistical significance (-6.5% ; $P = 0.12$; $n = 14$ routes). This species is monitored by *MCB* with point transects.

Biological Objective: Maintain or increase the species' distribution and abundance based on results of the *MCB* or other monitoring programs.

Selected References: Andrews and Righter 1992, Kingery 1998, Webster 1961.

Sagebrush Shrubland

Description and Ecology: In Colorado, sagebrush is found at elevations of approximately 1200 to 3050 m (4,000–10,000 ft). On moist sites it may reach 3 m (10 ft) tall, but more typically it is under 1.5 m (5 ft). It exists in a variety of climatic conditions, including low-elevation semidesert habitats and moist, cool, mountainous areas. Sagebrush species common in Colorado include big sagebrush and mountain sagebrush. Plants found in association with sagebrush shrublands include rabbitbrush, bitterbrush, snowberry, mountain mahogany, pinyon pine, juniper, and aspen. Grasses, especially bunchgrasses, are common components of sagebrush shrublands, including wheatgrass species, Junegrass, Arizona fescue, and Idaho fescue.

Immense stands of sagebrush interspersed with small openings of native bunchgrasses formerly covered hundreds of thousands of hectares in the West (Vale 1975). Little is known about the natural disturbance regimes that shaped this ecosystem, although presettlement sagebrush shrublands probably experienced at least occasional wildfires. Given a slow recovery rate (sagebrush will not resprout after fire, but must come back from seed, a process that can take 15–30 years), these wildfires probably sculpted a landscape mosaic of sagebrush stands of varying age interspersed with grassy open areas, on the scale of tens to thousands of hectares.

Importance and Conservation Status: Sagebrush birds evolved in this mostly contiguous habitat, where openings were comparatively small. Consequently, some sagebrush-obligate bird species exhibit area sensitivity, i.e., they will not occupy otherwise suitable habitat patches unless the patches exceed some minimum size, which is often much larger than their home range. Much of this contiguous habitat has been fragmented by removing sagebrush shrubs, leaving small stands separated by large openings. Such fragmentation by anthropogenic causes is a recent phenomenon in terms of evolutionary history. In some other habitat types, higher rates of predation and nest parasitism have been documented in fragmented habitat than in more contiguous habitat, although this has not been studied extensively in sagebrush.

The primary use of sagebrush shrublands by humans has been for livestock grazing. Historically, large expanses of sagebrush have been cleared to increase forage and to allow a higher stocking rate of domestic animals or to support more grazing wildlife. Where little or no sagebrush has been removed, heavy grazing sometimes has led to the elimination of native perennial grasses, which have been replaced by exotic annual grasses, especially cheatgrass. In some cases, the herbaceous cover has been lost entirely and replaced by shrubs. This replacement in turn has prompted land managers to remove the shrub cover by plowing, burning, chaining, or herbicide treatment and then reseed the land for forage, often with exotic grass species.

Sagebrush shrublands that are converted entirely to another cover type have limited potential to revert to sagebrush. Factors such as increased frequency of fire, excessive distance to seed sources, loss of symbiotic mycorrhizal fungi, and competitive exclusion by other plants combine to maintain the new cover type.

Perhaps 30% of Colorado's sagebrush received some treatment between 1900 and 1974 (Braun et al. 1976), and the ecological integrity of sagebrush shrublands has been widely compromised by the invasion of exotic (e.g., cheatgrass) or native (e.g., pinyon-juniper) plant species; conversion to agricultural, residential, and other developed land types; and changes in natural fire regimes.

Implementation Strategies:

Bird Monitoring

Goal: To monitor or track all breeding birds in sagebrush habitat to document distribution, population trends, and abundance in a statistically acceptable manner.

Objective: All species with AI > 2 will be monitored with count-based methods.

Strategy: Monitoring will be accomplished through the combined efforts of agencies with primary responsibility for managing this habitat.

Strategy: Monitoring efforts will continue to rely on BBS data, with CBO's *Monitoring Colorado's Birds (MCB)* data incorporated as it becomes available.

Status: MCB implemented sagebrush habitat transects in 1999 and ran a total of 29 transects; trend data should be available for most species within 5–12 years.

Objective: All species with AI # 2 will be tracked through count-based methods or their presence/absence noted in the state.

Strategy: The MCB monitoring program will address this.

Status: MCB was implemented in sagebrush habitat in 1999.

Objective: All species with PT of 4 or 5 will be tracked with demographic monitoring.

Strategy: CBO's MCB monitoring program will address this.

Status: MCB demographic monitoring will begin in 2001.

Habitat Monitoring

Goal: To document the amount, condition, and ownership of sagebrush habitat in Colorado.

Objective: Develop collaborative efforts to use GIS in mapping sagebrush habitat, documenting amount, condition, and ownership.

Status: This effort has not been initiated to date. Potential collaborators include CDOW, CNHP, CBO, USGS, BLM, and TNC.

Habitat Core Areas

Goal: To conserve unique representatives and/or large, ecologically-functioning examples of sagebrush habitat in Colorado used during the breeding season, during migration, and/or during the winter.

Objective: Identify such areas, use agency- or organization-specific means of designating and conserving them, and work with the appropriate agency or organization to promote conservation activities.

Status: Appropriate areas include Colorado Natural Areas Program sites.

Objective: Identify any of these areas that are appropriate for designation as *Important Bird Areas (IBAs)*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: No sagebrush *IBAs* were nominated in 1999.

Objective: To maintain or increase the quantity and quality of sagebrush habitat on private lands.

Strategy: Encourage landowners to take advantage of funding opportunities and expertise for creating, restoring, and maintaining sagebrush habitat on their properties.

Strategy: Promote collaboration/cooperation between agencies, organizations, and individuals in conserving unique representatives/core areas with multiple ownership.

Strategy: Identify key landowners and encourage them to incorporate management guidelines from the *Birds in a Sagebrush Sea* (Paige and Ritter 1999) document into their management plans.

Objective: To maintain or increase the quantity and quality of sagebrush habitat on public lands.

Strategy: Integrate the BCP into management plans for public lands in the physiographic area.

Strategy: Identify key land managers and encourage them to incorporate management guidelines from the *Birds in a Sagebrush Sea* (Paige and Ritter 1999) document into management plans for public lands.

Objective: To recreate the heterogeneous landscape mosaic of prehistory so that breeding birds are always offered a patchwork of shrubland parcels in a variety of structural stages and densities.

Strategy: Incorporate landscape-scale habitat management into management plans for public and private lands.

Site-based Conservation

Goal: To conserve local breeding sites, migratory stopover sites, and wintering sites in sagebrush that are important for the conservation of priority species.

Objective: Identify agency- or organization-specific means of designating and conserving key local sites. Work with appropriate agencies and organizations to designate such sites, and promote conservation activities.

Objective: Identify key local sites that are appropriate for designation as *IBAs*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: No sagebrush *IBAs* were nominated in 1999.

Management Practices

Goal: To promote management practices that benefit birds in sagebrush habitats.

Objective: A Best Management Practices (BMP) manual will be produced and distributed.

Status: The PIF Western Working Group document *Birds in a Sagebrush Sea* (Paige and Ritter 1999) is available for distribution as a hard copy or as a downloadable PDF file at <http://www.partnersinflight.org>.

Objective: Identify key landowners and land managers and encourage them to incorporate management guidelines from the *Birds in a Sagebrush Sea* (Paige and Ritter 1999) document into management plans for public lands.

Interstate/International Wintering Grounds

Goal: To conserve the wintering ground habitat used by birds of sagebrush shrublands.

Objective: Track the amount of habitat available on the wintering grounds.

Strategy: Utilize GIS (state GAP projects, Heritage Program, and/or CBO).

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to obtain data.

Objective: Protect key tracts of wintering habitat.

Strategy: Identify the wintering distribution and key habitat associations of priority species.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect wintering habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Migration Concerns

Goal: To protect migratory stopover habitat of birds of sagebrush habitats as they migrate outside of the state.

Objective: Identify important migratory stopover areas for priority species that breed in Colorado, and key sites for priority species that breed elsewhere.

Objective: Track amount, condition, and ownership of key migratory stopover sites.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect migratory habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Outreach and Education

Goal: To provide information on sagebrush birds (conservation, habitat needs, natural history, etc.) to children, teachers, naturalists, landowners, natural resource professionals, and other interested parties.

Strategy: Make educational materials available at local nature centers and natural resource agency offices.

Strategy: Hold workshops and field programs for teachers.

Strategy: Hold workshops and field programs for natural resource professionals (CDOW, BLM, and USFS staff).

Strategy: Present information at Teacher Association meetings, conferences, other annual meetings.

Strategy: Submit manuscripts to popular magazines for children and adults.

Research Priorities

Goal: To identify and facilitate research that will aid in understanding and managing sagebrush habitats for Colorado's birds.

Objective: To identify the top ten research needs in sagebrush habitat in Colorado.

Strategy: Update the list of research needs annually to reflect shifting conservation priorities and to remove research needs from the list as they are investigated.

Strategy: Solicit input from researchers and managers on research needs and accomplishments.

Status: The following research needs have been identified:

1. The minimum patch sizes needed by area-sensitive sagebrush bird species, as measured by reproductive success.
2. How other habitat factors may affect area sensitivity (such as structural stage or adjacent land cover types).
3. The consequences of habitat fragmentation, such as possible increases in nest predation or cowbird parasitism rates.
4. The effects on sagebrush birds of different management prescriptions, including prescribed burns and different grazing regimes.

Strategy: Facilitate investigations to answer these questions by providing information about priority needs to universities, public and private research entities, identifying funding sources, and promoting collaboration between management and research agencies.

Priority Species Accounts: Three species have been identified as having high conservation need in sagebrush shrubland in Physiographic Area 62: Northern Sage Grouse, Brewer's Sparrow, and Sage Sparrow.

NORTHERN SAGE GROUSE (*Centrocercus urophasianus*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Brewer's Sparrow, Sage Thrasher, Vesper Sparrow, and Sage Sparrow.

Distribution: The largest populations of Northern Sage Grouse in Colorado inhabit Jackson, Moffat, Rio Blanco, and Routt counties with smaller populations (<500 birds) occurring in Larimer, Grand, Eagle, Garfield, and Mesa counties. Populations in Moffat, Routt, and Jackson counties are contiguous with populations in Utah and Wyoming.

Habitat Requirements: Northern Sage Grouse are sagebrush obligates, depending upon big sagebrush as a primary food and as habitat for nesting, brood rearing, and roosting. They prefer large expanses of big sagebrush on flat or gently rolling terrain, and utilize riparian meadows as brood and summer habitat. They prefer shrub canopy cover averaging between 10% and 20% in brood rearing areas and between 20% and 30% in adult loafing areas. They require the higher

percentages for winter habitat (Braun et al.1977). In northwestern Colorado these grouse most commonly reside between 2400 and 2900 m (7,900–9,500 ft) elevation.

Ecology: Males begin arriving on lekking areas (strutting grounds) in March; hen attendance on leks peaks and mating occurs in early to mid April. Strutting grounds may have 50–100 males, although only a few dominant males perform the majority of copulations. Hens disperse up to 30 km (19 mi) for nesting, although most nest within 5 km (3 mi) of the lek where they mated. Except for summer, when insects and forbs predominate the diet, Sage Grouse depend upon the leaves of sagebrush for food.

Management Issues and Conservation Recommendations: Sage Grouse have been extirpated from four states and are considered at risk in six additional states—including Colorado—and two Canadian provinces. Long term data indicate Sage Grouse populations have declined by 33% range-wide since the mid-1980s, and show a 31% decline in Colorado. The loss of sagebrush habitats through burning, herbicide applications, and conversion to cropland present the greatest threat to Sage Grouse. Additionally, excessive livestock grazing is believed to have detrimental effects upon Sage Grouse nesting and brood-rearing habitat. Better than average grass cover is associated with better than average nest success. Livestock loafing areas around ponds and salting areas coinciding with leks during the spring months may remove the lek from use by grouse. *Protect and manage existing sagebrush rangeland to improve nesting and brood-rearing habitats. These improvements are critical to reversing the trends in population and productivity. Restore summer range conditions, and restore relatively undisturbed wet meadows and forbs in the upland plant association.*

Status and Reasons for Concern: This species has a high conservation need locally and throughout its range. Although this species is not monitored by the BBS, data from state wildlife agencies have documented severe population declines and loss of sagebrush habitats range-wide. The BLM lists Sage Grouse as a Sensitive Species. This species is not on the national Watch List, but it would qualify based on its National Partners in Flight Database scores. This species is monitored by CDOW.

Biological Objective: Maintain or increase the distribution of this species and increase size and productivity of all breeding populations, based on CDOW surveys.

Selected References: Andrews and Righter 1992, Braun 1995, Braun et al. 1977, Connelly and Braun 1997, Kingery 1998.

BREWER'S SPARROW (*Spizella breweri*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Sage Grouse, Sage Thrasher, Green-tailed Towhee, and Sage Sparrow.

Distribution: The distribution of Brewer's Sparrows generally coincides with the distribution of sagebrush in the West, from east central British Columbia, southeast to southwestern Saskatchewan, then south to southern California and east to central New Mexico. A disjunct population in the Yukon Territory and northwestern British Columbia may be a separate species. In Colorado in Physiographic Area 62, Brewer's Sparrows are concentrated in mountain parks in the north (especially North Park) with smaller concentration in the northeast, and the San Luis Valley.

Habitat Requirements: Brewer's Sparrows are tied closely to sagebrush, where it breeds in tall, dense stands or stands broken up by grassy openings. They also nest in other shrubs, such as willows, mountain mahogany, rabbitbrush, and snowberry. These sparrows prefer an abundance of shrub cover: within a given habitat patch, their probability of occurrence increases with increases in total shrub cover.

Ecology: These birds arrive in Colorado in mid to late April, and nesting begins by mid May. Most young fledge in June and July. Most birds have left the state by early October, en route to their wintering grounds in the southwestern states and Mexico. Their diet consists of insects, spiders, grass and forb seeds.

Management Issues and Conservation Recommendations: Brewer's Sparrows suffer habitat loss due to removal of sagebrush, usually for conversion to housing or to improve forage for livestock or wildlife. Treatment of large areas of sagebrush with herbicides causes individuals to abandon the treated area (Schroeder and Sturges 1975). Prescribed burns that remove no more than 50% of the sagebrush may result in a decline in local Brewer's Sparrow populations for 1–2 years, but populations should rebound after that (Petersen and Best 1987). These sparrows prefer large, contiguous sagebrush stands; the minimum acceptable stand size has not been determined but isolated stands of sagebrush smaller than 2 ha (5 ac) are not likely to be nesting habitat (Knick and Rotenberry 1995). *Maintain contiguous sagebrush stands of at least 12 ha (30 ac).*

Status and Reasons for Concern: This species is on the national Watch List, indicating a high conservation need throughout its range. Within Physiographic Area 62, BBS data do not show a statistically significant annual rate of change between 1966 and 1996 ($P = 0.28$; $n = 21$ routes). However, BBS data for the same period indicate a significant, survey-wide annual rate of decline (-3.7% ; $P < 0.01$; $n = 397$ routes). Brewer's Sparrows were present on an average of 27.55% (SE = 2.52) of the BBS routes run in Physiographic Area 62 in Colorado during 1988–1997, at an average abundance of 2.18 (SE = 0.41) individuals per route. The mean number of routes run each year was 21.1 (SE = 3.06). This species is monitored by *MCB* with point transects.

Biological Objective: Maintain or increase the species' distribution and abundance, based upon results of the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Kingery 1998, Rotenberry et al. 1999, Paige and Ritter 1999, Short 1984.

SAGE SPARROW (*Amphispiza belli*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Sage Grouse, Sage Thrasher, and Brewer's Sparrow.

Distribution: Sage Sparrows breed from western Wyoming west to central Washington, and as far south as north central New Mexico in the east and Baja California in the west; they are also found in the foothills of the Sierra Nevada Mountains of California. In Colorado, Moffat County has the greatest concentration of Sage Sparrows, with Mesa, Montrose, and Montezuma counties having smaller concentrations. Sage Sparrows have a very limited distribution in Colorado in Physiographic Area 62, occurring only uncommonly in the mountain parks. Their elevational range is narrower than that of the other sagebrush obligate species and lies at the low to middle elevations of sagebrush. These sparrows winter in the Southwest, Baja California, and northern Mexico.

Habitat Requirements: As its name suggests, this species breeds almost exclusively in sagebrush (especially big sagebrush), or sagebrush mixed with other shrubs. It prefers semi-open to dense stands of evenly-spaced to clumped, 0.5 to 2 m (1.5–6.5 ft) tall sagebrush (Knick and Rotenberry 1995). As ground feeders, they prefer only a modest amount of understory vegetation. Like the Brewer's Sparrow, this species requires large, contiguous sagebrush stands. Not all necessary habitat features have been identified, however, as this species is often absent from areas where the habitat otherwise appears suitable.

Ecology: Most individuals of this species arrive in Colorado by April, initiate nesting by May, and fledge young during June and July. Most birds leave the state by mid October. Their diet consists primarily of insects and spiders, but they also eat some grass and forb seeds and small fruits.

Management Issues and Conservation Recommendations: Sage Sparrows prefer large patches of sagebrush, and may need patches of continuous habitat of at least 130 ha (320 ac); however, at least one study has shown that this species will accept the loss of up to 50% of the shrubs to wildfire or prescribed fire, provided the landscape pattern is a mosaic of burned and unburned areas (Petersen and Best 1987).

Status and Reasons for Concern: This species is on the national Watch List, indicating a high conservation need throughout its range. Sage Sparrows are not adequately monitored by the BBS within Physiographic Area 62, and BBS data collected between 1969 and 1996 are too sparse to allow analysis of trend ($n = 6$ routes). This species is monitored by *MCB* with tracking transects.

Biological Objective: Maintain or increase the species' distribution and abundance, based upon results of the BBS and *MCB* programs.

Selected References: Andrews and Righter 1992, Kingery 1998, Martin and Carlson 1998.

Spruce-Fir

Description and Ecology: Spruce-fir forest in Physiographic Area 62 is present at 2750 to 3650 m (9,000–12,000 ft) in elevation. Engelmann spruce and subalpine fir are the dominant tree species. Engelmann spruce is found without subalpine fir at the lower elevations, but only on cool, sheltered sites. Lodgepole pine and aspen are often mixed in at lower and middle elevations, and limber pine and bristlecone pine are present at middle and higher elevations. At the highest elevations, where spruce-fir gives way to alpine tundra, the harsh climate restricts these trees to a small, contorted, often ground-hugging growth form known as “krummholz.” Most precipitation is in the form of snow, which remains on the ground well into spring. Because spruce-fir forests are cooler and wetter than other forests in Physiographic Area 62, fire is comparatively uncommon, with perhaps several hundred years passing between fires at a given location. As a result, these forests produce large trees, with mature specimens reaching 90 cm (3 ft) dbh and 35 m (120 ft) tall. Understory vegetation can vary from sparse to quite dense, perhaps the densest of the conifer forests in this region with the exception of dense Gambel oak under ponderosa pine. Blueberry, shrubby cinquefoil, and Colorado currant are common components. The primary disturbance agents are blowdown and insect infestations (Engelmann spruce beetle and western spruce budworm). When fires do occur, they are often stand-replacement fires, fed by the dense trees and understory, although moisture and other factors result in patchy dispersal across the landscape. Recovery from disturbance is slow due to the cold winters and a short, cool growing season.

Importance and Conservation Status: In comparison with spruce-fir forests of eastern North America, which generally support more insects and insectivorous birds, many of which are Neotropical migrants, spruce-fir forests in the Southern Rocky Mountains support fewer insects and insectivorous birds and fewer Neotropical migrants. Instead, the avian community in this area has a comparatively large number of seed-eating birds, a reflection of the abundant cone crops available here. Compared to eastern spruce forests, fewer birds of this region are of conservation concern. Birds commonly found in this forest type include the Gray Jay, Mountain Chickadee, Red-breasted Nuthatch, Ruby-Crowned Kinglet, Hermit Thrush, Pine Grosbeak, and Pine Siskin.

Spruce-fir forests are a valuable source of timber in Colorado; the resulting logging pressure along with slow regeneration may have negative consequences for avian communities.

Implementation Strategies:

Bird Monitoring

Goal: To monitor or track all breeding birds in spruce-fir habitat to document distribution, population trends, and abundance in a statistically acceptable manner.

Objective: All species with AI > 2 will be monitored with count-based methods.

Strategy: Monitoring will be accomplished through the combined efforts of agencies with primary responsibility for managing this habitat.

Strategy: Monitoring efforts will continue to rely on BBS data, with CBO's *Monitoring Colorado's Birds (MCB)* data incorporated as it becomes available.

Status: *MCB* implemented spruce-fir habitat transects in 1998 and ran a total of 23 transects in 1999; trend data should be available for most species within 5–12 years.

Objective: All species with AI # 2 will be tracked through count-based methods or their presence/absence noted in the state.

Strategy: The *MCB* monitoring program will address this.

Status: *MCB* was implemented in spruce-fir habitat in 1999.

Objective: All species with PT of 4 or 5 will be tracked with demographic monitoring.

Strategy: CBO's *MCB* monitoring program will address this.

Status: *MCB* demographic monitoring will begin in 2001.

Habitat Monitoring

Goal: To document the amount, condition, and ownership of spruce-fir habitat in Colorado.

Objective: Develop collaborative efforts to use GIS in mapping spruce-fir habitat, documenting amount, condition, and ownership.

Status: This effort has not been initiated to date. Potential collaborators include CDOW, CNHP, CBO, USGS, USFS, and TNC.

Habitat Core Areas

Goal: To conserve unique representatives and/or large, ecologically-functioning examples of spruce-fir habitat in Colorado used during the breeding season, during migration, and/or during the winter.

Objective: Identify such areas, use agency- or organization-specific means of designating and conserving them, and work with the appropriate agency or organization to promote conservation activities.

Status: Appropriate areas that have been identified include USFS Research Natural Areas (Gothic in Gunnison County, Saddle Mountain in Park County), USFS Wilderness Areas, and Colorado Natural Areas Program sites.

Objective: Identify any of these areas that are appropriate for designation as *Important Bird Areas (IBAs)*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with spruce-fir habitat were nominated in 1999, and the *IBA* committee will make final selections in 2000.

Objective: To maintain or increase the quantity and quality of spruce-fir habitat on private lands.

Strategy: Encourage landowners to take advantage of funding opportunities and expertise for creating, restoring, and maintaining spruce-fir habitat on their properties.

Strategy: Promote collaboration/cooperation between agencies, organizations, and individuals in conserving unique representatives/core areas with multiple ownership.

Objective: To maintain or increase the quantity and quality of spruce-fir habitat on public lands.

Strategy: Integrate the BCP into management plans for public lands in the physiographic area.

Objective: To recreate the heterogeneous landscape mosaic of prehistory so that breeding birds are always offered a patchwork of forested parcels in a variety of structural stages and densities.

Strategy: Incorporate landscape-scale habitat management into management plans for public and private lands.

Strategy: Allow wildfires to burn and allow insect outbreaks to run their courses.

Site-based Conservation

Goal: To conserve local breeding sites, migratory stopover sites, and wintering sites in spruce-fir that are important for the conservation of priority species.

Objective: Identify agency- or organization-specific means of designating and conserving key local sites. Work with appropriate agencies and organizations to designate such sites, and promote conservation activities.

Objective: Identify key local sites that are appropriate for designation as *IBAs*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with spruce-fir habitat were nominated in 1999, and the *IBA* committee will make final selections in 2000.

Management Practices

Goal: To promote management practices that benefit birds in spruce-fir habitats.

Objective: A Best Management Practices (BMP) manual will be produced and distributed.

Status: Not yet initiated.

Objective: Identify key landowners and land managers and encourage them to incorporate best management practices to conserve spruce-fir birds and their habitat.

Interstate/International Wintering Grounds

Goal: To conserve the wintering ground habitat used by birds of spruce-fir forests.

Objective: Track the amount of habitat available on the wintering grounds.

Strategy: Utilize GIS (state GAP projects, Heritage Program, and/or CBO).

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to obtain data.

Objective: Protect key tracts of wintering habitat.

Strategy: Identify the wintering distribution and key habitat associations of priority species.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect wintering habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Migration Concerns

Goal: To protect migratory stopover habitat of birds of spruce-fir forests as they migrate outside of the state.

Objective: Identify important migratory stopover areas for priority species that breed in Colorado, and key sites for priority species that breed elsewhere.

Objective: Track amount, condition, and ownership of key migratory stopover sites.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect migratory habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Outreach and Education

Goal: To provide information on spruce-fir birds (conservation, habitat needs, natural history, etc.) to children, teachers, naturalists, landowners, natural resource professionals, and other interested parties.

Strategy: Make educational materials available at local nature centers and natural resource agency offices.

Strategy: Hold workshops and field programs for teachers.

Strategy: Hold workshops and field programs for natural resource professionals (CDOW and USFS staff).

Strategy: Present information at Teacher Association meetings, conferences, other annual meetings.

Strategy: Submit manuscripts to popular magazines for children and adults.

Research Priorities

Goal: To identify and facilitate research that will aid in understanding and managing spruce-fir habitats for Colorado's birds.

Objective: To identify the top ten research needs in spruce-fir habitat in Colorado.

Strategy: Update the list of research needs annually to reflect shifting conservation priorities and to remove research needs from the list as they are investigated.

Strategy: Solicit input from researchers and managers on research needs and accomplishments.

Status: The following research needs have been identified:

1. The numerical and spatial distribution of disturbance-caused patches, by size and structural stages, across the pre-settlement landscape.
2. Management practices (prescribed burns, timber harvesting) that may be used to mimic the outcome of natural disturbances.

Strategy: Facilitate investigations to answer these questions by providing information about priority needs to universities, public and private research entities, identifying funding sources, and promoting collaboration between management and research agencies.

Priority Species Accounts: Three priority species are identified for spruce-fir habitat: Boreal Owl, Olive-sided Flycatcher, and Hammond's Flycatcher.

BOREAL OWL (*Aegolius funereus*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Hammond's Flycatcher, Golden-crowned Kinglet, and Ruby-crowned Kinglet.

Distribution: The continental distribution of Boreal Owls follows the distribution of the boreal forest—from central Alaska south and east in a broad band across Canada, into the northern regions of the Great Lakes states and the Northeast, and down through the Northern Rockies south into northwestern Wyoming. The population in the Southern Rockies may be disjunct, although more intensive studies may show connections between this population and that of the Northern Rockies. The birds are widespread in the spruce-fir habitat type in Physiographic Area 62.

Habitat Requirements: Boreal Owls primarily reside in mature and old-growth coniferous forests, especially spruce-fir (and occasionally lodgepole pine) in Physiographic Area 62. Structural characteristics of occupied territories vs. unoccupied sites include greater basal area, more large trees, and less understory vegetation. Multiple canopy layers are typical. The high canopy closure limits the development of low vegetation in summer and crusted snow in winter, allowing the owls year-round access to prey. The high-elevation distribution of spruce-fir forests also conveys a thermal advantage, as the owls apparently do not tolerate high temperatures. The nests are in natural or flicker-excavated cavities in large trees or snags; nest trees in an Idaho study averaged 64 cm (25 in) dbh (Hayward et al. 1993).

Ecology: Boreal Owls do not migrate, but they are nomadic in response to cyclic prey populations. Nesting is initiated as early as mid April and most young leave the nest by mid June. The diet consists of small mammals, especially red-backed voles.

Management Issues and Conservation Recommendations: The distribution and abundance of Boreal Owls is largely tied to nest cavity availability (they require large trees and snags for nesting) and prey populations. The principal prey species, the red-backed vole, prefers mature, mesic forests with high canopy closure and large downed woody material; it is absent from clearcut areas, but local populations appear largely unaffected by patch cuts (<1.2 ha; 3 ac) or selection cuts (Martell 1983). *Utilize uneven-aged management, patch cuts with long rotations (\$150 years), and other silvicultural practices that preserve these conditions.*

Status and Reasons for Concern: Boreal Owls require large areas of mature spruce-fir forest—home ranges in Colorado have been measured at about 1500 ha (3,700 ac) (Palmer 1986). By protecting habitat for Boreal Owls, managers will ensure habitat protection for other spruce-fir species. Boreal Owls are classified as a Sensitive Species in U.S. Forest Service Region 2. Due

to this species' nocturnal habits and early nesting season, no data from BBS or other long-term monitoring projects are available. Grande Mesa and Uncompahgre National Forests began an attempt to monitor this species with a nest box program in 1993. This species is monitored by *MCB* with nocturnal surveys.

Biological Objective: Maintain the current distribution of the Boreal Owl as determined by nocturnal surveys of the *MCB* monitoring program, the nest box project of Grande Mesa and Uncompahgre National Forests, and other monitoring programs.

Selected References: Andrews and Righter 1992, Hayward 1997, Hayward and Hayward 1993, Hayward and Verner 1994, Kingery 1998.

OLIVE-SIDED FLYCATCHER (*Contopus borealis*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Three-toed Woodpecker and Mountain Bluebird.

Distribution: Olive-sided Flycatchers' distribution follows the boreal forest, which describes a broad band from central Alaska south and east across Canada; the populations stretch south into southern California and through the Rockies into southern New Mexico. Olive-sided Flycatchers breed in suitable habitat throughout Physiographic Area 62. They winter in southern Mexico, Central and South America.

Habitat Requirements: Olive-sided Flycatchers reside in mature spruce-fir and mixed-conifer forests. They are closely associated with burned areas, where they take advantage of the open forest structure for aerial pursuit of insects. They hunt from snags or trees that extend above the canopy, often frequenting steep slopes where tall snags or live trees afford opportunities for unimpeded aerial sallying.

Ecology: Olive-sided Flycatchers arrive on the breeding grounds in Colorado in May. They initiate nesting by late May, and most young leave the nest by August. Most of these flycatchers leave the breeding grounds by early September. Their diet consists exclusively of flying insects, especially bees and flies.

Management Issues and Conservation Recommendations: Clearcuts may provide a forest structure similar to that of stand-replacement fires. However, the suitability of clearcuts as habitat for Olive-sided Flycatchers and other members of the post-fire avian guild has not been assessed. Fire suppression precludes creation of breeding habitat. *Allow stand-replacing fires to burn. Leave the tallest trees and snags when implementing salvage cuts after fires, insect outbreaks, or blow-downs; exclude some affected areas entirely from salvage cutting. In timber harvest prescriptions, include the creation of forest openings with tall trees or snags around the margins.*

Status and Reasons for Concern: Although this species is apparently secure in this physiographic area, it is declining in other parts of its range, indicating sensitivity to habitat change or other events. In light of natural resource agency fire suppression policies and the Olive-sided Flycatcher's association with post-fire habitats, the species could be expected to decline across its range. The Olive-sided Flycatcher is classified as a Sensitive Species in U.S. Forest Service Region 2. Within Physiographic Area 62, BBS data do not show a statistically significant annual rate of change between 1966 and 1996 ($P = 0.78$; $n = 35$ routes). However, BBS data for the same period reveal a significant, survey-wide annual rate of decline (-3.9% ; $P < 0.01$; $n = 683$ routes). Olive-sided Flycatchers were present on an average of 59.92% (SE = 2.35) of the BBS routes run in Physiographic Area 62 in Colorado during 1988–1997, at an average abundance of 2.74 (SE = 0.13) individuals per route. The mean number of routes run each year was 21.1 (SE = 3.06). This species is monitored by *MCB* with point transects.

Biological Objective: Maintain or increase the species' distribution and abundance, based upon results from the BBS and *MCB* monitoring programs.

Selected References: Altman 1997, Andrews and Righter 1992, Hutto 1995, Kingery 1998.

HAMMOND'S FLYCATCHER (*Empidonax hammondi*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Three-toed Woodpecker, Brown Creeper, Golden-crowned Kinglet, and Hermit Thrush.

Distribution: Hammond's Flycatchers breed from central Alaska south in the mountains to northern New Mexico and south-central California. They breed throughout the Southern Rocky Mountains in suitable habitat. Their wintering grounds extend from northern Mexico south into Central America.

Habitat Requirements: Hammond's Flycatchers breed in mature closed-canopy spruce-fir, mixed-conifer, and aspen forests with limited ground vegetation.

Ecology: Birds arrive in Colorado in late May, and lay eggs in early June. Most young leave the nest by early August. Most birds leave for the wintering grounds by the end of August. These flycatchers are strictly insectivorous, their diet consisting of beetles, caterpillars, butterflies, and moths.

Management Issues and Conservation Recommendations: Harvesting of mature forests has been shown to be detrimental to this species. *Maintain mature, closed-canopy coniferous forests in stands >10 ha (25 ac).*

Status and Reasons for Concern: Hammond's Flycatchers share habitat components with other bird species of mature spruce-fir forests, and thus serve as a suitable "umbrella" species for management actions. Within Physiographic Area 62, BBS data do not show a statistically significant annual rate of change between 1966 and 1996 ($P = 0.80$; $n = 18$ routes). Hammond's Flycatchers were present on an average of 33.16% (SE = 3.77) of the BBS routes run in Physiographic Area 62 in Colorado during 1988–1997, at an average abundance of 2.36 (SE = 0.41) individuals per route. The mean number of routes run each year was 21.1 (SE = 3.06). This species is monitored by *MCB* with point transects.

Biological Objective: Maintain or increase the species' abundance and distribution, based upon results of the BBS, *MCB*, or other monitoring programs.

Selected References: Andrews and Righter 1992, Beaver and Baldwin 1975, Kingery 1998, Sedgwick 1994.

Wetlands

Description and Ecology: The habitat category of wetlands encompasses a large variety of ecosystems of large and small proportions. The state of Colorado has numerous representatives of this variety: marshes, wet meadows, seeps, springs, rivers, lakes, ponds, swamps, fens, bogs, hanging gardens, and playas (Windell et al.1986, Benedict 1991). Many of Colorado's wetlands, including some that support priority species, are artificial. Such wetlands include irrigated meadows and man-made reservoirs, lakes and ponds with their associated marshes. Less than 3% of the surface area of Colorado originally occurred as wetlands (Dahl 1990). Approximately 40% to 60% (0.4–1.2 ha; 1–3 million ac) of the original wetlands area have been lost (Dahl 1990, Wilen 1995). Losses are greater proportionately in wetlands than in other habitat types in Colorado.

Wetlands in Colorado range in size from a few square meters (e.g., springs and splash pools) to large areas of wet meadows and riparian wet forests. They include wetlands along riparian corridors that may continue for many kilometers yet are quite narrow (discussion of riparian habitats will be found in the appropriate sections: lowland riparian or high elevation riparian habitats). What all wetlands have in common is water. The water occurs in sufficient quantities and in such patterns that the soils, geomorphology, and vegetation respond characteristically, forming repeated patterns on the landscape. The repeated patterns are categorized as types of wetlands.

All wetlands likely play a role in the lives of birds, at least as sources of water. But many wetland types are very small and unlikely to make a large contribution to Colorado's avifauna (although any wetlands may be important to local conservation). Wetlands that support high priority bird species include lakes, ponds, reservoirs, wet meadows, playas, and marshes. The remaining, smaller wetlands are perhaps best considered as patch types and important habitat components within a larger habitat matrix.

Importance and Conservation Status: Thirty-seven of Colorado's breeding bird species are dependent on wetlands. That means that 14% of the breeding species depend on less than 3% of the state's area. Many of the species are common and are presently of little current conservation concern (e.g., Red-winged Blackbird). However two species are in need of special conservation attention in Colorado: Willet and Short-eared Owl.

In the water-restricted western United States, water resources are necessary for life, and control of water can become a most lucrative asset. Water law in Colorado, as in most western states, recognizes water as one of a bundle of property rights. As such, water is owned, bought and sold, as property. For mining operations, agricultural irrigation, and drinking water for a growing population, water has been harnessed, moved, stored, slowed, and spread. Wetlands have often been considered impediments to efficient water use, slowing its downstream progress to areas of human use. Many wetlands have been drained and others heavily altered. Dahl (1990) estimated wetland losses in Colorado to be approximately 50%. More specific estimates for wetland losses

in the Southern Rocky Mountains are not available, and interpretations are very complicated because of the large number of created wetlands.

Wetland manipulations have resulted in the addition of many acres of wetlands in Colorado (Kingery 1998). For example, large irrigation canals have moved water from mountain rivers or streams into the prairie. Some of the water has escaped the confines of ditches and leaks into the surrounding landscape, creating artificial springs. Such seepages have created wet prairie, wet meadows, small standing waters, shrub thickets, and woody groves. Such areas are often rich with birds, and where trees and shrubs occur, the associated birds represent those found in riparian habitats. The largest changes in the wetlands of Colorado's prairies have come from the creation of water storage facilities, reservoirs and ponds (Kingery 1998). These reservoirs are often placed on top of existing wetlands and greatly expand the total wetlands acreage. (This does not imply good or bad since there may be a significant change in wetlands or habitat type with the creation of these wetlands. It is important to remember that different wetland types are not equivalent in biodiversity terms.)

The wetlands that support high priority bird species in Colorado have experienced many changes over the past 150 years. Shallow lakes and ponds that supported large populations of breeding waterfowl have declined in many areas and have been replaced by reservoirs with little vegetation. A common goal of water users—to provide the smallest surface area of water to limit evaporation losses—often creates wetlands habitats that are relatively sterile.

Since agricultural practices have created numerous marshes, the comparative extent of marshland habitat is difficult to assess. However, it is clear that native graminoid-dominated marshes have suffered extensive losses, especially when the condition of the landscape in which they occur is considered (J. Sanderson, personal communication). For example, a marsh which has adequate breeding habitat for Northern Harriers may lie in a landscape that is inadequate or ecologically dysfunctional.

The concept of no net loss of wetlands appears adequate for protecting wetlands associated birds in Colorado. However, the existing guidelines for wetland mitigation and their focus on jurisdictional wetlands rarely give adequate attention to bird communities or to high priority species without legal status. Cumulative changes of wetland types and loss of ecosystem-level biological attributes continue to reduce the amounts of wetlands habitats suitable for the more sensitive wetlands species. Recommendations for making wetlands mitigation more suitable for birds often do not adequately address concerns for the most sensitive species.

The wetland types that support most wetlands bird species in the Southern Rocky Mountains are playas, marshes, wet meadows, lakes, and ponds. The status of these wetlands communities is checkered: lakes, ponds, and seeps have increased, but springs, wet meadows, and playas have suffered notable losses. Marshes have probably declined somewhat, but mostly have shifted from native condition to altered and scattered patches.

Implementation Strategies:

Bird Monitoring

Goal: To monitor or track all breeding birds in wetlands habitat to document distribution, population trends, and abundance in a statistically acceptable manner.

Objective: All species with AI > 2 will be monitored with count-based methods.

Strategy: Monitoring will be accomplished through the combined efforts of agencies with primary responsibility for managing this habitat.

Strategy: Monitoring efforts will continue to rely on BBS data, with CBO's *Monitoring Colorado's Birds (MCB)* data incorporated as it becomes available.

Status: *MCB* implemented wetlands transects in 1999 and ran a total of nine transects; trend data should be available for most species within 5–12 years.

Objective: All species with AI # 2 will be tracked through count-based methods or their presence/absence noted in the state.

Strategy: The *MCB* monitoring program will address this.

Status: *MCB* was implemented in wetlands habitat in 1999.

Objective: All species with PT of 4 or 5 will be tracked with demographic monitoring.

Strategy: CBO's *MCB* monitoring program will address this.

Status: *MCB* demographic monitoring will begin in 2001.

Objective: Establish monitoring protocols that precisely monitor specific populations of Willets and Short-eared Owls.

Strategy: The *MCB* monitoring program will address this.

Status: Beginning in 1998, *MCB* has conducted a thorough annual census of all known Willet breeding sites in Colorado (several North Park sites and smaller populations on the Yampa River and at Fruitgrower's Reservoir). Short-eared Owl protocols are in the planning stage.

Habitat Monitoring

Goal: To document the amount, condition, and ownership of wetlands habitat in Colorado.

Objective: Develop collaborative efforts to use GIS in mapping wetlands habitat, documenting amount, condition, and ownership. (Mapping of important examples of wetlands is needed as a first step in a monitoring program. Subsequent monitoring of the areas should include size, ecological composition, and landscape context.)

Status: This effort has not been initiated to date. Potential collaborators include CDOW, CNHP, CBO, USGS, USFS, and TNC.

Strategy: Support the wetlands programs of the Colorado Natural Heritage Program and the Colorado Division of Wildlife and their initiatives to identify high priority wetlands that support native natural communities or high priority species.

Objective: Identify and protect the ecological processes that support specific wetlands and their associated bird communities. This is particularly important where wetlands are supported by groundwater.

Habitat Core Areas

Goal: To conserve unique representatives and/or large, ecologically-functioning examples of wetlands habitat in Colorado used during the breeding season and/or during migration.

Objective: Identify such areas, use agency- or organization-specific means of designating and conserving them, and work with the appropriate agency or organization to promote conservation activities.

Objective: Identify any of these areas that are appropriate for designation as *Important Bird Areas (IBAs)*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with wetlands habitat were nominated in 1999 (including Walden Reservoir), and the *IBA* committee will make final selections in 2000.

Objective: To maintain or increase the quantity and quality of wetlands habitat on private lands.

Strategy: Encourage landowners to take advantage of funding opportunities and expertise for creating, restoring, and maintaining wetlands habitat on their properties.

Strategy: Promote collaboration/cooperation between agencies, organizations, and individuals in conserving unique representatives/core areas with multiple ownership.

Objective: To maintain or increase the quantity and quality of wetlands habitat on public lands.

Strategy: Integrate the BCP into management plans for public lands in the physiographic area.

Site-based Conservation

Goal: To conserve local breeding sites, migratory stopover sites, and wintering sites in wetlands that are important for the conservation of priority species.

Objective: Identify agency- or organization-specific means of designating and conserving key local sites. Work with appropriate agencies and organizations to designate such sites, and promote conservation activities. Work with the State Wetlands Initiative to ensure that funded conservation projects support the goals of this plan.

Strategy: Work with waterfowl management interests to conserve regionally significant areas, insuring that non-game interests are maintained.

Strategy: Identify areas with high numbers of breeding priority bird and determine if they are appropriate as site-based conservation projects

Objective: Identify key local sites that are appropriate for designation as *IBAs*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with wetlands habitat were nominated in 1999, and the *IBA* committee will make final selections in 2000.

Management Practices

Goal: To promote management practices that benefit birds in wetlands habitats.

Objective: A Best Management Practices (BMP) manual specific to wetlands birds will be produced and distributed. (A more general wetlands BMP manual is available: Peale 1996.) The manual should include the following topics and recommendations:

1. Conservation activities in wetlands should enhance the current legal protection of wetland functions by emphasizing the protection of natural wetland structure, composition, and the ecological processes that support them and their bird residents. The current focus on protecting jurisdictional wetlands is insufficient to conserve many wetlands associated species, particularly the more sensitive bird species (Buhlmann et al. 1996).
2. Include bird conservationists in the process of planning and approving new reservoirs to produce more bird-friendly projects.
3. Develop grazing plans for wetlands that support wetlands bird conservation. Grazing is a natural, perhaps even essential, ecological process. However, large numbers of livestock (cattle) permitted to graze in wetlands during the breeding season may accidentally trample nests or young and significantly alter habitat.
4. Impose limits on free-ranging dogs.
5. Guidance on landscape context, particularly with respect to buffers against incompatible land uses (e.g., some urbanization).
6. Man-made wetlands (e.g., reservoirs surrounded by extensive marshes, return flows from ditches and canals, agricultural return flows, etc.) that provide habitat for birds, including high priority species, should be managed to protect the supported bird communities. This includes BMPs centered on water level management, recreation, maintenance.

Status: Not yet initiated.

Objective: Identify key landowners and land managers and encourage them to incorporate best management practices to conserve wetlands birds and their habitat.

Objective: Integrate wetlands bird BMPs into waterfowl management plans as appropriate, insuring conservation of the entire avian community.

Interstate/International Wintering Grounds

Goal: To conserve the wintering ground habitat used by birds of wetlands habitats.

Objective: Track the amount of habitat available on the wintering grounds.

Strategy: Utilize GIS (state GAP projects, Heritage Program, and/or CBO).

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to obtain data.

Objective: Protect key tracts of wintering habitat.

Strategy: Identify the wintering distribution and key habitat associations of priority species.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect wintering habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Migration Concerns

Goal: To protect migratory stopover habitat of birds of wetlands habitats as they migrate outside of the state.

Objective: Identify important migratory stopover areas for priority species that breed in Colorado, and key sites for priority species that breed elsewhere.

Objective: Track amount, condition, and ownership of key migratory stopover sites.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect migratory habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Outreach and Education

Goal: To provide information on wetlands birds (conservation, habitat needs, ecological processes, natural history, etc.) to children, teachers, naturalists, landowners, natural resource professionals, and other interested parties.

Strategy: Make educational materials available at local nature centers and natural resource agency offices.

Strategy: Hold workshops and field programs for teachers.

Strategy: Hold workshops and field programs for natural resource professionals (CDOW and USFS staff).

Strategy: Present information at Teacher Association meetings, conferences, other annual meetings.

Strategy: Submit manuscripts to popular magazines for children and adults.

Research Priorities

Goal: To identify and facilitate research that will aid in understanding and managing wetlands habitats for Colorado's birds.

Objective: To identify the top ten research needs in wetlands habitat in Colorado.

Strategy: Update the list of research needs annually to reflect shifting conservation priorities and to remove research needs from the list as they are investigated.

Strategy: Solicit input from researchers and managers on research needs and accomplishments.

Status: The following research needs have been identified:

1. The habitat requirements, including landscape context, of wetlands birds. This is particularly important where wetland area is small and surrounded by dissimilar vegetation types.
2. The actual locations of nesting habitat for Willets and Short-eared Owls.
3. The criteria for successful reserve design. Some examples exist relative to human disturbance (Klein et al. 1995), but little is known about the more comprehensive needs of wetland avian communities.

Strategy: Facilitate investigations to answer these questions by providing information about priority needs to universities, public and private research entities, identifying

funding sources, and promoting collaboration between management and research agencies.

Priority Species Accounts: Two species are identified as high priority birds for wetlands habitats in Physiographic Area 62: Willet and Short-eared Owl.

WILLET (*Catoptrophorus semipalmatus*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Wilson's Phalarope, American Avocet, Killdeer, and Savannah Sparrow.

Distribution: Willets nest only in North America. Nesting occurs in saltwater marshes of the Atlantic and Gulf coasts and in the Great Basin and prairies of the western U.S. and Canada. In Colorado, the species breeds primarily in North Park. A small number (1 or 2 pairs) recently began breeding at Fruitgrower's Reservoir in Delta County, and there is evidence of breeding at Antero Reservoir, and in Moffat and Alamosa counties (Kingery 1998).

Habitat Requirements: Willets nest near open water in marshes, wet meadows, and prairies with short, sparse vegetation. They forage largely in the shallow water of ponds and playas. Broods need taller, denser vegetation (>15 cm; 6 in) than that found at the nest site. Territory size is about 44 ha (110 ac), but nesting birds may be area-sensitive—in North Dakota, they are rarely found in small (<100-ha; 250-ac) wetland/grassland blocks (Ryan and Renken 1987). Preferred areas are those that provide a mosaic of these habitat types (wet meadows for nesting, shallow open water for foraging, taller vegetation for brood rearing) within an area large enough to contain at least one territory (i.e., \$40 ha; 100 ac).

Ecology: Colorado's Willets arrive on the breeding grounds in late April and May, lay eggs in late May, and hatch young by late June. The birds leave for their wintering grounds by September.

Management Issues and Conservation Recommendations: As with nearly all species of conservation concern, habitat loss is a consideration. *Preserve suitable habitat by protecting it from conversion to other land cover types (cropland, urbanization) or other development (roads, trails, recreational sites).*

Willetts are ground-nesters and therefore highly susceptible to predation. Where land management encourages proliferation of such species as foxes, coyotes, skunks, and raccoons, there is the possibility of increased mortality during nesting. In addition, since adults abandon the nests readily to distract potential predators, frequent human disturbance is likely to have significant impacts to breeding success. *Limit visitor access to known breeding habitat. Maintain trails and roads away from breeding habitat.*

Burning or grazing outside of the nesting season can create the short, sparse vegetation profile preferred by nesting Willets. However, livestock densities are likely to correlate with the possibility of nest trampling. *Limit stocking rates during nesting season in known Willet breeding areas.*

Waterfowl management can maintain or enhance the habitat for this species, such as protection of taller vegetation for nesting. However, management that maintains deep water with few beaches or shallow water areas can be detrimental. *Waterfowl management plans and activities should consider impacts on Willet habitat.*

Focus conservation efforts on the North Park population (unless additional breeding populations are discovered). Population increases may be possible by determining the direct causes of mortality during breeding (e.g., predation by enhanced populations of some carnivores).

Status and Reasons for Concern: This species is on the national Watch List, indicating a high conservation need throughout its range. Willets are not adequately monitored by the BBS within Physiographic Area 62, and data collected between 1966 and 1996 are too sparse for meaningful analysis. This species is monitored by *MCB* with a statewide census.

Biological Objective: Maintain or increase the species' distribution and abundance, as based upon results of BBS or *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Kantrud and Higgins 1992, Kingery 1998, Ryan and Renken 1987.

SHORT-EARED OWL (*Asio flammeus*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Northern Harrier and Western Meadowlark.

Distribution: Short-eared Owls are sparsely and widely distributed in Colorado, with more birds present in winter than in summer. Breeding birds are most common on the plains, with additional populations in the San Luis Valley and North Park. They are not believed to have ever been common breeders in Colorado (Boyle 1998).

Habitat Requirements: Short-eared Owls breed and forage in Colorado's grasslands, prairies, wetlands, and croplands. Breeding pairs require large blocks of suitable habitat (100 ha; 250 ac). Nests are built on the ground, usually on a dry site, often elevated on a small hummock.

Ecology: Eggs are laid in April or May, and young leave the nest by June. Fall migrants arrive in September-October, and leave in March. Short-eared Owls eat small mammals (especially voles, *Microtus* spp.) and occasionally small birds.

Management Issues and Conservation Recommendations: Loss of suitable habitat is the most pressing issue, with losses coming from conversion to land use types incompatible with this species' nesting and foraging (such as urbanization). Conservation efforts should focus on landscapes of prairies with suitable habitat for Short-eared Owls. Current breeding sites can be used as one layer of information in selecting the sites; however, any single effort appears likely to have a relatively small impact if current population and distribution records are accurate. Determining habitat suitability in landscapes identified for conservation initiatives for other elements of biodiversity (e.g., TNC 1998) may indicate efficiencies. *Assure that large areas of habitat are available for the species.*

Habitat management schemes for nesting waterfowl and upland gamebirds generally benefit Short-eared Owls. *Consider the needs of this species when managing for game species. Populations of the principal prey species (voles) should be maintained at levels compatible with economic activities on the land.*

Status and Reasons for Concern: This species is on the national Watch List, indicating a high conservation need throughout its range. Short-eared Owls are not adequately monitored by the BBS within Physiographic Area 62, and data collected between 1966 and 1996 are too sparse to allow meaningful analysis of trends. This species is monitored by *MCB* with nocturnal surveys.

Biological Objective: Increase the species' distribution and abundance, as based upon results of *MCB* and other monitoring programs.

Selected References: Andrews and Righter 1992, Clark 1975, Holt and Leasure 1993, Kingery 1998.

PHYSIOGRAPHIC AREA 87: COLORADO PLATEAU	178
Background	178
Conservation Issues	180
Conservation Opportunities	181
Avifaunal Analysis	182
Habitats, Implementation Strategies, and Priority Species Accounts	183
Cliff/Rock	183
Peregrine Falcon	187
White-throated Swift	188
Lowland Riparian	190
Lewis's Woodpecker	194
Western Kingbird	195
Mountain Shrubland	197
Common Poorwill	201
Virginia's Warbler	202
Pinyon-Juniper	204
Black-chinned Hummingbird	211
Gray Flycatcher	213
Cassin's Kingbird	214
Gray Vireo	216
Pinyon Jay	217
Juniper Titmouse	218
Black-throated Gray Warbler	219
Scott's Oriole	221
Ponderosa Pine	223
Band-tailed Pigeon	227
Mexican Spotted Owl	228
Western Bluebird	229
Grace's Warbler	230
Sagebrush Shrubland	232
Northern Sage Grouse	236
Gunnison Sage Grouse	237
Brewer's Sparrow	238
Sage Sparrow	240
Semidesert Shrubland	242
Burrowing Owl	249
Loggerhead Shrike	250
Horned Lark	252
Wetlands	254
Northern Harrier	260
Short-eared Owl	261

PHYSIOGRAPHIC AREA 87: COLORADO PLATEAU

Background

Physiographic Area 87 includes into two subregions—the Colorado Plateau and the Basin and Range country of central New Mexico. The Colorado Plateau is a high, flat tableland carved into soaring mesas, great cliffs, chasms, and canyons. It includes much of northern Arizona, eastern Utah, western Colorado, and northwestern New Mexico. The entire length of the Colorado-Utah state line lies within the region, and in Colorado the region extends upstream along the lower basins of the Yampa, White, Colorado, Gunnison, Dolores, and San Juan rivers to the Southern Rocky Mountain region to the east and the Wyoming Basin to the north. The Basin and Range region borders the Colorado Plateau at the continental divide in northwestern New Mexico and takes in much of central New Mexico, extending northward into Colorado to include Raton Mesa, Mesa de Maya, and the San Luis Valley. The Colorado portion of the Basin and Range region is included in the Colorado Plateau in this plan, although New Mexico Partners in Flight distinguishes the two subregions. The Colorado Plateau Coalition delineates other boundaries excluding most of northwestern Colorado and the Uncompahgre Plateau.

In Colorado, elevations of the mesa tops range from 1500 to 2800 m (4,921–9,186 ft) and some mountain peaks reach as high as 3840 m (12,598 ft). In many areas, local relief is greater than 900 m (2,953 ft). The area takes in 34,213 km² (13,210 mi²) of Colorado.

Within Colorado, the Colorado Plateau contains a high proportion of publicly owned lands. The Bureau of Land Management is the area's largest landowner. The National Park Service maintains a national park and five national monuments in western Colorado. The parks and monuments are devoted to geologic phenomena, especially canyons, and to the archeological remains of ancient cultures. Most of the highest elevations fall within the domain of the U.S. Forest Service, and three national forests lie partially within the region. The Southern Ute Indian Reservation lies along the New Mexico-Colorado border. The largest portion of private lands in Physiographic Area 87 are farm and ranch lands. These, along with the area's rather limited urban developments, are primarily located along the lowland riparian zones.

Historically, the most extensive land use in the Colorado Plateau has been livestock grazing, and most of the public as well as private land is currently grazed. There has also been extensive mineral, oil, and gas development. Aspen, ponderosa pine, and spruce-fir forests at higher elevations are logged. The region is popular for outdoor recreation, and many miles of primitive roads and trails support extensive off-road vehicle use.

Land Ownership	Hectares in Colorado	Acres in Colorado	Hectares CO PA 87	% of PA 87 in Colo	% of PA 87 total	PA 87's % of Colo
BLM	3,353,000	8,285,149	2,266,320	41	5	8.4
USFS	5,832,000	14,410,674	90,248	2	<1	0.3
NPS	254,004	627,635	126,671	2	<1	0.5
BOR	82,480	203,805	14,165	0.3	<1	0.1
USFWS	21,600	53,373	15,379	0.3	<1	0.1
DOD	21,600	53,373	0	-	-	-
State	1,211,000	2,992,340	161,880	3	<1	0.6
Private*	16,131,200	39,859,649	2,788,787	51	6	10.4
TOTALS	26,906,884	66,486,000	5,463,450	100	12	20

*Private includes Native American lands

The tablelands that give the physiographic area its name also host its most significant vegetative habitats: pinyon-juniper and sagebrush. In the northern part of the physiographic area in Colorado, sagebrush covers broad areas and is the most expansive habitat. Pinyon-juniper woodlands are scattered through the sagebrush in northwestern Colorado, and moving south pinyon-juniper becomes more and more extensive and sagebrush becomes less so. Pinyon-juniper covers most of the lower slopes in western Colorado and the mesas of southeastern Colorado and is the most representative habitat of Physiographic Area 87.

Semidesert grasslands, often intermixed or replaced by introduced annuals, especially cheatgrass, cover large expanses at the broad low valleys of the physiographic area in Colorado. This habitat is typically the result of wildfires killing the shrubs. Desert shrubs, especially greasewood and four or five saltbush species, often grow in open stands among the grasses.

Although they are widely scattered in this dry area, wetlands support dense bird populations. Many of Colorado's largest and richest ponds, lakes, and marshes lie in the San Luis Valley. In lowland riparian, Fremont cottonwood and a variety of other trees and shrubs, including skunkbrush and box elder, support a large number of birds. In addition, a number of bird species rely on the shores and banks of the lowland streams and rivers. Several exotic plants, notably salt cedar, Russian-olive, and Russian knapweed have extensively invaded lowland riparian areas in the last century. Irrigated agriculture has also extensively invaded the lowland riparian areas, with the effect of broadening the riparian zone, while degrading the original riparian areas. The rivers

of the Colorado Plateau have carved numerous deep canyons in the tableland, and cliff/rock habitats may be more significant here than in any other Colorado region.

On the higher plateaus, mesas, and mountains a wide variety of less extensive habitats are found. Just above the pinyon-juniper zone, and often intermixed with that vegetative type, Gambel oak, mountain mahogany, serviceberry, and other mountain shrubs dominate.

On the flanks of higher plateaus, ponderosa pine is found, often mixed with aspen. Gambel oak frequently forms an important understory. Large stands of aspen that appear not to be successional are found in western Colorado. At similar elevations, mixed conifer stands, especially Douglas-fir, tend to dominate on steep north-facing slopes and in other situations of greater moisture and cooler temperatures.

Along streams in the mountainous areas, narrowleaf cottonwoods stand above a wide variety of shrubs in the narrow riparian zones, which, although limited in extent, support an extraordinarily rich avifauna. The cottonwoods in this zone often are intermixed with or replaced by blue spruce and Douglas-fir at higher elevations.

Spruce-fir forests cover the highest plateaus and mountain tops in the area.

Habitat Type	Hectares in Colo	Acres in Colo	Hectares CO PA 87	% of PA 87 in Colo	% of PA 87 Total	PA 87's % of Colo
Low elevation	14,149,526	34,963,000	1,804,962	33	4	7
Sagebrush	2,428,200	6,000,000	1,540,288	28	3	6
Pinyon-juniper	2,023,500	5,000,000	1,740,210	32	4	6
Montane	8,305,658	20,523,000	377,990	7	1	1
TOTALS	26,906,884	66,486,000	5,463,450	100	12	20

Conservation Issues

Livestock grazing is the most extensive use of land in western Colorado, and the extent and timing of grazing are constant conservation issues. The manipulation of habitats (e.g., sagebrush and pinyon-juniper “treatment”) for improved grazing and the degradation of habitats (especially riparian) by grazing have significant effects on wildlife. Livestock water development and operation offers hazards and opportunities for wildlife. It should be kept in mind that the prevailing opinion in the industry is that public rangelands have improved since 1934, the year of the Taylor Grazing Act, the law that put order onto the public grazing land and incentives for ranchers to improve the range.

The manipulation of water, including irrigation and dam building, and the resultant land uses (orchards, farms, industrial, residential) have created major threats to wildlife habitats, especially the lowland riparian where water storage and allocation has greatly reduced cottonwood regeneration and has encouraged exotic plant invasion (e.g., salt cedar, Russian knapweed). Irrigation has also expanded waterbird habitat in the arable valleys. New threats continue to emerge: a ballot issue on quantifying water use in the San Luis Valley was recently defeated, primarily over the concern that surpluses might be identified, declared, or trumped-up and diverted outside the upper Rio Grande River system. If this concern were to become fact, significant impacts to bird life could occur not only in Colorado, but also in New Mexico and the lower Rio Grande Valley, which is nationally significant.

The control of natural fires has created successional patterns that may be quite different from historical patterns and which may have profound effects on wildlife populations and distribution. Pinyon-juniper has expanded. Fire exclusion has resulted in stands overstocked with small trees. Wildfires tend to be less frequent and more catastrophic. The result has probably been harmful to non-forest raptors and seed-eaters, and has been beneficial mostly to non-game upland bird species.

The widespread recreational use of lands in western Colorado also creates several conservation issues, including wilderness designation, off-road vehicle use, and trail proliferation.

Conservation Opportunities

The incipient BLM fire management planning process, with PIF participation, will consider practices which would maintain or enhance bird habitat.

Several cities and counties (Delta, Montrose, Naturita, DeBeque, Parachute, Rifle-Silt, Rangely, Durango, Alamosa, towns of the Grand Valley) in the region have initiated riverfront improvement projects and may be responsive to guidance on restoring degraded lowland riparian habitats.

The many units of the National Park System on the Colorado Plateau create numerous public information opportunities.

Widespread public concern about wildlife could make an illustrated guide to wildlife (bird) hazards (e.g., power lines, fences, antenna towers, buildings, petroleum waste pits, road settings, feral animals, etc.) effective in reducing those hazards.

Public debate on water issues (e.g., Animas-LaPlata) could highlight lowland riparian conservation issues.

The Endangered Fishes Program of the USFWS and CDOW, by increasing spring flows and creating backwaters, may have significant implications to birds.

Travel use planning could incorporate bird considerations (e.g., keeping distance from nesting raptors).

The Colorado Plateau Coalition in Moab could be an effective agent in promoting bird conservation.

Ranchers and wildlife habitat developers have yet to find effective guidance on developing watering sites. An example of this is that a simple and effective wildlife ramp for a circular water tank has yet to be designed and published widely.

Avifaunal Analysis

Physiographic Area 87 hosts at least 190 species of breeding birds in the eight habitats that will be discussed below. This area has few species that are wholly or nearly absent from other regions of the state; Gambel's Quail, Black-throated Sparrow, Sage Sparrow, and Scott's Oriole fit this group. More species reach their best numbers in this physiographic area; Chukar, Western Screech-Owl, Canyon Wren, Brewer's Sparrow, and several pinyon-juniper woodland species are in this class. Curiously, nesting Purple Martins cluster along the boundary between the Colorado Plateau and the Southern Rocky Mountain physiographic areas.

Habitats, Implementation Strategies, and Priority Species Accounts

Cliff/Rock

Description and Ecology: Colorado's geologic history lends itself to creation of cliff/rock habitats for birds. Formation of the Rocky Mountains by uplift and volcanism, followed by erosion by glacial and other forces, led to the development of a landscape with high topographic relief. On the Colorado Plateau (included in Physiographic Area 87), erosion sculpted a landscape of bluffs, cliffs, plateaus, and canyons. The stability and persistence of cliff/rock formations encourages the repeated use of specific areas as breeding habitat by birds, use which frequently extends well beyond the lifetimes of individual birds. Unlike other habitat types that are vulnerable to direct manipulation by humans, cliff/rock habitats are relatively unchangeable, although their value to birds can be degraded.

Importance and Conservation Status: Birds that use cliffs for nesting are more susceptible to loss of nesting habitat than many other species because they rely completely on cliffs as nest sites and because the number of suitable nest sites is finite and essentially non-renewable. For some species, all suitable nest sites may be occupied in some areas, making it impossible for the local population to increase.

Conflicts related to nesting birds that use cliffs, rocky ledges, and small rocky outcrops include rock climbing, mining, housing development, and construction of roads, hiking, bicycling, and horseback riding trails. Probably the greatest disturbance factor in cliff/rock habitats is rock climbing. Mining and construction can have negative impacts when they occur at the base or the top of cliffs, rocky ledges, or small rocky outcrops.

Cliff/rock habitat can be protected by making land managers and the general public more aware of the importance of this habitat type and by controlling the use and development of these habitats wherever necessary and possible. Establishing buffer zones, temporary closures, and in some cases designation of special areas (Research Natural Areas, Areas of Critical Environmental Concern, Special Management areas, or sanctuaries) can provide essential protection. These protective designations can include significant surrounding habitat such as primary foraging areas, where there may be additional impacts to consider.

Implementation Strategies:

Bird Monitoring

Goal: To monitor or track all breeding birds in cliff/rock habitat to document distribution, population trends, and abundance in a statistically acceptable manner.

Objective: All species with AI > 2 will be monitored with count-based methods.

Strategy: Monitoring will be accomplished through the combined efforts of agencies with primary responsibility for managing this habitat.

Strategy: Monitoring efforts will continue to rely on BBS data, with CBO's *Monitoring Colorado's Birds (MCB)* data incorporated as it becomes available.

Objective: All species with AI # 2 will be tracked through count-based methods or their presence/absence noted in the state.

Strategy: The *MCB* monitoring program will address this.

Objective: Continue with long-term statewide monitoring of Peregrine Falcon.

Strategy: The Colorado Division of Wildlife will take the lead in a statewide monitoring program for the Peregrine Falcon, with continued reliance on U.S. Forest Service, Colorado Division of Wildlife, National Park Service, Bureau of Land Management and others to monitor known nest sites.

Status: Monitoring for the Peregrine Falcon is fully implemented.

Habitat Monitoring

Goal: To document the amount, condition, and ownership of cliff/rock habitat in Colorado.

Objective: Develop collaborative efforts to use GIS in mapping cliff/rock habitat, documenting amount, condition, and ownership.

Status: This effort has not been initiated to date. Potential collaborators include CDOW, CNHP, CBO, USGS, BLM, and TNC.

Habitat Core Areas

Goal: To conserve unique representatives and/or core areas of White-throated Swift nesting colonies and a high concentration of breeding Peregrine Falcons in Colorado.

Objective: Identify such areas, use agency- or organization-specific means of designating and conserving them, and work with the appropriate agency or organization to promote conservation activities.

Status: Appropriate areas that have been identified include USFS Research Natural Areas, USFS Wilderness Areas, Colorado Natural Areas Program sites (Cross Mountain Canyon Natural Area in Moffat County).

Objective: Identify any of these areas that are appropriate for designation as *Important Bird Areas (IBAs)*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with cliff/rock habitat were nominated in 1999, and the *IBA* committee will make final selections in 2000.

Site-based Conservation

Goal: To conserve local sites that are important for the conservation of the White-throated Swift and Peregrine Falcon in Physiographic Area 87. These sites may include key nesting spots (e.g., cliffs, nest colonies, individual nest sites, historic sites etc.).

Objective: Identify agency- or organization-specific means of designating and conserving key local sites. Work with appropriate agencies and organizations to designate such sites, and promote conservation activities.

Objective: Identify key local sites that are appropriate for designation as IBAs, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with cliff/rock habitat were nominated in 1999, and the IBA committee will make final selections in 2000.

Management Practices

Goal: To promote management practices that benefit birds in cliff/rock habitats.

Objective: A Best Management Practices (BMP) manual will be produced and distributed.

Status: Not yet initiated.

Objective: Identify key landowners and land managers and encourage them to incorporate best management practices to conserve cliff/rock birds and their habitat.

Objective: Protect known nest sites and potential nest sites from disturbance.

Strategy: Close or reroute of some hiking trails, or temporarily close some hiking trails or cliff faces during the breeding season, and establish buffer zones around nesting sites.

Interstate/International Wintering Grounds

Goal: To conserve the wintering ground habitat used by birds of cliff/rock habitats.

Objective: Track the amount of habitat available on the wintering grounds.

Strategy: Utilize GIS (state GAP projects, Heritage Program, and/or CBO).

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to obtain data.

Objective: Protect key tracts of wintering habitat.

Strategy: Identify the wintering distribution and key habitat associations of priority species.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect wintering habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Migration Concerns

Goal: To protect migratory stopover habitat of birds of cliff/rock habitats as they migrate outside of the state.

Objective: Identify important migratory stopover areas for Peregrine Falcons and White-throated Swifts, and key sites for priority species that breed elsewhere.

Objective: Track amount, condition, and ownership of key migratory stopover sites.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect migratory habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Outreach and Education

Goal: To provide information on cliff/rock birds (conservation, habitat needs, natural history, etc.) to children, teachers, naturalists, landowners, natural resource professionals, and other interested parties.

Strategy: Make educational materials available at local nature centers and natural resource agency offices.

Strategy: Hold workshops and field programs for teachers.

Strategy: Hold workshops and field programs for natural resource professionals (CDOW, BLM, and USFS staff).

Strategy: Present information at Teacher Association meetings, conferences, other annual meetings.

Strategy: Submit manuscripts to popular magazines for children and adults.

Strategy: Presentations or printed materials could help to educate the rock climbing community on the fragility of cliff-nesting bird communities—their susceptibility to disturbance and limited nesting opportunities—and could serve to recruit climbers in identifying nesting sites, educating other climbers, and posting closures and buffer zones. Signs that instruct climbers on routes and areas to avoid may encourage compliance.

Research Priorities

Goal: To identify and facilitate research that will aid in understanding and managing cliff/rock habitats for Colorado's birds.

Objective: To identify the top ten research needs in cliff/rock habitat in Colorado.

Strategy: Update the list of research needs annually to reflect shifting conservation priorities and to remove research needs from the list as they are investigated.

Strategy: Solicit input from researchers and managers on research needs and accomplishments.

Status: The following research needs have been identified:

1. There is a pressing need to identify the causes for the observed decline in White-throated Swift populations in this physiographic area. Avenues of investigation could include: analyzing eggshells and/or adult specimens for pesticide contamination; cataloging the locations of known nesting colonies; checking historical nesting sites for evidence of occupancy; documenting disturbance or other habitat degradation at current and historical nesting sites.
2. Identify the key migratory stopover areas and habitats of White-throated Swifts.
3. Test and evaluate monitoring protocols for the White-throated Swifts at breeding sites.
4. Determine whether habitat around colonies and/or nest sites is adequate for foraging White-throated Swifts and Peregrine Falcons.
5. Identify principal wintering areas for White-throated Swifts and Peregrine Falcons in Mexico, Central or South America.

Objective: Facilitate investigations to answer these questions by providing information about priority needs to universities, public and private research entities, identifying funding sources, and promoting collaboration between management and research agencies.

Priority Species Accounts: Two species, the Peregrine Falcon and White-throated Swift, have been identified as conservation priorities in this habitat in Physiographic Area 87.

PEREGRINE FALCON (*Falco peregrinus*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Golden Eagle, Prairie Falcon, Great Horned Owl, White-throated Swift, and Common Raven.

Distribution: Peregrine Falcons have a more extensive worldwide range than any other bird: they occur on all continents except Antarctica (Kingery 1998). They breed across the North American Arctic and southward along the Pacific Coast, through the Rocky Mountains, and in scattered locations in the eastern U.S. In Colorado, three-fourths of the breeding birds occur in Physiographic Area 87, principally along the Dolores and Colorado River canyons in Mesa and Montrose counties and in Dinosaur National Monument. Statewide in 1998, CDOW personnel found peregrines occupying 90 of 107 known nesting sites and located six new sites. Seventy-six of the sites were occupied by adult breeding pairs which produced 157 young.

Habitat Requirements: In Colorado, Peregrine Falcons breed on cliffs and rock outcrops from 1370 m to more than 2740 m (4,500–9000 ft) in elevation. They most commonly choose cliffs that lie within pinyon-juniper and ponderosa pine zones, but this choice probably depends on the nature and location of the cliffs rather than an attraction to these habitats. They select a ledge that has a wide view and plentiful prey in the area. Most eyries (nest sites) are within a mile of water. The falcons hunt in adjacent open meadows, forested tree top areas, around lakes and rivers, and shrubsteppe. Early records suggest that they once nested in somewhat more accessible spots, but now they tend choose cliffs higher than 60 m (200 ft) in undisturbed areas. Recovery efforts have also succeeded in coaxing them to nest on tall buildings in urban areas where they subsist largely on Rock Doves.

Ecology: Some peregrines reside in their territories in Colorado throughout the year, but most winter south of Colorado and arrive on the breeding grounds in March. They immediately begin courtship activities and are laying eggs in April. The eyrie is a level ledge beneath an overhang where they can scrape a depression in debris. Eggs hatch after a 32–35 day incubation period and the young remain on the nest for another 39–46 days. The young remain dependent on the parents for another period of 30 days or more until dispersing in August and September. They winter in Mexico, Central and South America. These falcons feed on smaller birds almost exclusively, with White-throated Swifts and Rock Doves being among their favored prey. They have been known to take bats in the early morning or late in the day when bats become active.

Management Issues and Conservation Recommendations: Disturbance from recreational activities (rock climbing and hiking) can cause nest failure. *Identify nest sites and restrict recreational activities during the nesting period. This may require seasonal closures or rerouting of some hiking trails around the base or top of some cliffs during the breeding season. Establish buffer zones to minimize conflicts around nesting sites, especially if the cliff is a popular destination point for hikers or rock climbers. Establish Research Natural Areas, Areas of Critical*

Environmental Concern, Special Management areas, Important Bird Areas, or sanctuaries where appropriate to protect eyries.

Most of the known nest sites in Colorado are on public lands administered by the Bureau of Land Management, U.S. Forest Service and National Park Service. *Coordinate with land managers in protecting nest sites.*

In the 1980s there were still occasionally White-throated Swift and swallow die-offs in western Colorado and eastern Utah due to pesticide poisoning (J. Connor, National Park Service, personal observation). Many birds that migrate are still subjected to chemical exposure especially around agricultural fields. In the United States, DDT caused the near extinction of the Peregrine Falcon in the 1950s and 1960s and pesticides are still a serious threat to birds in the late 1990s. *Monitor Peregrine Falcons and their habitat for herbicides, pesticides, and other chemicals that would have a direct or indirect impact on them. Research Peregrine Falcon food sources for pesticide and herbicide poisoning. Research threats to food in Peregrine Falcon winter habitat.*

Status and Reasons for Concern: This species occupies a unique habitat type (cliff/rock) in this physiographic area. It was delisted from the Federal Threatened and Endangered Species list in 1999. Monitoring protocols call for the peregrines to be monitored for at least the next 13 years (2012) to ensure 100 to 120 breeding pairs are maintained in Colorado (Gray 1995). Within the cliff/rock habitat in Physiographic Area 62, BBS data collected between 1969 and 1996 are too sparse to allow analysis of trend data. This species is monitored by CDOW.

Biological Objective: Maintain or increase the species' distribution and abundance, based upon results from the CDOW monitoring program. Maintain current breeding densities at all known nest sites, and improve breeding densities by protecting these sites from human disturbance. Continue to monitor known breeding sites and survey other potential nest sites with the state.

Selected References: Andrews and Righter 1992, Gray 1995, Kingery 1998.

WHITE-THROATED SWIFT (*Aeronautes saxatalis*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Turkey Vulture, Golden Eagle, Peregrine Falcon, Common Raven, and Canyon Wren.

Distribution: White-throated Swifts breed from northern Idaho south to the central California coast and into Baja, and from north-central Montana south into Central America. They nest in cliff/rock habitat throughout Physiographic Area 87 in Colorado.

Habitat Requirements: These swifts require cliffs, where colonies build their nests in rock crevices. White-throated Swifts forage on the wing over many different habitats, staying within a few miles of their nests.

Ecology: Birds begin arriving in Colorado in April and begin nest activities in June. Most young leave the nest by July, but some nests remain active into August. Most birds leave the state by the end of September. In the fall, birds from Colorado and other northern areas retreat to more southerly portions of the range, but we do not know precisely where Colorado's birds winter. Their diet consists of aerial insects, including flies, beetles, bees, and flying ants. The inaccessibility of their nest sites and their tremendous flight speed make White-throated Swifts difficult to study; consequently, comparatively little is known about them beyond basic natural history facts.

Management Issues and Conservation Recommendations: The causes for the observed population declines are not known, but could be related to disturbance at nest sites, degradation of wintering habitat, or pesticide exposure; elevated levels of pesticides were found in specimens collected in the 1970s. *Determine the role of pesticides, if any, in their population declines.*

Nest sites are often used year after year. *Enforce seasonal closures at known nest sites to minimize nest-site disturbance.*

Status and Reasons for Concern: This species has a moderately high conservation need throughout its range, along with high representation in the physiographic area and a declining population. Within Physiographic Area 87, BBS data show a statistically significant annual rate of decline between 1969 and 1996 ($P = 0.10$; $n = 21$ routes). An even more disconcerting trend is evident in the BBS pinyon-juniper stratum (84) during 1966–1996, where this species exhibited a significant annual rate of decline ($P = 0.08$; $n = 18$ routes). White-throated Swifts were present on an average of 32.87% (SE = 6.83) of the BBS routes run in Physiographic Area 87 in Colorado during 1988–1997, at an average abundance of 4.24 (SE = 1.06) individuals per route. The mean number of routes run each year was 11.4 (SE = 1.55). This species is monitored by MCB with tracking transects.

Biological Objective: Increase the species' distribution and abundance, based upon results from the BBS and MCB monitoring programs.

Selected References: Andrews and Righter 1992, Bradbury 1918, Kingery 1998.

Lowland Riparian

Description and Ecology: Lowland riparian forests border stream systems as they flow out of the foothills onto the eastern plains and into the San Luis Valley and valleys on the Western Slope. The lowland riparian forests on the Western Slope generally consist of Rio Grande cottonwoods with an understory of willows and a mixture of red-osier dogwood, buffaloberry, skunkbrush, greasewood, and other shrubs (Andrews and Righter 1992, Kingery 1998). Salt cedar and Russian-olive are exotics that are now major components of lowland riparian communities. Russian knapweed has become a ubiquitous exotic forb in lowland riparian zones.

Various sources report that riparian forests comprise less than 3% of the total landscape, but up to 80% of the resident bird species use them for some part of their life cycle. Birds use this habitat for nesting, cover, resting, migration stopover areas, and migration corridors. This system has the richest avian species component of any of Colorado's habitats. The most frequently detected species in lowland riparian forests in Physiographic Area 87 include American Kestrel, Western Screech-Owl, Great Horned Owl, Mourning Dove, Northern Flicker, Western Wood-Pewee, Western Kingbird, Eastern Kingbird, House Wren, Black-billed Magpie, American Robin, Yellow Warbler, Blue Grosbeak, and Bullock's Oriole (Andrews and Righter 1992, Krueper 1995, Howe 1996, Kingery 1998).

Importance and Conservation Status: Lowland riparian systems provide dispersal corridors for woodland birds across otherwise treeless terrain. Well-defined, unique, and highly productive, riparian zones areas are sensitive to disturbance (Melton et al. 1984).

Riparian ecosystems are highly important areas for both humans and wildlife. During historic times, humans have used riparian zones intensively for many different purposes. They have been substantially altered to create residential, industrial, and recreational developments and to create highways and gravel mines. Riparian zones are convenient locations for those activities. They are also productive areas for domestic livestock grazing. However, the impacts of domestic livestock are not as dominant as in high elevation riparian zones (Melton et al. 1984, Wozniak 1995).

Unlike the high elevation riparian habitat in Colorado, much of the lowland riparian ecosystem is in private ownership. Consequently it is much more susceptible to loss and degradation by urban and industrial development, mining, road and trail development, and recreational development.

Implementation Strategies:

Bird Monitoring

Goal: To monitor or track all breeding birds in the lowland riparian habitat and document distribution, population trends, and abundance in a statistically acceptable manner.

Objective: All species with AI > 2 will be monitored with count-based methods.

Strategy: Monitoring will be accomplished through the combined efforts of agencies with primary responsibility for managing this habitat.

Strategy: Monitoring will continue to rely on BBS data, with data from CBO's *Monitoring Colorado's Birds (MCB)* program incorporated as it becomes available.

Status: MCB implemented lowland riparian habitat transects in 1999 and ran a total of 25 transects; trend data should be available for most species within 5–12 years.

Objective: All species with AI # 2 will be tracked through count-based methods or their presence/absence noted in the state.

Strategy: CBO's MCB monitoring program will address this.

Status: MCB monitoring was implemented on lowland riparian habitat beginning in 1999.

Objective: All colonial-nesting species will be monitored or tracked with colony counts.

Strategy: MCB will census all known colonies of Double-crested Cormorant, Great Blue Heron, Black-crowned Night-Heron, and Snowy Egret.

Status: MCB demographic monitoring of colonial-nesters began in 1999.

Objective: Population demographic monitoring will be instituted for all species in lowland riparian habitats with PT of 4 or 5.

Strategy: CBO's MCB will address this objective.

Status: MCB demographic monitoring will begin in 2001.

Habitat Monitoring

Goal: To document the amount, condition, and ownership of lowland riparian habitat in Colorado.

Objective: Develop collaborative efforts to use GIS in mapping lowland riparian habitat, documenting amount, condition, and ownership.

Status: This effort has not been initiated to date. Potential collaborators include CDOW, CNHP, CBO, USGS, BLM, and TNC.

Habitat Core Areas

Goal: To conserve unique representatives and/or large, ecologically-functioning examples of lowland riparian habitat in Colorado used by birds during the breeding season, during migration, or during the winter.

Objective: Identify such areas, use agency- or organization-specific means of designating and conserving them, and work with the appropriate agency or organization to promote conservation activities.

Status: None have been identified to date.

Objective: Identify riparian core areas that are appropriate for designation as *Important Bird Areas (IBAs)*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with lowland riparian habitat were nominated in 1999, and the *IBA* committee will make final selections in 2000.

Objective: To maintain or increase the quantity and quality of lowland riparian habitat on private lands.

Strategy: Promote collaboration/cooperation between agencies, organizations, and individuals in conserving unique representatives/core areas with multiple ownership. Specifically, support the efforts of the Tamarisk Task Force coalition in the Grand Valley.

Strategy: Encourage landowners to take advantage of funding opportunities for creating, restoring, and maintaining lowland riparian habitat on their properties.

Strategy: Encourage private owners of existing mature and late-successional cottonwood-riparian communities along Colorado's lowland riparian systems to adopt grazing systems and other management practices that maintain and enhance stand conditions and ecosystem integrity.

Strategy: Encourage private owners of Colorado's lowland riparian lands to replant native cottonwoods and willows along stream reaches that have become degraded.

Objective: To maintain or increase the quantity and quality of lowland riparian habitat on public lands.

Strategy: Integrate the BCP into management plans for public lands in the physiographic area.

Strategy: Encourage public managers of existing mature and late-successional cottonwood-riparian communities along Colorado's lowland riparian systems to adopt grazing systems and other management practices that maintain and enhance stand conditions and ecosystem integrity.

Strategy: Encourage public managers of Colorado's lowland riparian lands to replant native cottonwoods and willows along stream reaches that have become degraded.

Site-based Conservation

Goal: To conserve local breeding sites, wintering sites, and migration stopover sites that are important for the conservation of priority species of lowland riparian habitats.

Objective: Identify agency- or organization-specific means of designating and conserving key local sites. Work with appropriate agencies and organizations to designate such sites, and promote conservation activities.

Objective: Identify key local sites that are appropriate for designation as *IBAs*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with lowland riparian habitat were nominated in 1999, and the *IBA* committee will make final selections in 2000.

Management Practices

Goal: To promote management practices that benefit birds in lowland riparian habitat.

Objective: Produce Best Management Practices manual for lowland riparian habitat.

Objective: Identify key landowners and land managers and encourage them to incorporate BMPs into management plans for public and private lands.

Interstate/International Wintering Grounds

Goal: To conserve the wintering ground habitat used by Colorado's lowland riparian birds that migrate outside of the state.

Objective: Identify the wintering distribution and key habitat associations of priority species.

Objective: Track amount of available habitat on the wintering grounds.

Strategy: Utilize GIS (state GAP projects, Heritage Program, and/or CBO).

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to obtain data.

Objective: To protect wintering habitat for lowland riparian birds.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect wintering habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Migration Concerns

Goal: To protect migratory stopover habitat for lowland riparian birds.

Objective: Identify important migratory stopover areas for priority species that breed in Colorado, and key sites for priority species that breed elsewhere.

Objective: Track amount, condition, and ownership of key migratory stopover sites.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect migratory habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Outreach and Education

Goal: To provide information on lowland riparian habitat birds (conservation, habitat needs, natural history, etc.) to children, teachers, naturalists, landowners, natural resource professionals, and other interested parties.

Strategy: Make educational materials available at local nature centers and natural resource agency offices.

Strategy: Hold workshops and field programs for teachers.

Strategy: Hold workshops and field programs for natural resource professionals (CDOW, BLM, and USFS staff).

Strategy: Present information at Teacher Association meetings, conferences, other annual meetings.

Strategy: Submit manuscripts to popular magazines for children and adults.

Research Priorities

Goal: To identify and facilitate research that will aid in understanding and managing riparian habitats for Colorado's birds.

Objective: To identify the top ten research needs in lowland riparian habitat in Colorado.

Strategy: Update the list of research needs annually to reflect shifting conservation priorities and to remove research needs from the list as they are investigated.

Strategy: Solicit input from researchers and managers on research needs and accomplishments.

Status: The following research needs have been identified:

1. The impact of Brown-headed Cowbird nest parasitism on the reproductive success of riparian species.
2. The impact on Lewis's Woodpecker reproductive success of competition for nest cavities with European Starlings.
3. The influence of exotic plant species (especially Russian-olive and tamarisk) on habitat suitability during breeding, wintering, and migration periods.
4. The impact on habitat suitability during breeding, wintering, and migration periods of livestock grazing in lowland riparian habitat.

Objective: Facilitate investigations to answer these questions.

Strategy: Provide information about priority needs to universities, public and private research entities, identify funding sources, and promote collaboration between management and research agencies.

Priority Species Accounts: Two species are identified as high priority in lowland riparian habitat in Physiographic Area 87: Lewis's Woodpecker and Western Kingbird.

LEWIS'S WOODPECKER (*Melanerpes lewis*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include American Kestrel, Great Horned Owl, Northern Flicker, Western Kingbird, Eastern Kingbird, Yellow Warbler, and Bullock's Oriole.

Distribution: Lewis's Woodpeckers breed from central British Columbia and western Alberta south to northern Mexico, and as far east as eastern Wyoming. In Colorado, Lewis's Woodpeckers reside in the valleys, plains and foothills from 1100 to 2400 m (3,500–8,000 ft) in elevation. In Physiographic Area 87, Lewis's Woodpeckers are year-round residents in western valleys, although some withdraw to lower latitudes during the winter.

Habitat Requirements: Lewis's Woodpeckers breed in riparian forests, agricultural areas and urban areas with scattered, mature cottonwoods, adjacent to areas of low vegetation, such as ungrazed or lightly grazed grasslands, mowed hayfields, or fallow fields. In southeastern Colorado, mean dbh of nest trees was 112.6 cm (44.3 in), significantly greater than that of unused trees (Vierling 1997). These woodpeckers avoid dense riparian forests, and those which contain Red-headed Woodpeckers. They excavate their nesting and roosting cavities in the soft wood of dead or decaying trees, or rely on natural cavities or cavities excavated by other woodpeckers because they have relatively weak bills and skulls and cannot excavate cavities in sound wood.

Ecology: Lewis's Woodpeckers initiate nesting by late April, and most young leave the nest by the end of July. The diet during the warmer months is largely flying insects, caught on the wing. During colder months, the diet shifts to nuts, grains, and berries.

Management Issues and Conservation Recommendations: Lewis's Woodpeckers depend upon large trees and snags and are sensitive to disturbance at the nest. *Reduce or eliminate activities that degrade the structure and quality of the overstory or understory of riparian systems. Do not permit timber cutting within 100 feet of the riparian area. Locate recreational facilities such as roads, trails and campgrounds up, out of riparian areas.*

Competition with European Starlings for limited nest cavities may limit breeding success of this species in some areas. *Research ways to reduce competition from these unprotected, introduced birds.*

Status and Reasons for Concern: This species has a high conservation need locally and throughout its range. This species is on the national Watch List, indicating a high conservation need throughout its range. This is a USFS Sensitive Species in Region 2. Long-term declines in some areas are extreme. The Lewis's Woodpecker is not adequately monitored by the BBS, and data are too sparse for meaningful analysis of trends. This species was present on an average of 7.00% (SE = 2.76) of routes run in Physiographic Area 87 in Colorado, 1988–1997, at an average abundance of 0.12 (SE = 0.04) individuals per route. The mean number of routes run each year was 11.4 (SE = 1.55). This species is monitored by *MCB* with tracking transects.

Biological Objective: Increase the species' distribution and abundance, with progress toward this objective measured by results of the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Hadow 1973, Kingery 1998, Tobalske 1997, Vierling 1997.

WESTERN KINGBIRD (*Tyrannus tyrannus*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Great Horned Owl, American Kestrel, Lewis's Woodpecker, Northern Flicker, and Bullock's Oriole.

Distribution: Western Kingbirds breed from southwestern Canada to northern Mexico. In Colorado they are common summer residents of the eastern plains and western valleys. They winter from central Mexico south to Costa Rica.

Habitat Requirements: Kingbirds nest in open areas, including open riparian forests, agricultural areas, urban areas with scattered trees, and pinyon-juniper woodlands.

Ecology: Western Kingbirds arrive on the breeding grounds in early May. Nest building begins shortly thereafter and most young fledge by mid July. Fall migration takes place in August and September.

Management Issues and Conservation Recommendations: Altered water flows, excessive grazing, timber and firewood cutting, recreational activities, and invasions by weedy, nonnative plants have degraded the overstory in riparian zones, especially cottonwood. *Reduce or eliminate activities that degrade the structure and quality of the overstory of riparian systems. Timber cutting should not be permitted within 30 m (100 ft) of the riparian area. Monitor livestock grazing to ensure tree and shrub regeneration. Design recreational facilities such as roads, trails, and campgrounds to allow the long-term persistence of wooded riparian areas (Myers 1991). Include plant species that attract large numbers of insect pollinators as prey in rehabilitation schemes in lowland riparian areas.*

Status and Reasons for Concern: This species has a moderately high conservation need throughout its range, along with high representation in the physiographic area. Within Physiographic Area 87, BBS data do not show a statistically significant annual rate of change between 1966 and 1996 ($P = 0.26$; $n = 53$ routes). Western Kingbirds were present on an average of 67.55% (SE = 5.00) of the routes run in Physiographic Area 87 in Colorado, 1988–1997, at an average abundance of 5.14 (SE = 0.56) individuals per route. The mean number of routes run each year was 11.4 (SE = 1.55). This species is monitored by *MCB* with point transects.

Biological Objective: Maintain or increase Western Kingbirds' distribution and abundance, based upon results of the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Gamble and Bergin 1996, Kingery 1998, MacKenzie and Sealey 1981.

Mountain Shrubland

Description and Ecology: The shrubs that form dominant stands in mountain shrubland are mountain mahogany, serviceberry, and/or Gambel oak. This habitat occurs from the upper limit of grasslands and pinyon-juniper up into the lower transition zone forests of mountain shrubland, Douglas-fir, and aspen, roughly 1700 to 2600 m (5,500–8,500 ft) in elevation. Other plants associated with mountain shrublands include snowberry, common chokecherry, skunkbrush, sumac, *Ceanothus* spp., elk sedge, and numerous grass and forb species. Big and silver sagebrush stands form mosaics with these other shrubs, especially on deeper, more level soils.

Gambel oak vigorously re-sprouts from stem bases or from underground tubers and rhizomes following fire. It is extremely fire tolerant. Gambel oak can recover to original heights from a fire in 30 to 40 years. A healthy stand of Gambel oak contains shrubs of varying heights and has robust native bunchgrasses and forbs growing between them and relatively little bare ground.

Importance and Conservation Status: This is an often-overlooked habitat type, perhaps because of its limited utilization by humans. Mountain shrubland is occasionally cleared to increase forage for livestock or big game, to the detriment of shrub-nesting bird species. Housing and associated development consume and fragment this habitat.

Implementation Strategies:

Bird Monitoring

Goal: To monitor or track all breeding birds in mountain shrubland habitat to document distribution, population trends, and abundance in a statistically acceptable manner.

Objective: All species with AI > 2 will be monitored with count-based methods.

Strategy: Monitoring will be accomplished through the combined efforts of agencies with primary responsibility for managing this habitat.

Strategy: Monitoring efforts will continue to rely on BBS data, with CBO's *Monitoring Colorado's Birds (MCB)* data incorporated as it becomes available.

Status: *MCB* implemented mountain shrubland habitat transects in 1998 and ran a total of 29 transects in 1999; trend data should be available for most species within 5–12 years.

Objective: All species with AI # 2 will be tracked through count-based methods or their presence/absence noted in the state.

Strategy: The *MCB* monitoring program will address this.

Status: *MCB* was implemented in mountain shrubland habitat in 1999.

Objective: All species with PT of 4 or 5 will be tracked with demographic monitoring.

Strategy: CBO's *MCB* monitoring program will address this.

Status: *MCB* demographic monitoring will begin in 2001.

Habitat Monitoring

Goal: To document the amount, condition, and ownership of mountain shrubland habitat in Colorado.

Objective: Develop collaborative efforts to use GIS in mapping mountain shrubland habitat, documenting amount, condition, and ownership.

Status: This effort has not been initiated to date. Potential collaborators include CDOW, CNHP, CBO, USGS, BLM, and TNC.

Habitat Core Areas

Goal: To conserve unique representatives and/or large, ecologically-functioning examples of mountain shrubland habitat in Colorado used during the breeding season, during migration, and/or during the winter.

Objective: Identify such areas, use agency- or organization-specific means of designating and conserving them, and work with the appropriate agency or organization to promote conservation activities.

Status: Appropriate areas that have been identified include USFS Research Natural Areas (Narraguinep in Dolores County), USFS Wilderness Areas, and Colorado Natural Areas Program sites (Deer Gulch Natural Area in Rio Blanco County).

Objective: Identify any of these areas that are appropriate for designation as *Important Bird Areas (IBAs)*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with mountain shrubland habitat were nominated in 1999, and the *IBA* committee will make final selections in 2000.

Objective: To maintain or increase the quantity and quality of mountain shrubland habitat on private lands.

Strategy: Encourage landowners to take advantage of funding opportunities and expertise for creating, restoring, and maintaining mountain shrubland habitat on their properties.

Strategy: Promote collaboration/cooperation between agencies, organizations, and individuals in conserving unique representatives/core areas with multiple ownership.

Objective: To maintain or increase the quantity and quality of mountain shrubland habitat on public lands.

Strategy: Integrate the BCP into management plans for public lands in the physiographic area.

Objective: To recreate the heterogeneous landscape mosaic of prehistory so that breeding birds are always offered a patchwork of shrubland parcels in a variety of structural stages and densities.

Strategy: Incorporate landscape-scale habitat management into management plans for public and private lands.

Strategy: Allow wildfires to burn and allow insect outbreaks to run their courses.

Site-based Conservation

Goal: To conserve local breeding sites, migratory stopover sites, and wintering sites in mountain shrubland that are important for the conservation of priority species.

Objective: Identify agency- or organization-specific means of designating and conserving key local sites. Work with appropriate agencies and organizations to designate such sites, and promote conservation activities.

Objective: Identify key local sites that are appropriate for designation as IBAs, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with mountain shrubland habitat were nominated in 1999, and the IBA committee will make final selections in 2000.

Management Practices

Goal: To promote management practices that benefit birds in mountain shrubland habitats.

Objective: A Best Management Practices (BMP) manual will be produced and distributed.

Status: Not yet initiated.

Objective: Identify key landowners and land managers and encourage them to incorporate best management practices to conserve mountain shrubland birds and their habitat.

Interstate/International Wintering Grounds

Goal: To conserve the wintering ground habitat used by birds of mountain shrubland habitats.

Objective: Track the amount of habitat available on the wintering grounds.

Strategy: Utilize GIS (state GAP projects, Heritage Program, and/or CBO).

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to obtain data.

Objective: Protect key tracts of wintering habitat.

Strategy: Identify the wintering distribution and key habitat associations of priority species.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect wintering habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Migration Concerns

Goal: To protect migratory stopover habitat of birds of mountain shrubland habitats as they migrate outside of the state.

Objective: Identify important migratory stopover areas for priority species that breed in Colorado, and key sites for priority species that breed elsewhere.

Objective: Track amount, condition, and ownership of key migratory stopover sites.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect migratory habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Outreach and Education

Goal: To provide information on mountain shrubland birds (conservation, habitat needs, natural history, etc.) to children, teachers, naturalists, landowners, natural resource professionals, and other interested parties.

Strategy: Make educational materials available at local nature centers and natural resource agency offices.

Strategy: Hold workshops and field programs for teachers.

Strategy: Hold workshops and field programs for natural resource professionals (CDOW, BLM, and USFS staff).

Strategy: Develop materials for county commissioners and local planning boards.

Strategy: Present information at Teacher Association meetings, conferences, other annual meetings.

Strategy: Submit manuscripts to popular magazines for children and adults.

Research Priorities

Goal: To identify and facilitate research that will aid in understanding and managing mountain shrubland habitats for Colorado's birds.

Objective: To identify the top ten research needs in mountain shrubland habitat in Colorado.

Strategy: Update the list of research needs annually to reflect shifting conservation priorities and to remove research needs from the list as they are investigated.

Strategy: Solicit input from researchers and managers on research needs and accomplishments.

Status: The following research needs have been identified:

1. Inventory the mountain shrubland in the physiographic area (and state) for area, location, condition, rate and potential of conversions by controlled burns and other means to assess the risk to this habitat and to obtain a monitoring baseline.
2. Determine the relationships of precipitation, habitat condition, and population distributions at the landscape level.
3. Determine the effects of prescribed burning in mountain shrubland on bird populations, with an emphasis on Common Poorwills and Virginia's Warblers.
4. Determine the effects on bird populations of different grazing regimes.
5. Identify key migratory stopover areas and habitats.
6. Conduct demographic studies for Virginia's Warbler and Common Poorwill.
7. Determine minimum shrub canopy cover (threshold level) needed to support viable populations of Virginia's Warbler.
8. Identify areas of concern in the state where impacts from humans have a negative impact on the priority species.
9. Identify principal wintering areas for Virginia's Warbler and Common Poorwill.

Strategy: Facilitate investigations to answer these questions by providing information about priority needs to universities, public and private research entities, identifying funding sources, and promoting collaboration between management and research agencies.

Priority Species Accounts: Two species have been identified as being of high conservation priority in mountain shrubland in Physiographic Area 87: Common Poorwill and Virginia's Warbler.

COMMON POORWILL (*Phalaenoptilus nuttallii*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Wild Turkey, Band-tailed Pigeon, Plumbeous Vireo, Orange-crowned Warbler, Virginia's Warbler, Black-headed Grosbeak, and Green-tailed Towhee.

Distribution: Common Poorwills breed from south-central British Columbia south through Baja, and in the east from southwestern Saskatchewan and western North Dakota south to north-central Mexico; they are absent from western Montana and the northern half of Idaho. They nest in suitable habitat throughout Physiographic Area 87 in Colorado. Poorwills winter in the southwestern U.S. and in Mexico.

Habitat Requirements: Common Poorwills nest in rocky sagebrush and mountain shrublands, pinyon-juniper woodlands, and ponderosa pine woodlands. Foraging sites include grassy meadows, riparian zones, and forest edges within 500 m (0.3 mi) of the nest.

Ecology: Poorwills arrive on their breeding grounds in Colorado by mid May and lay their first clutch by the end of May. They lay a second clutch in late June or July. The eggs are laid on the ground, often with at least partial shading from a rock, shrub, log, etc. Most birds have left for their wintering grounds by mid October. The diet consists of nocturnal insects, especially moths and beetles, with occasional flies, grasshoppers, and flying ants.

Management Issues and Conservation Recommendations: Efforts to set management guidelines are hampered by a profound lack of specific information on the Common Poorwill's habitat requirements. The most pressing issues are undoubtedly habitat degradation and permanent conversion of shrublands to other cover types. *Set aside suitable blocks of habitat and restrict shrub clearing to promote livestock or big game forage, fire suppression (which would allow trees to form dense stands), mining, and development of housing, recreational sites, and roads.*

Status and Reasons for Concern: Common Poorwills have a moderately high conservation need throughout their range and a high representation in the physiographic area. Their population trend is uncertain, and they are not adequately monitored by the BBS within Physiographic Area 87; data collected between 1966 and 1996 are too sparse for meaningful analysis of trends. Common Poorwills were present on an average of 3.26% (SE = 1.41) of the BBS routes run in Physiographic Area 87 in Colorado during 1992–1997, at an average abundance of 0.04 (SE = 0.02) individuals per route. The mean number of routes run each year was 11.4 (SE = 1.55). This species is monitored by *MCB* with nocturnal transects.

Biological Objective: Maintain or increase the species' distribution and abundance, as based upon results of the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Csada and Brigham 1992, Kingery 1998.

VIRGINIA'S WARBLER (*Vermivora virginiae*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Broad-tailed Hummingbird and Green-tailed Towhee.

Distribution: Virginia's Warblers breed throughout Utah and Arizona, in eastern Nevada, western New Mexico, and from the Front Range westward in Colorado. They breed in suitable habitat throughout Physiographic Area 87 in Colorado. They winter in western and central Mexico.

Habitat Requirements: Virginia's Warblers nest in dense mountain shrublands, especially Gambel oak, and in ponderosa pine and pinyon-juniper woodlands with a shrubby understory.

Ecology: Spring migrants arrive in Colorado in late April, but nesting may not begin until late May. Young may still be in nests in August, indicating either very late nesting or a second brood. Most birds have left the state by the end of September.

Management Issues and Conservation Recommendations: Management of large acreages of mountain shrubland in young growth stages for deer and elk does not benefit Virginia's Warblers, which require larger shrubs, especially Gambel oak. Large-diameter Gambel oaks, which produce acorns for deer, bears, Wild Turkeys, and Band-tailed Pigeons and which provide shade and access to elk sedge understory production for cattle and elk, benefit Virginia's Warblers as well. *Manage for mature and old-growth Gambel oak stands.*

Virginia's Warblers may be subject to high rates of Brown-headed Cowbird nest parasitism in some areas; cowbirds are often found in association with livestock. *Rest large mountain shrubland pastures in rotation to allow relief from cowbird parasitism.*

Status and Reasons for Concern: This species is on the national Watch List, indicating a high conservation need throughout its range. A very high proportion (estimated at 42%) of this species' total population occurs within Physiographic Area 87, indicating that this area has high responsibility for the conservation of Virginia's Warblers. This species is not adequately monitored by the BBS within Physiographic Area 87, and data collected between 1969 and 1996 are too sparse to allow analysis of trend data ($n = 9$ routes). However, BBS data for the period 1966–1996 approach a statistically significant, survey-wide annual rate of increase ($P = 0.11$; $n = 44$ routes). Virginia's Warblers were present on an average of 51.97% (SE = 2.61) of the BBS

routes run in Physiographic Area 87 in Colorado during 1988–1997, at an average abundance of 3.44 (SE = 0.38) individuals per route. The mean number of routes run each year was 11.4 (SE = 1.55). This species is monitored by *MCB* with point transects.

Biological Objective: Maintain or increase the species' distribution and abundance, as based upon results of the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Kingery 1998, Martin 1998.

Pinyon-Juniper

Description and Ecology: Pinyon-juniper habitat extends over large areas in Utah, Colorado, Arizona, Nevada, and New Mexico (Tueller et al. 1979, Figure 1; Balda and Masters 1980). The estimates of total area range widely, between 17 and 40 million ha (43–100 million ac) depending on the definition of pinyon-juniper woodland; the high figure includes juniper of western North America outside the range of pinyon pines. In Colorado, there are approximately 2,000,000 ha (5 million ac) of pinyon-juniper habitat (Brown 1994). Seventy percent of Colorado's pinyon-juniper woodland is in Physiographic Area 87, the Colorado Plateau.

Pinyon-juniper habitat type is a cold-adapted evergreen woodland situated above desert or grassland vegetation and below mountain shrub and pinyon-juniper zones (Pieper 1977); elevations range from 1400 to 2300 m (4,500–7,500 ft; Brown 1994). Colorado pinyon occurs in the eastern two-thirds of the pinyon pine range, and singleleaf pinyon predominates in Nevada. Several species of juniper are dominant or co-dominant, including Rocky Mountain juniper, Utah juniper, one-seed juniper, alligator juniper, California juniper, and redberry juniper. In Colorado, Rocky Mountain juniper grows predominately on the east side of Physiographic Area 62 and in southeast Colorado; farther west it becomes an increasingly rare mesic site species. Eastern red cedar and one-seed juniper enter eastern and southeastern Colorado. Utah juniper grows in the western third of the state.

Proportions of juniper and pinyon within the habitat vary greatly, and pure stands of either tree may occur. Typically, as elevation increases pinyon dominance increases, juniper density decreases, total tree density increases, and trees become larger (Pieper 1977, LaRue 1994). Pinyon pines drop out completely at the lowest elevations. Depending on site variables, pinyon-juniper may range from an openly spaced savanna to a closed forest. Pinyon-juniper understories vary from completely open to quite dense, the densest understories occurring in open canopy woodland/sagebrush communities and where Gambel oak is encroaching.

Soils underlying pinyon-juniper often are shallow, rocky and low in fertility (Pieper 1977). The relative resistance to fire of these soil types favors pinyon-juniper growth. Deep soil sites that are burned tend to revert to open “parks,” often sagebrush, and resist returning to pinyon-juniper cover.

Importance and Conservation Status: Pinyon-juniper habitat supports the largest nesting bird species list of any upland vegetation type in the West. Lowland riparian habitats will, across an entire year, harbor more species of birds due to their importance to migrants. A single ponderosa pine stand typically supports more species than a single pinyon-juniper stand. Aspen stands may hold a higher density of birds. However, the richness of the pinyon-juniper vegetation type is collected across its broad range and due to its middle elevation (Balda and Masters 1980). Survey tallies in pinyon-juniper are similar in species diversity to the best riparian and other types.

Human activities have affected the distribution of pinyon-juniper habitat. Wide-scale programs designed to convert pinyon-juniper woodlands to grasslands for grazing began in earnest after World War II. By the mid 1960s about three million acres had been razed throughout the West (Terrell and Spillett 1975). Seeding with grass to improve forage has met with mixed results, and large conversion projects have proven to be minimally useful to native wildlife (Swenson 1977). In spite of these conversions, human activity has generally increased pinyon-juniper coverage. Fire suppression in grasslands adjacent to pinyon-juniper woodland has allowed the woodlands to advance by out-competing grasses (Little 1977).

Today human activities in pinyon-juniper woodlands are diverse and increasing. Big game hunting and firewood, fence post, and pine nut harvesting are currently stabilized; however, recreational pursuits are burgeoning. Many of these pursuits include all-terrain vehicles which can rapidly turn paths and trails into roads. Oil and gas development has also increased the quantity and quality of roads in the pinyon-juniper zone. The esteem of land managers and users for the pinyon-juniper vegetation type is generally low. The low benefit/cost ratio of conversion projects has served to protect much of what exists today.

Implementation Strategies:

Bird Monitoring

Goal: To monitor or track all breeding birds in pinyon-juniper habitat to document distribution, population trends, and abundance in a statistically acceptable manner.

Objective: All species with AI > 2 will be monitored with count-based methods.

Strategy: Monitoring will be accomplished through the combined efforts of agencies with primary responsibility for managing this habitat.

Strategy: Monitoring efforts will continue to rely on BBS data, with CBO's *Monitoring Colorado's Birds (MCB)* data incorporated as it becomes available.

Status: *MCB* implemented pinyon-juniper habitat transects in 1999 and ran a total of 30 transects; trend data should be available for most species within 5–12 years.

Objective: All species with AI # 2 will be tracked through count-based methods or their presence/absence noted in the state.

Strategy: The *MCB* monitoring program will address this.

Status: *MCB* was implemented in pinyon-juniper habitat in 1999.

Objective: All species with PT of 4 or 5 will be tracked with demographic monitoring.

Strategy: CBO's *MCB* monitoring program will address this.

Status: *MCB* demographic monitoring will begin in 2001.

Habitat Monitoring

Goal: To document the amount, condition, and ownership of pinyon-juniper habitat in Colorado.

Objective: Develop collaborative efforts to use GIS in mapping pinyon-juniper habitat, documenting amount, condition, and ownership.

Status: This effort has not been initiated to date. Potential collaborators include CDOW, CNHP, CBO, USGS, USFS, BLM, and TNC.

Objective: Annually quantify the progress of attitudes and practices of landowners and managers as to their desires, plans, actions, and predictions for specified bird habitats, including their pinyon-juniper habitats.

Strategy: Administer a survey and report the results in a widely circulated medium, e.g., The Denver Post.

Status: Conceptual.

Habitat Core Areas

Goal: To conserve unique representatives and/or large, ecologically-functioning examples of pinyon-juniper habitat in Colorado used during the breeding season, during migration, and/or during the winter.

Objective: Identify such areas, use agency- or organization- specific means of designating and conserving them, and work with the appropriate agency or organization to promote conservation activities.

Status: The Colorado Natural Heritage Program is identifying best examples of vegetation types in their county inventories. These "Conservation Sites" may serve as core area nominees for protecting bird habitat. Some of these sites are fine specimen pinyon-juniper stands.

Objective: Identify any of these areas that are appropriate for designation as *Important Bird Areas (IBAs)*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with pinyon-juniper habitat were nominated in 1999 (including Rabbit Valley Recreation Area, with significant Gray Vireo habitat), and the *IBA* committee will make final selections in 2000.

Objective: Initiate the development of a conservation strategy with the landowners of these *IBAs* and CNAP sites, or by using CNAP and The Nature Conservancy experience.

Status: Landowners of the nominated *IBAs* have been contacted for approval of *IBA* status.

Objective: To maintain or increase the quantity and quality of pinyon-juniper habitat on private lands.

Strategy: Encourage landowners to take advantage of funding opportunities and expertise for creating, restoring, and maintaining pinyon-juniper habitat on their properties.

Strategy: Promote collaboration/cooperation between agencies, organizations, and individuals in conserving unique representatives/core areas with multiple ownership.

Objective: To maintain or increase the quantity and quality of pinyon-juniper habitat on public lands.

Strategy: Integrate the BCP into management plans for public lands in the physiographic area.

Objective: Test the assumption that the winter habitat of pinyon-juniper in Colorado will not seriously limit any species as long as the pinyon-juniper summer habitat roles are addressed successfully.

Strategy: Every five years analyze the Christmas Bird Count (CBC) data to determine the adequacy of the CBC for acquiring pinyon-juniper bird data ,and if needed nominate one or more new count circles to boost these data.

Status: Conceptual.

Site-based Conservation

Goal: To conserve local breeding sites, migratory stopover sites, and wintering sites in pinyon-juniper that are important for the conservation of priority species.

Objective: Identify agency- or organization-specific means of designating and conserving key local sites. Work with appropriate agencies and organizations to designate such sites, and promote conservation activities.

Status: Rabbit Valley Recreation Area has been nominated as a Colorado Watchable Wildlife Site for its importance to Colorado Gray Vireos and Scott's Orioles. The biological and educational significance of these two birds has been incorporated into BLM's Ruby Canyon/Black Ridge Integrated Resource Management Plan, which includes Rabbit Valley.

Objective: Identify key local sites that are appropriate for designation as *IBAs*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with pinyon-juniper habitat were nominated in 1999, including Rabbit Valley Recreation Area, and the *IBA* committee will make final selections in 2000.

Management Practices

Goal: To promote management practices that benefit birds in pinyon-juniper habitats.

Objective: Develop a Best Management Practices manual for pinyon-juniper habitat to the standard of the document *Birds in a Sagebrush Sea*. *Birds in a Juniper Jungle*, therefore, should be written as a west-wide, perhaps nationwide application (red cedar, Ashe juniper). The scope will be determined by the willing participants. COPIF will participate and initiate as needed, seeking a team leader and publisher. The manual will include the following recommendations:

1. Discourage clearing of large mature tracts of habitat.
2. Encourage small-scale opening of habitat.
3. Prevent high-grading opportunities in wood harvesting.
4. Favor cattle grazing over sheep grazing in order to favor forbs over grasses thus favoring nectar flowers.
5. Limit seasonal pinyon nut collection (May through July); limit commercial collection.
6. Manage pinyon ips beetles to prevent extensive pinyon kills, yet maintain adequate food supplies for Hairy Woodpeckers, by allowing a number of slash piles in firewood harvests.

7. Avoid the temptation or pressure to join insect control projects.
8. At the low elevation side of the pinyon-juniper zone fully suppress wildfires, which can be devastating to Cassin's Kingbirds, Gray Vireos, and Scott's Orioles. However, in low-country pinyon-juniper habitat that is dense, consider wildfire as a potential tool to create habitat.
9. Divide pinyon-juniper woodland into subtypes and provide prescriptions and desired percentages for each: 1) Young (isolated "invading" juniper); 2) Young, re-invading trees—often pinyon; 3) Mid age, spaced juniper woodland (savannah); 4) Mature juniper dominated woodland; 5) Mature dense pinyon dominated woodland; and 6) Spaced, old juniper savannah.
10. The partners involved with fire management—BLM, USFS, NPS, USFWS, CDOW, and others—will insert in their fire management plans measures to preserve adequate amounts of quality pinyon-juniper habitat (requires fire size limitations in management units with good potential or existing quality pinyon-juniper habitat; requires inventory to know the area of old growth sites, deep soil sites, open juniper savannah sites; requires monitoring of the annual loss due to fire relative replacement rates).
11. Maintain or increase the quantity of quality habitat on public lands. Integrate the BCP into management plans for public lands in the physiographic area.
12. Recreate the historic open stands of large size class pinyon pine and juniper woodlands and savannahs (Tausch et al. 1981). Encourage managers of public and private lands to set aside pastures for intensive treatment, e.g., thinning, seeding, permanent or long-term rest from grazing.

Status: Production of the BMP manual has not yet been initiated.

Objective: Identify key landowners and land managers and encourage them to incorporate best management practices to conserve pinyon-juniper birds and their habitat.

Strategy: Include in the mailing of grazing authorizations to permittees on public land and national forests who have significant pinyon-juniper woodlands a copy of the pinyon-juniper recommended management practices handbook (BMP manual).

Status: Conceptual.

Interstate/International Wintering Grounds

Goal: To conserve the wintering ground habitat used by birds of pinyon-juniper woodland.

Objective: Track the amount of habitat available on the wintering grounds.

Strategy: Add a map and explanatory text to this plan, showing the primary winter range of the priority pinyon-juniper summer resident bird species. Utilize GIS (state GAP projects, Heritage Program, and/or CBO).

Strategy: Lend support to the quest to miniaturize satellite technology to the point where tracking of "nano-migrants" such as flycatchers, vireos, warblers, and hummingbirds is possible.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to obtain data.

Status: DeGraaf and Rappole (1995) illustrate progress with winter range mapping.

Objective: Protect key tracts of wintering habitat.

Strategy: Identify the wintering distribution and key habitat associations of priority species.

Status: Conceptual.

Strategy: Coordinate with appropriate domestic and foreign government agencies, NGOs.

Collaborate with PIF in Texas, New Mexico, Arizona, and Mexico to indicate Colorado's interest in habitats of highest winter use by priority pinyon-juniper bird species.

Status: Conceptual.

Strategy: Add a prioritized protection strategy to this plan as information accumulates.

Status: Conceptual.

Strategy: Expand coordination that will promote the protection of Sierra de Manantlan Biosphere Reserve (SW of Guadalajara, Mexico), which is in the center of the Colorado pinyon-juniper migrant bird wintering area.

Status: Conceptual.

Strategy: Explore ways to promote the protection of La Michilia Biosphere Reserve, Durango State, Mexico. School adoptions, personnel exchange program, birding-oriented language camp are proposed.

Status: Conceptual.

Strategy: Gather support for conserving a sizeable area at Cerro Mohinoro, Chihuahua State, Mexico (Wege and Long 1995). School adoptions, nature-oriented language camp, eco-friendly business conferencing are proposed.

Status: Conceptual.

Strategy: Explore ways to assist the creation of visitor centers at dedicated natural areas in Mexico to help encourage pride in and protection of these areas.

Status: Conceptual in COPIF; NPS et al. may have made progress.

Migration Concerns

Goal: To protect migratory stopover habitat of birds of pinyon-juniper woodland as they migrate outside of the state.

Objective: Identify important migratory stopover areas for priority species that breed in Colorado.

Objective: Track amount, condition, and ownership of key migratory stopover sites.

Strategy: Utilize GIS (Heritage Program and/or CBO).

Strategy: Collaborate with PIF in Texas, New Mexico, Arizona, and Mexico to indicate Colorado interest in habitats of highest use during spring and late summer by priority pinyon-juniper bird species.

Strategy: Lend support to the quest to miniaturize satellite technology to the point where tracking of "nano-migrants" such as flycatchers, vireos, warblers, and hummingbirds is possible.

Objective: Protect key migration sites for pinyon-juniper migrant species.

Strategy: Emphasize good habitat management across broad sub-pinyon-juniper zones and intensive protective measures on lowland riparian areas.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs.

Strategy: Add a prioritized protection strategy to this plan as information accumulates.

Status: Conceptual, although some sites are under protective status.

Strategy: Explore ways for Coloradans to promote the protection of the San Pedro River National Conservation Area (near Sierra Vista, Arizona), which is demonstrably important to Colorado pinyon-juniper migrant birds.

Status: Conceptual.

Outreach and Education

Goal: To provide information that will improve landowner and general public esteem for the pinyon-juniper woodlands, promoting this habitat's unique values, specialty birds and how to enjoy them—field exercises, and suggesting solutions to management issues.

Strategy: Produce a booklet on pinyon-juniper woodlands for distribution in elementary schools, nature centers, and natural resource agencies. Some educational materials exist that include the pinyon-juniper zone. *From Grassland to Glacier* is an easy textbook for Colorado (Mutel and Emerick 1992).

Strategy: Prepare a syllabus for brief and more extensive presentations at conferences, annual meetings, workshops, and field training programs.

Strategy: Hold workshops and field programs for teachers.

Strategy: Hold workshops and field programs for natural resource professionals (CDOW, BLM, and USFS staff).

Strategy: Produce an agricultural extension bulletin.

Strategy: Submit manuscripts to popular magazines for children and adults and those targeted at landowners, farmers, and ranchers.

Strategy: Explore ways of getting a foot in the door of museums in Colorado and Mexico. Museums are popular outing destinations for school children, especially in Mexico.

Research Priorities

Goal: To identify and facilitate research that will aid in understanding and managing pinyon-juniper habitats for Colorado's birds.

Objective: To identify the top ten research needs in pinyon-juniper habitat in Colorado.

Strategy: Update the list of research needs annually to reflect shifting conservation priorities and to remove research needs from the list as they are investigated.

Strategy: Solicit input from researchers and managers on research needs and accomplishments.

Status: The following research needs have been identified:

1. The general natural history of the priority pinyon-juniper bird species including: breeding biology (Determine second brood fledgling survival; Of the permanent residents, do they form permanent pair bonds? Do they defend territories throughout the year?), foraging biology (Is the species important in limiting number of devastating insects in pinyon?), and habitat requirements.

2. The effects of common fuelwood harvest practices on pinyon-juniper woodland birds. Assessments of its local effects on birds and of its significance, the scope West-wide, should be made.
3. The effect of percent slope on bird use of sites. This will help to answer the question of whether the level and near level sites can be sacrificed to fuelwood sales, wildfires, and vegetation conversion treatments.
4. The hypothesis that Gray Vireo habitat can be created by tree stand thinning.
5. The flower phenology in the pinyon-juniper zone that sustains the Black-chinned Hummingbird through its Nearctic season: it would be helpful to know if livestock grazing systems could be designed to assure adequate nectar sources through the summer season. Site rehabilitation mixes should have the information that could help to bolster flower species that are needed during the leanest nectar periods.
6. Measure the effects of cowbird parasitism on Black-chinned Hummingbirds, Gray Flycatchers, Gray Vireos, Juniper Titmice, and Black-throated Gray Warblers.
7. The conditions that lead to excessive parasitism and predation failure in nesting of pinyon-juniper birds: vireos, including Gray and Plumbeous, are known to not be able to raise their own young when there's a cowbird chick present, but how likely is this to be threatening to a population? Are nest mites more common in closed canopy than open canopy pinyon-juniper, lightly grazed than heavily grazed sites? What level of human presence brings in the jays and drives out the Cooper's Hawks resulting in more nest predation? (This raises a lot of Watchable Wildlife concerns that need studying.) What conditions put snakes into a higher nest predating mode?

Status: The BLM Colorado Plateau Managers Coalition submitted sagebrush steppe and pinyon-juniper woodland research topics recommendations out of the draft Colorado BCP to the 5th Biennial Conference of Research on the Colorado Plateau in Flagstaff on October 25, 1999.

Strategy: Facilitate investigations to answer these questions by providing information about priority needs to universities, public and private research entities, identifying funding sources, and promoting collaboration between management and research agencies.

Strategy: Solicit research funding from the Colorado Plateau Science Committee, the USGS Biological Resources Division, the National Fish and Wildlife Foundation, and other appropriate foundations and agencies.

Priority Species Accounts: Eight priority species are identified for pinyon-juniper habitat: Black-chinned Hummingbird, Gray Flycatcher, Cassin's Kingbird, Gray Vireo, Pinyon Jay, Juniper Titmouse, Black-throated Gray Warbler, and Scott's Oriole.

BLACK-CHINNED HUMMINGBIRD (*Archilochus alexandri*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Gray Flycatcher and Juniper Titmouse.

Distribution: Black-chinned Hummingbirds summer in the western United States. The breeding range indicates avoidance of high mountains where spring arrives late. Their range traces that of the pinyon and/or juniper woodlands of the interior states and semi-arid lands of Pacific states. In Colorado, Black-chinned Hummingbirds are fairly common summer residents in the western valleys and lower mesas. These hummingbirds are uncommon in southeastern Colorado foothills and mesas (Andrews and Righter 1992). They are rare in the ring of pinyon-juniper around the San Luis Valley. Black-chinned Hummingbirds winter in all of Mexico except the southernmost part and the Yucatan Peninsula. Scattered winter reports come from south Texas and the northern Gulf Coast.

Habitat Requirements: Black-chinned Hummingbirds prefer open pinyon-juniper woodland and adjacent shrub and herb covered lands. Alternatives to pinyon-juniper habitat include lowland riparian woodland and tall riparian shrub, including Gambel oak. These hummingbirds also find acceptable habitat in suburban settings. Ornamental plantings such as trumpet vine and hummingbird feeders maintain local nesting populations and assist the migrating population. Important nectar plants for these birds include paintbrushes, scarlet gilia, penstemons, larkspurs, twist flower, plus some rare plants, including giant helleborine and Arapien blazingstar. Black-chinned Hummingbirds are attracted to the flowers that abundantly follow a fire. Wild tobacco is a favorite.

Ecology: Black-chinned Hummingbirds are pinyon-juniper woodland semi-obligates in their Intermountain breeding range. In mid April, the birds return from their shrubby winter ranges. By the first of May the males are performing their courtship-territorial pendulum-like flights. They usually place nests only 1 to 2 m (3–6 ft) from the ground on a drooping branch or in a fork of a tree or even sagebrush or tall weeds. They construct their nests of light-colored plant down from sources such as willow catkins, milkweed pods, and thistle flowers, and the resulting elastic, spongy cup is thickly coated and securely bound by spider webs. Foliose lichens may decorate the cup (Harrison 1979). The summer menu includes flower nectar for energy and small insects to round out nutritional needs. The young are fed mostly insects until fledging. These insects are caught by short chases from a perch. These hummingbirds may assist in the pollination of some rare plants such as golden columbine, Eastwood's monkey flower, and several penstemon species. Cowbird parasitism is not known (Bent 1953). Hazards other than frosty weather are many, but probably are not major mortality factors. These hazards include shrikes, bullfrogs, dragonflies, thistles, and large spider webs (Bent 1953).

Management Issues and Conservation Recommendations: Maintaining a healthy forb component in nesting and adjacent habitats contributes to a healthy nectar and insect food supply for hummingbirds. Livestock grazing can damage this component. *Defer grazing in a rotation that has some pastures flowering at all times through the growing season. This should benefit the security of the forage resource for both livestock and hummingbirds.*

The lowland riparian habitat of this species in and near residential and recreation sites is susceptible to mosquito control demands. The chemical treatment of pinyon-juniper woodland is more likely to be herbicides and limited. *Chemical pest control programs should be limited and a last resort where hummingbirds are desired. Any chemical land treatment proposal should be checked for its hazards to wildlife.*

The sizeable segment of Colorado residents, and also all those along the way to the winter grounds who hang hummingbird feeders, make a considerable enlistment pool from which help for the species can be solicited, from monitoring to improvements in feeding practices.

Status and Reasons for Concern: This species has a high conservation need locally and throughout its range, and Colorado has a high area responsibility with more than 20% of the breeding population. Between 1988 and 1997 an average of 11.4 BBS transects were run in Physiographic Area 87 (SE = 1.55). Black-chinned Hummingbirds were detected on an average of 40% of these transects. The BBS trend for 1969–1996 for Physiographic Area 87 does not show a significant annual rate of change ($P = 0.36$, $n = 13$ routes). Populations throughout their range are vulnerable to mechanical and chemical habitat disturbances. This species is monitored by *MCB* with point transects.

Biological Objective: The objective, based upon results of the *MCB* monitoring program, is to maintain an average of one pair per 30 hectares (about one detection per 10 or fewer miles of continuous-count transects) in woodland types within and below the pinyon-juniper zone.

Selected References: Andrews and Righter 1992, Bent 1953, Harrison 1979, Kingery 1998.

GRAY FLYCATCHER (*Empidonax wrightii*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Ash-throated Flycatcher, Gray Vireo, Pinyon Jay, Juniper Titmouse, and Bewick's Wren.

Distribution: Gray Flycatcher breeding range extends from central Oregon throughout the Great Basin and Colorado Plateau in Nevada, Utah, Colorado, Arizona, and northern New Mexico. In western Colorado they breed from Moffat County southward and in eastern Colorado from Fremont County southward to New Mexico and eastward to southern Chaffee County. They winter from southern Arizona south to central Mexico.

Habitat Requirements: Gray Flycatchers are pinyon-juniper obligates in Colorado. They nest in open pinyon-juniper woodlands, especially where they are adjacent to or intermixed with sagebrush and/or greasewood openings. They use stands with large decadent and dead trees, whether dominated by juniper or by pinyon.

Ecology: These birds arrive from Mexico by early May, and the nesting cycle begins soon after arrival. They build open cup nests of bark, plant down, weed stems and grass, lined with feathers and hair, in the crotch of a juniper or sagebrush 0.6–3 m (2–9 ft) above the ground. Gray Flycatchers lay 3–4 eggs, which the females incubate. They incubate for 14 days, and the young remain in the nest for another 16 days. Gray Flycatchers are strict insectivores. They frequently forage for insects flying low to the ground.

Management Issues and Conservation Recommendations: Gray Flycatchers have a relatively high tolerance for habitat disturbance. They occur in stands of less than one hectare (2.5 ac), but not in such stands isolated from larger stands by a kilometer (0.6 mi) or more. *Avoid management practices which result in fragmenting pinyon-juniper stands into very small patches.*

As with most other pinyon-juniper woodland birds, extensive use of insecticides would be catastrophic to the population. *Use pesticides as sparingly as possible, and postpone such use until birds have completed their breeding cycle.*

Brown-headed Cowbirds frequently parasitize Gray Flycatcher nests (Terres 1981). *Rest pastures in rotation to allow relief from cowbird parasitism.*

Status and Reasons for Concern: This species has a high conservation need locally and throughout its range. Colorado has a high area responsibility with more than 20% of the Gray Flycatcher's breeding range, and populations throughout its range are highly vulnerable. In Physiographic Area 87, BBS data do not show a statistically significant annual rate of change between 1966 and 1996 ($P = 0.55$, $n = 14$ routes). Gray Flycatchers were present on an average of 34.79% (SE = 3.60) of the BBS routes run in Physiographic Area 87 in Colorado during 1988–1997, at an average abundance of 1.60 (SE = 0.19) individuals per route. Mean number of routes run in Physiographic Area 87 during 1988–1997 was 11.4 (SE = 1.55). This species is monitored by MCB with point transects.

Biological Objective: Maintain or increase the species' distribution and abundance, based upon results of the BBS and MCB monitoring programs. A pinyon-juniper woodland point count average of 0.1 or better occurrence rate per point would demonstrate adequate population densities.

Selected References: Andrews and Righter 1992, Kingery 1998, Terres 1981.

CASSIN'S KINGBIRD (*Tyrannus vociferans*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Ash-throated Flycatcher, Gray Flycatcher, and Gray Vireo.

Distribution: Cassin's Kingbirds breed in the Great Plains from southeastern Montana southward, and in the Southwest from central California, southern Utah and Colorado, southward to southern Mexico. They are uncommon to fairly common summer residents locally in southeastern Colorado, and rare to uncommon in western Colorado.

Habitat Requirements: Cassin's Kingbirds choose pinyon-juniper woodlands more often than other types. Sagebrush and rimrock are common habitat features. The percentage of sagebrush park area may exceed that of juniper or pinyon-juniper cover. In southeastern Colorado, cholla (candlestick) cactus is a component of their territory. While they nest in deciduous riparian and agriculture areas, Western Kingbirds exclude them from extensive use of these habitats.

Ecology: In comparison with Western Kingbirds, Cassin's prefer denser vegetation. They prefer pinyon-juniper habitat, and they appear to be less attracted to man-made structures. Both are migrants, but Cassin's Kingbirds usually stay longer and most individuals winter north of the Neotropics (Andrews and Righter 1992). Cassin's Kingbirds arrive in Colorado in mid to late April. Apparently they begin nesting activities later than Western Kingbirds and this may put them at a competitive disadvantage to their congener. The incubation and nestling period is 26 to 28 days. Their nests are usually on horizontal limbs in the upper third of trees (Kingery 1998). The pugnacious nature of these birds may compensate for the ease with which predators and parasitic cowbirds can find their nests. Their sensitivity to human activity seems to be low.

Management Issues and Conservation Recommendations: Research is needed before many specific recommendations for this species can be offered. As with all kingbirds, promoting good nectar plant species would appear to be a significant practice to benefit this species.

Status and Reasons for Concern: This species has a high conservation need locally and throughout its range. The Colorado Plateau has the highest area responsibility for Cassin's Kingbirds, with more than 40% of their range falling within the physiographic area, and the species has a high overall priority ranking. The BBS results for 1969–1996 in Physiographic Area 87 do not indicate a statistically significant annual rate of change ($P = 0.83$, $n = 45$ routes). Cassin's Kingbirds were present on an average of 2.83% (SE = 1.49) of BBS routes run in Physiographic Area 87 in Colorado during 1988–1997, at an average abundance of 0.14 (SE = 0.09) individuals per route. This species is monitored by *MCB* with tracking transects.

Biological Objective: Maintain the presence of this species in every county in which nesting has been documented. In monitoring terms, it is to maintain the same number or more of pinyon-juniper woodland *MCB* point count transects on which this species occurs.

Selected References: Andrews and Righter 1992, Kingery 1998.

GRAY VIREO (*Vireo vicinior*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Gray Flycatcher and Scott's Oriole.

Distribution: Gray Vireo breeding range extends from central California, southern Utah, and southwestern Colorado south to northern Baja California, southern Arizona and New Mexico and western Texas. In Colorado, Gray Vireos nest along the western tier of counties, with centers of abundance in Mesa, Montrose, and Montezuma counties. They also nest on the Eastern Slope in Las Animas County. Gray Vireos winter from the southwestern corner of Arizona south into western Mexico.

Habitat Requirements: Gray Vireos are pinyon-juniper woodland obligates in their Intermountain breeding range. They nest in open pinyon-juniper woodlands between 1350 and 1950 m (4,400–6,500 ft), at the lower edges of the pinyon-juniper belt. These woodlands generally have an understory of grass, sagebrush, mat saltbush, and other desert scrub. Gray Vireos usually inhabit stands dominated by juniper or thin stands of pure juniper. The birds often select stands on steep slopes, and in Colorado National Monument, territories were found that had nearly 300 m (1,000 ft) of elevation range. They do not use dense stands with tall trees, which are frequented by Plumbeous Vireos. Tree density is less than 280 per ha (110/ac). Gray Vireos seem to prefer small patch sizes.

Ecology: These birds arrive from Mexico by early May and the nesting cycle begins soon after arrival. Gray Vireos defend large territories (16 ha; 40 ac). They construct nests of dry grasses, plant fibers, stems, and hair, often camouflaging them with sagebrush leaves. They place their nests 0.6 to 2.4 m (2–8 ft) high in a juniper bush that has a snag protruding from the top where the male frequently sings (Hutchings 1996). The normally lay 3 or 4 eggs, which both parents incubate. Hatching follows an incubation period of 13–14 days and a nestling period of similar length follows.

Management Issues and Conservation Recommendations: In 1995 and 1996 researchers with CBO found 21 Gray Vireo nests during a monitoring effort at Colorado National Monument; the birds had a very low (20% in 1995) success rate. Predators—probably jays, squirrels, and chipmunks—destroyed half of the nests in that study. *Research techniques and management practices which might reduce nest predation.*

Brown-headed Cowbirds frequently parasitize Gray Vireo nests. Only one nest was parasitized in the CNM study where grazing does not occur. *Reduce nest parasitism by Brown-headed Cowbirds by not grazing Gray Vireo nesting areas every year.*

Status and Reasons for Concern: This species has a high conservation need locally and throughout its range. This species is on the national Watch List, indicating a high conservation

need throughout its range. The Colorado Plateau has the highest area responsibility for Gray Vireo, with more than 80% of its range falling within the physiographic area, and the species has a high overall priority ranking. In Physiographic Area 87 BBS data do not show a statistically significant annual rate of change between 1966 and 1996 ($P = 0.29$, $n = 13$ routes). Gray Vireos were present on an average of 7.75% (SE = 2.39) of the BBS routes run in Physiographic Area 87 in Colorado during 1988–1997, at an average abundance of 0.14 (SE = 0.06) individuals per route. Mean number of routes run in Physiographic Area 87 during 1988–1997 was 11.4 (SE = 1.55). This species is monitored by *MCB* with point transects.

Biological Objective: Maintain or increase the species' distribution and abundance, based upon results of the BBS and *MCB* monitoring programs. Achieve and maintain a pinyon-juniper woodland point count average of at least 0.1 per point on all transects that this species ever occurs.

Selected References: Andrews and Righter 1992, Hutchings 1996, Kingery 1998, Terres 1981.

PINYON JAY (*Gymnorhinus cyanocephalus*)

Associated Species: Other species that may use habitats in a similar way and/or respond similarly to threats, management, and conservation activities include Ash-throated Flycatcher, Juniper Titmouse, and Bewick's Wren.

Distribution: Pinyon Jays range the semiarid lands of the West. The *Colorado Breeding Bird Atlas* map shows them south of a diagonal line drawn from the northwest corner to the southeast corner of the state (Kingery 1998).

Habitat Requirements: Pinyon Jays are pinyon and juniper obligates in Colorado and over most of their range. They nest commonly at the lower elevations of pinyon-juniper woodlands, often where junipers dominate. A few nest in ponderosa pine. They prefer extensive stands far from high human activity.

Ecology: For these year-round residents, courtship and nesting begins in the winter. Everything is a group activity. Colonies consist of several dozen pairs, usually with one nest per tree, but sometimes with up to three. They build deep, bulky nests of twigs and shredded bark in the bottom half of the tree canopy, often on the south sides of trees. The colony ranges up to 13 km (8 mi) to find food for the nestlings. This communal species seems relatively safer from predation and more vulnerable to human intrusion than most other pinyon-juniper species. Common Ravens may be the primary nestling predators. Pinyon Jays eat many foods, but pinyon nuts and juniper cones are their staples. Their harvest and storage system allows the use of these foods well beyond the season of ripeness. They typically locate caches on the south sides of trees, where the snow melts the soonest (Balda and Bateman 1971).

Management Issues and Conservation Recommendations: Older pinyon and juniper trees produce the majority of the cones and berries. *Manage for large and old age-class trees for high pinyon nut and juniper berry production.*

Pinyon Jays are secretive during the nesting season and will not nest near human activity. *Consider this jay's nesting sites to be road density sensitive.*

Status and Reasons for Concern: Pinyon Jays are indicators of healthy pinyon-juniper woodlands. The Colorado Plateau has high area responsibility for Pinyon Jay, with more than 20% of its range falling within the physiographic area, and the species has a high overall priority ranking. Partners in Flight in the Intermountain West states uniformly consider it a priority species. The BBS results for 1969–1996 for Physiographic Area 87 do not show a statistically significant annual rate of change ($P = 0.58$, $n = 45$ routes). Pinyon Jays were present on an average of 47.84 (SE = 4.97) of the BBS routes run in Physiographic Area 87 in Colorado during 1988–1997, at an average abundance of 9.54 (SE = 2.15) individuals per route. The mean number of routes run each year was 11.4 (SE = 1.55). This species is monitored by *MCB* with tracking transects.

Biological Objective: Maintain or increase the species' distribution and abundance, based upon results of the BBS and *MCB* monitoring programs. To do this, a target is set to maintain an average of at least one occurrence per 75 points or at least five birds per 100 points on all *MCB* pinyon-juniper woodland transects where they have ever occurred.

Selected References: Andrews and Righter 1992, Balda and Bateman 1971, Kingery 1998.

JUNIPER TITMOUSE (*Baeolophus ridgwayi*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Hairy Woodpecker, Ash-throated Flycatcher, Mountain Chickadee, and White-breasted Nuthatch.

Distribution: The range of the Juniper Titmouse extends from the eastern slope of the Sierra Nevada eastward across most of Utah, Arizona, New Mexico and into western and southern Colorado. They nest in pinyon-juniper woodlands in western and southeastern Colorado. They seem not to inhabit the pinyon-juniper belt encircling the San Luis Valley.

Habitat Requirements: Juniper Titmice reside throughout the year in pinyon-juniper woodlands; few species are as closely tied to a single habitat. They rely on the dense canopies for predator protection and will forage on the ground only where the understory and ground cover are thin (Ryser 1985). They will wander briefly into adjacent habitats to gather food, but nearly all nests are located in pinyon-juniper (Kingery 1998). They seem to use nearly all of the many variations of pinyon-juniper habitats from thin, scattered stands of juniper at its lower limits to very dense stands of predominately pinyon pine heavily mixed with deciduous shrubbery at its upper limits.

Ecology: Juniper Titmice may form permanent pair bonds and may defend territories throughout the year (Ryser 1985). They nest in knotholes and other natural or woodpecker-excavated cavities 1–3 m (3–10 ft) above the ground; the birds often partially excavate the nest hole. They construct their nest of moss, grass, and forbs and line it with fur and feathers (Ehrlich 1988). They begin to incubate in May and most young hatch in early June. Most young leave the nest by late June or early July. Titmice forage by gleaning insects from the bark of small branches and twigs within the canopy. They also take insect galls, fruit, seeds, and other vegetable matter when available. In winter, titmice often join mixed-species foraging flocks (Ryser 1985).

Management Issues and Conservation Recommendations: Titmice require mature pinyon and juniper trees for foraging and nesting cover. *Manage for large size-class junipers to benefit this species.*

Status and Reasons for Concern: This species has a high conservation need locally and throughout its range. The Colorado Plateau has the highest area responsibility for Juniper Titmice with more than 40% of their range falling within the physiographic area. In Physiographic Area 87, BBS data do not show a statistically significant annual rate of change between 1966 and 1996 ($P = 0.47$, $n = 29$ routes). Between 1988 and 1997 an average of 11.4 BBS transects were run in Physiographic Area 87 (SE = 1.55). This species is monitored by *MCB* with point transects.

Biological Objective: Increase the species' distribution and abundance, based upon results of the BBS and *MCB* monitoring programs. A pinyon-juniper woodland *MCB* point count average of 0.08 or better occurrence rate per point would indicate adequate population densities.

Selected References: Andrews and Righter 1992, Ehrlich 1988, Kingery 1998, Ryser 1985.

BLACK-THROATED GRAY WARBLER (*Dendroica nigrescens*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Ash-throated Flycatcher, Mountain Chickadee, Juniper Titmouse, White-breasted Nuthatch, Bewick's Wren, and Chipping Sparrow.

Distribution: Black-throated Gray Warblers have two nesting season ranges, the first in Pacific coastal areas from southwestern British Columbia south sparingly to northern Baja California, and the second in the Intermountain West from central Oregon, the southern fringe of Idaho, and southwestern Wyoming to southeastern Arizona, adjacent Mexico, and southern New Mexico. These warblers winter from coastal southern California and southern Arizona south through the highlands of Mexico and casually to Guatemala (AOU 1983, DeGraaf and Rappole 1995). They are fairly common summer residents in pinyon-juniper woodlands across the southwestern half of Colorado. Some surveys show these warblers to be the most frequently encountered birds in the pinyon-juniper woodland (BLM unpublished records). They are rare in the ring of pinyon-juniper

around the San Luis Valley. In migration they are casual on the eastern plains of Colorado to the Kansas state line (Andrews and Righter 1992).

Habitat Requirements: Black-throated Gray Warblers, in Colorado, are pinyon-juniper obligates, preferring tall, dense pinyon-juniper woodlands (Andrews and Righter 1992). They also occasionally use other conifer types adjacent to pinyon-juniper, such as ponderosa pine and Douglas-fir. Although there are few controlled data, the density of Black-throated Gray Warblers in small tracts (<16 ha; <40 ac) appears to be just as high as it is in large acreages (BLM unpublished data). Small tracts isolated by more than 8 km (5 mi) may have sparser populations than those less than 8 km (5 mi) from larger stands. In a one-year data set, these warblers and the White-breasted Nuthatch showed a preference for pinyon-juniper stands with little understory. This may be due to their preference for stands of larger, taller trees, which typically will have out-competed most of the understory shrubs. Black-throated Gray Warblers selected for stands of pinyon pine dominance over juniper. Pinyon pine tends to dominate on higher elevation, wetter sites, where trees grow taller. Selection for pinyon pine dominance was also observed with White-breasted Nuthatches, Mountain Chickadees, Clark's Nutcrackers, and Hermit Thrushes. In the Southwest and Pacific states, these warblers are consistently associated with oaks in the habitat mix. Gambel oak is almost always associated with upper elevation pinyon-juniper, but Gambel oak has yet to be associated with the occurrence of Black-throated Gray Warblers in the Intermountain West.

Ecology: Black-throated Gray Warblers are pinyon-juniper woodland obligates in their Intermountain breeding range. This obligation may weaken in southeastern Arizona, but in Colorado it is strong. In mid April, the birds return from their shrubby winter ranges to the pinyon-juniper stands and begin tentatively to sing. By the second week of May the males are on territory singing strongly. They generally begin to lay eggs in late May. The young hatch in June and most have left the nest before the end of that month. The nest is built in the low to mid canopy of a tree on a horizontal limb. The nest is built with juniper bark shreds, bits of cocoons, dry leaves, plant down, and hair, and always has feathers woven into the interior lining. These materials are neatly held together and to twigs with spider webs (Harrison 1979). Summer foods are almost wholly insects. Black-throated Gray Warblers are foliage feeders. Black-throated Gray Warblers are inquisitive and tolerate at least temporary human presence well. This species may be vital in the control of pine and pinyon needle scales, juniper scales, leaf miners, oak lace bugs, fruitworm caterpillars, and tree crickets among other potential pests (Furniss and Carolin 1977). In pinyon-juniper woodlands in the White and Inyo mountains of California, pinyon pines were used more than junipers after mid June. Males foraged higher on average than females and spent more time working twigs and branches, while females searched foliage more (Keane 1991 *in* Guzy and Lowther 1997). Cowbird parasitism is apparently low (Bent 1953). Two of three parasitized nests in California had layers of new flooring laid over the cowbird eggs (Guzy and Lowther 1997). Predation by jays and snakes is apparently often high (Bent 1953).

Management Issues and Conservation Recommendations: Black-throated Gray Warblers serve as indicators of healthy pinyon-juniper woodland. *Monitor for significant changes that could identify problems in either its summer or winter ranges.*

Status and Reasons for Concern: The Colorado and Physiographic Area 87 overall priority scores are relatively high (21) for this species. Within Physiographic Area 87, BBS data do not show a statistically significant annual rate of change between 1969 and 1996 ($P = 0.35$, $n = 14$ routes). Black-throated Gray Warblers were present on an average of 39.56% (SE = 3.73) of the BBS routes run in Physiographic Area 87 in Colorado during 1988–1997, at an average abundance of 1.16 (SE = 0.22) individuals per route. Mean number of routes run in Physiographic Area 87 during 1988–1997 was 11.4 (SE = 1.55). This species is monitored by *MCB* with point transects.

Biological Objective: Maintain the species' distribution and abundance, based upon results of the BBS and *MCB* monitoring programs. A *MCB* pinyon-juniper woodland point count average of 0.3 or better occurrence rate per point would indicate good population densities.

Selected References: Andrews and Righter 1992, AOU 1983, Bent 1953, DeGraaf and Rappole 1995, Furniss and Carolin 1977, Guzy and Lowther 1997, Harrison 1979, Kingery 1998.

SCOTT'S ORIOLE (*Icterus perisorum*)

Associated Species: Other species that may use habitats in a similar way and/or respond similarly to threats, management, and conservation activities include Ferruginous Hawk, Mourning Dove, Cassin's Kingbird, Gray Vireo, Northern Mockingbird, Western Meadowlark, and Black-throated Sparrow.

Distribution: Scott's Orioles breed from central Nevada and Utah and western Colorado south into Mexico. In Colorado, Scott's Orioles are extremely localized and insecure. The Atlas project confirmed nesting at the western edges of Montezuma, Mesa, and Garfield counties (Kingery 1998). They have historically occurred in western Rio Blanco County as well. They winter in Mexico and Central America.

Habitat Requirements: Scott's Orioles, like Gray Vireos, nest at the lowest elevations of pinyon-juniper woodlands, where junipers create a savannah with herbaceous vegetation and desert shrubs. Tree density is less than 150 trees per ha (60 trees per ac).

Ecology: These orioles arrive in Colorado in the first week of May and soon begin building their nests in juniper trees. The incubation and nestling period is 28 days. The documented span of nesting activity in Colorado is May 31 to July 7. They feed on fruit and at nectar feeders in the Southwest, but their food preference in Colorado is unknown. Young are fed regurgitated food first and then whole food (insects and fruits) after five days.

Management Issues and Conservation Recommendations: Brown-headed Cowbirds parasitize Scott's Oriole nests. *Provide Scott's Oriole's nesting areas regular spring/summer rest from livestock grazing to reduce nest parasitism by Brown-headed Cowbirds.*

Full suppression is likely the appropriate prescription for fire management in Scott's Oriole habitat; however, prescribed fires may create habitat by opening dense stands. Scott's Oriole's limited range suggests a need to limit congested recreation activities.

Status and Reasons for Concern: The Colorado Plateau has a high responsibility for this species. Colorado supports the Arizona Partners in Flight designation of this species as a priority species. It is a peripheral species in Colorado, but one that is especially attractive to birdwatchers in this state and is vulnerable to habitat change. The Colorado periphery represents a distinct monitoring opportunity for the entire species, whose range can be expected to expand or contract proportionate to the population. Scott's Orioles also represent the needs of species in scattered, open juniper woodlands at the edge of desert shrubland. They have not been detected on BBS routes in Colorado. The BBS results for 1969–1996 for Physiographic Area 87 do not show a statistically significant annual rate of change ($P = 0.15$, $n = 26$ routes). This species is monitored by *MCB* with a statewide census.

Biological Objective: Maintain or increase the species' distribution and abundance, based upon results of *MCB*. Maintain at least 20 pairs in Mesa, Montezuma, and northwestern counties.

Selected References: Andrews and Righter 1992, Kingery 1998.

Ponderosa Pine

Description and Ecology: In Colorado, ponderosa pine is found at 1700 to 2700 m (5,600–9,000 ft). It is a very dry and warm forest, with less than 65 cm (25 in) of precipitation annually. Mature ponderosa pine forests on dry sites are open and park-like; mature trees achieve wide separation as they compete for limited soil moisture, and a luxuriant grassy ground cover is maintained by frequent low-intensity fires. On more mesic sites, ponderosa stands are denser, and closed-canopy stands are common. Ponderosa pines are the largest conifers in Colorado, with mature specimens reaching 120 cm (4 ft) dbh and 45 m (150 ft) tall. Gambel oak is a common component of the understory, typically in a shrubby form in central Colorado and reaching tree form in the southwest. Gambel oak is important for insectivorous birds, since it supports higher insect populations than other vegetation types in the region. Other common understory shrubs include mountain mahogany and wax currant. Tree species sometimes found mixed with ponderosa pine are junipers, pinyon pine, aspen, lodgepole pine, and Douglas-fir.

Ponderosa pine distribution at local and landscape scales is influenced by soil moisture and fire. Ponderosa forests are shaped primarily by fire, which affects species composition and forest structure. Ponderosa forests evolved with frequent, low-intensity fires that cleared understory vegetation and other tree species with lower fire tolerance, but left unharmed the large ponderosa pines with their thick bark (Moir et al. 1997). Heavy grazing in the 1800s and early 1900s reduced and made discontinuous the grass fuels that fed the low-intensity ground fires. As a result, fires have become far less frequent and shrubs and saplings have crowded the once open stands. Another natural disturbance agent shaping ponderosa pine forests is the mountain pine beetle, which kills many ponderosa pines.

Importance and Conservation Status: Birds typical of the ponderosa pine forest type include Wild Turkey, Williamson's Sapsucker, Pygmy Nuthatch, Western Bluebird, and Chipping Sparrow. Ponderosa pine forests support a rich avifauna, in part a reflection of the prevalence of Gambel oak in many ponderosa stands. Oak adds structure and prey—insect densities are higher in oak than in nearby conifers.

Their large size and low-elevation distribution make ponderosa pines popular for timber harvesting. It was the first species extensively harvested in the 1800s, when it was cut for railroad ties, mining timbers, firewood, and construction lumber. It remains a favored timber type for commercial logging and residential firewood collecting. Much of the old-growth ponderosa has been lost due to logging; the structure of many of the old-growth stands that remain has been compromised by dense growth of young trees. Many of the ponderosa pine snags have also been removed, removing a valuable resource for cavity-nesting bird species.

Implementation Strategies:

Bird Monitoring

Goal: To monitor or track all breeding birds in ponderosa pine habitat to document distribution, population trends, and abundance in a statistically acceptable manner.

Objective: All species with AI > 2 will be monitored with count-based methods.

Strategy: Monitoring will be accomplished through the combined efforts of agencies with primary responsibility for managing this habitat.

Strategy: Monitoring efforts will continue to rely on BBS data, with CBO's *Monitoring Colorado's Birds (MCB)* data incorporated as it becomes available.

Status: MCB implemented ponderosa pine habitat transects in 1998 and ran a total of 29 transects in 1999; trend data should be available for most species within 5–12 years.

Objective: All species with AI # 2 will be tracked through count-based methods or their presence/absence noted in the state.

Strategy: The MCB monitoring program will address this.

Status: MCB was implemented in ponderosa pine habitat in 1999.

Objective: All species with PT of 4 or 5 will be tracked with demographic monitoring.

Strategy: CBO's MCB monitoring program will address this.

Status: MCB demographic monitoring will begin in 2001.

Habitat Monitoring

Goal: To document the amount, condition, and ownership of ponderosa pine habitat in Colorado.

Objective: Develop collaborative efforts to use GIS in mapping ponderosa pine habitat, documenting amount, condition, and ownership.

Status: This effort has not been initiated to date. Potential collaborators include CDOW, CNHP, CBO, USGS, USFS, BLM, and TNC.

Habitat Core Areas

Goal: To conserve unique representatives and/or large, ecologically-functioning examples of ponderosa pine habitat in Colorado used during the breeding season, during migration, and/or during the winter.

Objective: Identify such areas, use agency- or organization-specific means of designating and conserving them, and work with the appropriate agency or organization to promote conservation activities.

Status: Appropriate areas that have been identified include USFS Research Natural Areas (Hurricane Canyon in El Paso County), USFS Wilderness Areas, and Colorado Natural Areas Program sites (Rajadero Canyon Natural Area in Conejos County, Cottonwood Canyon State Park in Douglas County).

Objective: Identify any of these areas that are appropriate for designation as *Important Bird Areas (IBAs)*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with ponderosa pine habitat were nominated in 1999, and the *IBA* committee will make final selections in 2000.

Objective: To maintain or increase the quantity and quality of ponderosa pine habitat on private lands.

Strategy: Encourage landowners to take advantage of funding opportunities and expertise for creating, restoring, and maintaining ponderosa pine habitat on their properties.

Strategy: Integrate bird habitat conservation goals and objectives into Colorado State Forest Service materials for landowners.

Strategy: Promote collaboration/cooperation between agencies, organizations, and individuals in conserving unique representatives/core areas with multiple ownership.

Objective: To maintain or increase the quantity and quality of ponderosa pine habitat on public lands.

Strategy: Integrate the BCP into management plans for public lands in the physiographic area.

Objective: To recreate the heterogeneous landscape mosaic of prehistory so that breeding birds are always offered a patchwork of forested parcels in a variety of structural stages and densities.

Strategy: Incorporate landscape-scale habitat management into management plans for public and private lands.

Strategy: Allow wildfires to burn and allow insect outbreaks to run their courses.

Site-based Conservation

Goal: To conserve local breeding sites, migratory stopover sites, and wintering sites in ponderosa pine that are important for the conservation of priority species.

Objective: Identify agency- or organization-specific means of designating and conserving key local sites. Work with appropriate agencies and organizations to designate such sites, and promote conservation activities.

Objective: Identify key local sites that are appropriate for designation as *IBAs*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with ponderosa pine habitat were nominated in 1999, and the *IBA* committee will make final selections in 2000.

Management Practices

Goal: To promote management practices that benefit birds in ponderosa pine habitats.

Objective: A Best Management Practices (BMP) manual will be produced and distributed.

Status: Not yet initiated.

Objective: Identify key landowners and land managers and encourage them to incorporate best management practices to conserve ponderosa pine birds and their habitat.

Interstate/International Wintering Grounds

Goal: To conserve the wintering ground habitat used by birds of ponderosa pine forests.

Objective: Track the amount of habitat available on the wintering grounds.

Strategy: Utilize GIS (state GAP projects, Heritage Program, and/or CBO).

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to obtain data.

Objective: Protect key tracts of wintering habitat.

Strategy: Identify the wintering distribution and key habitat associations of priority species.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect wintering habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Migration Concerns

Goal: To protect migratory stopover habitat of birds of ponderosa pine forests as they migrate outside of the state.

Objective: Identify important migratory stopover areas for priority species that breed in Colorado.

Objective: Track amount, condition, and ownership of key migratory stopover sites.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect migratory habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Outreach and Education

Goal: To provide information on ponderosa pine birds (conservation, habitat needs, natural history, etc.) to children, teachers, naturalists, landowners, natural resource professionals, and other interested parties.

Strategy: Make educational materials available at local nature centers and natural resource agency offices.

Strategy: Hold workshops and field programs for teachers.

Strategy: Hold workshops and field programs for natural resource professionals (CDOW, BLM, and USFS staff).

Strategy: Present information at Teacher Association meetings, conferences, other annual meetings.

Strategy: Submit manuscripts to popular magazines for children and adults.

Research Priorities

Goal: To identify and facilitate research that will aid in understanding and managing ponderosa pine habitats for Colorado's birds.

Objective: To identify the top ten research needs in ponderosa pine habitat in Colorado.

Strategy: Update the list of research needs annually to reflect shifting conservation priorities and to remove research needs from the list as they are investigated.

Strategy: Solicit input from researchers and managers on research needs and accomplishments.

Status: The following research needs have been identified:

1. The effects on bird populations of using thinning and burning to restore ponderosa pine forests to presettlement conditions.
2. The numerical and spatial distribution of disturbance-caused patches, by size and structural stages, across the pre-settlement landscape.
3. Management practices (prescribed burns, timber harvesting) that may be used to mimic the outcome of natural disturbances.

Strategy: Facilitate investigations to answer these questions by providing information about priority needs to universities, public and private research entities, identifying funding sources, and promoting collaboration between management and research agencies.

Priority Species Accounts: Ponderosa pine habitat in Physiographic Area 87 is represented by four priority species: Band-tailed Pigeon, Mexican Spotted Owl, Western Bluebird, and Grace's Warbler.

BAND-TAILED PIGEON (*Columba fasciata*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Wild Turkey, Plumbeous Vireo, Virginia's Warbler, and Black-headed Grosbeak.

Distribution: Two separate populations exist: a coastal population along the West Coast from west-central British Columbia south to northern Baja, and an interior population from southeastern Wyoming to north-central Utah south to west-central Mexico. In Physiographic Area 87 in Colorado, populations are concentrated in the southwestern quarter of the state, with lower numbers throughout the area in appropriate habitat. Birds in this area are of the interior subspecies (*C.f. fasciata*).

Habitat Requirements: In Colorado, these birds breed primarily in ponderosa pine forests and Gambel oak shrublands, but also occasionally in pinyon pine, lodgepole pine, and spruce-fir forests.

Ecology: Birds arrive in the region as early as late March; by mid October, most have left for wintering areas in the southern U.S. south to Central America. The diet consists of Gambel oak acorns, pinyon nuts, seeds, and cultivated grains. Band-tailed Pigeons regularly visit feedlots that lie within their foraging range.

Management Issues and Conservation Recommendations: Band-tailed Pigeons are hunted in Colorado, although hunter activity and harvest are low. Detailed information on the preferred habitat of the birds inhabiting Colorado is lacking, hampering conservation efforts and precluding formulation of management recommendations as related to timber harvest and prescribed burns. Obvious needs of the species include good mast and fruit crops. *Identify and remove the most*

productive oak, serviceberry, and chokecherry stands from big game and livestock range conversion projects. Retain large pines for nesting and roosting.

Status and Reasons for Concern: This species is on the national Watch List, indicating a high conservation need throughout its range. Band-tailed Pigeons are not adequately monitored by the BBS within Physiographic Area 87, and the data collected during 1966–1996 are too sparse for meaningful analysis of trends. However, BBS data for 1966–1996 reveal a statistically significant, survey-wide annual rate of decline ($P = 0.01$; $n = 191$ routes). Band-tailed Pigeons were present on an average of 4.15% (SE = 2.08) of the BBS routes run in Physiographic Area 87 in Colorado, 1988–1997, at an average abundance of 0.11 (SE = 0.06) individuals per route. The mean number of routes run each year was 11.4 (SE = 1.55). This species is monitored by CDOW.

Biological Objective: Maintain or increase the species' distribution and abundance, based upon results of the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Braun 1994, Gutiérrez et al. 1975, Kingery 1998.

MEXICAN SPOTTED OWL (*Strix occidentalis lucida*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Flammulated Owl and Red-breasted Nuthatch.

Distribution: Mexican Spotted Owls reside locally from southern Utah and southern Colorado south into central Mexico. Within the Colorado Plateau region in Colorado, they inhabit only the Mesa Verde National Park area.

Habitat Requirements: Mexican Spotted Owls nest in steep canyons with dense stands of large ponderosa pine or pinyon-juniper with Douglas-fir, and in old-growth mixed-conifer forest with high canopy closure and open understory. They generally favor multi-storied stands with snags and downed logs. In Canyonlands National Park in Utah, they also nest in deep canyons that lack the dense coniferous cover. They nest in tree cavities and on cliff ledges.

Ecology: Mexican Spotted Owls form pair bonds in February and March and lay eggs in March and April. Young birds fledge in June. These owls do not migrate, although individuals sometimes move to lower elevations in winter. Their diet consists primarily of small- to medium-sized mammals, especially woodrats and white-footed mice; they also take voles, rabbits, and some birds.

Management Issues and Conservation Recommendations: The primary threat Mexican Spotted Owls face is the loss of mature trees to timber harvesting and to stand-replacement fires,

especially in steep canyons and in riparian zones. Even-aged management in particular is detrimental because it eliminates habitat and eventually results in stands that lack the multi-storied structure the owls prefer. Prescribed burns outside of the breeding season can reduce the fuel load and lessen the potential for catastrophic fires. The Mexican Spotted Owl Recovery Team recommendations include protecting 240 ha (600 ac) of habitat around each nest (U.S. Fish and Wildlife Service 1995). *Management activities should follow recommendations in the recovery plan.*

Status and Reasons for Concern: This species has a high conservation need locally and throughout its range. The Mexican Spotted Owl is listed as a threatened species at both the federal and state levels. This species is not adequately monitored, and no data from BBS or other long-term monitoring are available. The U.S. Forest Service has conducted extensive surveys to determine this species' range and abundance in Colorado. This species is monitored by *MCB* with nocturnal surveys.

Biological Objective: Increase the species' distribution and abundance; progress toward meeting the objective will be based upon results of the U.S. Forest Service surveys, *MCB* nocturnal surveys, or other monitoring programs.

Selected References: Andrews and Righter 1992, Gutiérrez et al. 1995, Kingery 1998.

WESTERN BLUEBIRD (*Sialia mexicana*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Flammulated Owl, Williamson's Sapsucker, Northern Flicker, Olive-sided Flycatcher, and Pygmy Nuthatch.

Distribution: Western Bluebirds breed in western North America from southern British Columbia south to southern Mexico, and as far east as eastern New Mexico. In Physiographic Area 87 in Colorado, they occur most abundantly in the Southwest.

Habitat Requirements: Western Bluebirds favor open ponderosa pine forests containing large trees and snags with nest cavities. They also frequent meadows, burns, and other open areas within closed ponderosa forests.

Ecology: Western Bluebirds remain year-round in the southwestern part of the state, and some overwinter in river valleys in the west. They initiate nesting by early May, and most young leave the nest by mid August. Their diet consists of invertebrates (grasshoppers, caterpillars, beetles) and berries.

Management Issues and Conservation Recommendations: As with all cavity-nesting species, loss of large trees and snags reduces nesting opportunities. Western Bluebirds and other bird

species of open ponderosa pine forest also lose habitat as fire suppression practices allow the development of dense stands. *Restore ponderosa pine forests to presettlement conditions of large trees and snags, in clusters, with open, grassy understory.*

Status and Reasons for Concern: A very high proportion (estimated at 29.4%) of this species' total population occurs within Physiographic Area 87, indicating that this region has high responsibility for the conservation of Western Bluebirds. Within Physiographic Area 87, BBS data do not show a statistically significant annual rate of change between 1969 and 1996 ($P = 0.75$; $n = 30$). Western Bluebirds were present on an average of 10.44% (SE = 3.21) of the BBS routes run in Physiographic Area 87 in Colorado, at an average abundance of 0.54 (SE = 0.28) individuals per route. The mean number of routes run each year was 11.4 (SE = 1.55). This species is monitored by *MCB* with point transects.

Biological Objective: Maintain or increase the species' distribution and abundance based upon results of the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Kingery 1998, Winternitz 1973.

GRACE'S WARBLER (*Dendroica graciae*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Flammulated Owl, Olive-sided Flycatcher, Violet-green Swallow, Pygmy Nuthatch, and Western Tanager.

Distribution: Grace's Warblers breed from southwestern Colorado and southern Utah, south through central Arizona, western New Mexico, and into north-central Mexico. Wintering areas extend from northern Mexico to Central America.

Habitat Requirements: Grace's Warblers inhabit open ponderosa pine forests with pines 5 m (16 ft) tall, especially with a shrubby understory, usually Gambel oak.

Ecology: Birds arrive in Colorado in early May and lay eggs in late May and early June; the young fledge by late June and early July. Nearly four decades after Webster (1961) declared this "one of the least known of North American parulids," little new information has been published about its ecology.

Management Issues and Conservation Recommendations: Threats to Grace's Warblers include the loss of mature ponderosa pines due to timber harvest, and the closing of ponderosa stands by dense young trees due to fire suppression. *Restore ponderosa pine forests to presettlement conditions of large trees, in clusters, with an open understory of grasses.*

Status and Reasons for Concern: Grace's Warblers have a high conservation need locally and throughout their range. A very high proportion (estimated at 30.6%) of their total population occurs within Physiographic Area 87, indicating that this area has high responsibility for their conservation. These warblers are not adequately monitored by the BBS within Physiographic Area 87, and data collected between 1969 and 1996 are too sparse to allow analysis of trends ($n = 11$ routes). Continent-wide results do not show a statistically significant annual rate of change ($P = 0.42$; $n = 32$) between 1966 and 1996, although results for the same period in New Mexico approach statistical significance ($P = 0.12$; $n = 14$ routes). This species is monitored by *MCB* with point transects.

Biological Objective: Maintain or increase the species' distribution and abundance, based upon results of the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Kingery 1998, Webster 1961.

Sagebrush Shrubland

Description and Ecology: In Colorado, sagebrush is found at elevations of approximately 1200 to 3050 m (4,000–10,000 ft). On moist sites it may reach 3 m (10 ft) tall, but more typically it is under 1.5 m (5 ft). It exists in a variety of climatic conditions, including low-elevation semidesert habitats and moist, cool, mountainous areas. Sagebrush species common in Colorado include big sagebrush and mountain sagebrush. Plants found in association with sagebrush shrublands include rabbitbrush, bitterbrush, snowberry, mountain mahogany, pinyon pine, juniper, and aspen. Grasses, especially bunchgrasses, are common components of sagebrush shrublands, including wheatgrass species, Junegrass, Arizona fescue, and Idaho fescue.

Immense stands of sagebrush, interspersed with small openings of native bunchgrasses, formerly covered hundreds of thousands of hectares in the West (Vale 1975). Little is known about the natural disturbance regimes that shaped this ecosystem, although presettlement sagebrush shrublands probably experienced at least occasional wildfires. Given the slow recovery rate of sagebrush (it will not resprout after fire, but must come back from seed, a process that can take 15–30 years), these wildfires probably sculpted a landscape mosaic of sagebrush stands of varying age interspersed with grassy open areas, on the scale of tens to thousands of hectares.

Importance and Conservation Status: Sagebrush birds evolved in this mosaic, a generally contiguous habitat with comparatively small openings. Consequently, some sagebrush bird species exhibit area sensitivity, i.e., they will not occupy otherwise suitable habitat patches unless the patches exceed some minimum size, often much larger than the home range. This contiguous habitat has been heavily fragmented by removing sagebrush shrubs, leaving small stands separated by large openings. Such fragmentation by anthropogenic causes is a recent phenomenon in evolutionary history. In other habitat types, researchers have documented higher rates of predation and nest parasitism in fragmented habitat than in more contiguous habitat, but these patterns have not been studied extensively in sagebrush.

The primary use of sagebrush shrublands by humans has been for livestock grazing. Historically, sagebrush was cleared to increase forage and to allow a higher stocking rate of domestic animals or to support more grazing wildlife. Where little or no sagebrush removal has occurred, heavy grazing sometimes leads to the elimination of native perennial grasses, which are replaced by exotic annual grasses. In some cases, the herbaceous cover is lost entirely and is replaced by shrubs, which prompts land managers to remove the shrub cover through plowing, burning, chaining, or herbicide treatment. The land is then reseeded for forage, often with exotic grass species.

Sagebrush shrublands that are converted to another cover type have limited potential to revert to sagebrush. Instead, they are usually maintained in those other cover types via increased frequency of fire, distance to seed sources, loss of symbiotic mycorrhizal fungi, and competitive exclusion by other plants.

Much sagebrush has been removed in the interest of improving forage productivity on grazing lands. Perhaps 30% of Colorado's sagebrush had received some treatment between 1900 and 1974 (Braun et al. 1976). Other factors compromising the ecological integrity of sagebrush shrublands include invasion by exotic (e.g., cheatgrass) or native (e.g., pinyon-juniper) plant species, conversion to agricultural, residential and other developed land types, and changes in natural fire regimes.

Implementation Strategies:

Bird Monitoring

Goal: To monitor or track all breeding birds in sagebrush habitat to document distribution, population trends, and abundance in a statistically acceptable manner.

Objective: All species with AI > 2 will be monitored with count-based methods.

Strategy: Monitoring will be accomplished through the combined efforts of agencies with primary responsibility for managing this habitat.

Strategy: Monitoring efforts will continue to rely on BBS data, with CBO's *Monitoring Colorado's Birds (MCB)* data incorporated as it becomes available.

Status: *MCB* implemented sagebrush habitat transects in 1999 and ran a total of 29 transects; trend data should be available for most species within 5–12 years.

Objective: All species with AI # 2 will be tracked through count-based methods or their presence/absence noted in the state.

Strategy: The *MCB* monitoring program will address this.

Status: *MCB* was implemented in sagebrush habitat in 1999.

Objective: All species with PT of 4 or 5 will be tracked with demographic monitoring.

Strategy: CBO's *MCB* monitoring program will address this.

Status: *MCB* demographic monitoring will begin in 2001.

Habitat Monitoring

Goal: To document the amount, condition, and ownership of sagebrush habitat in Colorado.

Objective: Develop collaborative efforts to use GIS in mapping sagebrush habitat, documenting amount, condition, and ownership.

Status: This effort has not been initiated to date. Potential collaborators include CDOW, CNHP, CBO, USGS, BLM, and TNC.

Habitat Core Areas

Goal: To conserve unique representatives and/or large, ecologically-functioning examples of sagebrush habitat in Colorado used during the breeding season, during migration, and/or during the winter.

Objective: Identify such areas, use agency- or organization-specific means of designating and conserving them, and work with the appropriate agency or organization to promote conservation activities.

Status: Appropriate areas include Colorado Natural Areas Program sites (Yanks Gulch/Upper Greasewood Creek Natural Area in Rio Blanco County).

Objective: Identify any of these areas that are appropriate for designation as *Important Bird Areas (IBAs)*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: No sagebrush *IBAs* were nominated in 1999.

Objective: To maintain or increase the quantity and quality of sagebrush habitat on private lands.

Strategy: Encourage landowners to take advantage of funding opportunities and expertise for creating, restoring, and maintaining sagebrush habitat on their properties.

Strategy: Promote collaboration/cooperation between agencies, organizations, and individuals in conserving unique representatives/core areas with multiple ownership.

Objective: To maintain or increase the quantity and quality of sagebrush habitat on public lands.

Strategy: Integrate the BCP into management plans for public lands in the physiographic area.

Objective: To recreate the heterogeneous landscape mosaic of prehistory so that breeding birds are always offered a patchwork of shrubland parcels in a variety of structural stages and densities.

Strategy: Incorporate landscape-scale habitat management into management plans for public and private lands.

Site-based Conservation

Goal: To conserve local breeding sites, migratory stopover sites, and wintering sites in sagebrush that are important for the conservation of priority species.

Objective: Identify agency- or organization-specific means of designating and conserving key local sites. Work with appropriate agencies and organizations to designate such sites, and promote conservation activities.

Objective: Identify key local sites that are appropriate for designation as *IBAs*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: No sagebrush *IBAs* were nominated in 1999.

Management Practices

Goal: To promote management practices that benefit birds in sagebrush habitats.

Objective: A Best Management Practices (BMP) manual will be produced and distributed.

Status: The PIF Western Working Group document *Birds in a Sagebrush Sea* (Paige and Ritter 1999) is available for distribution as hard copy or as a PDF file at <http://www.partnersinflight.org>.

Objective: Identify key landowners and land managers and encourage them to incorporate management guidelines from the *Birds in a Sagebrush Sea* (Paige and Ritter 1999) document into management plans for public lands.

Interstate/International Wintering Grounds

Goal: To conserve the wintering ground habitat used by birds of sagebrush shrublands.

Objective: Track the amount of habitat available on the wintering grounds.

Strategy: Utilize GIS (state GAP projects, Heritage Program, and/or CBO).

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to obtain data.

Objective: Protect key tracts of wintering habitat.

Strategy: Identify the wintering distribution and key habitat associations of priority species.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect wintering habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Migration Concerns

Goal: To protect migratory stopover habitat of birds of sagebrush shrublands as they migrate outside of the state.

Objective: Identify important migratory stopover areas for priority species that breed in Colorado, and key sites for priority species that breed elsewhere.

Objective: Track amount, condition, and ownership of key migratory stopover sites.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect migratory habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Outreach and Education

Goal: To provide information on sagebrush birds (conservation, habitat needs, natural history, etc.) to children, teachers, naturalists, landowners, natural resource professionals, and other interested parties.

Strategy: Make educational materials available at local nature centers and natural resource agency offices.

Strategy: Hold workshops and field programs for teachers.

Strategy: Hold workshops and field programs for natural resource professionals (CDOW, BLM, and USFS staff).

Strategy: Present information at Teacher Association meetings, conferences, other annual meetings.

Strategy: Submit manuscripts to popular magazines for children and adults.

Research Priorities

Goal: To identify and facilitate research that will aid in understanding and managing sagebrush habitats for Colorado's birds.

Objective: To identify the top ten research needs in sagebrush habitat in Colorado.

Strategy: Update the list of research needs annually to reflect shifting conservation priorities and to remove research needs from the list as they are investigated.

Strategy: Solicit input from researchers and managers on research needs and accomplishments.

Status: The following research needs have been identified:

1. The minimum patch sizes needed by area-sensitive sagebrush bird species, as measured by reproductive success.
2. How other habitat factors may affect area sensitivity (such as structural stage or adjacent land cover types).
3. The consequences of habitat fragmentation, such as possible increases in nest predation or cowbird parasitism rates.
4. The effects on sagebrush birds of different management prescriptions, including prescribed burns and different grazing regimes.

Strategy: Facilitate investigations to answer these questions by providing information about priority needs to universities, public and private research entities, identifying funding sources, and promoting collaboration between management and research agencies.

Priority Species Accounts: Four species have been identified as having high conservation need in sagebrush shrubland in Physiographic Area 87: Northern Sage Grouse, Gunnison Sage Grouse, Brewer's Sparrow, and Sage Sparrow.

NORTHERN SAGE GROUSE (*Centrocercus urophasianus*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Sage Thrasher, Brewer's Sparrow, Vesper Sparrow, and Sage Sparrow.

Distribution: The largest populations of Northern Sage Grouse in Colorado inhabit Jackson, Moffat, Rio Blanco, and Routt counties with smaller populations (<500 birds) occurring in Larimer, Grand, Eagle, Garfield, and Mesa counties. Populations in Moffat, Routt, and Jackson counties are contiguous with populations in Utah and Wyoming.

Habitat Requirements: Northern Sage Grouse are sagebrush obligates, depending upon big sagebrush as a primary food and as habitat for nesting, brood rearing, and roosting. They prefer large expanses of big sagebrush on flat or gently rolling terrain, and utilize riparian meadows as brood and summer habitat. They prefer shrub canopy cover averaging between 10% and 20% in brood rearing areas and between 20% and 30% in adult loafing areas. They require the higher percentages for winter habitat (Braun et al.1977). In northwestern Colorado these grouse most commonly reside between 2400 and 2900 m (7,900–9,500 ft) elevation.

Ecology: Males begin arriving on lekking areas (strutting grounds) in March; peak hen attendance on leks and mating occur in early to mid April. Strutting grounds may have 50–100 males, although only a few dominant males perform the majority of copulations. Hens disperse up to 30

km (19 mi) for nesting, although most nest within 5 km (3 mi) of the lek where they mated. Except for summer, when insects and forbs predominate the diet, Sage Grouse depend upon the leaves of sagebrush for food.

Management Issues and Conservation Recommendations: Sage Grouse have been extirpated from four states and are considered at risk in six additional states—including Colorado—and two Canadian provinces. Long term data indicate Sage Grouse populations have declined by 33% range-wide since the mid-1980s, and show a 31% decline in Colorado. The loss of sagebrush habitats through burning, herbicide applications, and conversion to cropland present the greatest threat to Sage Grouse. Additionally, excessive livestock grazing is believed to have detrimental effects upon Sage Grouse nesting and brood-rearing habitat. Better than average grass cover is associated with better than average nest success. Livestock loafing areas around ponds and salting areas coinciding with leks during the spring months may remove the lek from use by grouse. *Protection and management of existing sagebrush rangeland to improve nesting and brood-rearing habitats is critical to reversing the trends in population and productivity. Restoration of summer range conditions is also likely vital. This includes restoration of relatively undisturbed wet meadows and forbs in the upland plant association.*

Status and Reasons for Concern: This species has a high conservation need locally and throughout its range. Although this species is not monitored by the BBS, data from state wildlife agencies have documented severe population declines and loss of sagebrush habitat range-wide. The BLM lists Sage Grouse as a Sensitive Species. This species is not on the national Watch List, but it would qualify based on its National Partners in Flight Database scores. This species is monitored by CDOW.

Biological Objective: Maintain or increase the distribution of this species and increase size and productivity of all breeding populations, based on CDOW surveys.

Selected References: Andrews and Righter 1992, Braun 1995, Braun et al. 1977, Connelly and Braun 1997, Kingery 1998.

GUNNISON SAGE GROUSE (*Centrocercus minimus*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Sage Thrasher, Green-tailed Towhee, Brewer's Sparrow, Vesper Sparrow, and Sage Sparrow.

Distribution: Gunnison Sage Grouse are most abundant in sagebrush habitats in Gunnison County, but they also inhabit suitable sagebrush habitats in Dolores, San Miguel, Montrose, and Saguache counties in southwestern Colorado. They have recently been extirpated in Montezuma County. A small number reside in San Juan County, Utah.

Habitat Requirements: A sagebrush obligate, Gunnison Sage Grouse depend upon big sagebrush as a primary food and as habitat for nesting, roosting, and brood rearing. Their primary habitat consists of large expanses of sagebrush dissected with wet meadows and riparian areas at elevations from 2300 to 2900 m (7,500–9,500 ft).

Ecology: Males begin arriving on lekking areas (strutting grounds) in March to defend territories and attract females. Although strutting grounds may have up to 50–100 males, only a few dominant males perform most copulations of hens, primarily in early April. Hens disperse up to 18 km (11 mi) for nesting, with most nesting within 6.0 km (4 mi) of the lek where they mated. Except for summer, when insects and forbs predominate in their diet, Sage Grouse depend upon the leaves of sagebrush for food, and in the winter they seek sagebrush exposed above the snow. These grouse gather in flocks of 5–50 birds during most of the year.

Management Issues and Conservation Recommendations: Gunnison Sage Grouse occur in eight isolated populations in six different counties with an estimated total breeding population of less than 4,000 individuals. The largest population occurs in Gunnison County, the other populations each having a few hundred individuals at most. The greatest threat to Gunnison Sage Grouse is loss of habitat due to agricultural conversion, encroachment of pinyon-juniper forests, residential development, and other activities which create a fragmented sagebrush landscape. Excessive livestock grazing reduces nesting success and brood survival. The genetic effects of population isolation may eventually result in demographic problems including reduced fertility and hatching success. *Protect existing sagebrush habitats and reestablish corridors to maintain viable populations of this species outside Gunnison County.*

Status and Reasons for Concern: This species has a high conservation need locally and throughout its range. Because of its restricted and fragmented population, and its small population size, this species may become a candidate for listing under the Federal Endangered Species Act. It is listed as a BLM Sensitive Species. This species is monitored by CDOW.

Biological Objective: Gunnison Sage Grouse are not monitored by the BBS. Because of population declines and small populations, the objective is to maintain existing populations in Gunnison County and increase the populations and distribution throughout the remainder of their range based on CDOW surveys.

Selected References: Andrews and Righter 1992, Commons 1997, Kingery 1998, Young 1994.

BREWER'S SPARROW (*Spizella breweri*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Sage Grouse, Sage Thrasher, Green-tailed Towhee, and Sage Sparrow.

Distribution: The distribution of Brewer's Sparrows generally coincides with the distribution of sagebrush in the West, from east-central British Columbia, southeast to southwestern Saskatchewan, then south to southern California and east to central New Mexico. A disjunct population in the Yukon Territory and northwestern British Columbia may be a separate species. In Colorado in Physiographic Area 87, this species is concentrated in the Northwest, with scattered breeders at other locations in suitable habitat.

Habitat Requirements: Brewer's Sparrows are tied closely to sagebrush, where they breed in tall, dense stands or in stands broken up by grassy openings. They also nest in other shrubs, such as willows, mountain mahogany, or rabbitbrush. These sparrows prefer an abundance of shrub cover: within a given habitat patch, their probability of occurrence increases with increases in total shrub cover.

Ecology: Brewer's Sparrows arrive in Colorado in mid to late April, and nesting begins by mid May. Most young fledge in June and July. Most birds have left the state by early October. They winter in the southwestern states and Mexico. Their diet consists of insects, spiders, and grass and forb seeds.

Management Issues and Conservation Recommendations: Brewer's Sparrows suffer habitat loss due to removal of sagebrush, usually for conversion to housing or to improve forage for livestock or wildlife. Treatment of large areas of sagebrush with herbicides causes individuals to abandon the treated area (Schroeder and Sturges 1975). Prescribed burns that remove no more than 50% of the sagebrush may result in a decline in local Brewer's Sparrow populations for 1–2 years, but populations should rebound after that (Petersen and Best 1987). These sparrows prefer large, contiguous sagebrush stands; the minimum acceptable stand size has not been determined but isolated stands of sagebrush smaller than 2 ha (5 ac) are not likely to be nesting habitat (Knick and Rotenberry 1995). *Maintain contiguous sagebrush stands of at least 12 ha (30 ac).*

Status and Reasons for Concern: This species is on the national Watch List, indicating a high conservation need throughout its range. Within Physiographic Area 87, BBS data show a statistically significant annual rate of increase between 1969 and 1996 ($P = 0.03$; $n = 20$ routes). However, BBS data for the period 1966–1996 reveal a significant, survey-wide annual rate of decline ($P < 0.01$; $n = 397$ routes). Brewer's Sparrows were present on an average of 57.68% (SE = 5.05) of the BBS routes run in Physiographic Area 87 in Colorado during 1988–1997, at an average abundance of 18.22 (SE = 2.40) individuals per route. The mean number of routes run each year was 11.4 (SE = 1.55). This species is monitored by *MCB* with point transects.

Biological Objective: Maintain or increase the species' distribution and abundance, with progress toward meeting this objective based upon results of BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Kingery 1998, Knick and Rotenberry 1995, Rotenberry et al. 1999, Short 1984.

SAGE SPARROW (*Amphispiza belli*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Sage Grouse, Sage Thrasher, and Brewer's Sparrow.

Distribution: Sage Sparrows breed from western Wyoming west to central Washington, and as far south as north-central New Mexico in the east and Baja in the west; they also occur in the foothills of the Sierra Nevada Mountains of California. In Colorado, Moffat County has the greatest concentration of Sage Sparrows, with Mesa, Montrose, and Montezuma counties having smaller concentrations. Sage Sparrows have a very limited distribution in Colorado outside of Physiographic Area 87, occurring only uncommonly in the mountain parks. Sage Sparrows' elevational range is narrower than that of the other sagebrush obligate species and is at the low to middle elevations of sagebrush. They winter in the Southwest U.S., Baja California, and northern Mexico.

Habitat Requirements: Sage Sparrows breed almost exclusively in sagebrush (especially big sagebrush), or sagebrush mixed with other shrubs. They prefer semi-open to dense stands of evenly-spaced to clumped, 0.5 to 2 m (1.5–6.5 ft) tall sagebrush (Knick and Rotenberry 1995). As ground feeders, they prefer only a modest amount of understory vegetation. Like the Brewer's Sparrow, they require large, contiguous sagebrush stands. Not all necessary habitat features have been identified, however, as they are often absent from areas where the habitat otherwise appears suitable.

Ecology: Most individuals of this species arrive in Colorado by April, initiate nesting by May, and fledge young during June and July. Most birds leave the state by mid October. Their diet consists primarily of insects and spiders, but they also eat some grass and forb seeds and small fruits.

Management Issues and Conservation Recommendations: Sage Sparrows prefer large patches of sagebrush, and may need patches of continuous habitat of at least 130 ha (320 ac); however, at least one study has shown that this species will accept the loss of up to 50% of the shrubs to wildfire or prescribed fire, provided the landscape pattern is a mosaic of burned and unburned areas (Petersen and Best 1987).

Status and Reasons for Concern: This species is on the national Watch List, indicating a high conservation need throughout its range. Within Physiographic Area 87, BBS data do not show a statistically significant annual rate of change between 1969 and 1996 ($P = 0.68$; $n = 23$ routes). Sage Sparrows were present on an average of 14.82% (SE = 2.65) of the BBS routes run in Physiographic Area 87 in Colorado during 1989–1997, at an average abundance of 2.97 (SE = 0.74) individuals per route. The mean number of routes run each year was 11.4 (SE = 1.55). This species is monitored by *MCB* with tracking transects.

Biological Objective: Maintain or increase Sage Sparrows' distribution and abundance, based upon results of the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Kingery 1998, Knick and Rotenberry 1995, Martin and Carlson 1998, Petersen and Best 1985.

Semidesert Shrubland

Description and Ecology: The semidesert shrubland, or cold desert shrub, habitat is typical of arid continental interiors and is widespread in the vast rain shadows of western North America and central Asia, where annual precipitation is usually below 25 cm (10 in). Generally the lowest upland vegetation type in elevation, it consists of expanses of low widely-spaced shrubs growing in regions with cold harsh winters. North America's best expressions of this type lie in the Great Basin, which begins almost half the state of Utah away from Colorado. However, the rainshadow effect of several mountain chains preserve the arid conditions of the Great Basin onto the Colorado Plateau and into the state of Colorado. Colorado's semidesert shrubland habitats lie in the basins along the western border, in the ascending valleys of the major rivers and tributaries (Platte River excepted), and on the floor of the San Luis Valley.

Semidesert shrubland is a structurally simple habitat. Typical shrub species include budsage, fourwing saltbush, Nuttall's saltbush, mat saltbush, spiny horsebrush (cottonthorn), greasewood, and shadscale. Mormon tea, winterfat, green molly, spiny hopsage, blackbrush, and other shrubs may occur. Native grasses include galleta, blue grama, squirreltail, Indian ricegrass, Sandberg bluegrass, and Salina wildrye. Crested wheatgrass, an exotic species, has been planted widely. Native flowering forbs are numerous, but evening primroses, sego lilies, Indian paintbrushes, and globemallows are among the best known. Annual plants are more abundant in semidesert shrubland than in any other habitat type. Unfortunately, most of these are aggressive non-natives. Cheatgrass tops this list. It, along with filaree, provide the green in the desert winter and early spring. In the fall, Russian thistle becomes the well known tumbling tumbleweed. Cryptobiotic soils are common over these arid soils. Mosses, lichens, and blue-green algae occur, likely in that order of prevalence.

Importance and Conservation Status: Post-Columbian use of this habitat has been primarily livestock grazing, and to a lesser extent hunting and agriculture. With irrigation, cropland and dense settlement has developed in scattered locations. In a few areas, coal mining and petroleum development indicate that some of these lands were not always desert.

Throughout its range, semidesert shrubland is largely intact. However, livestock over-grazing, especially between 1880 and 1934, altered the amount and composition of the vegetal components across much of this zone. Patches of native grasses died out, cheatgrass and halogeton among other undesirable species took their place. Wildfires became more devastating, killing off large expanses of shrub cover (Whisenant 1990).

Bird diversity and density are typically low in semidesert shrubland (Wiens and Rotenberry 1981). This is due to its structural and floristic simplicity (MacArthur and MacArthur 1961, Willson 1974, Rotenberry 1985). However, all semidesert shrubland is not equal. In the washes where tall greasewood becomes dense, the density and diversity of birds matches that of the mountain shrub zone. Nesting species typical of semidesert shrubland habitats include Horned Lark (the dominant

and sometimes only species in low semidesert shrubland country), Mourning Dove, Western Meadowlark, Northern Mockingbird, Loggerhead Shrike, Black-throated Sparrow, and Lark Sparrow. Sage Thrasher, Sage Sparrow, and Brewer's Sparrow occur in the best developed greasewood habitat, especially where big sagebrush is in the mix. Because prairie dogs are typical inhabitants of semidesert shrubland, especially on deeper soils that have a reduced shrub density, this habitat is of considerable importance to Golden Eagles, Ferruginous Hawks, and Prairie Falcons. Lark Buntings are irruptive breeders in semidesert shrubland outside of their usual range (Andrews and Righter 1992, AOU 1998). In a rare year these buntings suddenly appear on the desert, becoming locally common.

Implementation Strategies:

Bird Monitoring

Goal: To monitor or track all breeding birds in semidesert shrubland habitat to document distribution, population trends, and abundance in a statistically acceptable manner.

Objective: All species with AI > 2, including Loggerhead Shrike, Black-throated Sparrow, and Horned Lark, will be monitored with count-based methods.

Strategy: Monitoring will be accomplished through the combined efforts of agencies with primary responsibility for managing this habitat.

Strategy: As a member of Partners in Flight, the Bureau of Land Management will fund the point count work in the semidesert shrubland habitat across Colorado.

Status: The first two years of funding have been approved.

Strategy: Monitoring efforts will continue to rely on BBS data, with CBO's *Monitoring Colorado's Birds (MCB)* data incorporated as it becomes available.

Status: MCB implemented semidesert shrubland habitat transects in 1999 and ran a total of 30 transects; trend data should be available for most species within 5–12 years.

Objective: All species with AI # 2 will be tracked through count-based methods or their presence/absence noted in the state. Burrowing Owl will be monitored using a species-specific technique.

Strategy: The MCB monitoring program will address this.

Status: MCB was implemented in semidesert habitat in 1999.

Objective: All species with PT of 4 or 5 will be tracked with demographic monitoring.

Strategy: CBO's MCB monitoring program will address this.

Status: MCB demographic monitoring will begin in 2001.

Habitat Monitoring

Goal: To document the amount, condition, and ownership of semidesert shrubland habitat in Colorado.

Objective: Develop collaborative efforts to use GIS in mapping semidesert shrubland habitat, documenting amount, condition, and ownership.

Status: This effort has not been initiated to date. Potential collaborators include CDOW, CNHP, CBO, USGS, BLM, and TNC.

Habitat Core Areas

Goal: To conserve unique representatives and/or large, ecologically-functioning examples of semidesert shrubland habitat in Colorado used during the breeding season, during migration, and/or during the winter.

Objective: Identify such areas, use agency- or organization-specific means of designating and conserving them, and work with the appropriate agency or organization to promote conservation activities.

Status: The Colorado Natural Heritage Program (CNHP) database includes a list of protected areas for each species that it tracks.

Objective: Identify any of these areas that are appropriate for designation as *Important Bird Areas (IBAs)*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Strategy: CBO will request that the CNHP and the Colorado Natural Areas Program (CNAP) assist the nomination of at least three of what appear to be the most significant desert or semidesert shrubland sites as *IBAs* in the state. Considerations include size of area, collective variety of birds including the priority species, semidesert shrubland value of the existing *IBAs*, and representation of taller saltbushes, greasewood, and cane cholla habitats.

Status: Conceptual.

Strategy: Initiate the development of a conservation strategy with the landowners of these *IBAs* and CNAP sites, or by using CNAP and The Nature Conservancy experience.

Status: The landowners of the nominated *IBAs* were contacted for approval of *IBA* status.

Objective: To maintain or increase the quantity and quality of semidesert shrubland habitat on private lands.

Strategy: Encourage landowners to take advantage of funding opportunities and expertise for creating, restoring, and maintaining semidesert shrubland habitat on their properties.

Strategy: Promote collaboration/cooperation between agencies, organizations, and individuals in conserving unique representatives/core areas with multiple ownership.

Objective: To maintain or increase the quantity and quality of semidesert shrubland habitat on public lands.

Strategy: Integrate the BCP into management plans for public lands in the physiographic area.

Objective: To recreate the heterogeneous landscape mosaic of prehistory so that breeding birds are always offered a patchwork of shrubland parcels in a variety of structural stages and densities.

Strategy: Incorporate landscape-scale habitat management into management plans for public and private lands.

Site-based Conservation

Goal: To conserve local breeding sites, migratory stopover sites, and wintering sites in semidesert shrubland that are important for the conservation of priority species.

Objective: Identify agency- or organization-specific means of designating and conserving key local sites. Work with appropriate agencies and organizations to designate such sites, and promote conservation activities.

Status: BLM will protect the Rabbit Valley Recreation Area greasewood valley floors from excessive trail development. Semidesert shrubland priority birds and those of local and statewide interest occur here.

Status: The Ruby Canyon/Black Ridge Integrated Resource Management Plan calls for control of trail proliferation here and for the acquisition of the private in-holdings. The site has been nominated as a Colorado Watchable Wildlife Site.

Strategy: Encourage Colorado Division of Parks and Recreation to protect the wide and robust greasewood stand at the northern end of Highline Lake from additional trail development and the prairie dog town on the west side of the lake from facilities expansion.

Status: Current manager has been informed of the concern.

Objective: Identify key local sites that are appropriate for designation as *IBAs*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with semidesert shrubland habitat, including Rabbit Valley Recreation Area, were nominated in 1999, and the *IBA* committee will make final selections in 2000.

Status: Significant migration stopover sites—all wetlands and reservoirs that lie in semidesert shrubland areas—including Alamosa/Monte Vista NWR, Blanca Wetlands Area, and Highline Lake State Park were nominated in 1999.

Interstate/International Wintering Grounds

Goal: To conserve the wintering ground habitat used by birds of semidesert shrublands.

Objective: Track the amount of habitat available on the wintering grounds.

Strategy: Add a map and explanatory text to this plan, showing the primary winter range of the priority summer resident bird species of Colorado semidesert shrublands. Utilize GIS (Heritage Program and/or CBO).

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to obtain data.

Status: An international bird database is being discussed by Partners in Flight.

Objective: Protect the primary winter range of the priority bird species of Colorado's semidesert shrublands.

Strategy: Identify the wintering distribution and key habitat associations of priority species.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs.

Status: CBO and the Denver Audubon Society are developing connections with Mexican counterparts. Southern tier United States are recognizing the same species as priority. Better information exchange and entry of information on each species' scorecard are needed.

Strategy: Collaborate with PIF in Texas, New Mexico, Arizona, and Mexico to indicate Colorado's interest in habitats of disproportionately highest winter use by priority bird species of Colorado semidesert shrublands.

Status: CBO and Denver Audubon Society have developed contacts and visited sites.

Strategy: Explore ways for Coloradans to promote the protection of the Gulf Coast shrub plains of Texas and Tamaulipas, which is the suspected winter destination of the majority of the Colorado population of Loggerhead Shrikes (S. Paynter, personal communication).

Status: Conceptual.

Strategy: Identify the regions where the Burrowing Owls from major populations in East Slope and West Slope Colorado winter, and add specific conservation measures to this plan.

Status: The *Prairie Partners* program from CBO will be doing initial investigations in Mexico in January and February 2000.

Migration Concerns

Goal: To protect migratory stopover habitat of birds of semidesert shrublands as they migrate outside of the state.

Objective: Identify important migratory stopover areas for priority species that breed in Colorado.

Objective: Track amount, condition, and ownership of key migratory stopover sites.

Strategy: Collaborate with PIF in Texas, New Mexico, Arizona, and Mexico to indicate Colorado's interest in habitats of highest use during spring and late summer by priority birds of Colorado semidesert shrublands.

Status: CBO and Denver Audubon Society have developed contacts and visited sites.

Management Practices

Goal: To promote management practices that benefit birds in semidesert shrubland habitats.

Objective: Develop and distribute a Best Management Practices manual for semidesert shrubland habitat to the standard of the document *Birds in a Sagebrush Sea. Deserted Not By Birds*, therefore, should be written as a west-wide application. The scope will be determined by the willing participants. COPIF will participate and initiate as needed, seeking a team leader and publisher. BLM is nominated as the funding lead for this project. The manual should contain the following recommendations:

1. Protect arid shrublands from wildfires. Total wildfire suppression is the appropriate fire management prescription.
2. Improve the fire resistance of desert lands in the state to prevent the loss of shrub cover and to allow shrub recovery where shrub cover has been lost.
3. Avoid the temptation or pressure to join insect control projects.
4. Prevent the proliferation of off-highway-vehicles (OHV) trails.

5. Promote rodent and lagomorph populations of the semidesert shrublands to benefit wintering raptor populations without decreasing the area of quality habitat for summer resident birds.

6. Maintain or increase the quantity of high quality habitat on public lands. Integrate the BCP into management plans for public lands in the physiographic area.

Status: Conceptual.

Strategy: Identify key landowners and land managers and encourage them to incorporate best management practices to conserve semidesert shrubland birds and their habitat.

Strategy: Inquire of each public desert land managing office as to whether full suppression of wildfires on desert lands is the management policy, and adopt an advocacy role where such is not the policy. BLM, USFS, NPS, USFWS, and CDOW are some of the partners that manage semidesert shrubland habitats.

Strategy: Find examples of “greenstrip” plantings that appear to be successful barriers to the run of wildfires across strategic parts of semidesert shrubland. Use these examples to find extension agents and agencies that will promote and perform these projects. (BLM in the Snake River Plain of Idaho has made the most progress.)

Strategy: Negotiate with the USDA Animal and Plant Health Inspection Service to achieve agreements on rangeland pest control that provide assurances for semidesert shrubland wildlife communities. Vigorously oppose the formation of grasshopper control districts that take in large sections of semidesert shrubland.

Strategy: Encourage land management agencies to install in their management plans a recognition that they have a responsibility to set and enforce limits on the density of roads and trails on semidesert shrubland. Some agencies identify “sacrifice areas” and make attempts to discourage OHV use in some areas. However, the proliferation of trails continues and more strategies are needed to deal with conflicting laws and soft policies.

Outreach and Education

Goal: To improve landowner and general public respect for the hazards experienced by open country raptors and the priority semidesert shrubland species by providing information to children, teachers, naturalists, landowners, natural resource professionals, and other interested parties.

Strategy: Produce agricultural extension bulletins that address the role of poaching and “varmint” hunting in the loss of Burrowing Owls and other raptors, the effects of rangeland insect pest spraying, the effects of livestock grazing practices, and the damage to vegetation and ground nesters caused by OHVs and wildfire.

Strategy: Produce a booklet on semidesert shrublands and its fauna for distribution in elementary schools, nature centers, and natural resource agencies.

Strategy: Prepare a syllabus for brief and more extensive presentations at conferences, annual meetings, workshops, and field training programs.

Strategy: Produce or find a producer of a brochure on the value of semidesert shrublands, portraying where they are, how to identify the major shrub species, the importance of

keeping them (birds, other wildlife, livestock, visual, soil protection), the threats to them, and how to protect them.

Strategy: Make educational materials available at local nature centers and natural resource agency offices.

Strategy: Search for and collaborate with producers and publishers.

Strategy: Hold workshops and field programs for teachers.

Strategy: Hold workshops and field programs for natural resource professionals (CDOW, BLM, and USFS staff).

Strategy: Present information at Teacher Association meetings, conferences, other annual meetings.

Strategy: Submit manuscripts to popular magazines for children and adults, and to more specialized magazines targeted at landowners, farmers, and ranchers.

Research Priorities

Goal: To identify and facilitate research that will aid in understanding and managing semidesert shrubland habitats for Colorado's birds.

Objective: To identify the top ten research needs in semidesert shrubland habitat in Colorado.

Strategy: Update the list of research needs annually to reflect shifting conservation priorities and to remove research needs from the list as they are investigated.

Strategy: Solicit input from researchers and managers on research needs and accomplishments.

Status: The following research needs have been identified:

1. The general natural history of the priority semidesert shrubland bird species including: breeding biology (Determine second brood fledgling survival; Of the permanent residents, do they form permanent pair bonds? Do they defend territories throughout the year?), foraging biology (is species important in limiting number of devastating grasshoppers and Mormon crickets), and habitat requirements.
2. The conditions that lead to excessive parasitism and predation failure in nesting of semidesert shrubland birds. Are nest mites more common in lightly grazed than heavily grazed sites? What level of human presence brings in the corvids or changes the predator species balance?
3. The mortality of Colorado semidesert shrubland bird species on winter ranges.
4. The safety and value of the herbicide OUST for cheatgrass control, including the opportunities for small and large-scale applications to enhance bird habitat, without harming prized Chukar populations.
5. Determine the feasibility of re-introducing priority species (Loggerhead Shrike, Burrowing Owl) to habitats that appear to have recovered, yet do not have these birds.
6. Identify the significance of the arid basins in Colorado to wintering raptors and rank them according to importance. (Colorado Field Ornithologists is nominated to organize a schedule of events that will terminate in their publishing these sites with the goal information.)

Strategy: Advertise this and other research needs to the developing Colorado Plateau Cooperative Ecosystems Studies Unit on the campus of Northern Arizona University, Flagstaff, and assist with grant proposal writing.

Strategy: Facilitate investigations to answer these questions by providing information about priority needs to universities, public and private research entities, identifying funding sources, and promoting collaboration between management and research agencies.

Priority Species Accounts: Three species, Burrowing Owl, Loggerhead Shrike, and Horned Lark, are identified as high priority in semidesert shrubland.

BURROWING OWL (*Athene cunicularia*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Ferruginous Hawk, Rough-legged Hawk, Swainson's Hawk, Golden Eagle, Mountain Plover, and Horned Lark.

Distribution: Burrowing Owls nest from southern British Columbia east to southern Manitoba, south to central Mexico, and west to Baja California; a disjunct population occurs in Florida. In Colorado, Burrowing Owls breed throughout the eastern plains and in river valleys and mountain parks elsewhere. Mesa County has the largest population in Physiographic Area 87 in Colorado.

Habitat Requirements: These owls inhabit treeless areas with short vegetation (<10 cm; 4 in), especially in association with colonies of prairie dogs or ground squirrels. The owls nest in burrows dug by the rodents, and prefer the extremely short vegetation found in the colonies. There is some evidence that they prefer larger prairie dog towns, perhaps because of decreased threat of predation.

Ecology: Some uncertainty surrounds the timing of specific breeding events by this species, due to the relative difficulty of studying their underground nests. The owls arrive in Colorado at the end of March and early April, and probably initiate nesting by early May. Fledged young appear at the burrow opening from May through July. The birds leave for their wintering grounds in the Southwest, Mexico, and Central America by mid October. The breeding season diet consists primarily of insects, but small mammals are also taken.

Management Issues and Conservation Recommendations: Programs to control the principal prey species (grasshoppers, crickets, beetles) are detrimental to Burrowing Owl populations, as the insecticides have direct and indirect effects on the birds. *Postpone insecticide use until after young owls have fledged (i.e., after the end of July). To protect agricultural land, consider a grasshopper bait line only along the interface of agricultural and range land.*

Control of prairie dogs and ground squirrels, upon which owls in the western U.S. are totally dependent for burrows, also has a negative impact on Burrowing Owl populations. *Where burrowing mammals must be controlled, use nonlethal means (trapping and relocating) whenever possible to obviate the use of strychnine and other chemicals that also kill Burrowing Owls, or use chemical agents known not to result in secondary poisoning.*

Because these owls habitually perch on the ground outside of a burrow entrance, “varmint” hunters occasionally mistake them for prairie dogs or ground squirrels and shoot them. *Educate hunters on the ecological importance of the owls and provide information on identification.*

Loss of native grassland by conversion to agriculture results in loss of foraging and nesting habitat; urbanization also destroys habitat and results in elevated levels of disturbance related to humans (noise, harassment by pets, collisions with vehicles). *Maintain a 600 m (approx. 2,000 ft) buffer zone around burrows, and prohibit pesticide applications, rodent control, and other human disturbances within this zone.*

Status and Reasons for Concern: This species has a high conservation need locally and throughout its range. The Colorado Division of Wildlife has listed the Burrowing Owl as a Threatened Species. In Physiographic Area 87 the range is restricted, and the subjective evaluation of local birders is that the population has dipped significantly in the past five years. In Physiographic Area 87, BBS data do not show a statistically significant annual rate of change between 1966 and 1996 ($P = 0.65$, $n = 16$ routes). Burrowing Owls were present on an average of 2.92% (SE = 1.97) of the BBS routes run in Physiographic Area 87 in Colorado during 1988–1997, at an average abundance of 0.03 (SE = 0.02) individuals per route. The mean number of routes run each year was 11.4 (SE = 1.55). This species is monitored by *MCB* with nocturnal surveys.

Biological Objective: Maintain or increase the distribution and abundance of Burrowing Owls, based upon results from the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Haug et al. 1993, Kingery 1998, Pezolesi 1994.

LOGGERHEAD SHRIKE (*Lanius ludovicianus*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Long-eared Owl and Northern Mockingbird.

Distribution: Loggerhead Shrikes breed from central Washington, the prairie provinces of Canada, and the northeastern United States to southern Mexico. In Colorado, they frequent the eastern plains, the San Luis Valley, and the desert lowlands of the Western Slope.

Habitat requirements: Loggerhead Shrikes require shrubby habitats in open country. On the eastern plains these are usually shelterbelts, abandoned farmsteads, and other small copses. In Physiographic Area 87, they seek tall desert shrubs, especially greasewood, saltbush, and sagebrush. They will also use pinyon-juniper at the edge of open desert country. Shrikes require thorny shrubbery (or barbed wire) upon which they impale their prey.

Ecology: Loggerhead Shrikes are relatively early nesters, arriving on territories in April, incubating and feeding nestlings in May, and fledging young in June. Their bulky nests, built of small twigs and bark strips, are placed in tall shrubs or small trees in open country. Large insects, especially grasshoppers, provide the bulk of their diet during the breeding season, but Loggerhead Shrikes are effective predators and also capture small birds, mice, and lizards.

Management Issues and Conservation Recommendations: Greasewood and robust sagebrush stands compete for preferred livestock forage and thus are targeted for vegetation conversion projects. *Discourage conversions of this habitat. (Conversions in greasewood generally do not have a positive cost/benefit ratio. Conversions of other semidesert shrub types for livestock forage are not economical.)*

Wildfires are the most significant threat to Loggerhead Shrikes in their semidesert shrubland habitat. *Fully suppress wildfires in this habitat. Planting "greenstrips" to stop shrub-killing wildfires has shown promise in southern Idaho and may work as well in Colorado (BLM records).*

High cattle traffic poses a direct physical threat to nests. Livestock tend to congregate where greasewood has the potential to support the most birds, on flat floodplains. *Urge dispersal of grazing pressure in pastures with tall, dense shrub stands.*

In rare years semidesert shrubland experiences a grasshopper or Mormon cricket population explosion. These events inspire insecticide spray programs that need careful planning to prevent the collapse of whole animal communities. *Using insecticides across a broad area of non-agricultural semidesert shrubland is not appropriate on public lands and not economically viable on private rangelands, although it may be briefly politically attractive.*

Status and Reasons for Concern: This species has a moderately high conservation need throughout its range, a high representation in the physiographic area, and a declining population trend. The Loggerhead Shrike is a species of moderately high global vulnerability. Between 1988 and 1997 Loggerhead Shrikes were detected on an average of 9.52% of the BBS transects run in Physiographic Area 87 (SE = 3.34). The BBS results for 1969–1996 for Physiographic Area 87 indicate an 8.9% annual rate of decline ($P < 0.01$, $n = 44$ routes). Continental BBS trends suggest a decline of 3.5% per year, with 63% of the routes reporting drops. This rate of decline will lead to the loss of two-thirds of the population in three decades (Kingery 1998). Loss of tall desert shrub habitat to development, disturbance of this habitat by grazing (especially in desert riparian

areas), and heavy use of insecticides to combat grasshopper damage all pose threats to Loggerhead Shrike survival. This species is monitored by *MCB* with point transects.

Biological Objective: Maintain or increase the species' distribution and abundance, based upon results of the BBS and *MCB* monitoring programs. Maintain an average of one pair per 15 hectares (one pair per 37 ac) of >1 m (3 ft) tall desert shrub habitat [area equals about a 1.6 km (1 mi) continuous count belt transect 100 m (330 ft) wide]. Maintain nesting success averages greater than or equal to 2.5 on the Western Slope.

Selected References: Andrews and Righter 1992, Kingery 1998, Yosef 1996.

HORNED LARK (*Eremophila alpestris*)

Associated Species: Another species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities is the Burrowing Owl.

Distribution: Horned Larks are holarctic birds, ranging into North Africa and high into the eastern Andes of Columbia. In North America they occur in every province and state except Hawaii. They are less common in the East, frequenting beaches, plowed and low stubble fields, and airfields. Horned Larks are quite infrequent in Florida and the Yucatan states. In Colorado they inhabit expansive treeless areas: mountain parks, alpine tundra, and shortgrass prairie. In Physiographic Area 87, desert and low cover sagebrush steppe make up their primary range.

Habitat Requirements: Horned Larks choose treeless areas with short grass, forbs, and/or scattered short shrubs. They seem to prefer native perennial vegetation over pure annual vegetation for nest sites.

Ecology: This ground nester may begin building its nest cup in mid April and nesting can continue into August. Nest parasitism has been observed in Colorado, but predation is likely a larger threat to nesting success. Predators include bullsnakes, kit and swift foxes, ravens, Prairie Falcons and, in winter, Merlins. Livestock trampling destroys a few nests. In winter over 90% of the Horned Larks' diet is plant material, largely what are seen by humans as weed seeds. In summer their diet is about two-thirds plant matter and one-third arthropods. Snow conditions in winter brings flocks of Horned Larks to exposed highways, where many are killed by vehicles.

Management Issues and Conservation Recommendations: The Horned Lark is probably the most abundant bird in Physiographic Area 87 and despite its population declines, concern for it is more as an indicator species of land health on its preferred habitat type. On some ranges it is an indicator of degraded condition. *Monitor for changes that would indicate significant losses of appropriate habitat.*

Land use practices (vegetation cover reductions) that benefit Horned Larks, will probably be deleterious of conditions for most other arid land birds. Loss of native grassland by conversion to agriculture results in loss of nesting habitat and narrowing of the foraging season on such lands. *Discourage the conversion of native grassland to agriculture.*

Programs to control the principal prey species (grasshoppers, crickets, beetles) are detrimental to Horned Larks, as the insecticides have direct and indirect effects on the birds. *Avoid using insecticides over large expanses of public rangelands and discourage such use on private lands. Consider a grasshopper bait line only along the interface of agricultural and range land.*

Status and Reasons for Concern: Horned Larks were recorded on an average of 33% of the BBS transects run in Physiographic Area 87 between 1988 and 1997. The BBS results for 1969–1996 for Physiographic Area 87 show a 4.60% annual rate of decline ($P < 0.01$, $n = 59$ routes). Horned Larks represent the wildlife preferring the low-stature forms of this habitat and requiring relatively large habitat patches. The value of this species as an indicator species merits the attention here. However, the significant, long-term decline in Horned Larks should be noticed. No studies implicate improving range condition, decrease in weeds, agricultural practices, vehicular traffic or any other factor in this population decline. This uncertainty, of course, diminishes the value of Horned Larks as an indicator species. This species is monitored by *MCB* with point transects.

Biological Objective: Maintain or increase the species' distribution and abundance, based upon results of the BBS and *MCB* monitoring programs. Locally, where range potentials for vegetative cover are greater than are suitable for Horned Larks, reductions in population density is the objective.

Selected References: Andrews and Righter 1992, Hurley and Franks 1976, Kingery 1998.

Wetlands

Description and Ecology: The wetlands habitat category encompasses a large variety of ecosystems of large and small proportions. The state of Colorado has numerous representatives of this variety: marshes, wet meadows, seeps, springs, rivers, lakes, ponds, swamps, fens, bogs, hanging gardens, and playas (Windell et al. 1986, Benedict 1991). Many of Colorado's wetlands, including some that support priority species, are artificial. Such wetlands include irrigated meadows and man-made reservoirs, lakes, and ponds with their associated marshes. Less than 3% of the surface area of Colorado originally occurred as wetlands (Dahl 1990). Approximately 40% to 60% (0.4–1.2 ha; 1–3 million ac) of the original wetlands area has been lost (Dahl 1990, Wilen 1995). Losses are greater proportionately in wetlands than in other habitat types in Colorado.

Wetlands in Colorado range in size from a few square meters (e.g., springs and splash pools) to large areas of wet meadows and riparian wet forests. They include wetlands along riparian corridors that may continue for many kilometers, yet are quite narrow. (Discussion of riparian habitats will be found in the appropriate section: lowland riparian or high elevation riparian habitats.) What all wetlands have in common is water. The water occurs in sufficient quantities and in such patterns that the soils, geomorphology, and vegetation respond characteristically, forming repeated patterns on the landscape. The repeated patterns are categorized as types of wetlands.

All wetlands likely play a role in the lives of birds, at least as sources of water. But many wetland types are very small and unlikely to make a large contribution to Colorado's avifauna. (Although any wetlands may be important to local conservation.) Wetlands that support high priority bird species include lakes, ponds, reservoirs, wet meadows, playas, and marshes. The remaining, smaller wetlands are perhaps best considered as patch types and important habitat components within a larger habitat matrix.

Physiographic Area 87 contains a number of Colorado's most significant wetland areas. In the San Luis Valley, Alamosa and Monte Vista National Wildlife Refuges, Russell Lakes and San Luis Lakes State Wildlife Areas, Blanca Wetlands, and Cotton Lake host concentrations of wetlands birds that are among the state's largest. On the Colorado Plateau in western Colorado, Fruitgrower's Reservoir and Browns Park NWR both provide habitat for large numbers of nesting and migrating wetlands species. Numerous wet meadows dot the ranch lands in the river valleys.

Importance and Conservation Status: Thirty-seven of Colorado's breeding bird species are dependent on wetlands. That means that 14% of the breeding species depend on less than 3% of the state's area. Many of the species are common and are presently of little current conservation concern (e.g., Red-winged Blackbird).

In the water-restricted western United States, water resources are necessary for life, and control of water can become a most lucrative asset. Water law in Colorado, as in most western states,

recognizes water as one of a bundle of property rights. As such, water is owned, bought and sold, as property. For mining operations, agricultural irrigation, and drinking water for a growing population, water has been harnessed, moved, stored, slowed, and spread. Wetlands have often been considered impediments to efficient water use, slowing its downstream progress to areas of human use. Many wetlands have been drained and others heavily altered. Dahl (1990) estimated wetland losses in Colorado to be approximately 50%. More specific estimates for wetland losses in the Colorado Plateau are not available, and interpretations are very complicated because of the large number of created wetlands.

Wetland manipulations have resulted in the addition of many acres of wetlands (Kingery 1998). For example, irrigation canals move water from mountain rivers or streams into the desert. Some of the water escapes the confines of ditches and leaks into the surrounding landscape; this escaped water often creates artificial springs. Vegetation changes around such seepages are often the emergence of wetlands such as wet meadows, small standing waters, shrub thickets, and woody groves. Such areas are often rich with birds, and where trees and shrubs occur, the associated birds may represent those found in riparian habitats. The largest changes in Colorado's wetlands came from the creation of water storage facilities, reservoirs and ponds (Kingery 1998). These reservoirs are often placed on top of existing wetlands where they may greatly expand the total wetland acres.

Wetlands that support high priority bird species in Colorado have shown variable changes over the past 150 years. Shallow lakes and ponds that supported large populations of breeding waterfowl have declined in many areas. Instead, reservoirs are often maintained with little vegetation. A common goal of water users is to provide the smallest surface area of water to limit evaporation losses; this goal often creates wetlands habitats that are relatively sterile.

It is difficult to assess the status of marshes since agricultural practices have created numerous marshes. However, it is clear that native graminoid-dominated marshes have clearly suffered extensive losses, even more when the condition of the landscape in which they occur is considered (J. Sanderson, personal communication). For example, a marsh may have adequate breeding habitat for Northern Harriers, but a landscape that is inadequate or ecologically dysfunctional.

The concept of no net loss of wetlands appears to be adequate for protecting the associated birds in Colorado. However, existing guidelines for wetlands mitigation, i.e., the focus on jurisdictional wetlands, rarely give adequate attention to bird communities or high priority species that are not given legal status. Cumulative changes of wetland types and loss of ecosystem-level biological attributes continue to reduce the amounts of wetlands habitats that are suitable for the more sensitive wetlands species. Recommendations for making wetlands mitigation more suitable for birds are laudable but may not adequately address the concerns for the most sensitive species.

In summary, wetlands habitats are diverse and widespread on the Colorado Plateau. The wetland types that support most wetlands bird species are playas, marshes, wet meadows, lakes, and ponds.

The status of these wetlands communities is checkered, with an increase in lakes, ponds, and seeps. Losses of springs, wet meadows, and playas are notable. Marshes have probably declined somewhat, but mostly have changed from native condition to altered and scattered patches.

Implementation Strategies:

Bird Monitoring

Goal: To monitor or track all breeding birds in wetlands habitat to document distribution, population trends, and abundance in a statistically acceptable manner.

Objective: All species with AI > 2 will be monitored with count-based methods.

Strategy: Monitoring will be accomplished through the combined efforts of agencies with primary responsibility for managing this habitat.

Strategy: Monitoring efforts will continue to rely on BBS data, with CBO's *Monitoring Colorado's Birds (MCB)* data incorporated as it becomes available.

Status: MCB implemented wetlands transects in 1999 and ran a total of nine transects; trend data should be available for most species within 5–12 years.

Objective: All species with AI # 2 will be tracked through count-based methods or their presence/absence noted in the state.

Strategy: The MCB monitoring program will address this.

Status: MCB was implemented in wetlands habitat in 1998. In 1998 and 1999 the program conducted counts of Eared Grebes, Western Grebes, Clark's Grebes, and White-faced Ibis at historical nest sites.

Objective: All species with PT of 4 or 5 will be tracked with demographic monitoring.

Strategy: CBO's MCB monitoring program will address this.

Habitat Monitoring

Goal: To document the amount, condition, and ownership of wetlands habitat in Colorado.

Objective: Develop collaborative efforts to use GIS in mapping wetlands habitat. Mapping important examples of wetlands is needed as a first step in a monitoring program.

Subsequent monitoring of the areas should include size, ecological composition, and landscape context.

Status: This effort has not been initiated to date. Potential collaborators include CDOW, CNHP, CBO, USGS, BLM, and TNC.

Objective: Identify and protect the ecological processes that support specific wetlands and their associated bird communities. This is particularly important where wetlands are supported by groundwater.

Habitat Core Areas

Goal: To conserve unique representatives and/or large, ecologically-functioning examples of wetlands habitat in Colorado used during the breeding season and/or during migration.

Objective: Identify such areas, use agency- or organization-specific means of designating and conserving them, and work with the appropriate agency or organization to promote conservation activities.

Objective: Identify any of these areas that are appropriate for designation as *Important Bird Areas (IBAs)*, nominate them, and promote involvement of local groups in conserving these areas once they are designated.

Status: Sites with wetlands habitat were nominated in 1999 (including Alamosa NWR/Monte Vista NWR, Blanca Wetlands Area, Russell Lakes SWA, San Luis Lakes State Park, Browns Park NWR, Crawford State Park, Highline State Park, Sweitzer State Park, and Unaweep Seep), and the *IBA* committee will make final selections in 2000.

Objective: To maintain or increase the quantity and quality of wetlands habitat on private lands.

Strategy: Encourage landowners to take advantage of funding opportunities and expertise for creating, restoring, and maintaining wetlands habitat on their properties.

Strategy: Promote collaboration/cooperation between agencies, organizations, and individuals in conserving unique representatives/core areas with multiple ownership.

Objective: To maintain or increase the quantity and quality of wetlands habitat on public lands.

Strategy: Integrate the BCP into management plans for public lands in the physiographic area.

Site-based Conservation

Goal: To conserve local breeding sites, migratory stopover sites, and wintering sites in wetlands that are important for the conservation of priority species.

Objective: Identify agency- or organization-specific means of designating and conserving key local sites. Work with appropriate agencies and organizations to designate such sites, and promote conservation activities. Work with the State Wetlands Initiative to ensure that funded conservation projects support the goals of this plan.

Strategy: Work with waterfowl management interests to conserve regionally significant areas, ensuring that non-game interests are maintained to incorporate best management practices to conserve wetlands birds and their habitat.

Objective: Integrate wetlands bird BMPs into waterfowl management plans as appropriate, ensuring conservation of the entire avian community.

Interstate/International Wintering Grounds

Goal: To conserve the wintering ground habitat used by birds of wetlands habitats.

Objective: Track the amount of habitat available on the wintering grounds.

Strategy: Utilize GIS (state GAP projects, Heritage Program, and/or CBO).

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to obtain data.

Objective: Protect key tracts of wintering habitat.

Strategy: Identify the wintering distribution and key habitat associations of priority species.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect wintering habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Migration Concerns

Goal: To protect migratory stopover habitat of birds of wetlands habitats as they migrate outside of the state.

Objective: Identify important migratory stopover areas for priority species that breed in Colorado, and key sites for priority species that breed elsewhere.

Objective: Track amount, condition, and ownership of key migratory stopover sites.

Strategy: Coordinate with appropriate state PIFs, domestic and foreign government agencies, and NGOs to protect migratory habitat through Habitat Core Areas and Site-based Conservation goals and objectives.

Management Practices

Goal: To promote management practices that benefit birds in wetlands habitats.

Objective: A Best Management Practices (BMP) manual specific to wetlands birds will be produced and distributed. (A more general wetlands BMP manual is available: Peale 1996.) The manual should include the following topics and recommendations:

1. Enhance the current legal protection of wetland functions by emphasizing the protection of natural wetland structure, composition, and ecological processes. The current focus on protecting jurisdictional wetlands is insufficient to conserve many wetlands-associated species, particularly the more sensitive bird species (Buhlmann et al. 1996).
2. Include bird conservationists in the process of planning and approving new reservoirs to produce more bird-friendly projects.
3. Develop grazing plans for wetlands that support wetlands bird conservation.
4. Impose limits on free-ranging dogs.
5. Guidance on landscape context, particularly with respect to buffers against incompatible land uses (e.g., some urbanization).
6. Manage man-made wetlands (e.g., reservoirs surrounded by extensive marshes, return flows from ditches and canals, agricultural return flows, etc.) that provide habitat for birds to protect the supported bird communities. This includes best management practices centered on water level management, recreation, and maintenance.

Status: Not yet initiated.

Objective: Identify key landowners and land managers and encourage them to incorporate best management practices to conserve wetlands birds and their habitat.

Objective: Integrate wetlands bird BMPs into waterfowl management plans as appropriate, insuring conservation of the entire avian community.

Outreach and Education

Goal: To provide information on wetlands birds (conservation, habitat needs, ecological processes, natural history, etc.) to children, teachers, naturalists, landowners, natural resource professionals, and other interested parties.

Strategy: Make educational materials available at local nature centers and natural resource agency offices.

Strategy: Hold workshops and field programs for teachers.

Strategy: Hold workshops and field programs for natural resource professionals (CDOW, BLM, and USFS staff).

Strategy: Present information at Teacher Association meetings, conferences, other annual meetings.

Strategy: Submit manuscripts to popular magazines for children and adults.

Research Priorities

Goal: To identify and facilitate research that will aid in understanding and managing wetlands habitats for Colorado's birds.

Objective: To identify the top ten research needs in wetlands habitat in Colorado.

Strategy: Update the list of research needs annually to reflect shifting conservation priorities and to remove research needs from the list as they are investigated.

Strategy: Solicit input from researchers and managers on research needs and accomplishments.

Status: The following research needs have been identified:

1. The status, variability, and locations of playas and playa complexes. Specific attention should be paid to the identification of playa complexes and their local and regional roles.
2. The habitat requirements, including landscape context, of wetlands birds. This is particularly important where the wetlands area is small and surrounded by dissimilar vegetation types.
3. The criteria for successful reserve design. Some examples exist relative to human disturbance (Klein et al. 1995), but little is known about the more comprehensive needs of wetlands avian communities.

Strategy: Facilitate investigations to answer these questions by providing information about priority needs to public and private research entities, identifying funding sources, and promoting collaboration between management and research agencies.

Priority Species Accounts: Two species are identified as high priority birds for the wetlands habitats in Physiographic Area 87: Northern Harrier and Short-eared Owl.

NORTHERN HARRIER (*Circus cyaneus*)

Associated Species: Species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Virginia Rail, Sora, Common Snipe, Short-eared Owl, Marsh Wren, Red-winged Blackbird, and Yellow-headed Blackbird.

Distribution: Northern Harriers breed in North America and Eurasia. They breed throughout North America except for the South and Southeast, with their highest densities occurring in the northern prairie regions (Price et al. 1995). They reside throughout Colorado, with highest densities on the eastern plains, mountain parks, and western valleys.

Habitat Requirements: Northern Harriers breed in a wide array of habitats, but they typically prefer large tracts (100 ha; 250 ac) of wetlands with dense vegetation. Actual breeding habitat preferences are fairly broad and specific habitats include wet meadows, grasslands, sagebrush, and mountain shrublands. This species has a large home range (Craighead and Craighead 1956), which makes the researcher's task of locating nests difficult.

Ecology: Although breeding dates vary considerably with altitude, in Colorado Northern Harriers generally initiate breeding in late April. Females construct the nest on the ground in abundant cover. They incubate during May; incubation begins before laying is complete and lasts 24–30 days. Hatching takes place in June, and young spend approximately five weeks in the nest, leaving by early August. Females do the incubation and brooding, and males provide food for the females during this period and for the young. These hawks feed on small mammals, birds, reptiles and amphibians. They hunt by flying low over wetlands, grasslands, shrublands, and croplands. Their keen sense of hearing and sight make their low altitude hunting strategy successful.

Management Issues and Conservation Recommendations: The population of Northern Harriers has declined due to wetlands habitat losses. Large feeding areas are needed. *Identify and protect larger wetlands used by this species. Erect buffers to incompatible land uses such as urban development.*

In wetlands where water levels are regulated, nests become flooded by sudden rises in water levels. *Do not allow water levels to rise more than 6 in (15 cm) during nesting season.*

Large numbers of livestock permitted to graze in wetlands during the breeding season may accidentally trample nests or young. *Stock wet meadow and wetland pastures at low level.*

Habitat management schemes for waterfowl and upland game birds generally benefit harriers. *Managers should continue to consider the potential benefits and impacts of such management to Northern Harriers.*

Loss of prey species, either through direct control or through habitat loss, reduces populations. *Maintain populations of voles at levels compatible with economic uses of the land.*

Some nests are destroyed by agricultural equipment. *Postpone haying until after the end of nesting, or avoid the area immediately around harrier nests.*

Status and Reasons for Concern: This species has a moderately high conservation need throughout its range, along with high representation in the physiographic area and a declining population trend. The BBS data for 1966–1996 are too sparse for meaningful analysis of trends. Northern Harriers were present on an average of 6.99% (SE = 2.29) of BBS routes run in Physiographic Area 87 in Colorado, 1988–1997, at an average abundance of 0.09 (SE = 0.03) individuals per route. The mean number of routes run each year was 11.4 (SE = 1.55). This species is monitored by *MCB* with point transects.

Biological Objective: Increase the species' distribution and abundance, based upon results of the BBS and *MCB* monitoring programs.

Selected References: Andrews and Righter 1992, Kingery 1998, MacWhirter and Bildstein 1996.

SHORT-EARED OWL (*Asio flammeus*)

Associated Species: Other species that may use habitat in a similar way and/or respond similarly to threats, management, and conservation activities include Northern Harrier, Barn Owl, and a variety of waterfowl.

Distribution: Short-eared Owls' breeding range is circumpolar in the northern hemisphere, primarily above 40 degrees north latitude. Northern populations withdraw in the winter, but they are residents through the year in mid latitudes. The southern states and Mexico host wintering birds. They also reside in the unforested regions of South America. These owls are sparsely and widely distributed in Colorado, with more birds present in winter than in summer. Breeding birds are most common on the northeastern plains, in North Park, and in the San Luis Valley. Browns Park NWR has also reported this species as an occasional breeder. Records indicate that they have never been common breeders in Colorado (Boyle 1998).

Habitat Requirements: These owls breed and forage in grasslands, prairies, wetlands, and croplands. In Physiographic Area 87, almost all nesting takes place in wetlands. Large blocks of suitable habitat (100 ha; 250 ac) seem necessary to support breeding pairs, and only the San Luis Valley has sufficient quantities to host a stable population.

Ecology: Short-eared Owls nest on the ground, usually on a dry site, often elevated on a small hummock. They are rare among owls in that they construct their own nests. In Colorado, they begin nesting in April or May, incubating for 26–28 days and brooding young on the nest for 31–36 days. Most young fledge by mid July or early August. Fall migrants arrive in September and October and leave in March. Short-eared Owls eat small mammals (especially voles, *Microtus* spp.) and occasionally small birds.

Management Issues and Conservation Recommendations: Habitat management schemes for nesting waterfowl and upland gamebirds generally benefit Short-eared Owls. *Consider the needs of this species when managing for game species. Populations of the principal prey species (voles) should be maintained at levels compatible with economic activities on the land.*

Status and Reasons for Concern: This species is not globally threatened, but is declining in much of its range due to drainage of wetlands, intensification of agriculture, persecution, rodenticide poisoning, urbanization, and traffic mortality (del Hoyo et al. 1999). It is on the national Watch List, indicating a high conservation need throughout its range in North America, where populations have declined in many areas. It is considered the rarest and most threatened owl in the Northeast, and several northwestern states have also reported significant declines. The Short-eared Owl is not adequately monitored by the BBS within Physiographic Area 87, and the data are too sparse to allow meaningful analysis of trends. This species is monitored by *MCB* with nocturnal surveys.

Biological Objective: Increase the species' distribution and abundance, as measured by results of *MCB* and other monitoring programs.

Selected References: Andrews and Righter 1992, Clark 1975, del Hoyo et al. 1999, Holt and Leasure 1993, Kingery 1998.

LITERATURE CITED

- Allen, J. N. 1980. The ecology and behavior of the Long-billed Curlew in southeastern Washington. *Wildlife Monographs* 73:1–65.
- Altman, B. 1997. Olive-sided Flycatcher in western North America. Status review report prepared for the U.S. Fish and Wildlife Service, Portland, Oregon.
- American Ornithologists' Union. 1983. Check-list of North American birds. Sixth edition. Allen Press, Lawrence, Kansas.
- _____. 1998. Check-list of North American birds. Seventh edition. Allen Press, Lawrence, Kansas.
- Ammon, E. M. 1995. Reproductive strategies and factors determining nest success in subalpine ground-nesting passerines. Ph.D. dissertation, University of Colorado, Boulder, Colorado.
- Andrews, R., and R. Righter. 1992. Colorado Birds: a reference to their distribution and habitat. Denver Museum of Natural History, Denver, Colorado.
- Baicich, P. J., and C. J. O. Harrison. 1997. A guide to the nests, eggs, and nestlings of North American birds. Second edition. Academic Press, New York, New York.
- Bailey, A. M., and R. J. Niedrach. 1965. Birds of Colorado. Denver Museum of Natural History, Denver, Colorado.
- Balda, R. P. and G. C. Bateman. 1971. Flocking and annual cycle of the Pinyon Jay, *Gymnorhinus cyanocephalus*. *Condor* 73:287–302.
- _____, and N. Masters. 1980. Avian communities in the pinyon-juniper woodland: a descriptive analysis. Pages 146–169 in *Management of western forests and grasslands for nongame birds*. Workshop Proceedings, Salt Lake City, Utah. U.S. Forest Service General Technical Report INT-86.
- Beauvais, G., J. H. Enderson, and A. J. Magro. 1992. Home range, habitat use, and behavior of Prairie Falcons wintering in east-central Colorado. *Journal of Raptor Research* 26:13–18.
- Beaver, D. L., and P. H. Baldwin. 1975. Ecological overlap and the problem of competition and sympatry in the Western and Hammond's Flycatchers. *Condor* 77:1–13.
- Bechard, M. J. 1983. Food supply and the occurrence of brood reduction in Swainson's Hawk. *Wilson Bulletin* 95:233–242.

- _____, and J. K. Schmutz. 1995. Ferruginous Hawk (*Buteo regalis*). In *The birds of North America*, No. 172 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.
- Benedict, A. D. 1991. *A Sierra Club naturalist's guide: the Southern Rockies*. Sierra Club Books, San Francisco, California.
- Bennetts, R. E., G. C. White, F. G. Hawksworth, and S. E. Severs. 1996. The influence of dwarf mistletoe on bird communities in Colorado ponderosa pine forests. *Ecological Applications* 6:899–909.
- Benson, R. E., and A. W. Green. 1987. Colorado's timber resources. U.S. Forest Service Resource Bulletin INT-48.
- Bent, A. C. 1940. Life histories of North American cuckoos, goatsuckers, hummingbirds, and their allies. U.S. National Museum Bulletin 176:254–271.
- _____. 1953. Life histories of North American wood warblers. U.S. National Museum Bulletin 203.
- _____. 1968. Life histories of North American cardinals, grosbeaks, buntings, towhees, finches, sparrows, and allies. U.S. National Museum Bulletin 237.
- Bergtold, W. H. 1928. *A guide to Colorado birds*. Smith-Brooks Printing, Denver, Colorado.
- Bock, C. E., J. H. Bock, and H. M. Smith. 1993. Proposal for a system of federal livestock enclosures on public rangelands in the western United States. *Conservation Biology* 7:731–733.
- _____, V. A. Saab, T. D. Rich, and D. S. Dobkin. 1992. Effects of livestock grazing on Neotropical migratory land birds in western North America. Pages 296–309 in *Status and management of Neotropical migratory birds* (D. M. Finch and P. W. Stangel, editors). U.S. Forest Service General Technical Report RM-229.
- _____, and B. Webb. 1984. Birds as grazing indicator species in southeastern Arizona. *Journal of Wildlife Management* 48:1045–1049.
- Bolster, D. C. 1990. *Habitat use by the Upland Sandpiper in northeastern Colorado*. M.A. thesis, University of Colorado, Boulder, Colorado.
- Boyle, S. 1998. Short-eared Owl. Pages 226–227 in *Colorado breeding bird atlas* (H. E. Kingery, editor). Colorado Bird Atlas Partnership, Denver, Colorado.

- Bradbury, W. C. 1918. Notes on the nesting habits of the White-throated Swift in Colorado. *Condor* 20:103–110.
- Braun, C. E. 1971. Habitat requirements of Colorado White-tailed Ptarmigan. *Proceedings of the Western Association of Game and Fish Commissioners*. 51:284–292.
- _____. 1980. Alpine bird communities of western North America: implications for management and research. Pages 280–291 *in* Workshop proceedings: management of western forests and grasslands for nongame birds. U.S. Forest Service General Technical Report INT-86.
- _____. 1994. Band-tailed Pigeon. Pages 61–74 *in* Migratory shore and upland game bird management in North America (T. C. Tacha and C. E. Braun, editors). International Association of Fish and Wildlife Agencies, Washington, D.C.
- _____. 1995. Distribution and status of Sage Grouse in Colorado. *Prairie Naturalist* 27:1–9.
- _____, M. F. Baker, R. L. Eng, J. S. Gashwiler, and M. H. Schroeder. 1976. Conservation committee report on effects of alteration of sagebrush communities on the associated avifauna. *Wilson Bulletin* 88:165–171.
- _____, T. Britt, and R. O. Wallestad. 1977. Guidelines for maintenance of Sage Grouse habitats. *Wildlife Society Bulletin* 5(3): 99–106.
- _____, R. B. Davies, J. R. Dennis, K. A. Green, and J. L. Sheppard. 1992. Plains Sharp-tailed Grouse recovery plan. Colorado Division of Wildlife, Denver, Colorado.
- _____, R. W. Hoffman, and G. E. Rogers. 1976. Wintering areas and winter ecology of White-tailed Ptarmigan in Colorado. Colorado Division of Wildlife Special Report No. 38.
- _____, K. Martin, and L. A. Robb. 1993. White-tailed Ptarmigan (*Lagopus leucurus*). *In* The birds of North America, No. 68 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.
- Brown, B. T. 1993. Bell's Vireo (*Vireo bellii*). *In* The birds of North America, No. 35 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and the American Ornithologists' Union, Washington, D.C.
- Brown, D. E. (editor). 1994. Biotic communities southwestern United States and northwestern Mexico. University of Utah Press, Salt Lake City, Utah.

- Brown, R. W., R. S. Johnson, and D. A. Johnson. 1978. Rehabilitation of alpine tundra disturbances. *Journal of Soil and Water Conservation* 33:154–160.
- Buhlmann, K. A., J. C. Mitchell, and C. A. Pague. 1996. Amphibian and small mammal abundance and diversity in saturated forested wetlands and adjacent uplands of southeastern Virginia. *In Proceedings of a workshop on saturated forested wetlands in the Mid-Atlantic Region: the state of the science* (S. D. Eckles, A. Jennings, A. Spingarn, and C. Wienhold, editors). U.S. Fish and Wildlife Service.
- Busch, D. E., and M. L. Scott. 1995. Western riparian areas. *In Our living resources: a report to the nation on the distribution, abundance, and health of U.S. plants, animals, and ecosystems* (E. T. LaRoe, G. S. Farris, C. E. Puckett, P. D. Doran, and M. J. Mac, editors). U.S. Department of the Interior, National Biological Service, Washington, D.C.
- Carter, M. F., and S. W. Gillihan. *In press*. Influence of stand shape, size, and structural stage on forest bird communities in Colorado. Pages 271–284 *in Forest fragmentation in the Southern Rocky Mountains* (R. L. Knight, F. W. Smith, S. W. Buskirk, W. H. Romme, and W. L. Baker, editors). University Press of Colorado, Boulder.
- _____, W. C. Hunter, and D. N. Pashley. 1999. Setting landbird conservation priorities for states, provinces, and physiographic areas of North America. *In Strategies for bird conservation: The Partners in Flight planning process* (R. Bonney, D. N. Pashley, R. J. Cooper, and L. Niles, editors). Cornell Lab of Ornithology, Ithaca, New York.
- Central Shortgrass Prairie Ecoregional Planning Team. 1998. Ecoregion-based conservation in the Central Shortgrass Prairie. The Nature Conservancy of Colorado, Boulder, Colorado.
- Chase, C. A., S. J. Bissell, H. E. Kingery, and W. D. Graul (editors). 1982. Colorado bird distribution latilong study. Colorado Field Ornithologists and Colorado Division of Wildlife, Denver.
- Clark, R. J. 1975. A field study of the Short-eared Owl, *Asio flammeus* (Pontoppidan), in North America. *Wildlife Monographs* 47:1–67.
- Cochran, J. F., and S. H. Anderson. 1987. Comparison of habitat attributes at sites of stable and declining Long-billed Curlew populations. *Great Basin Naturalist* 47:459–466.
- Commons, M. L. 1997. Movement and habitat use by Gunnison sage grouse (*Centrocercus minimus*) in southwestern Colorado. M.S. thesis, University of Manitoba, Winnipeg, Canada.

- Connelly, J. W., and C. E. Braun. 1997. Long-term changes in Sage Grouse *Centrocercus urophasianus* populations in western North America. *Wildlife Biology* 3:229–234.
- _____, M. W. Gratson, and K. P. Reese. 1998. Sharp-tailed Grouse (*Tympanuchus phasianellus*). In *The birds of North America*, No. 354 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and the American Ornithologists' Union, Washington, D.C.
- Conry, J. A. 1978. Resource utilization, breeding biology and nestling development in an alpine tundra passerine community. Ph.D. dissertation, University of Colorado, Boulder, Colorado.
- Cooke, W. W. 1897. The birds of Colorado. State Agricultural College, Bulletin No. 37, Technical Series No. 2, Fort Collins, Colorado.
- Cooper, D. J. 1986. Community structure and classification of Rocky Mountain wetland ecosystems. Pages 66–147 in *An ecological characterization of Rocky Mountain montane and subalpine wetlands* (J. T. Windell, T., B. E. Willard, D. J. Cooper, S. Q. Foster, C. F. Knud-Hansen, L. P. Rink, and G. N. Kiladis, editors). U.S. Fish and Wildlife Service Report 86(11). National Ecology Center, Washington D.C.
- Craighead, J. J., and F. C. Craighead. 1956. Hawks, owls, and wildlife. Wildlife Management Institute, Washington, D.C., and Stackpole Books, Harrisburg, Pennsylvania.
- Creighton, P. D. 1974. Habitat exploitation by an avian ground-foraging guild. Ph.D. dissertation, Colorado State University, Fort Collins, Colorado.
- _____, and P. H. Baldwin. 1974. Habitat exploitation by an avian ground-foraging guild. Grassland Biome, U.S. International Biological Program Technical Report No. 263.
- Crockett, A. B., and H. H. Hadow. 1975. Nest site selection by Williamson's and Red-naped Sapsuckers. *Condor* 77:365–368.
- Csada, R. D., and R. M. Brigham. 1992. Common Poorwill (*Phalaenoptilus nuttallii*). In *The birds of North America*, No. 32 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.
- Dahl, T. E. 1990. Wetland losses in the United States: 1780s to 1980s. U.S. Fish and Wildlife Service. Washington, D.C.

- DeByle, N. V. 1981. Songbird populations and clearcut harvesting of aspen in northern Utah. U.S. Forest Service Research Note INT-302.
- _____. 1985. Wildlife. Pages 135–152 in *Aspen: ecology and management in the western United States* (N. V. DeByle and R. P. Winokur, editors). U.S. Forest Service General Technical Report RM-119.
- _____, C. D. Bevins, and W. C. Fischer. 1987. Wildfire occurrence in aspen in the interior western United States. *Western Journal of Applied Forestry* 2:73–76.
- Dechant, J. A., M. L. Sondreal, D. H. Johnson, L. D. Igl, C. M. Goldade, P. A. Rabie, and B. R. Euliss. 1999. Effects of management practices on grassland birds: McCown's Longspur. Northern Prairie Wildlife Research Center, Jamestown, North Dakota. [<http://www.npwr.usgs.gov/resource/literatr/grasbird/grasbird.htm>]
- DeGraaf, R. M. and J. H. Rappole. 1995. Neotropical migratory birds: natural history, distribution, and population change. Comstock Publishing Associates, a division of Cornell University Press, Ithaca, New York.
- del Hoyo, J., A. Elliott, and J. Sargatal. (editors). 1999. Handbook of the birds of the world. Volume 5. Barn-owls to Hummingbirds. Lynx Edicions, Barcelona, Spain.
- Dobbs, R. C., T. E. Martin, and C. J. Conway. 1997. Williamson's Sapsucker (*Sphyrapicus thyroideus*). In *The birds of North America*, No. 285 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.
- Dobkin, D. S. 1994. Conservation and management of Neotropical migrant land birds in the Northern Rockies and Great Plains. University of Idaho Press, Moscow, Idaho.
- Dorn, R. D., and J. L. Dorn. 1995. Cassin's Sparrow nesting in Wyoming. *Western Birds* 26:104–106.
- Ehrlich, P. R., D. S. Dobkin, and D. Wheye. 1988. *The birder's handbook: a field guide to the natural history of North American birds*. Simon and Shuster, New York, New York.
- England, A. S., M. J. Bechard, and C. S. Houston. 1997. Swainson's Hawk (*Buteo swainsoni*). In *The birds of North America*, No. 265 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.

- Estelle, V. B., and T. M. Mabee. 1994. Breeding success of Least Terns, Piping Plovers, and Snowy Plovers: evaluation of predator exclosures in southeast Colorado. Unpublished report to Colorado Division of Wildlife and Bureau of Land Management, Denver. Colorado Bird Observatory, Brighton, Colorado.
- _____. 1995. Nesting success of Least Terns, Piping Plovers, and Snowy Plovers: evaluation of predator exclosures in southeastern Colorado. Unpublished report to Colorado Division of Wildlife and Bureau of Land Management, Denver. Colorado Bird Observatory, Brighton, Colorado.
- Eyre, F. H. 1980. Forest cover types of the United States and Canada. Society of American Foresters, 5400 Grosvenor Lane, Washington, D.C. 20014.
- Faanes, C. A., B. A. Hanson, and H. A. Kantrud. 1979. Cassin's Sparrow—first record for Wyoming and recent range extensions. *Western Birds* 10:163–164.
- Finch, D. M., S. H. Anderson, and W. A. Hubert. 1987. Habitat suitability index models: Lark Bunting. U.S. Fish and Wildlife Service Biological Report 82 (10.137).
- Flickinger, E. L., and D. M. Swineford. 1983. Environmental contaminant hazards to Attwater's Greater Prairie-Chickens. *Journal of Wildlife Management* 47:1132–1137.
- Furniss, R. L. and V. M. Carolin. 1977. Western forest insects. Miscellaneous Publication 1339, U.S. Department of Agriculture, Washington, D.C.
- Gaines, M. S., and M. R. Ryan. 1988. Piping Plover habitat use and reproductive success in North Dakota. *Journal of Wildlife Management* 52:266–73.
- Gamble, L. R., and T. M. Bergin. 1996. Western Kingbird (*Tyrannus verticalis*). In *The birds of North America*, No. 227 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and the American Ornithologists' Union, Washington, D.C.
- Geissler, P. H. and J. R. Sauer. 1990. Topics in route-regression analysis. Pages 54–57 in *Survey design and statistical methods for the estimation of avian population trends* (J. R. Sauer and S. Droege, editors). U.S. Fish and Wildlife Service, Biological Report 90(1).
- Giesen, K. M. 1994a. Breeding range and population status of Lesser Prairie-Chickens in Colorado. *Prairie Naturalist* 26:175–182.
- _____. 1994b. Movements and nesting habitat of Lesser Prairie-Chickens in Colorado. *Southwestern Naturalist* 39:96–98.

- _____. 1998. Lesser Prairie-Chicken (*Tympanuchus pallidicinctus*). In *The birds of North America*, No. 364 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.
- _____, and C. E. Braun. 1992. Winter home range and habitat characteristics of White-tailed Ptarmigan in Colorado. *Journal of Wildlife Management* 57:72-77.
- Graul, W. D. 1973. Adaptive aspects of the Mountain Plover social system. *Living Bird* 12:69-94.
- _____. 1975. Breeding biology of the Mountain Plover. *Wilson Bulletin* 87:6-31.
- _____. 1980. Grassland management practices and bird communities. Pages 38-47 in *Management of western forests and grasslands for nongame birds* (R. M. DeGraaf, technical coordinator). U.S. Forest Service General Technical Report INT-86.
- Gray, M. T. 1995. DOW Working for Wildlife: Peregrine Falcon. Colorado's Wildlife Company, Colorado Division of Wildlife, Denver, Colorado.
- Greene, E., V. R. Muether, and W. Davison. 1996. Lazuli Bunting (*Passerina amoena*). In *The birds of North America*, No. 232 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and the American Ornithologists' Union, Washington, D.C.
- Gutiérrez, R. J., C. E. Braun, and T. P. Zapatka. 1975. Reproductive biology of the Band-tailed Pigeon in Colorado and New Mexico. *Auk* 92:665-677.
- _____, A. B. Franklin, and W. S. Lahaye. 1995. Spotted Owl (*Strix occidentalis*). In *The birds of North America*, No. 179 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.
- Guzy, M. J. and P. E. Lowther. 1997. Black-throated Gray Warbler (*Dendroica nigrescens*). In *The birds of North America*, No. 319. (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.
- Hadow, H. H. 1973. Winter ecology of migrant and resident Lewis' Woodpeckers in southeastern Colorado. *Condor* 75:210-224.

- Haig, S. M. 1992. Piping Plover (*Charadrius melodus*). In *The birds of North America*, No. 2 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.
- _____, T. Eubanks, W. Harrison, R. Lock, L. Pfannmuller, M. Ryan, and J. Sidle. 1992. 1991 Piping Plover breeding census. Unpublished letter to cooperating agencies.
- Harmata, A. R. 1981. Recoveries of Ferruginous Hawks banded in Colorado. *North American Bird Bander* 6:144–147.
- Harrison, H. H. 1979. A field guide to western birds' nests in the United States west of the Mississippi River. Houghton Mifflin, Boston, Massachusetts.
- Hart, R. H., and J. A. Hart. 1997. Rangelands of the Great Plains before European settlement. *Rangelands* 19:4–11.
- Haug, E. A., B. A. Millsap, and M. S. Martell. 1993. Burrowing Owl (*Speotyto cunicularia*). In *The birds of North America*, No. 61 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.
- Hayward, G. D. 1997. Forest management and conservation of Boreal Owls in North America. *Journal of Raptor Research* 31:114–124.
- _____, and P. H. Hayward. 1993. Boreal Owl (*Aegolius funereus*). In *The birds of North America*, No. 63 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.
- _____, P. H. Hayward, and E. O. Garton. 1993. Ecology of Boreal Owls in the northern Rocky Mountains, USA. *Wildlife Monographs* 124:1–59.
- _____, and J. Verner (technical editors). 1994. Flammulated, Boreal, and Great Gray owls in the United States: a technical conservation assessment. U.S. Forest Service General Technical Report RM-253.
- Hejl, S. J. 1994. Human-induced changes in bird populations in coniferous forests in western North America during the past 100 years. *Studies in Avian Biology* 15:232–246.
- Hobbs, N. T., and D. M. Theobald. 1998. Effects of population growth on wildlife habitat in Colorado. Briefing paper for the Colorado Division of Wildlife Commissioners. [<http://ndis.nrel.colostate.edu/escop/briefing.html>]

- Hoffman, R. W., and K. M. Giesen. 1983. Demography of an introduced population of white-tailed ptarmigan. *Canadian Journal of Zoology* 61:1758–1764.
- Holroyd, G. L. 1993. Dark secrets: discovering the unusual habits of the Black Swift. *Birder's World* 7(5):22–25.
- Holt, D. W., and S. M. Leasure. 1993. Short-eared Owl (*Asio flammeus*). In *The birds of North America*, No. 62 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.
- Howe, F. 1996. Use of riparian areas by land birds. Pages 71–73 in *Is the green line green? Proceedings of the Eighth Annual Conference of the Colorado Riparian Association*. Pagosa Springs, Colorado.
- Hubbard, J. P. 1977. The status of Cassin's Sparrow in New Mexico and adjacent states. *American Birds* 31:933–941.
- Hurley, R.J., and E.C. Franks. 1976. Changes in the breeding ranges of two grassland birds. *Auk* 92:108–115.
- Hutchings, S. 1996. Gray Vireos in Colorado National Monument. Unpublished report. Colorado Bird Observatory, Brighton, Colorado.
- Hutto, R.L. 1995. Composition of bird communities following stand-replacement fires in Northern Rocky Mountain (USA) conifer forests. *Conservation Biology* 9:1041–1058.
- Johnston, B.C., and L. Hendzel. 1985. Examples of aspen treatment, succession, and management in western Colorado. U.S. Forest Service, Rocky Mountain Region, Lakewood, Colorado.
- Johnson, D. H., L. D. Igl, J. A. Dechant, M. L. Sondreal, C. M. Goldade, and B. R. Euliss. 1998. Effects of management practices on grassland birds: Mountain Plover. U.S. Geological Survey, Biological Resources Division, Northern Prairie Wildlife Research Center, Jamestown, North Dakota. [www.npwrc.usgs.gov/resource/literatr/grasbird/grasbird.htm]
- Jones, J. R., and N. V. DeByle. 1985. Climates. Pages 57–64 in *Aspen: ecology and management in the western United States* (N. V. DeByle and R. P. Winokur, editors). U.S. Forest Service General Technical Report RM-119.
- Kalcounis, M. C., and R. M. Brigham. 1998. Secondary use of aspen cavities by tree-roosting big brown bats. *Journal of Wildlife Management* 62:603–611.

- Kantrud, H. A., and K. F. Higgins. 1992. Nest and nest site characteristics of some ground-nesting, non-passerine birds of northern grasslands. *Prairie Naturalist* 24:67–84.
- King, R. 1978. Habitat use and related behaviors of breeding Long-billed Curlews. M.S. thesis, Colorado State University, Fort Collins, Colorado.
- Kingery, H. E. 1996. American Dipper (*Cinclus mexicanus*). In *The birds of North America*, No. 229 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and the American Ornithologists' Union, Washington, D.C.
- _____. (editor). 1998. Colorado breeding bird atlas. Colorado Breeding Bird Atlas Partnership, Denver, Colorado.
- _____, and M. B. Dillon (editors). 1988. Colorado bird distribution latilong study. Colorado Division of Wildlife, Denver.
- Kirsch, L. M., and K. F. Higgins. 1976. Upland Sandpiper nesting and management in North Dakota. *Wildlife Society Bulletin* 4:16–20.
- Klein, M. L., S. R. Humphrey, and H. F. Percival. 1995. Effects of ecotourism on distribution of waterbirds in a wildlife refuge. *Conservation Biology* 9:1454–1465.
- Knick, S. T., and J. T. Rotenberry. 1995. Landscape characteristics of fragmented shrubsteppe habitats and breeding passerine birds. *Conservation Biology* 9:1059–1071.
- Knopf, F. L. 1986. Changing landscapes and the cosmopolitanism of the eastern Colorado avifauna. *Wildlife Society Bulletin* 14:132–142.
- _____. 1994. Avian assemblages on altered grasslands. Pages 247–257 in *A century of avifaunal change in western North America* (J. R. Jehl, Jr., and N. K. Johnson, editors). *Studies in Avian Biology* No. 15.
- _____. 1996a. Mountain Plover (*Charadrius montanus*). In *The birds of North America*, No. 211 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.
- _____. 1996b. Prairie legacies—birds. Pages 135–148 in *Prairie Conservation* (F. B. Samson and F. L. Knopf, editors). Island Press, Washington, D.C.
- _____, and J. R. Rupert. 1996. Reproduction and movements of Mountain Plovers breeding in Colorado. *Wilson Bulletin* 108:28–35.

- _____, and M. L. Scott. 1990. Altered flows and created landscapes in the Platte River Headwaters, 1840–1990. Pages 47–70 *in* Management of dynamic ecosystems (J. M. Sweeney, editor). North Central Section, The Wildlife Society, West Lafayette, Indiana.
- Knorr, O. A. 1961. The Geographical and ecological distribution of the Black Swift in Colorado. *Wilson Bulletin* 73(2):155–169.
- _____, and A. L. Baily. 1950. First breeding record of Black Swifts, *Nepoecetes n. borealis*, in Colorado. *Auk* 67:516.
- Knowles, C. J., C. J. Stoner, and S. P. Gieb. 1982. Selective use of black-tailed prairie dog towns by Mountain Plovers. *Condor* 84:71–74.
- Krueper, D. J. 1995. Effects of livestock management on southwestern riparian ecosystems. Pages 281–301 *in* Desired future condition for southwestern riparian ecosystems: bringing interests and concerns together (D. W. Shaw and D. M. Finch, editors). U.S. Forest Service General Technical Report RM-272.
- LaRue, C. T. 1994. Birds of northern Black Mesa, Navajo County, Arizona. *Great Basin Naturalist* 54(1).
- Laubhan, M. K., and L. H. Fredrickson. 1997. Wetlands of the Great Plains: habitat characteristics and vertebrate aggregations. Pages 20–48 *in* Ecology and conservation of Great Plains vertebrates (F. L. Knopf and F. B. Samson, editors). Springer-Verlag, New York, New York.
- Leukering, T., and J. Bradley. 1997. Some observations of birds on the Central Mexican Plateau. *Western Birds* 28:177–180.
- _____, and M. Carter. 1999. Colorado birds monitored by 2001: results of point transects in three Colorado habitats with an appendix of results of special-species monitoring. Unpublished report. Colorado Bird Observatory, Brighton, Colorado.
- Licht, D. S. 1997. Ecology & economics of the Great Plains. University of Nebraska Press, Lincoln, Nebraska.
- Little, E. L. 1977. Research in the pinyon-juniper woodland. Pages 8–19 *in* Proceedings of ecology, uses and management of pinyon-juniper woodlands (E. F. Alson and T. J. Loring, editors). U.S. Forest Service General Technical Report RM-39.
- MacArthur, R. H., and J. W. MacArthur. 1961. On bird species diversity. *Ecology* 42:594–598.

- MacKenzie, D. I., and S. G. Sealey. 1981. Nest site selection in Eastern and Western Kingbirds: a multivariate approach. *Condor* 83:310–321.
- MacWhirter, R. B., and K. L. Bildstein. 1996. Northern Harrier (*Circus cyaneus*). In *The birds of North America*, No. 210 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and the American Ornithologists' Union, Washington, D.C.
- Martell, A. M. 1983. Demography of southern red-backed voles (*Clethrionomys gapperi*) and deer mice (*Peromyscus maniculatus*) after logging in north-central Idaho. *Canadian Journal of Zoology* 61:970–980.
- Martin, J. W., and B. A. Carlson. 1998. Sage Sparrow (*Amphispiza belli*). In *The birds of North America*, No. 326 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.
- Martin, T. E. 1998. Are microhabitat preferences of coexisting species under selection and adaptive? *Ecology* 79:656–670.
- May, T. A., and C. E. Braun. 1972. Seasonal foods of adult White-tailed Ptarmigan in Colorado. *Journal of Wildlife Management* 36:1180–1186.
- McCallum, D. A. 1994. Flammulated Owl (*Otus flammeolus*). In *The birds of North America*, No. 93 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.
- _____, W. D. Graul, and R. Zaccagnini. 1977. The breeding status of the Long-billed Curlew in Colorado. *Auk* 94:599–601.
- Melton, B. L., R. L. Hoover, R. L. Moore, and D. J. Pfankuch. 1984. Aquatic and riparian wildlife. Pages 261–298 in *Managing forested lands for wildlife* (R. L. Hoover and D. Wills, editors). Colorado Division of Wildlife.
- Merrill, S. B., F. J. Cuthbert, and G. Oehlert. 1998. Residual patches and their contribution to forest-bird diversity on northern Minnesota aspen clearcuts. *Conservation Biology* 12:190–199.
- Miller, S. G., R. L. Knight, and C. K. Miller. 1998. Influence of recreational trails on breeding bird communities. *Ecological Applications* 8:162–169.
- Moir, W. M., B. Geils, M. A. Benoit, and D. Scurlock. 1997. Ecology of southwestern ponderosa pine forests. Pages 3–27 in *Songbird ecology in southwestern ponderosa pine*

- forests: a literature review (W. M. Block and D. M. Finch, technical editors). U.S. Forest Service General Technical Report RM-292.
- Morrison, M. L. 1981. The structure of western warbler assemblages: analysis of foraging and habitat selection in Oregon. *Auk* 98:578–588.
- Mueggler, W. F. 1989. Status of aspen woodlands in the west. Pages 32–37 *in* Response of breeding birds to commercial clearcutting of aspen in southwestern Colorado (V. E. Scott and G. L. Crouch, editors). U.S. Forest Service Research Note RM-475.
- Mutel, C. F., and J. C. Emerick. 1992. From grassland to glacier, the natural history of Colorado and the surrounding region. Johnson Books, Boulder, Colorado.
- Myers, L. 1991. Managing livestock to minimize impacts on riparian areas. Pages 24–30 *in* Riparian: what does it mean to me? (R. Roth, C. Bridges, and C. Zimmerman, editors). Third annual Colorado Riparian Association Conference, Pueblo, Colorado.
- Nelson, D. L. 1998a. Piping Plover. Pages 166–167 *in* Colorado breeding bird atlas (H. E. Kingery, editor). Colorado Bird Atlas Partnership, Denver, Colorado.
- _____. 1998b. Least Tern. Pages 192–193 *in* Colorado breeding bird atlas (H. E. Kingery, editor). Colorado Bird Atlas Partnership, Denver, Colorado.
- Page, G. W., J. C. Warriner, and P. W. C. Paton. 1995. Snowy Plover (*Charadrius alexandrinus*). *In* The birds of North America, No. 154 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.
- Paige, C., and S. A. Ritter. 1999. Birds in a sagebrush sea: managing sagebrush habitats for bird communities. Partners in Flight Western Working Group, Boise, Idaho.
- Palmer, D. A. 1986. Habitat selection, movements and activity of Boreal and Saw-whet Owls. M.S. thesis, Colorado State University, Fort Collins, Colorado.
- Peale, M. 1996. Best management practices for wetlands within Colorado state parks. Colorado Natural Areas Program, Colorado State Parks, Colorado Department of Natural Resources, Denver, Colorado. [http://elbert.state.co.us/cnap/wetlands_BMP/BMPindex.htm]
- Petersen, K. L., and L. B. Best. 1985. Nest-site selection by Sage Sparrows. *Condor* 87:217–221.

- _____. 1987. Effects of prescribed burning on nongame birds in a sagebrush community. *Wildlife Society Bulletin* 15:317–325.
- Pezzolesi, L. S. W. 1994. The western Burrowing Owl: increasing prairie dog abundance, foraging theory, and nest site fidelity. M.S. thesis, Texas Technical University, Lubbock, Texas.
- Pieper, R. 1977. The southwestern pinyon-juniper ecosystem. Pages 1–2 in *Ecology, use and management of pinon-juniper woodlands: Proceedings of the workshop* (E. F. Aldon and T. J. Loring, editors). U.S. Forest Service General Technical Report RM-39.
- Pitocchelli, J. 1995. MacGillivray's Warbler (*Oporornis tolmiei*). In *The birds of North America*, No. 159 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and the American Ornithologists' Union, Washington, D.C.
- Price, F. E., and C. E. Bock. 1983. Population ecology of the Dipper (*Cinclus mexicanus*) in the Front Range of Colorado. *Studies in Avian Biology* 7:1–84.
- Price, J., S. Droege, and A. Price. 1995. *The summer atlas of North American birds*. Academic Press, New York, New York.
- Prose, B. L. 1985. Habitat suitability index models: Greater Prairie-Chicken. U.S. Fish and Wildlife Service Biological Report 82 (10.102).
- _____. 1987. Habitat suitability index models: Plains Sharp-tailed Grouse. U.S. Fish and Wildlife Service Biological Report 82 (10.142).
- Raphael, M. G., and M. White. 1984. Use of snags by cavity-nesting birds in the Sierra Nevada. *Wildlife Monographs* 86:1–66.
- Reynolds, R. T. 1992. Flammulated Owls in ponderosa pine: evidence of preference for old-growth. Pages 166–169 in *Old-growth forests in the Southwest and Rocky Mountain regions* (M. R. Kaufmann, W. H. Moir, and R. L. Bassett, technical coordinators). U.S. Forest Service General Technical Report RM-213.
- _____, D. P. Kane, and D. M. Finch. 1991. Tree-nesting habitat of Purple Martins in Colorado. Unpublished manuscript.
- _____, and B. D. Linkhart. 1987. The nesting biology of Flammulated Owls in Colorado. Pages 239–248 in *Biology and conservation of northern forest owls* (R.W. Nero, R. J. Clark, R. J. Knapton, and R. H. Hamre, editors). U.S. Forest Service General Technical Report RM-142.

- Rotenberry, J. T. 1985. The role of habitat in avian community composition: physiognomy or floristics. *Oecologia* 67:213–217.
- _____, M. A. Patten, and K. L. Preston. 1999. Brewer's Sparrow (*Spizella breweri*). In *The birds of North America*, No. 390 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and the American Ornithologists' Union, Washington, D.C.
- Ryan, M. R., L. W. Burger, Jr., D. P. Jones, and A. P. Wywialowski. 1998. Breeding ecology of Greater Prairie-Chickens (*Tympanuchus cupido*) in relation to prairie landscape configuration. *American Midland Naturalist* 140:111–121.
- _____, and R. B. Renken. 1987. Habitat use by breeding Willets in the northern Great Plains. *Wilson Bulletin* 99:175–189.
- Ryser, F. 1985. *Birds of the Great Basin*. University of Nevada Press, Reno, Nevada.
- Saab, V. A., C. E. Bock, T. D. Rich, and D. S. Dobkin. 1995. Livestock grazing effects in western North America. Pages 311–353 in *Ecology and management of Neotropical migratory birds* (T. E. Martin and D. M. Finch, editors). Oxford University Press, New York, New York.
- Schroeder, M. A., and L. A. Robb. 1993. Greater Prairie-Chicken (*Tympanuchus cupido*). In *The birds of North America*, No. 36 (A. Poole and F. Gill, editors). The Academy of Sciences, Philadelphia, Pennsylvania, and the American Ornithologists' Union, Washington, D.C.
- Schroeder, M. H., and D. L. Sturges. 1975. The effect on the Brewer's Sparrow of spraying big sagebrush. *Journal of Range Management* 28:294–297.
- Schroeder, R. L. 1984. Habitat suitability index models: Blue Grouse. U.S. Fish and Wildlife Service FWS/OBS-82/10.81.
- Sclater, W. H. 1912. *A history of the birds of Colorado*. Witherby and Company, London, England.
- Scott, V. E., and G. L. Crouch. 1987. Response of breeding birds to commercial clearcutting of aspen in southwestern Colorado. U.S. Forest Service Research Note RM-475.
- Sedgwick, J. A. 1994. Hammond's Flycatcher (*Empidonax hammondi*). In *The birds of North America*, No. 109 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists Union, Washington, D.C.

- Shepperd, W. D., and M. L. Fairweather. 1994. Impact of large ungulates in restoration of aspen communities in a southwestern ponderosa pine ecosystem. Pages 344–347 in *Sustainable ecological systems: implementing an ecological approach to land management* (W. W. Covington and L. F. DeBano, editors). U.S. Forest Service General Technical Report RM-247.
- Short, H. L. 1984. Habitat suitability index models: Brewer's Sparrow. U.S. Fish and Wildlife Service FWS/OBS-82/10.83.
- Side, J. G., and W. F. Harrison. 1990. Recovery plan for the interior population of the Least Tern (*Sterna antillarum*). U.S. Fish and Wildlife Service.
- Slater, J. 1994. Least Tern and Piping Plover management plan. Draft Plan, January 1994, Colorado Division of Wildlife, Denver, Colorado.
- Soule, M. E., and J. Terborgh. 1999. *Continental Conservation*. Island Press, Washington, D.C.
- Sousa, P. J. 1983. Habitat suitability index models: Williamson's Sapsucker. U.S. Fish and Wildlife Service FWS/OBS-82/10.47.
- Steenhof, K. 1998. Prairie Falcon (*Falco mexicanus*). In *The birds of North America*, No. 346 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and the American Ornithologists' Union, Washington, D.C.
- Stewart, R. M. 1973. Breeding behavior and life history of the Wilson's Warbler. *Wilson Bulletin* 85:21–30.
- Stohlgren, T. J., M. B. Coughenour, G. W. Chong, D. Binkley, M. Kalkhan, L. D. Schell, D. Buckley, and J. Berry. 1997. Landscape analysis of plant diversity. *Landscape Ecology* 12:155–170.
- _____, M. B. Falkner, and L. D. Schell. 1995. A modified-Whittaker tested vegetation sampling method. *Vegetation* 117:113–121.
- Swenson, E. 1977. Pinyon-juniper wildlife habitats. Pages 22–24 in *Ecology, uses and management of pinyon-juniper woodlands*. U.S. Forest Service General Technical Report RM-3.
- Svoboda, P. L., K. E. Young, and V. E. Scott. 1980. Recent nesting records of Purple Martins in western Colorado. *Western Birds* 11:195–198.

- Tausch, R. J., West, N. E., Nabi, A. A. 1981. Tree age and dominance patterns in Great-Basin pinyon-juniper woodlands. *Journal of Range Management* 34:(4)259–264.
- Taylor, M. A., and F. S. Guthery. 1980. Status, ecology, and management of the Lesser Prairie Chicken. U.S. Forest Service General Technical Report RM-77.
- Terrell, T. L., and J. J. Spillett. 1975. Pinyon-juniper conversion: its impact on mule deer and other wildlife. Pages 105–119 *in* The pinyon-juniper ecosystem: Symposium in May, Utah State University, Logan, Utah.
- Terres, J. K. (editor). 1981. The Audubon Society encyclopedia of North American birds. Alfred A. Knopf, New York, New York.
- The Nature Conservancy. 1998. Draft Site Conservation Planning Workbook. Boulder, Colorado.
- Thompson, B. C., J. A. Jackson, J. Burger, L. A. Hill, E. M. Kirsch, and J. L. Atwood. 1997. Least Tern (*Sterna antillarum*). *In* The birds of North America, No. 290 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.
- Tobalske, B. W. 1997. Lewis's Woodpecker (*Melanerpes lewis*). *In* The birds of North America, No. 284 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and the American Ornithologists' Union, Washington, D.C.
- Torrence, J. F. 1984. The opportunity before us. Pages 1–5 *in* Proceedings of the Aspen Symposium, Colorado Springs, Colorado.
- Tueller, P. T., C. D. Beeson, R. J. Tausch, N. E. West, and K. H. Rea. 1979. Pinyon-juniper woodlands of the Great Basin: distribution, flora, vegetal cover. U.S. Forest Service Research Publication INT-229.
- Udvardy, M. 1977. The Audubon society field guide to North American birds. Alfred A. Knopf, New York, New York.
- U.S. Department of Commerce. 1991. 1990 census of population and housing—summary population and housing characteristics—Colorado. U.S. Government Printing Office, Washington, D.C., 1990 CPH-1-7.
- U. S. Fish and Wildlife Service. 1995. Recovery plan for the Mexican Spotted Owl (*Strix occidentalis lucida*). Albuquerque, New Mexico.

- U. S. Fish and Wildlife Service. 1996. Piping Plover (*Charadrius melodus*), Atlantic Coast population, revised recovery plan. Hadley, Massachusetts.
- Vale, T. R. 1975. Presettlement vegetation in the sagebrush-grass area of the Intermountain West. *Journal of Range Management* 28:32–36.
- Vance, D. R., and R. L. Westemeier. 1979. Interactions of pheasants and prairie-chickens in Illinois. *Wildlife Society Bulletin* 7:221–225.
- Van Sant, B. F., and C. E. Braun. 1990. Distribution and status of Greater Prairie-Chickens in Colorado. *Prairie Naturalist* 22:225–230.
- Verbeek, N. A. M. 1970. Breeding biology of the Water Pipit. *Auk* 87:425–451.
- _____, and P. Hendricks. 1994. American Pipit (*Anthus rubescens*). In *The birds of North America*, No. 95 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.
- Vickery, P. D. 1996. Grasshopper Sparrow (*Ammodramus savannarum*). In *The birds of North America*, No. 239 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and the American Ornithologists' Union, Washington, D.C.
- Vierling, K. T. 1997. Habitat selection of Lewis' Woodpeckers in southeastern Colorado. *Wilson Bulletin* 109:121–130.
- Weaver, T., E. M. Payson, and D. L. Gustafson. 1996. Prairie ecology—the shortgrass prairie. Pages 67–75 in *Prairie conservation* (F. B. Samson and F. L. Knopf, editors). Island Press, Washington, D.C.
- Webster, J. D. 1961. A revision of Grace's Warbler. *Auk* 78:554–566.
- Wege, D. C., and A. J. Long. 1995. Key areas for threatened birds in the Neotropics. BirdLife International. Smithsonian Institution Press, Washington, D.C.
- Whisenant, S. G. 1990. Changing fire frequencies on Idaho's Snake River plains: ecological and management implications. Pages 4–10 in *Proceedings-Symposium on cheatgrass invasion, shrub die-off, and other aspects of shrub biology and management*. U.S. Department of Interior General Technical Report INT-276.
- Wiens, J. A. 1970. Avian populations and patterns of habitat occupancy at the Pawnee Site, 1968–69. U.S. International Biological Program Technical Report No. 63.

- _____. 1972. Predictability of patterns and variability of precipitation in grasslands. U.S. International Biological Program Technical Report No. 168.
- _____. 1974. Climatic instability and the “ecological saturation” of bird communities in North American grasslands. *Condor* 76:385–400.
- _____, and J. T. Rotenberry. 1981. Habitat associations and community structure of birds in shrubsteppe environments. *Ecological Monographs* 51:21–41.
- Wilen, B. O. 1995. The nation’s wetlands. Pages 473–476 *in* Our living resources: a report to the nation on the distribution, abundance, and health of U.S. plants, animals, and ecosystems (E. T. LaRoe, G. S. Farris, C. E. Puckett, P. D. Doran, and M. J. Mac, editors). U.S. Department of the Interior, National Biological Service, Washington, D.C.
- Willson, M. F. 1974. Avian community organization and habitat structure. *Ecology* 55:1017–1029.
- Windell, J. T. 1986. Impacts to wetlands and implications for management of Rocky Mountain wetlands. Pages 215–236 *in* An ecological characterization of Rocky Mountain montane and subalpine wetlands (J. T. Windell, B. E. Willard, D. J. Cooper, S. Q. Foster, C. F. Knud-Hansen, L. P. Rink, and G. N. Kiladis, editors). U.S. Fish and Wildlife Service Report 86(11). National Ecology Center, Washington D.C.
- _____, B. E. Willard, and S. Q. Foster. 1986. Pages 18–41 *in* An ecological characterization of Rocky Mountain montane and subalpine wetlands (J. T. Windell, B. E. Willard, D. J. Cooper, S. Q. Foster, C. F. Knud-Hansen, L. P. Rink, and G. N. Kiladis, editors). U.S. Fish and Wildlife Service Report 86(11). National Ecology Center, Washington D.C.
- Winternitz, B. L. 1973. Ecological patterns in a montane breeding bird community. Ph.D. dissertation, University of Colorado, Boulder, Colorado.
- With, K. A. 1994. McCown’s Longspur (*Calcarius mccownii*). *In* The birds of North America, No. 96 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists’ Union, Washington, D.C.
- Wozniak, F. E. 1995. Human impacts on riparian ecosystems of the middle Rio Grande Valley during historic times. Pages 33–43 *in* Desired future condition for southwestern riparian ecosystems: bringing interests and concerns together (D. W. Shaw and D. M. Finch, editors). U.S. Forest Service General Technical Report RM-272.
- Wright, H. A., and A. W. Bailey. 1980. Fire ecology and prescribed burning in the Great Plains—a research review. U.S. Forest Service General Technical Report INT-77.

- Yanishevsky, R., and S. Petring-Rupp. 1998. Management of breeding habitat for selected bird species in Colorado. Colorado Division of Wildlife, Denver, Colorado.
- Young, J. R. 1994. The influence of sexual selection of phenotypic and genetic divergence among sage grouse populations. Ph.D. dissertation, Purdue University, West Lafayette, Indiana.
- Yosef, R. 1996. Loggerhead Shrike (*Lanius ludovicianus*). In *The birds of North America*, No. 231 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.
- Zwicker, F. C. 1992. Blue Grouse (*Dendragapus obscurus*). In *The birds of North America*, No.15 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.

APPENDIX A: Scientific and Common Names of Plants and Animals

Plants

alligator juniper	<i>Juniperus deppeana</i>
Arapien blazingstar	<i>Nuttallia argillosa</i>
antelope bitterbrush	<i>Purshia tridentata</i>
Arizona fescue	<i>Festuca arizonica</i>
Ashe juniper	<i>Juniperus ashei</i>
aspen	<i>Populus tremuloides</i>
big sagebrush	<i>Artemisia tridentata</i>
big bluestem	<i>Andropogon gerardii</i>
blackbrush	<i>Coleogyne ramosissima</i>
blue grama	<i>Bouteloua gracilis</i>
blue spruce	<i>Picea pungens</i>
blueberry	<i>Vaccinium myrtillus</i>
bog birch	<i>Betula glandulosa</i>
box elder	<i>Acer negundo</i>
bristlecone pine	<i>Pinus aristata</i>
buckbrush	<i>Ceanothus fendleri</i>
budsage	<i>Artemisia spinescens</i>
buffaloberry	<i>Shepherdia canadensis</i>
buffalo grass	<i>Buchloe dactyloides</i>
California juniper	<i>Juniperus californica</i>
cheatgrass	<i>Bromus tectorum</i>
Chinese elm	<i>Ulmus pumila</i>
chokecherry	<i>Prunus virginiana</i>
cholla	<i>Cylindropuntia imbricata</i>
Colorado currant	<i>Ribes coloradense</i>
crested wheatgrass	<i>Agropyron cristatum</i>
currant	<i>Ribes spp.</i>
dandelion	<i>Taraxacum officinale</i>
Douglas-fir	<i>Pseudotsuga menziesii</i>
dwarf mistletoe	<i>Arceuthobium spp.</i>
Eastern red cedar	<i>Juniperus virginianus</i>
Eastwood's monkey flower	<i>Mimulus eastwoodiae</i>
elk sedge	<i>Carex geyeri</i>
Engelmann spruce	<i>Picea engelmannii</i>
evening-primrose	<i>Oenothera spp.</i>
filaree	<i>Erodium cicutarium</i>
four-winged saltbush	<i>Atriplex canescens</i>
Fremont cottonwood	<i>Populus fremontii</i>
galleta	<i>Hilaria jamesii</i>

Gambel oak	<i>Quercus gambelii</i>
geranium	<i>Geranium</i> spp.
giant helleborine	<i>Epipactis gigantea</i>
globemallow	<i>Sphaeralcea</i> spp.
golden columbine	<i>Aquilegia chrysantha rydbergii</i>
greasewood	<i>Sarcobatus vermiculatus</i>
green molly	<i>Kochia americana</i>
hackberry	<i>Celtis occidentalis</i>
halogeton	<i>Halogeton glomeratus</i>
hawthorn	<i>Crataegus</i> spp.
Idaho fescue	<i>Festuca idahoensis</i>
Indian paintbrush	<i>Castilleja</i> spp.
Indian ricegrass	<i>Oryzopsis hymenoides</i>
Junegrass	<i>Koeleria macrantha</i>
kinnikinick	<i>Arctostaphylos uva-ursi</i>
larkspur	<i>Delphinium</i> spp.
limber pine	<i>Pinus flexilis</i>
little bluestem	<i>Schizachyrium scoparium</i>
lodgepole pine	<i>Pinus contorta</i>
mat saltbush	<i>Atriplex corrugata</i>
milkweed	<i>Asclepias</i> spp.
Mormon tea	<i>Ephedra viridis</i>
mountain alder	<i>Alnus tenuifolia</i>
mountain mahogany	<i>Cercocarpus montanus</i> , <i>C. ledifolius</i>
mountain sagebrush	<i>Artemisia frigida</i>
mountain spray	<i>Holodiscus dumosus</i>
narrowleaf cottonwood	<i>Populus angustifolia</i>
needle-and-thread	<i>Stipa comata</i>
Nuttall's saltbush	<i>Atriplex nuttallii</i>
one-seed juniper	<i>Juniperus monosperma</i>
paintbrush spp.	<i>Castilleja</i> spp.
penstemon spp.	<i>Delphinium</i> spp.
pinyon pine	<i>Pinus edulis</i>
plains cottonwood	<i>Populus deltoidea</i>
ponderosa pine	<i>Pinus ponderosa</i>
prairie sand-reed	<i>Calamovilfa longifolia</i>
prickly-pear cactus	<i>Opuntia polycantha</i>
rabbitbrush	<i>Chrysothamnus</i> spp.
raspberry	<i>Rubus</i> spp.
redberry juniper	<i>Juniperus erythrocarpa</i>
red-osier dogwood	<i>Cornus stolonifera</i>
Rio Grande cottonwood	<i>Populus deltoides wislizenii</i>

river birch	<i>Betula occidentalis</i>
Rocky Mountain juniper	<i>Juniperus scopulorum</i>
Russian knapweed	<i>Centaurea repens</i>
Russian-olive	<i>Elaeagnus angustifolia</i>
Russian thistle	<i>Salsola iberica</i>
Salina wildrye	<i>Elymus salina</i>
saltbush	<i>Atriplex</i> spp.
salt cedar	<i>Tamarix gallica</i>
Sandberg bluegrass	<i>Poa sandbergii</i>
sand sagebrush	<i>Artemisia filifolia</i>
sand bluestem	<i>Andropogon hallii</i>
sand dropseed	<i>Sporobolus cryptandrus</i>
scarlet gilia	<i>Ipomopsis aggregata</i>
sego lily	<i>Calochortus gunnisonii</i>
shadscale	<i>Atriplex confertifolia</i>
serviceberry	<i>Amelanchier</i> spp.
shinnery oak	<i>Quercus havardii</i>
shrubby cinquefoil	<i>Pentaphylloides floribunda</i>
side-oats gram	<i>Bouteloua curtipendula</i>
silver sagebrush	<i>Atriplex cana</i>
singleleaf pinyon	<i>Pinus monophylla</i>
skunkbrush	<i>Rhus aromatica/ Rhus trilobata</i>
slender wheatgrass	<i>Elymus trachycaulus</i>
snowberry	<i>Symphoricarpos</i> spp.
spiny hopsage	<i>Atriplex spinosa</i>
spiny horsebrush (cottonthorn)	<i>Tetradymia spinosa</i>
Squaw apple	<i>Peraphyllum ramosissimum</i>
squirreltail	<i>Sitanion hystrix</i>
strawberry	<i>Fragaria</i> spp.
subalpine fir	<i>Abies lasiocarpa</i>
sumac	<i>Rhus</i> spp.
switchgrass	<i>Panicum virgatum</i>
three-awn	<i>Aristida</i> spp.
threeleaf sumac	<i>Rhus trilobata</i>
trumpet vine	<i>Campsis radicans</i>
twist flower	<i>Streptanthus cordatus</i>
Utah juniper	<i>Juniperus osteosperma</i>
valerian	<i>Valeriana</i> spp.
wax currant	<i>Ribes cereum</i>
western serviceberry	<i>Amelanchier</i>
western wheatgrass	<i>Pascopyrum smithii</i>
white fir	<i>Abies concolor</i>

wild plum	<i>Prunus americana</i>
wild rose	<i>Rosa</i> spp.
wild tobacco	<i>Nicotiana attenuata</i>
willow	<i>Salix</i> spp.
winterfat	<i>Eurotia lanata</i>
yarrow	<i>Achillea</i> spp.
yucca	<i>Yucca glauca</i>

Amphibians and Reptiles

bullfrog	<i>Rana catesbeiana</i>
bullsnake	<i>Pituophis melanoleucus</i>

Insects

Douglas-fir bark beetle	<i>Dendroctonus pseudotsugae</i>
Douglas-fir tussock moth	<i>Orgyia pseudotsugata</i>
Englemann spruce beetle	<i>Dendroctonus rufipennis</i>
dragonfly spp.	<i>Aeshna & Libellula</i> spp.
fruit worm caterpillar	Noctuidae family
juniper scale	<i>Carulaspis juniperi</i>
leaf (pinyon needle) miner	<i>Coleotechnites edulicola</i>
Mormon cricket	<i>Anabrus simplex</i>
mountain pine beetle	<i>Dendroctonus ponderosae</i>
oak lace bug	<i>Corythucha arcuata</i>
pine needle scale	<i>Chionaspis pinifoliae</i>
pinyon ips beetle	<i>Ips confusus</i>
pinyon needle scale	<i>Matsucoccus acalyptus</i>
tree cricket	<i>Oecanthus</i> spp.
western spruce budworm	<i>Choristoneura occidentalis</i>

Mammals

badger	<i>Taxidea taxus</i>
coyote	<i>Canis latrans</i>
elk	<i>Cervus elaphus</i>
ground squirrel	<i>Spermophilus</i> spp.
kit fox	<i>Vulpes macrotis</i>
prairie dog	<i>Cynomys</i> spp.
red-backed vole	<i>Clethrionomys gapperi</i>
swift fox	<i>Vulpes velox</i>
vole	<i>Microtus</i> spp.
white-footed mouse	<i>Peromyscus</i> spp.
woodrat	<i>Neotoma</i> spp.
pronghorn	<i>Antilocapra americana</i>

APPENDIX B: Habitat and Species Tables by Physiographic Area

Species of Selected Habitats within Physiographic Area 36

Physiographic Area 36: Central Shortgrass Prairie - Cliff/Rock																
Common Name	TIER	PLAN	PIF Prioritization								COVERS				Cnts Needed	Demo. Needed
			AI	AI+PT	PT	PTU	TB	PIF	WL	B1	B2	IMPORT	T.Bio.			
Turkey Vulture			2	5	3	7	2	12	10		17	39	27	26	Y	
Golden Eagle			2	5	3	6	3	16	16		31	50	37	38	Y	
Chimney Swift			2	5	3	6	3	17	17		27	56	17	38	Y	
White-throated Swift			2	5	3	8	2	16	14		42	39	37	41	Y	
Say's Phoebe			3	5	2	2	2	16	14		16	0	0	10		
Cliff Swallow			3	6	3	5	2	13	7		11	0	0	6	Y	
Barn Swallow			3	4	1	1	1	10	9		23	0	0	14		
Common Raven			2	6	4	3	1	12	7		15	0	0	9		Y
Rock Wren			2	6	4	3	2	16	13		27	41	30	33		Y
Canyon Wren			2	5	3	8	2	16	14		33	34	30	33	Y	
Rufous-crowned Sparrow			2	5	3	8	2	19	18		19	34	15	25	Y	

Physiographic Area 36: Central Shortgrass Prairie - Grassland																
Common Name	TIER	PLAN	PIF Prioritization								COVERS				Cnts Needed	Demo. Needed
			AI	AI+PT	PT	PTU	TB	PIF	WL	B1	B2	IMPORT	T.Bio.			
Swainson's Hawk	I	Y	5	8	3	5	3	23	16		39	63	35	48	Y	
Ferruginous Hawk	I	Y	5	8	3	5	4	24	17		41	58	45	47	Y	
Prairie Falcon	VII	Y	3	6	3	6	3	20	16		33	43	35	37	Y	
Sharp-tailed Grouse	VII	Y	2	5	3	7	4	18	14		45	63	20	52	Y	
Sharp-tailed Grouse	VII	Y	2	5	3	7	4	18	14		57	59	20	58	Y	
Greater Prairie-Chicken	I	Y	4	7	3	7	4	29	25		46	56	12	50	Y	
Lesser Prairie-Chicken	I	Y	3	6	3	8	4	29	26		54	56	15	55	Y	
Scaled Quail			3	6	3	6	3	21	20		47	58	25	51	Y	
Mountain Plover	I	Y	5	7	2	2	4	28	26		67	61	62	65		
Upland Sandpiper	VII	Y	3	6	3	5	3	20	15		28	58	20	40	Y	
Long-billed Curlew	I	Y	4	9	5	2	3	25	21		46	67	27	54		Y
Burrowing Owl	I	Y	5	8	3	5	5	22	16		49	70	30	57	Y	
Common Nighthawk			3	5	2	1	3	14	12		29	43	30	35		
Scissor-tailed Flycatcher			2	5	3	8	2	21	19		24	0	0	15	Y	
Chihuahuan Raven			2	5	3	7	2	16	13		44	47	15	45	Y	
Cassin's Sparrow	I	Y	4	8	4	4	4	23	19		24	54	35	35		Y
Field Sparrow			2	5	3	7	3	17	17		45	56	15	49	Y	
Lark Bunting	I	Y	5	10	5	1	4	24	19		37	54	45	44		Y
Grasshopper Sparrow	II	Y	5	9	4	4	3	20	16		46	61	25	52		Y
McCown's Longspur	I	Y	4	7	3	6	3	27	24		44	52	30	47	Y	
Chestnut-collared Longspur			2	5	3	6	4	21	19		33	59	30	43	Y	
Western Meadowlark			5	7	2	1	2	16	15		36	58	35	44		

Physiographic Area 36: Central Shortgrass Prairie - Lowland Riparian																
Common Name	TIER	PLAN	PIF Prioritization								COVERS				Cnts Needed	Demo. Needed
			AI	AI+PT	PT	PTU	TB	PIF	WL	B1	B2	IMPORT	T.Bio.			
Double-crested Cormorant			2	5	3	7	2	13	9		21	47	17	31	Y	
Great Blue Heron			3	4	1	2	3	13	9		23	52	35	34		
Great Egret			2	5	3	8	2	13	9		32	54	15	40	Y	
Snowy Egret			2	5	3	8	2	13	9		24	56	17	36	Y	
Cattle Egret			2	5	3	8	1	11	7		6	50	17	23	Y	
Green Heron			2	5	3	8	2	14	10		16	50	17	29	Y	
Black-crowned Night-Heron			2	5	3	8	3	14	9		24	58	25	37	Y	
Yellow-crowned Night-Heron			1	4	3	8	3	15	14		27	0	0	17	Y	
Wood Duck			2	5	3	8	2	16	15		24	0	0	15	Y	
Hooded Merganser			1	4	3	8	2	18	16		25	0	0	15	Y	
Common Merganser			2	5	3	8	2	14	11		18	0	0	11	Y	
Mississippi Kite			2	5	3	8	2	19	18		13	43	17	24	Y	
Bald Eagle			2	5	3	8	4	18	15		34	65	30	46	Y	
Red-tailed Hawk			3	4	1	1	1	11	8		5	0	0	3		
American Kestrel			3	7	4	4	2	14	10		31	56	27	40		Y
Northern Bobwhite			2	6	4	3	3	18	17		42	63	17	50		Y
Black-billed Cuckoo			2	5	3	8	2	17	16		34	52	15	41	Y	
Yellow-billed Cuckoo			2	5	3	7	3	17	17		36	56	7	44	Y	
Yellow-billed Cuckoo			2	5	3	7	3	17	17		63	63	7	63	Y	
Eastern Screech-Owl			2	5	3	8	2	16	13		22	49	15	32	Y	
Great Horned Owl			3	5	2	4	1	12	8		7	0	0	4		
Long-eared Owl			2	5	3	8	2	15	15		36	45	27	40	Y	
Lewis's Woodpecker	I	Y	3	6	3	7	3	22	21		36	45	45	40	Y	
Red-headed Woodpecker			2	5	3	5	3	18	18		43	54	32	47	Y	
Red-bellied Woodpecker			2	5	3	8	2	16	14		19	47	32	30	Y	
Ladder-backed Woodpecker			2	5	3	8	2	16	16		31	36	32	33	Y	
Downy Woodpecker			2	5	3	7	2	13	11		18	0	0	11	Y	
Northern Flicker			3	6	3	7	2	13	11		35	45	47	39	Y	
Least Flycatcher			1	4	3	8	2	14	16		43	0	0	26	Y	
Eastern Phoebe			2	5	3	8	2	15	11		17	36	15	24	Y	
Vermilion Flycatcher			1	4	3	8	2	13	13						Y	
Great Crested Flycatcher			2	5	3	8	2	16	14		25	0	0	15	Y	
Western Kingbird			4	5	1	1	2	16	12		15	34	27	22		
Eastern Kingbird			3	7	4	4	2	16	12		21	41	15	28		Y
Blue Jay			2	5	3	6	1	12	12		16	39	15	25	Y	
Black-capped Chickadee			2	5	3	7	2	13	9		24	0	0	15	Y	
Carolina Wren			1	4	3	8	2	14	11		19	0	0	12	Y	
House Wren			3	4	1	2	2	11	7		11	0	0	6		
Eastern Bluebird			2	5	3	8	2	14	10		23	32	15	26	Y	
American Robin			3	4	1	1	1	9	6		13	0	0	8		

Physiographic Area 36: Central Shortgrass Prairie - Lowland Riparian																
Common Name	TIER	PLAN	PIF Prioritization								COVERS				Cnts Needed	Demo. Needed
			AI	AI+PT	PT	PTU	TB	PIF	WL	B1	B2	IMPORT	T.Bio.			
Gray Catbird			2	5	3	8	2	15	15		31	43	25	35	Y	
Brown Thrasher			2	4	2	4	2	15	17		38	49	15	42		
European Starling			3	5	2	4	1	10	6							
Bell's Vireo	I	Y	2	5	3	8	4	23	23		43	59	15	49	Y	
Red-eyed Vireo			1	4	3	8	2	13	10		25	49	15	34	Y	
Yellow Warbler			3	6	3	5	2	13	8		18	30	27	23	Y	
American Redstart			2	5	3	8	2	14	12		36	56	17	44	Y	
Yellow-breasted Chat			2	5	3	8	3	16	14		25	0	0	15	Y	
Northern Cardinal			2	5	3	8	2	11	8		11	27	17	17	Y	
Rose-breasted Grosbeak			2	5	3	8	2	17	15		25	43	15	32	Y	
Black-headed Grosbeak			2	5	3	7	3	19	17		17	0	0	11	Y	
Blue Grosbeak			3	5	2	2	2	15	11		12	38	25	22		
Lazuli Bunting			2	5	3	7	2	18	16		21	43	35	29	Y	
Indigo Bunting			2	5	3	8	2	14	13		28	49	15	36	Y	
Song Sparrow			2	5	3	8	3	12	11		34	0	0	21	Y	
Great-tailed Grackle			2	5	3	8	1	12	8		0	0	0	0	Y	
Common Grackle			3	4	1	1	1	10	11		18	34	15	24		
Orchard Oriole			2	4	2	4	2	15	17		33	39	15	35		
Baltimore Oriole			2	5	3	6	2	16	15		27	0	0	17	Y	
Bullock's Oriole			4	6	2	4	2	17	15		22	0	0	13		
American Goldfinch			3	6	3	5	2	13	12		34	30	15	33	Y	

Physiographic Area 36: Central Shortgrass Prairie - Shore/Bank																
Common Name	TIER	PLAN	PIF Prioritization								COVERS				Cnts Needed	Demo. Needed
			AI	AI+PT	PT	PTU	TB	PIF	WL	B1	B2	IMPORT	T.Bio.			
American White Pelican			3	6	3	7	3	21	16		26	67	17	42	Y	
Snowy Plover	I	Y	3	6	3	8	5	22	19		52	56	20	53	Y	
Piping Plover	I	Y	2	5	3	8	5	26	24		62	61	12	62	Y	
Killdeer			4	6	2	1	2	16	15		31	50	27	38		
Black-necked Stilt			2	5	3	8	3	15	11		26	0	0	16	Y	
American Avocet			3	6	3	6	3	21	19		36	49	30	41	Y	
Spotted Sandpiper			2	5	3	8	2	12	8		32	0	0	20	Y	
Wilson's Phalarope			2	5	3	8	3	19	17		38	0	0	24	Y	
California Gull			2	5	3	7	2	17	13		15	0	0	9	Y	
Least Tern	VI	Y	3	6	3	8	5	18	15		56	65	20	60	Y	
Belted Kingfisher			2	5	3	7	2	14	10		32	58	25	42	Y	
Northern Rough-winged Swallow			2	5	3	5	2	15	13		28	34	30	31	Y	
Bank Swallow			2	5	3	6	2	13	11		29	43	17	35	Y	

Physiographic Area 36: Central Shortgrass Prairie - Wetlands																
Common Name	TIER	PLAN	PIF Prioritization								COVERS				Cnts Needed	Demo. Needed
			AI	AI+PT	PT	PTU	TB	PIF	WL	B1	B2	IMPORT	T.Bio.			
Pied-billed Grebe			2	5	3	8	3	14	9	28	50	25	37	Y		
Eared Grebe			2	5	3	8	3	14	12	38	49	22	42	Y		
Western Grebe			3	6	3	8	3	20	17	29	38	35	33	Y		
Clark's Grebe			3	6	3	8	3	20	17	38	56	35	45	Y		
American Bittern			2	5	3	8	3	17	17	48	54	17	51	Y		
Least Bittern			1	4	3	8	3	16	15	45	59	17	51	Y		
Canada Goose			2	5	3	7	1	12	9	4	0	0	2	Y		
Green-winged Teal			2	5	3	7	2	13	10	19	0	0	12	Y		
Mallard			3	5	2	4	2	12	12	16	0	0	10			
Northern Pintail			2	5	3	6	3	13	13	38	58	27	46	Y		
Blue-winged Teal			2	5	3	6	3	14	12	23	0	0	14	Y		
Cinnamon Teal			2	5	3	8	3	17	15	36	0	0	22	Y		
Northern Shoveler			2	5	3	7	3	14	10	23	0	0	14	Y		
Gadwall			2	5	3	8	3	14	10	19	0	0	12	Y		
American Wigeon			2	5	3	8	3	15	14	27	0	0	17	Y		
Canvasback			1	4	3	8	4	17	17	19	63	15	36	Y		
Redhead			2	5	3	8	4	19	18	24	0	0	15	Y		
Lesser Scaup			2	5	3	8	2	15	15	41	58	35	47	Y		
Ruddy Duck			2	5	3	8	3	17	15	28	0	0	17	Y		
Northern Harrier	II	Y	3	8	5	2	4	20	16	35	52	30	42		Y	
Virginia Rail			3	6	3	8	2	15	11	35	52	30	42	Y		
Sora			2	5	3	8	2	13	11	33	52	17	40	Y		
American Coot			2	5	3	7	2	11	10	21	0	0	13	Y		
Willet			1	4	3	8	3	17	18	24	0	0	15	Y		
Common Snipe			2	5	3	6	2	13	12	19	0	0	12	Y		
Forster's Tern			3	6	3	8	4	21	15	29	49	22	37	Y		
Black Tern			3	6	3	8	4	18	17	46	59	17	51	Y		
Short-eared Owl	III	Y	2	5	3	8	4	19	19	36	49	27	41	Y		
Marsh Wren			2	5	3	8	4	18	14	18	56	17	33	Y		
Common Yellowthroat			2	5	3	6	3	14	13	32	50	17	39	Y		
Savannah Sparrow			2	5	3	7	3	13	12	34	49	32	40	Y		
Red-winged Blackbird			3	5	2	1	2	11	11	22	0	0	13			
Yellow-headed Blackbird			2	6	4	3	4	19	17	17	56	30	32		Y	

Partners in Flight Tier VI species (and subspecies) that breed within Physiographic Area 36 (Central Shortgrass Prairie). Tier VI species are those that have a special status as designated by an agency within Colorado.

BLM-SS = Bureau of Land Management Sensitive Species
 USFS-SS = U.S. Forest Service Sensitive Species
 CO-SC = Colorado Division of Wildlife Species of Special Concern
 CO-T = Colorado Threatened Species
 CO-E = Colorado Endangered Species
 FT = Federal Threatened Species
 FE = Federal Endangered Species

Common Name	BLM-SS	USFS-SS	CO-SC	CO-T	CO-E	FT	FE
American Bittern		X					
American White Pelican	X		X				
Bald Eagle				X		X	
Black Tern	X	X					
Columbian Sharp-tailed Grouse	X	X					
Ferruginous Hawk	X	X	X				
Greater Prairie-Chicken		X					
Interior Least Tern					X		X
Lesser Prairie-Chicken		X		X			
Lewis's Woodpecker		X					
Loggerhead Shrike		X					
Long-billed Curlew	X	X	X				
Mountain Plover	X	X	X				
Piping Plover				X		X	
Plains Sharp-tailed Grouse					X		
Prairie Falcon			X				
Scaled Quail			X				
Upland Sandpiper		X					
Western Burrowing Owl		X		X			
Western Snowy Plover	X	X	X				

Species of Selected Habitats within Physiographic Area 62

Physiographic Area 62: Southern Rocky Mountains - Alpine Tundra																
Common Name	TIER	PLAN	PIF Prioritization								COVERS				Cnts Needed	Demo. Needed
			AI	AI+PT	PT	PTU	TB	PIF	WL	B1	B2	IMPORT	T.Bio.			
White-tailed Ptarmigan	VII	Y	4	7	3	8	2	21	17		39	36	50	38	Y	
American Pipit	VII	Y	4	7	3	8	2	15	13		33	0	0	20	Y	
Brown-capped Rosy-Finch	I	Y	5	8	3	8	1	24	19		29	30	62	30	Y	

Physiographic Area 62: Southern Rocky Mountains - Aspen																
Common Name	TIER	PLAN	PIF Prioritization								COVERS				Cnts Needed	Demo. Needed
			AI	AI+PT	PT	PTU	TB	PIF	WL	B1	B2	IMPORT	T.Bio.			
Cooper's Hawk			3	6	3	7	2	15	11		31	39	35	34	Y	
Northern Saw-whet Owl			3	6	3	8	2	15	12		25	49	27	34	Y	
Broad-tailed Hummingbird	V	Y	5	7	2	4	1	20	17		16	41	42	26		
Red-naped Sapsucker	VII	Y	4	6	2	2	3	21	18		21	49	45	31		
Western Wood-Pewee			5	7	2	1	2	17	15		25	43	27	32		
Purple Martin	VII	Y	1	4	3	7	3	14	13		43	65	17	51	Y	
Tree Swallow			3	6	3	5	2	15	10		25	0	0	15	Y	
Violet-green Swallow	II	Y	5	8	3	5	2	19	14		27	47	35	35	Y	
Mountain Bluebird			4	7	3	8	2	18	14		34	34	35	34	Y	
Warbling Vireo			5	7	2	4	2	18	12		16	0	0	10		

Physiographic Area 62: Southern Rocky Mountains - Cliff/Rock																
Common Name	TIER	PLAN	PIF Prioritization								COVERS				Cnts Needed	Demo. Needed
			AI	AI+PT	PT	PTU	TB	PIF	WL	B1	B2	IMPORT	T.Bio.			
Turkey Vulture			2	5	3	5	2	12	10		17	39	27	26	Y	
Golden Eagle			3	5	2	2	3	16	16		31	50	37	38		
Peregrine Falcon	VII	Y	3	6	3	8	4	19	14		43	50	32	46	Y	
Prairie Falcon			3	6	3	7	3	20	16		33	43	35	37	Y	
Black Swift	I	Y	3	6	3	8	3	23	20		42	45	32	43	Y	
White-throated Swift			3	7	4	4	2	18	14		42	39	37	41		Y
Say's Phoebe			3	6	3	5	2	17	14		16	0	0	10	Y	
Cliff Swallow			3	5	2	4	1	11	7		11	0	0	6		
Barn Swallow			3	6	3	5	1	12	9		23	0	0	14	Y	
Common Raven			3	4	1	1	1	10	7		15	0	0	9		
Rock Wren			3	5	2	1	2	15	13		27	41	30	33		
Canyon Wren			3	6	3	6	2	17	14		33	34	30	33	Y	
Townsend's Solitaire			4	6	2	4	2	17	13		13	41	30	24		

Physiographic Area 62: Southern Rocky Mountains - High Elevation Riparian																
Common Name	TIER	PLAN	PIF Prioritization							COVERS				Cnts Needed	Demo. Needed	
			AI	AI+PT	PT	PTU	TB	PIF	WL	B1	B2	IMPORT	T.Bio.			
Barrow's Goldeneye			2	5	3	8	3	21	18		31	59	15	42	Y	
Bufflehead			2	5	3	8	3	17	15		29	0	0	18	Y	
Osprey			2	5	3	8	2	15	11		37	63	17	47	Y	
Willow Flycatcher			2	5	3	6	3	18	16		34	0	0	21	Y	
Willow Flycatcher			2	5	3	6	3	18	16		66	59	7	64	Y	
Cordilleran Flycatcher	V	Y	4	7	3	5	2	21	17		15	41	35	25	Y	
American Dipper	VII	Y	4	7	3	6	3	21	17		37	41	27	39	Y	
Veery			2	5	3	6	3	17	17		43	43	22	43	Y	
Swainson's Thrush			2	5	3	6	2	14	13		31	49	15	37	Y	
MacGillivray's Warbler	VII	Y	3	7	4	4	2	20	16		31	34	30	32		Y
Wilson's Warbler	II	Y	5	9	4	4	2	19	13		38	54	22	44		Y
Fox Sparrow			3	6	3	6	2	15	12		23	43	25	31	Y	
Lincoln's Sparrow			5	8	3	5	2	17	12		22	0	0	13	Y	
White-crowned Sparrow			5	7	2	2	2	14	12		34	45	35	38		

Physiographic Area 62: Southern Rocky Mountains - Lowland Riparian																
Common Name	TIER	PLAN	PIF Prioritization							COVERS				Cnts Needed	Demo. Needed	
			AI	AI+PT	PT	PTU	TB	PIF	WL	B1	B2	IMPORT	T. Bio.			
Double-crested Cormorant			2	5	3	8	2	13	9		21	47	17	31	Y	
Great Blue Heron			2	4	2	3	2	12	9		23	52	35	34		
Black-crowned Night-Heron			2	5	3	7	2	13	9		24	58	25	37	Y	
Black-crowned Night-Heron			2	5	3	7	3	14	9		24	58	25	37	Y	
Common Merganser			3	6	3	6	2	15	11		18	0	0	11	Y	
Red-tailed Hawk			3	6	3	5	1	13	8		5	0	0	3	Y	
American Kestrel			4	8	4	4	2	15	10		31	56	27	40		Y
Western Screech-Owl			2	5	3	8	1	15	13		24	49	15	33	Y	
Great Horned Owl			3	6	3	6	1	13	8		7	0	0	4	Y	
Long-eared Owl			3	6	3	8	2	16	15		36	45	27	40	Y	
Lewis's Woodpecker	I	Y	3	6	3	6	4	23	21		36	45	45	40	Y	
Downy Woodpecker			2	5	3	7	2	13	11		18	0	0	11	Y	
Northern Flicker			5	7	2	4	2	14	11		35	45	47	39		
Black-capped Chickadee			2	4	2	4	2	12	9		24	0	0	15		
House Wren			4	6	2	1	2	13	7		11	0	0	6		
American Robin			4	6	2	1	1	11	6		13	0	0	8		
Gray Catbird			2	5	3	7	2	15	15		31	43	25	35	Y	
European Starling			3	5	2	1	1	10	6							
Red-eyed Vireo			1	4	3	8	2	13	10		25	49	15	34	Y	
Yellow Warbler			5	7	2	4	2	14	8		18	30	27	23		
American Redstart			2	5	3	8	2	14	12		36	56	17	44	Y	
Yellow-breasted Chat			2	5	3	6	2	15	14		25	0	0	15	Y	
Black-headed Grosbeak			3	5	2	4	2	18	17		17	0	0	11		

Blue Grosbeak			2	5	3	5	2	15	11		12	38	25	22	Y	
Lazuli Bunting	VII	Y	4	7	3	5	2	20	16		21	43	35	29	Y	
Indigo Bunting			2	5	3	8	1	13	13		28	49	15	36	Y	
Song Sparrow			3	5	2	1	2	11	11		34	0	0	21		
Great-tailed Grackle			2	5	3	7	1	12	8		0	0	0	0	Y	
Common Grackle			2	4	2	4	1	10	11		18	34	15	24		
Bullock's Oriole			3	5	2	2	2	16	15		22	0	0	13		
American Goldfinch			2	5	3	5	2	12	12		34	30	15	33	Y	

Physiographic Area 62: Southern Rocky Mountains - Mixed Conifer

Common Name	TIER	PLAN	PIF Prioritization							COVERS				T. Bio.	Cnts Needed	Demo. Needed
			AI	AI+PT	PT	PTU	TB	PIF	WL	B1	B2	IMPORT				
Northern Goshawk			3	6	3	8	2	17	15		24	54	27	35	Y	
Blue Grouse	VII	Y	3	6	3	7	2	20	18		32	45	32	37	Y	
Northern Pygmy-Owl			3	6	3	8	2	17	14		24	0	0	15	Y	
Williamson's Sapsucker	I	Y	5	8	3	6	3	23	18		38	49	52	42	Y	
Steller's Jay			3	5	2	1	2	15	13		17	0	0	11		
White-breasted Nuthatch			3	4	1	2	2	13	10		16	41	32	26		
Brown Creeper			2	5	3	7	3	15	13		21	0	0	13	Y	
Yellow-rumped Warbler			4	7	3	5	2	14	9		21	38	27	27	Y	
Western Tanager			4	6	2	2	2	17	15		33	54	22	41		
Dark-eyed Junco			4	6	2	2	2	13	12		22	50	30	33		
Evening Grosbeak			3	6	3	6	2	14	9		25	34	30	28	Y	

Physiographic Area 62: Southern Rocky Mountains - Mountain Shrubland

Common Name	TIER	PLAN	PIF Prioritization							COVERS				T. Bio.	Cnts Needed	Demo. Needed
			AI	AI+PT	PT	PTU	TB	PIF	WL	B1	B2	IMPORT				
Common Poorwill			3	6	3	7	2	19	16		23	41	30	30	Y	
Dusky Flycatcher			3	5	2	2	2	19	17		17	47	22	28		
Western Scrub-Jay			3	5	2	4	3	18	13		15	0	0	9		
Cedar Waxwing			2	5	3	8	2	13	9		13	23	27	17	Y	
Orange-crowned Warbler			3	4	1	2	2	12	11		19	0	0	12		
Virginia's Warbler	I	Y	3	6	3	5	2	23	21		25	34	45	28	Y	
Green-tailed Towhee	V	Y	5	7	2	1	2	19	16		21	0	0	13		
Spotted Towhee			3	5	2	4	3	16	16		21	0	0	13		
Lesser Goldfinch			3	5	2	4	2	15	15		26	39	22	31		

Physiographic Area 62: Southern Rocky Mountains - Ponderosa Pine

Common Name	TIER	PLAN	PIF Prioritization							COVERS				T. Bio.	Cnts Needed	Demo. Needed
			AI	AI+PT	PT	PTU	TB	PIF	WL	B1	B2	IMPORT				
Wild Turkey			2	5	3	7	2	17	13		21	34	25	26	Y	
Band-tailed Pigeon	III	Y	3	6	3	7	2	19	18		43	58	17	48	Y	

Physiographic Area 62: Southern Rocky Mountains - Ponderosa Pine																
Common Name	TIER	PLAN	PIF Prioritization							COVERS				Cnts Needed	Demo. Needed	
			AI	AI+PT	PT	PTU	TB	PIF	WL	B1	B2	IMPORT	T.Bio.			
Flammulated Owl	I	Y	4	7	3	8	2	22	19		49	49	22	49	Y	
Spotted Owl	I	Y	2	5	3	8	3	22	23		59	72	17	64	Y	
Lewis's Woodpecker	III	Y	3	6	3	6	4	23			36	45	45	40	Y	
Acorn Woodpecker			1	4	3	8	2	14	14						Y	
Hairy Woodpecker			3	6	3	5	2	15	10		31	0	0	19	Y	
Pygmy Nuthatch			2	5	3	6	3	19	16		25	49	40	34	Y	
Western Bluebird			2	4	2	4	2	17	14		32	54	15	40		
Grace's Warbler	I	Y	4	7	3	8	3	23	19		32	38	15	34	Y	
Hepatic Tanager			2	5	3	8	2	15	12		21	47	15	31	Y	
Chipping Sparrow			3	7	4	4	3	16	11		29	38	22	33		Y

Physiographic Area 62: Southern Rocky Mountains - Sagebrush Shrubland																
Common Name	TIER	PLAN	PIF Prioritization							COVERS				Cnts Needed	Demo. Needed	
			AI	AI+PT	PT	PTU	TB	PIF	WL	B1	B2	IMPORT	T.Bio.			
Sage Grouse	I	Y									51	69	25	57	Y	
Sage Thrasher			3	6	3	5	2	18	15		19	0	0	12	Y	
Brewer's Sparrow	III	Y	3	7	4	4	3	19	18		42	50	42	45		Y
Vesper Sparrow			3	6	3	5	2	14	14		34	45	37	38	Y	
Sage Sparrow	III	Y	2	5	3	6	3	20	20		34	49	30	40	Y	

Physiographic Area 62: Southern Rocky Mountains - Spruce-Fir																
Common Name	TIER	PLAN	PIF Prioritization							COVERS				Cnts Needed	Demo. Needed	
			AI	AI+PT	PT	PTU	TB	PIF	WL	B1	B2	IMPORT	T.Bio.			
Sharp-shinned Hawk			3	6	3	8	2	15	11		32	54	27	40	Y	
Boreal Owl	VII	Y	3	6	3	8	2	18	15		32	49	22	38	Y	
Three-toed Woodpecker			3	6	3	7	3	18	16		38	56	40	45	Y	
Olive-sided Flycatcher	VII	Y	3	5	2	4	3	17	17		45	54	22	48		
Hammond's Flycatcher	VII	Y	3	6	3	5	2	20	18		19	49	22	31	Y	
Gray Jay			3	6	3	6	2	15	10		14	0	0	8	Y	
Clark's Nutcracker			4	6	2	4	1	16	12		12	0	0	7		
Mountain Chickadee			3	6	3	5	2	16	11		31	54	27	40	Y	
Red-breasted Nuthatch			3	6	3	5	2	14	9		11	49	45	25	Y	
Golden-crowned Kinglet			2	5	3	6	3	16	12		35	0	0	22	Y	
Ruby-crowned Kinglet			5	7	2	4	2	16	10		25	41	27	31		
Hermit Thrush			4	7	3	5	2	16	11		18	41	15	27	Y	
Pine Grosbeak			3	6	3	6	2	16	13		23	54	25	35	Y	
Cassin's Finch			4	6	2	2	3	18	17		15	34	35	22		
Red Crossbill			4	8	4	4	3	18	13		24	54	22	35		Y
White-winged Crossbill			1	4	3	8	2	14	13		27	59	15	40	Y	
Pine Siskin			4	8	4	4	2	15	7		33	45	27	37		Y

Physiographic Area 62: Southern Rocky Mountains - Wetlands																
Common Name	TIER	PLAN	PIF Prioritization								COVERS				Cnts Needed	Demo. Needed
			AI	AI+PT	PT	PTU	TB	PIF	WL	B1	B2	IMPORT	T.Bio.			
Pied-billed Grebe			2	5	3	7	2	13	9		28	50	25	37	Y	
Eared Grebe			2	5	3	8	3	14	12		38	49	22	42	Y	
Western Grebe			2	5	3	8	3	19	17		29	38	35	33	Y	
White-faced Ibis			2	5	3	7	3	16	12		35	61	35	45	Y	
Canada Goose			3	6	3	6	1	13	9		4	0	0	2	Y	
Green-winged Teal			3	6	3	6	2	14	10		19	0	0	12	Y	
Mallard			3	4	1	1	2	11	12		16	0	0	10		
Northern Pintail			2	5	3	7	3	13	13		38	58	27	46	Y	
Blue-winged Teal			2	5	3	7	3	14	12		23	0	0	14	Y	
Cinnamon Teal			3	6	3	6	3	18	15		36	0	0	22	Y	
Northern Shoveler			2	5	3	7	3	14	10		23	0	0	14	Y	
Gadwall			3	5	2	4	3	14	10		19	0	0	12		
American Wigeon			2	5	3	7	3	15	14		27	0	0	17	Y	
Canvasback			2	5	3	8	4	18	17		19	63	15	36	Y	
Redhead			2	5	3	8	4	19	18		24	0	0	15	Y	
Ring-necked Duck			3	6	3	8	3	19	15		16	0	0	10	Y	
Lesser Scaup			3	6	3	7	2	16	15		41	58	35	47	Y	
Ruddy Duck			3	6	3	6	3	18	15		28	0	0	17	Y	
Northern Harrier			2	5	3	6	4	17	16		35	52	30	42	Y	
Virginia Rail			3	6	3	7	3	16	11		35	52	30	42	Y	
Sora			3	6	3	6	2	14	11		33	52	17	40	Y	
American Coot			3	6	3	6	2	12	10		21	0	0	13	Y	
Willet	III	Y									24	0	0	15	Y	
Sandhill Crane			2	5	3	8	3	20	18		37	70	32	50	Y	
Sandhill Crane			2	5	3	8	3	20	18		45	74	55	56	Y	
Common Snipe			5	6	1	2	2	14	12		19	0	0	12		
Wilson's Phalarope			2	5	3	7	3	19	17		38	0	0	24	Y	
Short-eared Owl			1	4	3	8	4	18	19		36	49	27	41	Y	
Short-eared Owl	III	Y	3	6	3	8	4	20	19		36	49	27	41	Y	
Marsh Wren			2	5	3	7	4	18	14		18	56	17	33	Y	
Common Yellowthroat			2	6	4	4	2	14	13		32	50	17	39		Y
Savannah Sparrow			3	6	3	5	3	14	12		34	49	32	40	Y	
Red-winged Blackbird			3	5	2	1	2	11	11		22	0	0	13		
Yellow-headed Blackbird			2	5	3	5	4	18	17		17	56	30	32	Y	

Partners in Flight Tier VI species (and subspecies) that breed within Physiographic Area 62 (Southern Rocky Mountains). Tier VI species are those that have a special status as designated by an agency within Colorado.

BLM-SS = Bureau of Land Management Sensitive Species
 USFS-SS = U.S. Forest Service Sensitive Species
 NPS-SC = National Park Service Species of Concern
 CO-SC = Colorado Division of Wildlife Species of Special Concern
 CO-T = Colorado Threatened Species
 CO-E = Colorado Endangered Species
 FT = Federal Threatened Species
 FE = Federal Endangered Species

Common Name	BLM-SS	USFS-SS	NPS-SC	CO-SC	CO-T	CO-E	FT	FE
American White Pelican	X			X				
Bald Eagle					X		X	
Barrow's Goldeneye	X			X				
Black Swift		X						
Boreal Owl		X						
Columbian Sharp-tailed Grouse		X						
Flammulated Owl		X						
Fox Sparrow		X						
Golden-crowned Kinglet		X						
Gunnison Sage Grouse	X			X				
Lewis's Woodpecker		X						
Merlin		X						
Mexican Spotted Owl					X		X	
Mountain Plover	X	X		X				
Northern Goshawk	X	X						
Northern Pygmy-Owl			X					
Northern Sage Grouse	X			X				
Olive-sided Flycatcher		X						
Osprey			X					
Purple Martin		X						
Pygmy Nuthatch		X						
Southwestern Willow Flycatcher						X		X
Three-toed Woodpecker		X						

Species of Selected Habitats within Physiographic Area 87

Physiographic Area 87: Colorado Plateau - Cliff/Rock																
Common Name	TIER	PLA N	PIF Prioritization							COVERS				Cnts Needed	Demo. Needed	
			AI	AI+PT	PT	PTU	TB	PIF	WL	B1	B2	IMPORT	T.Bio.			
Turkey Vulture			4	6	2	2	2	13	10		17	39	27	26		
Golden Eagle			3	6	3	6	4	18	16		31	50	37	38	Y	
Peregrine Falcon	VII	Y	4	7	3	7	2	18	14		43	50	32	46	Y	
Prairie Falcon			3	6	3	6	3	20	16		33	43	35	37	Y	
White-throated Swift	II	Y	4	9	5	2	2	20	14		42	39	37	41		Y
Say's Phoebe			5	7	2	1	2	18	14		16	0	0	10		
Cliff Swallow			3	6	3	5	2	13	7		11	0	0	6	Y	
Barn Swallow			3	6	3	5	1	12	9		23	0	0	14	Y	
Common Raven			5	6	1	1	1	12	7		15	0	0	9		
Rock Wren			4	7	3	5	1	16	13		27	41	30	33	Y	
Canyon Wren			4	7	3	6	2	18	14		33	34	30	33	Y	
Townsend's Solitaire			2	4	2	3	3	16	13		13	41	30	24		
Rufous-crowned Sparrow			2	5	3	7	2	19	18		19	34	15	25	Y	

Physiographic Area 87: Colorado Plateau - Lowland Riparian																
Common Name	TIER	PLA N	PIF Prioritization							COVERS				Cnts Needed	Demo. Needed	
			AI	AI+PT	PT	PTU	TB	PIF	WL	B1	B2	IMPORT	T.Bio.			
Double-crested Cormorant			2	5	3	8	3	14	9		21	47	17	31	Y	
Great Blue Heron			2	5	3	7	2	13	9		23	52	35	34	Y	
Great Egret			1	4	3	8	2	12	9		32	54	15	40	Y	
Snowy Egret			2	5	3	8	3	14	9		24	56	17	36	Y	
Little Blue Heron			1	4	3	8	3	13	12		42	0	0	26	Y	
Cattle Egret			2	5	3	8	3	13	7		6	50	17	23	Y	
Green Heron			3	6	3	8	1	14	10		16	50	17	29	Y	
Black-crowned Night-Heron			2	5	3	8	3	14	9		24	58	25	37	Y	
Wood Duck			2	5	3	8	1	15	15		24	0	0	15	Y	
Hooded Merganser			1	4	3	8	3	19	16		25	0	0	15	Y	
Common Merganser			2	5	3	8	1	13	11		18	0	0	11	Y	
Mississippi Kite			2	5	3	8	3	20	18		13	43	17	24	Y	
Bald Eagle			2	5	3	8	4	18	15		34	65	30	46	Y	
Red-tailed Hawk			3	4	1	1	2	12	8		5	0	0	3		
American Kestrel			4	8	4	4	2	15	10		31	56	27	40		Y
Northern Bobwhite			1	4	3	8	2	15	17		42	63	17	50	Y	
Gambel's Quail			2	5	3	6	2	19	16						Y	
Yellow-billed Cuckoo			2	5	3	7	5	19	17		36	56	7	44	Y	
Yellow-billed Cuckoo			2	5	3	7	5	19	17		63	63	7	63	Y	
Western Screech-Owl			3	6	3	8	2	17	13		24	49	15	33	Y	
Great Horned Owl			3	6	3	7	1	13	8		7	0	0	4	Y	

Physiographic Area 87: Colorado Plateau - Lowland Riparian																
Common Name	TIER	PLA N	PIF Prioritization								COVERS				Cnts Needed	Demo. Needed
			AI	AI+PT	PT	PTU	TB	PIF	WL	B1	B2	IMPORT	T.Bio.			
Long-eared Owl			3	6	3	8	3	17	15		36	45	27	40	Y	
Lewis's Woodpecker	I	Y	3	6	3	6	3	22	21		36	45	45	40	Y	
Lewis's Woodpecker	III	Y	2	5	3	6	3	21	21		36	45	45	40	Y	
Red-headed Woodpecker			3	6	3	8	4	20	18		43	54	32	47	Y	
Ladder-backed Woodpecker			2	5	3	6	2	16	16		31	36	32	33	Y	
Downy Woodpecker			2	5	3	8	3	14	11		18	0	0	11	Y	
Northern Flicker			3	5	2	2	2	12	11		35	45	47	39		
Willow Flycatcher			3	6	3	7	4	20	16		34	0	0	21	Y	
Black Phoebe			2	5	3	7	3	17	13		19	47	15	30	Y	
Eastern Phoebe			2	5	3	8	1	14	11		17	36	15	24	Y	
Western Kingbird	II	Y	4	8	4	4	2	19	12		15	34	27	22		Y
Eastern Kingbird			2	5	3	8	2	14	12		21	41	15	28	Y	
Blue Jay			2	5	3	8	1	12	12		16	39	15	25	Y	
Black-capped Chickadee			3	6	3	8	3	15	9		24	0	0	15	Y	
House Wren			2	5	3	6	3	13	7		11	0	0	6	Y	
Eastern Bluebird			2	5	3	8	4	16	10		23	32	15	26	Y	
American Robin			3	5	2	4	2	11	6		13	0	0	8		
Gray Catbird			2	5	3	8	1	14	15		31	43	25	35	Y	
European Starling			3	5	2	2	1	10	6							
Bell's Vireo			2	5	3	8	3	22	23		43	59	15	49	Y	
Lucy's Warbler			2	5	3	8	2	22	22						Y	
Yellow Warbler			3	6	3	6	3	14	8		18	30	27	23	Y	
American Redstart			1	4	3	8	2	13	12		36	56	17	44	Y	
Yellow-breasted Chat			2	5	3	7	3	16	14		25	0	0	15	Y	
Black-headed Grosbeak			3	6	3	5	3	20	17		17	0	0	11	Y	
Blue Grosbeak			3	5	2	2	2	15	11		12	38	25	22		
Lazuli Bunting			2	5	3	6	2	18	16		21	43	35	29	Y	
Indigo Bunting			2	5	3	7	3	15	13		28	49	15	36	Y	
Song Sparrow			2	5	3	6	3	12	11		34	0	0	21	Y	
Great-tailed Grackle			2	5	3	7	2	13	8		0	0	0	0	Y	
Common Grackle			2	5	3	7	1	11	11		18	34	15	24	Y	
Bullock's Oriole			3	6	3	5	3	18	15		22	0	0	13	Y	
American Goldfinch			2	5	3	8	3	13	12		34	30	15	33	Y	

Physiographic Area 87: Colorado Plateau - Mountain Shrubland																
Common Name	TIER	PLA N	PIF Prioritization								COVERS				Cnts Needed	Demo. Needed
			AI	AI+PT	PT	PTU	TB	PIF	WL	B1	B2	IMPORT	T.Bio.			
Sharp-tailed Grouse			2	5	3	8	4	18	14		45	63	20	52	Y	
Sharp-tailed Grouse			2	5	3	8	4	18	14		57	59	20	58	Y	
Common Poorwill	II	Y	5	8	3	7	2	21	16		23	41	30	30	Y	
Dusky Flycatcher			3	6	3	7	3	21	17		17	47	22	28	Y	

Appendix B: Habitat and Species Tables by Physiographic Area

Western Scrub-Jay			4	6	2	1	3	19	13		15	0	0	9		
Cedar Waxwing			1	4	3	8	2	12	9		13	23	27	17	Y	
Orange-crowned Warbler			2	5	3	7	3	14	11		19	0	0	12	Y	
Virginia's Warbler	I	Y	3	5	2	3	2	22	21		25	34	45	28		
Green-tailed Towhee			4	7	3	6	3	20	16		21	0	0	13	Y	
Spotted Towhee			4	7	3	5	2	17	16		21	0	0	13	Y	
Lesser Goldfinch			3	5	2	4	2	15	15		26	39	22	31		

Physiographic Area 87: Colorado Plateau - Pinyon-Juniper																
Common Name	TIER	PLA N	PIF Prioritization							COVERS				Cnts Needed	Demo. Needed	
			AI	AI+PT	PT	PTU	TB	PIF	WL	B1	B2	IMPORT	T.Bio.			
Black-chinned Hummingbird	I	Y	4	7	3	6	3	23	18		36	50	37	42	Y	
Gray Flycatcher	I	Y	4	7	3	5	3	23	16		25	34	35	28	Y	
Ash-throated Flycatcher			3	5	2	4	3	17	12		18	49	15	30		
Cassin's Kingbird	I	Y	5	7	2	1	2	22	19		23	36	15	28		
Pinyon Jay	II	Y	5	8	3	5	3	21	14		34	0	0	21	Y	
Juniper Titmouse	I	Y	5	8	3	5	2	22	18		43	49	32	45	Y	
Bushtit			3	6	3	5	2	16	11		35	0	0	22	Y	
Bewick's Wren			4	5	1	2	2	16	15		31	43	17	35		
Blue-gray Gnatcatcher			4	5	1	2	2	14	10		15	0	0	9		
Northern Mockingbird			4	6	2	1	2	12	10		19	0	0	12		
Gray Vireo	I	Y	5	8	3	6	3	26	21		32	50	52	39	Y	
Plumbeous Vireo			3	4	1	2	3	18	17		21	41	35	28		
Black-throated Gray Warbler	VII	Y	3	5	2	4	3	21	19		23	41	35	30		
Scott's Oriole	VII	Y	4	6	2	4	3	21	18		19	34	15	25		

Physiographic Area 87: Colorado Plateau - Ponderosa Pine																
Common Name	TIER	PLA N	PIF Prioritization							COVERS				Cnts Needed	Demo. Needed	
			AI	AI+PT	PT	PTU	TB	PIF	WL	B1	B2	IMPORT	T.Bio.			
Wild Turkey			3	6	3	7	3	19	13		21	34	25	26	Y	
Band-tailed Pigeon	III	Y	3	6	3	7	3	20	18		43	58	17	48	Y	
Flammulated Owl			2	5	3	8	3	21	19		49	49	22	49	Y	
Spotted Owl	I	Y	3	6	3	8	4	24	23		59	72	17	64	Y	
Magnificent Hummingbird			1	4	3	8	2	17	16		23	0	0	14	Y	
Acorn Woodpecker			3	6	3	8	3	17	14						Y	
Hairy Woodpecker			3	6	3	6	3	16	10		31	0	0	19	Y	
Pygmy Nuthatch			2	5	3	6	3	19	16		25	49	40	34	Y	
Western Bluebird	V	Y	3	6	3	5	3	20	14		32	54	15	40	Y	
Grace's Warbler	I	Y	3	6	3	6	3	22	19		32	38	15	34	Y	
Hepatic Tanager			2	4	2	3	3	15	12		21	47	15	31		
Chipping Sparrow			3	7	4	4	3	16	11		29	38	22	33		Y

Physiographic Area 87: Colorado Plateau - Sagebrush Shrubland																
Common Name	TIER	PLA N	PIF Prioritization								COVERS				Cnts Needed	Demo. Needed
			AI	AI+PT	PT	PTU	TB	PIF	WL	B1	B2	IMPORT	T.Bio.			
Sage Grouse	I	Y	3	7	3	7	4	25	21		51	69	25	57	Y	
Sage Thrasher			3	6	3	5	2	18	15		19	0	0	12	Y	
Brewer's Sparrow	III	Y	3	4	1	2	2	15	18		42	50	42	45		
Vesper Sparrow			3	8	5	2	3	17	14		34	45	37	38		Y
Sage Sparrow	III	Y	3	6	3	5	2	20	20		34	49	30	40	Y	

Physiographic Area 87: Colorado Plateau - Semidesert Shrubland																
Common Name	TIER	PLA N	PIF Prioritization								COVERS				Cnts Needed	Demo. Needed
			AI	AI+PT	PT	PTU	TB	PIF	WL	B1	B2	IMPORT	T.Bio.			
Chukar			2	5	3	8	1	10	9						Y	
Greater Roadrunner			2	5	3	6	2	16	14		15	43	17	26	Y	
Burrowing Owl	VI	Y	3	6	3	5	4	19			49	70	30	57	Y	
Horned Lark	VII	Y	4	9	5	1	1	14			42	50	40	45	Y	
Bendire's Thrasher			4	7	3	6	2	26	23		32	47	15	37	Y	
Curve-billed Thrasher			3	6	3	6	1	18	18		28	56	15	39	Y	
Loggerhead Shrike	II	Y	4	9	5	1	2	19	17		33	61	27	44		Y
Canyon Towhee			3	6	3	5	2	19	18		32	43	15	36	Y	
Lark Sparrow			3	5	2	1	3	16	16		36	43	30	39		
Black-throated Sparrow			4	6	2	1	3	18	14		31	41	15	35		

Physiographic Area 87: Colorado Plateau - Wetlands																
Common Name	TIER	PLA N	PIF Prioritization								COVERS				Cnts Needed	Demo. Needed
			AI	AI+PT	PT	PTU	TB	PIF	WL	B1	B2	IMPORT	T.Bio.			
Pied-billed Grebe			2	5	3	8	3	14	9		28	50	25	37	Y	
Eared Grebe			2	5	3	8	3	14	12		38	49	22	42	Y	
Western Grebe			2	5	3	8	1	17	17		29	38	35	33	Y	
Clark's Grebe			2	5	3	8	1	17	17		38	56	35	45	Y	
American Bittern			2	5	3	8	2	16	17		48	54	17	51	Y	
Least Bittern			1	4	3	8	2	15	15		45	59	17	51	Y	
White-faced Ibis			2	5	3	8	2	15	12		35	61	35	45	Y	
Canada Goose			3	6	3	7	1	13	9		4	0	0	2	Y	
Green-winged Teal			3	6	3	8	2	14	10		19	0	0	12	Y	
Mallard			2	4	2	3	2	11	12		16	0	0	10		
Northern Pintail			2	5	3	8	3	13	13		38	58	27	46	Y	
Blue-winged Teal			2	5	3	8	3	14	12		23	0	0	14	Y	
Cinnamon Teal			3	6	3	8	3	18	15		36	0	0	22	Y	
Northern Shoveler			3	6	3	8	3	15	10		23	0	0	14	Y	
Gadwall			2	5	3	8	3	14	10		19	0	0	12	Y	
American Wigeon			2	5	3	8	3	15	14		27	0	0	17	Y	
Canvasback			2	5	3	8	4	18	17		19	63	15	36	Y	
Redhead			3	6	3	8	4	20	18		24	0	0	15	Y	

Physiographic Area 87: Colorado Plateau - Wetlands																
Common Name	TIER	PLA N	PIF Prioritization								COVERS				Cnts Needed	Demo. Needed
			AI	AI+PT	PT	PTU	TB	PIF	WL	B1	B2	IMPORT	T.Bio.			
Ring-necked Duck			3	6	3	8	3	19	15		16	0	0	10	Y	
Lesser Scaup			2	5	3	8	2	15	15		41	58	35	47	Y	
Ruddy Duck			2	5	3	8	3	17	15		28	0	0	17	Y	
Northern Harrier	VII	Y	2	5	3	8	4	17	16		35	52	30	42	Y	
Virginia Rail			3	6	3	8	2	15	11		35	52	30	42	Y	
Sora			2	5	3	8	3	14	11		33	52	17	40	Y	
American Coot			2	5	3	7	3	12	10		21	0	0	13	Y	
Sandhill Crane			2	5	3	8	3	20	18		37	70	32	50	Y	
Sandhill Crane			2	5	3	8	3	20	18		45	74	55	56	Y	
Willet			1	4	3	8	2	16	18		24	0	0	15	Y	
Common Snipe			3	6	3	8	2	14	12		19	0	0	12	Y	
Wilson's Phalarope			4	7	3	8	2	20	17		38	0	0	24	Y	
Short-eared Owl	III	Y	2	5	3	8	4	19	19		36	49	27	41	Y	
Marsh Wren			2	5	3	8	4	18	14		18	56	17	33	Y	
Common Yellowthroat			2	5	3	7	3	14	13		32	50	17	39	Y	
Savannah Sparrow			2	5	3	7	3	13	12		34	49	32	40	Y	
Red-winged Blackbird			3	8	5	2	2	14	11		22	0	0	13		Y
Yellow-headed Blackbird			2	5	3	6	4	18	17		17	56	30	32	Y	

Partners in Flight Tier VI species (and subspecies) that breed within Physiographic Area 87 (Colorado Plateau). Tier VI species are those that have a special status as designated by an agency within Colorado.

- BLM-SS = Bureau of Land Management Sensitive Species
- USFS-SS = U.S. Forest Service Sensitive Species
- CO-SC = Colorado Division of Wildlife Species of Special Concern
- CO-T = Colorado Threatened Species
- CO-E = Colorado Endangered Species
- FT = Federal Threatened Species
- FE = Federal Endangered Species

Common Name	BLM-SS	USFS-SS	CO-SC	CO-T	CO-E	FT	FE
Bald Eagle				X		X	
Columbian Sharp-tailed Grouse			X				
Ferruginous Hawk	X	X	X				
Greater Sandhill Crane		X		X			
Gunnison Sage Grouse	X		X				
Long-billed Curlew	X	X	X				

Common Name	BLM-SS	USFS-SS	CO-SC	CO-T	CO-E	FT	FE
Mexican Spotted Owl				X		X	
Northern Goshawk	X	X					
Northern Sage Grouse	X		X				
Pygmy Nuthatch		X					
Southwestern Willow Flycatcher					X		X
White-faced Ibis	X	X					
Yellow-billed Cuckoo		X					

APPENDIX C: Partners in Flight Planning Unit Maps for Colorado

Partners in Flight Planning Units within Colorado

Partners in Flight Planning Units within Physiographic Area 36

Partners in Flight Planning Units within Physiographic Area 62

Partners in Flight Planning Units within Physiographic Area 87

APPENDIX D: Colorado GAP Vegetation Classification Map

APPENDIX E: Monitoring Colorado's Birds Program

Monitoring Colorado's Birds: The Plan for Count-based Monitoring

Prepared by

Tony Leukering and Michael Carter

Colorado Bird Observatory
13401 Piccadilly Road, Brighton, CO 80601, ph: 303-659-4348
e-mail: monitoring@cbobirds.org

in cooperation with

Chris Schultz

U.S. Forest Service

Ken Giesen

Colorado Division of Wildlife

Ron Lambeth

Bureau of Land Management

U.S. Fish and Wildlife Service

and

National Park Service

30 September 1999

Introduction—Conservation and management of Colorado's birds depend on adequate monitoring information which, to a large extent, does not exist. Monitoring information is required by legislative and land/wildlife management agency mandates as well as a host of long-range plans, Forest plans, ecoregional plans, preserve management plans, etc. From a global biodiversity perspective, Colorado hosts many species at their highest abundances (Table 1) indicating that Colorado has high responsibility for many species.

In cooperation with the agencies/organizations charged with protecting and managing Colorado's birds, Colorado Bird Observatory (CBO) has developed and proposed a program of bird monitoring for the state in which **every** agency/organization contributes and benefits (Table 2). This plan depends on each of them taking on habitats in which they do much management. Three of these agencies (Colorado Division of Wildlife, U.S. Forest Service, and Bureau of Land Management) are embarking on a five-year Memorandum of Understanding to institutionalize this program. Two other agencies (National Park Service and U.S. Fish and Wildlife Service) are currently being approached by CBO. This project is *Monitoring Colorado's Birds*.

Monitoring Colorado's Birds (MCB) is designed to monitor all regularly-occurring breeding-bird species in the state. The first phase of *MCB* is to ensure count-based data are in place for all species which can be monitored and that a special-species tracking or census program is in place for species requiring special techniques. The second phase should include demographic information to determine the possible reasons for known declines and for the purposes of developing management information. Herein we develop a plan for the count-based monitoring of species for which we feel these data are obtainable. Appendix A contains much of the raw information used to develop this plan.

Background—We do not believe there are wholesale bird declines as reported by some media, individuals, initiatives, or environmental groups. In Colorado, 278 bird species have been recorded as breeding. Of those, 71.8% are not monitored by the Breeding Bird Survey, the best and most extensive existing bird-monitoring program (Table 3). Of the species that are well monitored by the BBS, there are some species whose populations are declining, some that are increasing, and some that are stable (Table 4). We assume that better data will detect more species in each of these categories which is of great concern since there are probably many declines that remain undetected.

Assumptions and design of plan—Monitoring should be efficient, low level, and permanent and we have designed this program with these points in mind. To do monitoring correctly, we need targets—thresholds of time span and population change that balance statistical rigor with cost-effectiveness. It is desirable to detect a fairly small population change (particularly, a negative one) in a fairly short amount of time. However, the sample sizes required would probably outstrip all funding available for the undertaking. Therefore, we have selected a rate of population change of -3.0% per year and a maximum time period of 30 years in which to detect that rate of change.

Thirty years is a reasonable number of years in which to conduct monitoring since it covers a number of known regular climatic cycles (e.g., El Niño). We used the formula

$$\text{cumulative change} = ((\text{annual change}/100)+1)^n-1)(100))$$

to calculate total population loss using a 30-year period and an annual decline of 3.0%. This equates to a 53% loss of a population in 30 years which is not large enough to trigger listing under the Endangered Species Act. It is, however, advance warning enough to trigger action.

Along with targets are assumptions: What levels of statistical rigor (i.e., power and significance) would we like to reach? We used a statistical probability of $p = 0.1$ which gives moderate protection against Type I error. We gave *MCB* only moderate protection, as it is often more useful and practical for wildlife management to determine direction and magnitude of a trend than its statistical significance. Similarly, we set power at 0.8, which gives moderate protection against Type II error.

Using these targets and assumptions, we used the computer program MONITOR (Patuxent Wildlife Research Center 1998) to model efficiency of pilot transects run in 1998 (Leukering and Carter 1999). Specifically, we used MONITOR to determine the threshold for the coefficient of variation (CV; standard deviation/mean) of distance-sampling associated with point transect data that will generate useful monitoring data. A CV reflects the overall variability of data scaled against the mean, that is, species with large abundances but high variability have CVs similar to those of species with low abundance and low variability. CVs are a function of factors inherent to a species (its abundance and variability in nature) and statistical consideration such as sample size and method of sampling. MONITOR indicates that CVs of less than 0.50 yield results that meet our requirements. We will be able to detect 3.0% declines within ten years of instigation of monitoring with statistical significance of $p = 0.1$ and power of 0.8. It is the nature of trend data that increases can be detected more quickly than can decreases of equal magnitude, therefore, with these thresholds we will be able to detect positive trends more quickly. Additionally, for species with large rates of population change and low CVs, we will be able to detect trends in as few as six years.

Methods—Not all species will be monitored by the same technique allocated equally to each habitat and we present the plan for all Colorado breeding species in Appendix A. Some species will only be monitored through the use a variety of special, species- or group-specific techniques. We have delineated the number of species and percentage of the total that will be monitored by each technique (Table 5). Protocol for point transects are detailed in a Appendix B. We want to stress the importance of conducting all point counts in each habitat in as short a time period as possible (we suggest three weeks) at the height of the song period for a given habitat. In addition, those species that will require special monitoring techniques are listed in the extensive section on special-species monitoring presented in Appendix C.

Products—Annual summaries of results of count-based monitoring will be available via paper reports and the Internet.

Funding/Cost—To date, the project has been substantially funded by the Great Outdoors Colorado Trust Fund through Colorado Division of Wildlife. Other partners have provided substantial cash and in-kind contributions. We estimate that count-based data for each habitat will cost approximately \$8,367/year (Appendix D). We have designated 16 habitats, though will conduct transects in only 13 of them, totaling \$108,771. Only 13 habitats will be studied directly, as two habitats (Cliff/Rock and Shore/Bank) are structurally defined, rather than vegetationally, and they occur in numerous of the vegetational habitats. The final habitat, Rural/Ag, supports mainly species that are non-native or are abundant inhabitants about which we have little concern.

Table 1. Partners in Flight (PIF) area importance scores for Colorado's breeding birds by habitat. Scores greater than 2 indicate species which exists in high abundances compared to other states.

Habitat	Area Importance (AI) Score ¹				
	1	2	3	4	5
Alpine Tundra	0	0	0	2	1
Aspen	2	1	4	0	5
Cliff/Rock	0	3	8	4	0
Grassland	1	5	5	4	5
High Elev. Riparian	2	6	2	3	2
Lowland Riparian	11	34	15	6	1
Mixed Conifer	0	1	6	3	1
Mountain Shrubland	2	3	4	4	1
Pinyon/Juniper	0	2	10	1	1
Ponderosa Pine	4	1	8	0	0
Rural/Ag	1	4	6	2	2
Sagebrush Shrubland	0	1	1	3	0
Semidesert Shrubland	1	4	1	0	1
Shore/Bank	0	5	8	0	0
Spruce/Fir	1	2	8	4	2
Wetlands	1	16	19	1	0
TOTALS	26	88	105	37	22

¹As developed by PIF, AI attempts to identify areas of high importance to a species, and is used to reflect the responsibility of those areas to that species' conservation. For example, Colorado hosts a large proportion of the world's Mountain Plovers and would receive a "5" for AI. AI evaluates the abundance of a species within a area relative to its abundance in other areas. It is intended to emphasize areas where a species is more common and to de-emphasize areas where it is rare or peripheral and thus to direct conservation efforts toward those areas most important to a species' survival. AI scores are not influenced by the size of the area, only by the abundance of the species within the area relative to that in other areas. Therefore, areas that contain centers of abundance or, in some cases, the entire range of a species, will have higher scores than those in which the species is peripheral.

BBS data are used for scoring AI. The first step to score a species is to identify the state with the maximum mean number of individuals per BBS route across years and across routes upon which the species occurs. Mean numbers per route for other states are compared to that maximum. Where BBS data are poor or non-existent, a second method is used in conjunction with local review by experts knowledgeable about the species. Expert opinion

Appendix E: Monitoring Colorado's Birds Program

criteria follow the BBS-derived criteria so that, for example, an expert-derived score of "5" is defined as 50–100% of BBS maximum abundance. AI values are assigned as follows:

<u>AI Score</u>	<u>AI criteria using BBS</u>	<u>AI criteria using expert opinion</u>
1	Accidental	Accidental; does not breed annually in the state.
2	0 - 5.9%	Species breeds regularly in state, but is peripheral.
3	6 - 24.9%	Species is present in low relative abundance.
4	25 - 49.9%	Species is present in moderate to high relative abundance.
5	50 - 100%	Species is present in highest relative abundance.

Table 2. Designations by habitat of responsible agencies with numbers of species expected to be monitored in each habitat.

Habitat	Agency ¹	# species monitored
Uniform-block habitats²		
Pinyon/Juniper	Bureau of Land Management	14
Sagebrush Shrubland	Bureau of Land Management	4
Semidesert Shrubland	Bureau of Land Management	5
Grassland	CO Division of Wildlife	15
Mountain Shrubland	CO Division of Wildlife	11
Ponderosa Pine	CO Division of Wildlife	7
Alpine Tundra	National Park Service	2
Spruce/Fir	U.S. Forest Service	16
Aspen	U.S. Forest Service	10
Mixed Conifer	U.S. Forest Service	10
Non-uniform-block habitats³		
High-elevation Riparian	CO Division of Wildlife	11
Lowland Riparian	CO Division of Wildlife	49
Wetlands	U.S. Fish and Wildlife Service	21
Dispersed, non-uniform, and/or anthropogenic habitats⁴		
Cliff/Rock	CO Division of Wildlife	14
Rural/Agriculture	CO Division of Wildlife	13
Shore/Bank	CO Division of Wildlife	10
TOTAL		212

¹Though some agencies are associated herein with certain habitats that host few species, all agencies will benefit from *Monitoring Colorado's Birds by 2001* due to the availability of monitoring data to all.

²Uniform-block habitats are those that we believe will be well sampled with random allocation of transects.

³Non-uniform-block habitats are those that will require extra effort or somewhat different counting techniques due to the widespread, but localized or narrow aspects of those habitats.

⁴These habitats are not vegetation-based and are found across large elevational gradients. Thus, species typical of these habitats can be found in various vegetation types, but are restricted in those vegetation types to specific features that are in turn NOT restricted to those vegetation types. [Example: Rock Wren can be found from Grassland to Alpine Tundra (and every vegetation type in between), but it would be difficult to sample adequately in any one vegetation type.] We do not anticipate allocating transects to these habitats; funding for these will be dispersed among other habitats, devoted to special species techniques, and/or used to interpret BBS data.

Appendix E: Monitoring Colorado's Birds Program

Table 3. Partners in Flight population trend uncertainty (PTU) scores from Breeding Bird Survey data for Colorado's breeding birds by habitat. PTU scores range from 1 (recorded on \$34 routes and $p < 0.10$) to 8 (species not recorded on BBS) with scores > 4 denoting unmonitored species.

Habitat	Population trend uncertainty (PTU) score							
	1	2	3	4	5	6	7	8
Alpine Tundra	0	0	0	0	0	0	0	3
Aspen	3	0	0	1	3	0	2	3
Cliff/Rock	3	0	0	2	3	3	1	3
Grassland	4	2	1	1	2	3	4	3
High Elev. Riparian	0	1	0	1	3	4	1	5
Lowland Riparian	9	5	1	1	4	9	4	33
Mixed Conifer	0	4	2	0	1	0	2	2
Mountain Shrubland	1	3	0	1	1	0	1	7
Pinyon/Juniper	1	1	1	1	3	3	2	2
Ponderosa Pine	0	0	1	1	1	1	2	7
Rural/Ag	6	0	0	2	2	1	0	4
Sagebrush Shrubland	0	1	0	1	1	0	2	0
Semidesert Shrubland	1	0	0	0	1	0	2	3
Shore/Bank	2	0	0	0	2	2	3	4
Spruce/Fir	2	2	0	3	2	4	1	3
Wetlands	2	3	1	0	3	6	8	14
TOTAL (277)	34	22	7	15	32	36	35	96

Table 4. Partners in Flight Breeding Bird Survey population trend scores for Colorado's breeding birds by habitat. Scores of 4 and 5 indicate declines, 1 and 2 increases or stable, and 3s denote unknown status.

Habitat	Population trend (PT) score				
	1	2	3	4	5
Alpine Tundra	0	0	3	0	0
Aspen	1	3	8	0	0
Cliff/Rock	2	3	10	0	0
Grassland	0	6	12	2	0
High Elev. Riparian	0	1	13	1	0
Lowland Riparian	8	7	50	0	1
Mixed Conifer	1	3	5	1	1
Mountain Shrubland	1	4	9	0	0
Pinyon/Juniper	0	3	10	0	1
Ponderosa Pine	0	1	11	1	0
Rural/Ag	1	5	7	1	1
Sagebrush Shrubland	1	0	3	1	0
Semidesert Shrubland	1	0	6	0	0
Shore/Bank	0	2	11	0	0
Spruce/Fir	0	7	10	0	0
Wetlands	2	2	31	1	1
TOTAL (277)	18	47	199	8	5

Table 5. Monitoring methods, numbers of species per method, and explanation of the method.

Method	Number sp. per method	Percent of total (<i>n</i> = 278)	Method explanation
Point transects	102	36.7	Transects (<i>n</i> = 30) of 15 points are placed randomly within each habitat.
Tracking transects	57	20.5	Data from all transects are analyzed for proportion of transects with the species. This is a less-powerful method, but one that provides quantitative information.
Total, count-based techniques	159	57.2	
Statewide census	33	11.9	Statewide estimate of all individuals of a target species, based on counts at all known breeding localities in the state.
Special technique	20	7.2	Species-specific technique required (see special species manual).
Peripheral	27	9.7	Annual occurrence of breeding in Colorado is tracked as # of pairs or yes/no.
Total, special techniques	80	28.8	
Threatened & Endangered	5	1.8	Populations are monitored by CDOW and/or USFWS.
Game species	34	12.2	Populations are monitored by CDOW and/or USFWS.
Total, political designations	39	14.0	
TOTAL	278	100.0	

Appendices included in *Monitoring Colorado's Birds*, but not included here:

Appendix A. Habitat, responsible agency, priority scores, and suggested methods for monitoring each of Colorado's breeding bird species.

Appendix B. Point Count Protocol.

Appendix C. *Monitoring Colorado's Birds* - 1999 Special Species Plan.

Appendix D. Proposed budget to perform the Point transects for one habitat.

APPENDIX F: Colorado Important Bird Areas Program

Introduction

In 1995, Pennsylvania became the first state to initiate an *Important Bird Areas (IBA)* Program; New York State followed soon afterwards in 1996. At the beginning of 1999 there were 21 states participating in this project with planning in about a dozen more. Approximately 300 sites within the United States have already been recognized as *IBAs*.

What is an *IBA*? An *IBA* is any site that provides essential habitat to one or more bird species during some portion of the year and is distinguishable from the surrounding landscape. These include nesting areas, migratory stop-over sites, and wintering grounds. Specific criteria differ slightly between states, but generally they can be placed into five categories:

- 1) Sites that support significant numbers of endangered or threatened species (state or federal).
- 2) Sites that support significant populations of globally, regionally, or state-ranked species of special concern.
- 3) Sites that contain rare, threatened, or representative habitats (such as wetlands), with complementary bird species.
- 4) Sites that support significant concentrations or diversity of birds.
- 5) Sites with a history of long-term research or education.

IBAs may be currently protected or unprotected, and occur on either private or public lands. They may range in size from a few to thousands of acres, although each site is generally a discrete land unit or contiguous area of habitat that is of manageable size. Some examples of potential *IBAs* in Colorado include large Burrowing Owl colonies, nesting areas for habitat-specific species like Mountain Plover and Sage Grouse, areas where large concentrations of waterfowl or shorebirds congregate during migration and areas with long-term research or educational value concerning bird conservation.

Birdlife International began the *IBA* Program in Europe in the late-1980s. Since then over 3200 *IBAs* have been identified in 32 countries. Hundreds of these areas and millions of acres have received some sort of protection. In Denmark, 98% of *IBAs* are now protected. In the United States, *IBAs* are being incorporated into Partners in Flight Bird Conservation Plans and used as a template for conservation legislation. In New York, one year after the *IBA* Program was started in that state, legislation was signed by the governor that adopted *IBA* criteria to identify sites important to birds on state-managed lands and makes habitat management for birds a top priority at these areas.

So what makes the *IBA* Program different from other bird habitat conservation efforts? The program is designed to use science-based criteria combined with grassroots level participation of local Audubon members, bird clubs, and other conservation-minded groups and individuals. By involving everyone from Partners in Flight participants to the backyard birder it hopes to promote

public awareness and popular support for preservation of these areas. Also, it values the rights of private landowners. One aim of this program is to set the groundwork for partnership and cooperation between all stakeholders. Landowners and managers are contacted when their nominated sites are reviewed by the *IBA* Technical Committee and must give their consent to have their areas designated as an *IBA*.

The Colorado *IBA* Program is a project of the National Audubon Society in partnership with the Colorado Bird Observatory, and is supported by Colorado Partners in Flight and Audubon of Colorado.

Criteria for Site Selection

- 1) Sites important to endangered or threatened species in Colorado.

Description: Sites that regularly support significant breeding or non-breeding densities of one or more of the following species listed as endangered, threatened, or of special concern in the state of Colorado. Applies primarily to breeding or wintering sites, though regular migratory areas may be considered if known to be of exceptional importance. The site should be one of regular and/or recent occurrence in the last ~10 years. Thresholds will vary and may include sites with 1% of the state population (if known) in a season, or the 3–5 sites in the state with the highest regularly occurring numbers.

Endangered

Whooping Crane
Least Tern
Plains Sharp-tailed Grouse
Southwestern Willow Flycatcher

Threatened

Greater Sandhill Crane
Piping Plover
Snowy Plover
Bald Eagle
Greater Prairie-Chicken
Lesser Prairie-Chicken
Spotted Owl

Special Concern

American White Pelican
Barrow's Goldeneye
Ferruginous Hawk
Long-billed Curlew
Mountain Plover

- 2) Sites important to species of high conservation priority in Colorado.

Description: Sites that regularly support significant breeding or non-breeding densities of the following species identified as high conservation priorities in Colorado by Partners in Flight. Thresholds will vary, but may include sites with 25 or more breeding pairs, 5% or more of the seasonal state population (if known), or the 2–3 sites in the state with the highest regularly occurring numbers. May also include sites with significant complement of species with a total of 50 or more breeding pairs of up to three listed species or 100 breeding pairs of any number of listed species (average of 15 pairs per species).

Western Grebe	Gunnison Sage Grouse	Lewis's Woodpecker	Virginia's Warbler
Clark's Grebe	Northern Sage Grouse	Red-naped Sapsucker	Black-throated Gray Warbler
Redhead	Short-eared Owl	Williamson's Sapsucker	MacGillivray's Warbler
Wilson's Phalarope	Northern Pygmy-Owl	American Dipper	Cassin's Sparrow
American Avocet	Flammulated Owl	Gray Flycatcher	McCown's Longspur
Northern Harrier	Boreal Owl	Cordilleran Flycatcher	Western Tanager
Prairie Falcon	Common Poorwill	Juniper Titmouse	Brown-capped Rosy-Finch
Swainson's Hawk	Black Swift	Gray Vireo	
White-tailed Ptarmigan	Black-chinned Hummingbird	Grace's Warbler	

3) Sites that contain rare or unique habitat within the state/region or an exceptional representative of a natural habitat, and that hold important species or species assemblages largely restricted to a distinctive habitat type.

Description: Sites with habitats that are rare or unique in the state, or are exceptional representative examples (large and intact) of the habitats that should support, or could be managed to support, the full complement of bird species dependent on that habitat type. Representative examples in Colorado might include wetlands (Virginia Rail, Yellow-headed Blackbird, Cinnamon Teal), alpine tundra (White-tailed Ptarmigan and Brown-capped Rosy-Finch), and short-grass prairie (Mountain Plover and McCown's Longspur). Consideration will also be given to sites with exceptionally high species and habitat diversity, and some attempt will be made to distribute representative sites throughout the state.

4) Sites where significant numbers of birds concentrate for breeding, during migration, or in winter.

Description: Sites that regularly hold significant numbers of one or more species, breeding or non-breeding, including migration. Significant numbers are not easily defined. The following guidelines are suggested to provide some logical thresholds for site selection. Except where indicated, numerical estimates should be based on a short period of time (e.g., one-time counts such as daily surveys—not on cumulative totals). Introduced, feral, and nuisance species (resident Canada Goose, European Starling, House Sparrow) should not be counted.

Waterfowl - >2000 over a short period.

Heronries - >50 nesting pairs total or >30 nesting pairs of Great Blue Herons west of the 106th parallel or >10 nesting pairs of Black-crowned Night-Herons west of the 106th parallel.

Shorebirds - >750 in migratory concentration.

Gulls - >2000 breeding pairs.

Terns - >25 breeding pairs.

Raptors - >1000 migrants (season total), or large breeding/wintering concentration.

Exceptional Diversity - holds an exceptional number of land birds in a seasonal concentration OR attracts an exceptional diversity of land birds over the course of a year.

5) Sites important for long-term research and/or monitoring projects that contribute substantially to ornithology, bird conservation, and/or education.

Description: These are generally sites with a distinguished record and/or unique potential for long-term research and monitoring, or exceptional educational value. Such sites may occur in urban, suburban, rural, or other settings. Evidence should be cited showing the area's value, such as publications of research conducted at the site.