

**U.S. Fish & Wildlife Service**

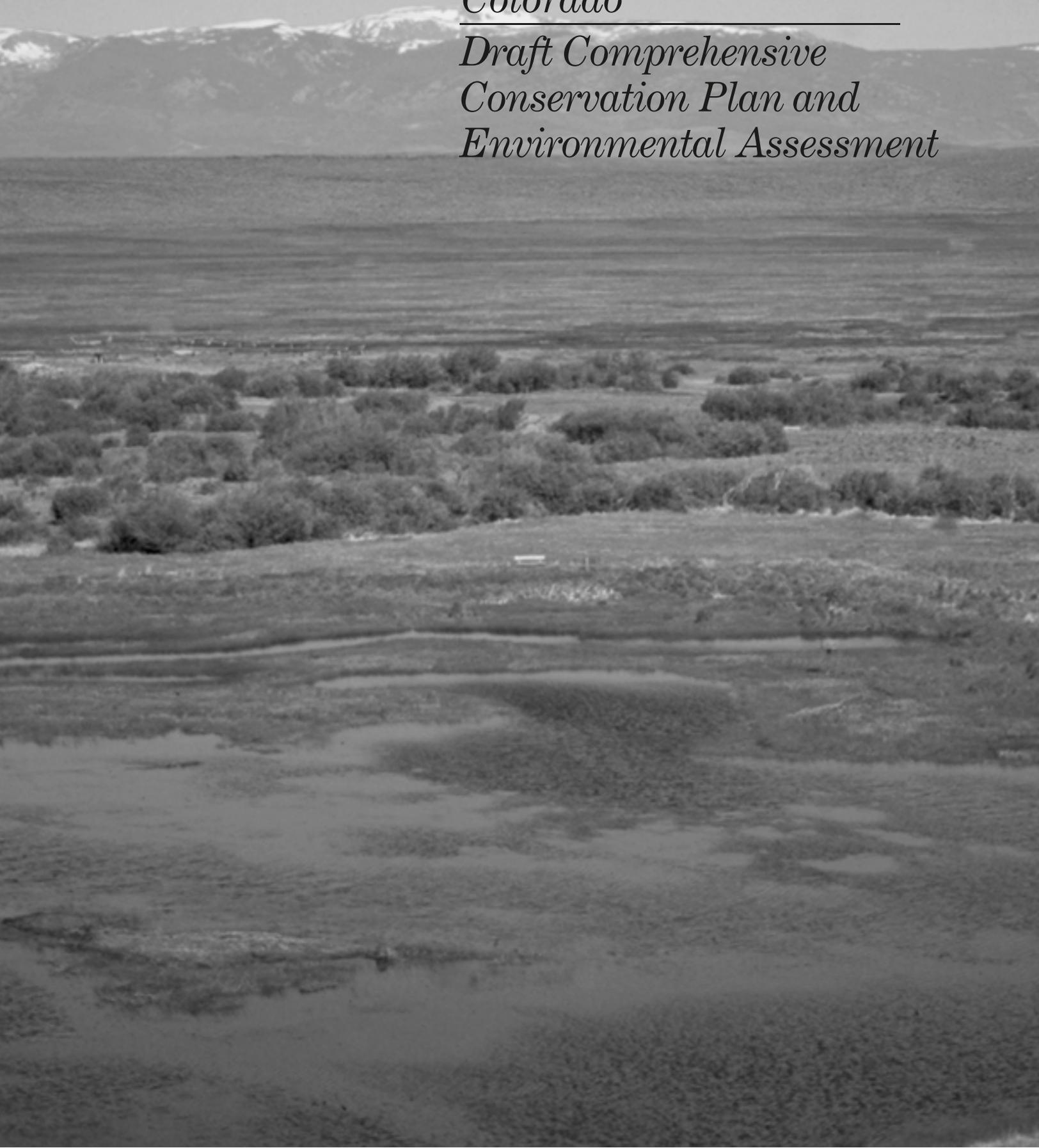
# **Arapaho**

*National Wildlife Refuge*

*Colorado*

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*Draft Comprehensive  
Conservation Plan and  
Environmental Assessment*



*CCPs provide long-term guidance for management decisions and set forth goals, objectives, and strategies needed to accomplish refuge purposes and identify the Service's best estimate of future needs. These plans detail program planning levels that are sometimes substantially above current budget allocations and, as such, are primarily for Service strategic planning and program prioritization purposes. The plans do not constitute a commitment for staffing increases, operational and maintenance increases, or funding for future land acquisition.*

# **ARAPAHO NATIONAL WILDLIFE REFUGE**

*Draft*  
*Comprehensive Conservation Plan  
and Environmental Assessment*

July 2003

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*Arapaho National Wildlife Refuge  
Comprehensive Conservation Plan Approval  
U.S. Fish & Wildlife Service, Region 6*

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# Summary

The U.S. Fish & Wildlife Service (Service) is the principal Federal agency with the responsibility for conserving, protecting, and enhancing fish and wildlife and plants and their habitats for the continuing benefit of the American people. The Service manages the 95-million-acre National Wildlife Refuge System (System) which encompasses more than 540 national wildlife refuges, thousands of small wetlands and other special management areas. It also operates 70 national fish hatcheries, 64 fishery resource offices, and 78 ecological services field stations. The agency enforces Federal wildlife laws, administers the Endangered Species Act, manages migratory bird populations, restores nationally significant fisheries, conserves and restores wildlife habitat such as wetlands, and helps foreign governments with their conservation efforts. It also oversees the Federal Aid program that distributes hundreds of millions of dollars in excise taxes on fishing and hunting equipment to state fish and wildlife agencies.

National wildlife refuges are established for a particular purpose. Formal establishment is generally based upon a statute or executive order that specifies a purpose for that Refuge. However, refuges can also be established by the U.S. Fish & Wildlife Service using the authorization found within laws such as the Endangered Species Act, Migratory Bird Conservation Act, and the Fish and Wildlife Act of 1956. Arapaho National Wildlife Refuge was established on September 26, 1967, for the following purposes:

“ . . . for use as an inviolate sanctuary, or for any other management purpose, for migratory birds.”  
16 U.S.C. § 715d (Migratory Bird Conservation Act)

“ . . . for the development, advancement, management, conservation, and protection of fish and wildlife resources . . . .” 16 U.S.C. § 742f (a)(4) “ . . . for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude . . . .” (Fish and Wildlife Act of 1956)

These two broad statements provide the “side-boards” to guide future management of Arapaho NWR.

To accomplish these purposes, the Refuge has utilized the existing ditch irrigation system to irrigate hay meadows for waterfowl, shorebird, and songbird nesting habitat. Additionally, 78 wetlands were created or enhanced to provide waterfowl brood-rearing habitat. The result is that Arapaho NWR contains abundant wildlife resources, produces 6,000 to 8,000 ducks annually, and supports a diverse wildlife community that is common to high mountain valleys in the central Southern Rocky Mountains. In April of 1997, Arapaho NWR experienced an office fire that completely destroyed the headquarters building. Unfortunately, much of the historic wildlife resource data was lost to this fire. Implementation of this plan will require some collection of baseline wildlife and plant resource information to regain what was lost to fire.

The Arapaho National Wildlife Refuge Complex includes the following four satellite refuges in Wyoming: Bamforth NWR, Hutton Lake NWR, Mortenson Lake NWR, and Pathfinder NWR. The Arapaho NWR staff administers all five refuges from Walden, Colorado with a combined total of 44,960 acres.

Comprehensive Conservation Plans (CCP) were mandated by the National Wildlife Refuge System Improvement Act of 1997. This Act requires that the CCP must identify and describe:

- 1) purposes of the Refuge;
- 2) fish, wildlife, and plant populations and their habitats;
- 3) archaeological and cultural values;
- 4) significant fish, wildlife, and plant problems; and
- 5) the actions necessary to correct them.

The CCP should also identify and describe compatible wildlife-dependent recreational opportunities and administrative and visitor facilities required to implement the Plan. This CCP only addresses the management of Arapaho NWR near Walden, Colorado. Management of the remaining four Wyoming satellite Refuges will be addressed in a separate planning effort.

Benefits of the CCP are several: better long-term continuity in Refuge management; better understanding of Refuge management actions for Refuge staff members and visitors; a clear description of future development and funding needs; and the assurance that Refuge management will fulfill the mission of the National Wildlife Refuge System and the specific purposes for which the Refuge was established.

The Arapaho CCP will be used to prepare step-down management plans and revise existing management plans. It also will be used to prepare budgets which describe specific actions to be taken by the Refuge over the next 15 years. Given that new information, guidance, and technology frequently change and become available, the CCP will be updated as necessary throughout the 15-year period.

The Environmental Assessment considered four management alternatives for management of the Arapaho National Wildlife Refuge. Each of these alternatives were evaluated for environmental consequences in accordance with the National Environmental Policy Act (NEPA). The CCP is the preferred alternative for Refuge management.

## **Refuge Vision**

Arapaho National Wildlife Refuge is managed to benefit the diversity of plants and wildlife found in this high mountain valley of the southern Rocky Mountains. The Refuge and its resources are also managed for the benefit of the citizens of the United States.

The Refuge includes wetland, meadow, sagebrush uplands, and riparian communities that provide habitat for large mammals, neotropical migratory birds, nesting waterfowl, fishes, and species of concern from national and regional conservation plans. In particular, efforts by Refuge staff to restore the Illinois River channel hydrology, areas of sagebrush uplands, and to effectively manage wetlands and meadows, contribute to the ecological integrity of the Refuge, North Park, and the overall North Platte River system.

Through wildlife-dependent recreation and education, people have opportunities to learn of the wonder and significance of North Park's fauna and flora. Firsthand experiences with the Refuge encourage people to participate as stewards, not only of the Refuge, but also of the natural resources in their own communities.

Working in collaboration with the local community and other agencies and organizations helps the U.S. Fish & Wildlife Service manage the Refuge as a contributing ecological, cultural, and economic component of the unique mountain valley within which it sits.

## Refuge Goals

Arapaho NWR lands will be managed using the following goals within four primary habitat types (riparian, wetlands, meadows, and uplands). Compatible public uses, cultural resources, research opportunities, and partnerships will be used to facilitate Refuge management, and enhance public understanding of natural resource values within North Park. Refuge staff recognize that many landscapes have been altered and may never be restored. Arapaho NWR goals include:

- **Riparian Habitats** - *Provide a riparian community representative of historic flora and fauna in a high valley of the southern Rocky Mountains to provide habitat for migratory birds, mammals, and river-dependent species.*
- **Wetland Habitats** - *Provide and manage natural and man-made permanent and semipermanent wetlands (in three wetland complexes) to provide habitat for migratory waterfowl, shorebirds, wading birds, and associated wetland-dependent wildlife.*
- **Meadow Habitats** - *Provide and manage irrigated, grass-dominated meadows historically developed for hay production, to support sage grouse broods, waterfowl nesting, and meadow-dependent migratory birds.*
- **Upland Habitats** - *Provide an upland community representative of the historic flora and fauna in a high valley of the southern Rocky Mountains to provide habitat for sage grouse, large mammals, and other shrub-associated species.*
- **Public Use** - *Through wildlife-dependent recreation and education, people of a range of abilities and interests are able to learn of, and appreciate, the natural resources of this unique high mountain park. Thereby, citizens become better stewards of nature in their own communities and stronger supporters of the Refuge specifically and the National Wildlife Refuge System generally.*
- **Cultural Resources** - *The cultural resources of the Refuge are preserved, protected, and interpreted for the benefit of present and future generations.*
- **Research** - *The Refuge is a learning platform for compatible research that assists management and science of high mountain park sage-steppe communities.*
- **Partnerships** - *A wide range of partners join with the Fish and Wildlife Service in promoting and implementing the Refuge vision.*

The vision and goals presented here will be implemented over the next 15 years using the measurable objectives and strategies identified within this CCP. Working with partners, the Arapaho National Wildlife Refuge will conserve, protect, and enhance fish and wildlife habitats for the continuing benefit of the American people.



*Sunset Over Arapaho NWR © Everett & Nancy Collin*



*House Wren © Everett & Nancy Collin*



*Gadwall with Brood © Virginia Heitman*

*Butterfly © William H. Miller*



*Sage Grouse Hen with Young © Everett & Nancy Collin*



*Prairie Dog © USFWS*





*Cottontail © Everett & Nancy Collins*



*American Avocet © William H. Miller*



*North Park Middle School Science Class*



*Eared Grebe © William H. Miller*

*Cow Moose with Twins © William H. Miller*



*Prairie Lupine © Everett & Nancy Collins*





# *Introduction/Background*

The Arapaho NWR Complex is located in the northwest corner of Colorado. The Complex includes the Arapaho National Wildlife Refuge (NWR) and the following four satellite refuges in Wyoming: Bamforth NWR, Hutton Lake NWR, Mortenson Lake NWR, and Pathfinder NWR (see Map 1 - Vicinity Map). On September 26, 1967, the Migratory Bird Conservation Commission, acting under the authority of the Migratory Bird Conservation Act, approved the established area known as the Arapaho NWR, which is currently is 23,243 acres in size and is located in Jackson County (see Map 2 - Base Map). Purchased acres total 18,451 while 4,792 acres have been withdrawn. The Arapaho Complex staff administers an additional 21,717 acres on the Wyoming satellite refuges for a total of 44,960 acres under Complex management.

The Refuge is located in an intermountain glacial basin just south of the town of Walden, the county seat of Jackson County, Colorado. The basin is approximately 30 miles wide and 45 miles long. Commonly known as “North Park” since it is the most northern of three such “parks” in Colorado. Jackson County is a high, isolated intermountain basin that lies in the northern tier of Colorado counties (see Map 3 - North Park).

Forming the headwaters of the North Platte River, the basin opens north into Wyoming and is rimmed on the west by the Park Range, on the south by the Rabbit Ears Range, and on the east by the Medicine Bow Range (see Map 4 - Physical Features of North Park, Colorado). Elevation ranges from 7,800 to 12,953 feet above sea level. The floor of the basin is interspersed with many slow meandering streams that come together in the north-central part of the county to form the North Platte River. Main tributary rivers are the Michigan, Illinois, Canadian, and Grizzly (Map 5 - Platte River Watershed).

A major portion of the bottom land along the streams is irrigated hay meadow and irrigated pasture while the low rises between streams are dry grassland and sagebrush grazing lands. The picture changes rapidly on the edges of the basin where the land pitches abruptly upward to the mountain tops, the slopes heavily clothed with aspen, spruce, pine, and fir up to timberline at about 11,000 feet, then tundra and rock up to the mountain summits.

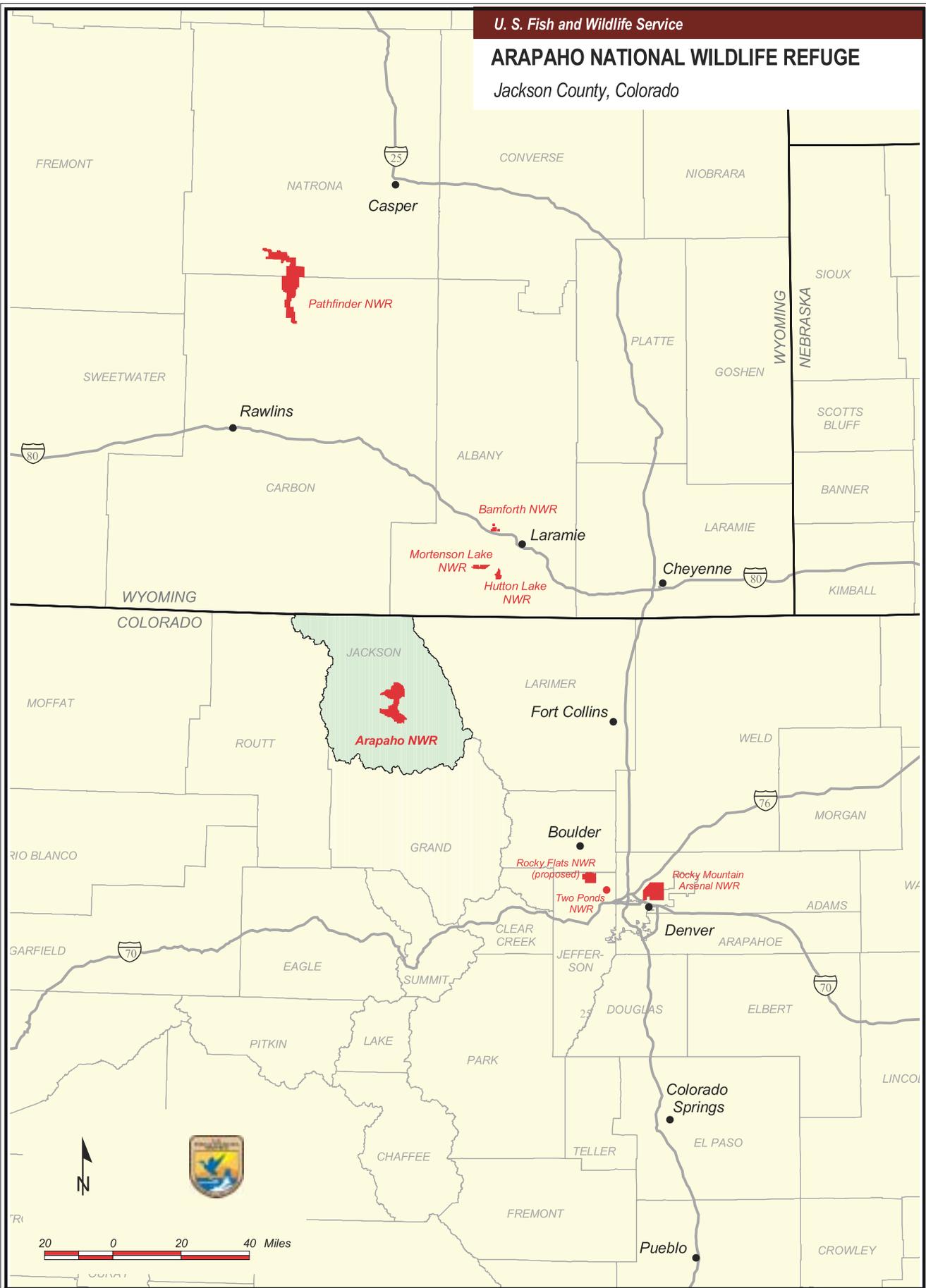
The ecosystems in the North Park area of Colorado have grown through hundreds of years in a fire-dependent system, with fire as an important, dominating influence. High elevations and a short season, with a cool, often moist, climate was part of the fire regime. Class 4 Fire Regime consist of combined crown fires and severe surface fires (25 to 100 year return interval). Most woody vegetation or stand elements were killed over large areas.

The fire regime has been altered, changing the cultural activities, i.e., grazing patterns over a 100-year period, in the North Park area. Early explorers noted tallgrass found in the Park. Native Americans dubbed North Park the “Bullpen,” referring to the bison inhabiting the area. This gives an indication that the area may have been more dominated by grasses, and thus likely was more influenced by fire than the present condition dominated by sagebrush hills.

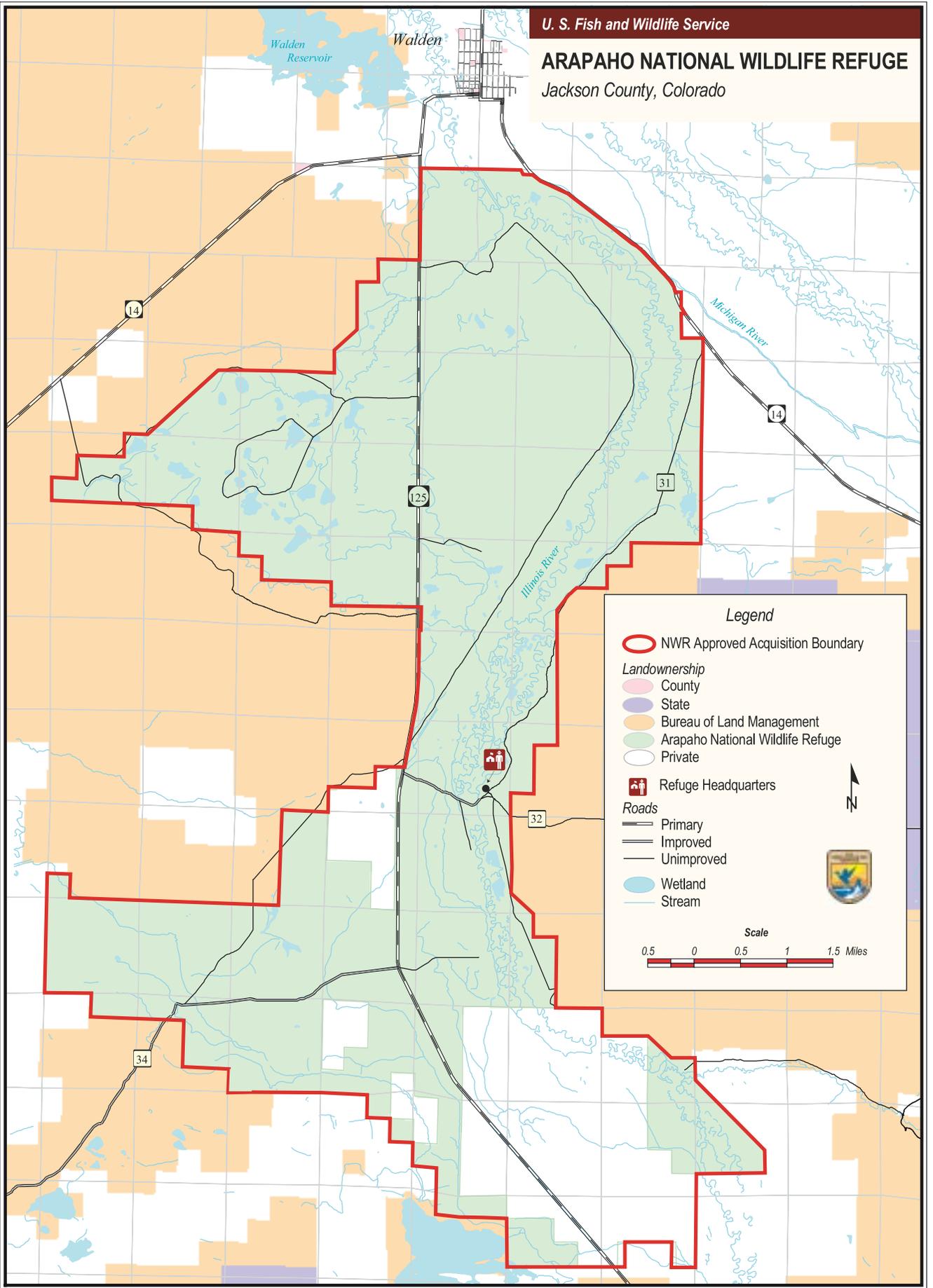
Records for North Park indicate little significant wildfire activity in the past 50 years.

# ARAPAHO NATIONAL WILDLIFE REFUGE

Jackson County, Colorado



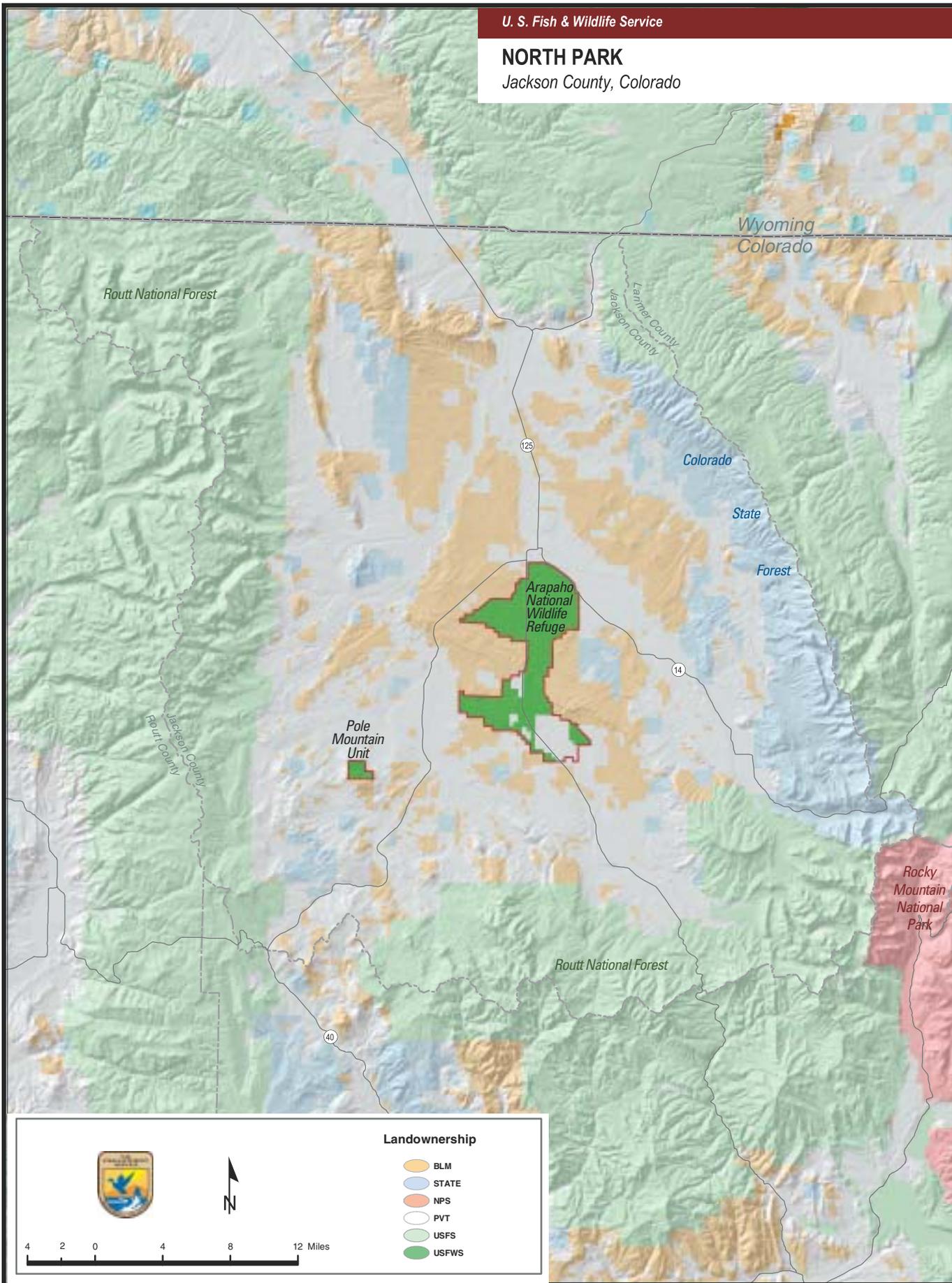
Map 1- Vicinity Map



**Map 2 - Base Map**

# NORTH PARK

Jackson County, Colorado

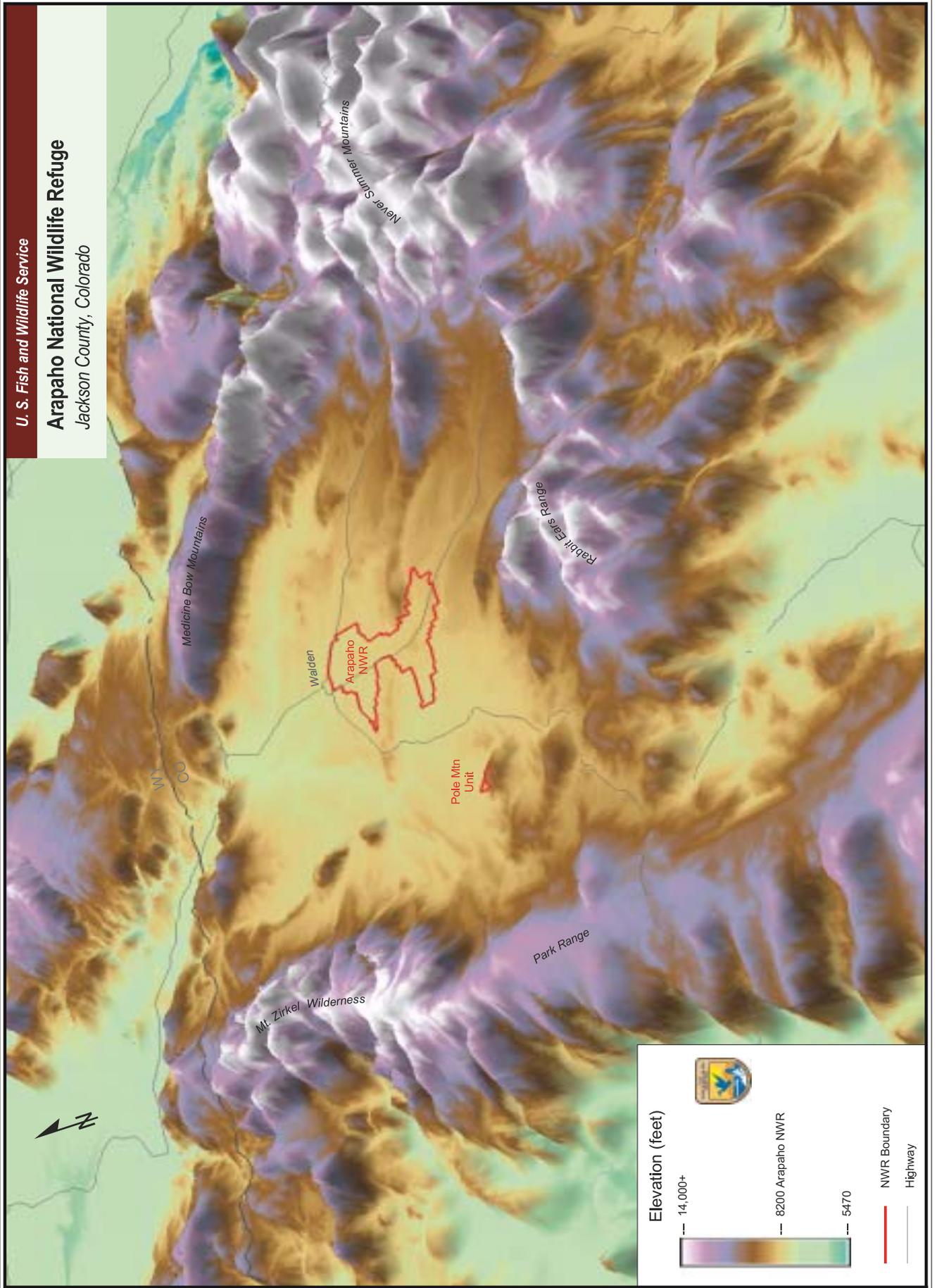


**Map 3 - North Park, Jackson County, Colorado**

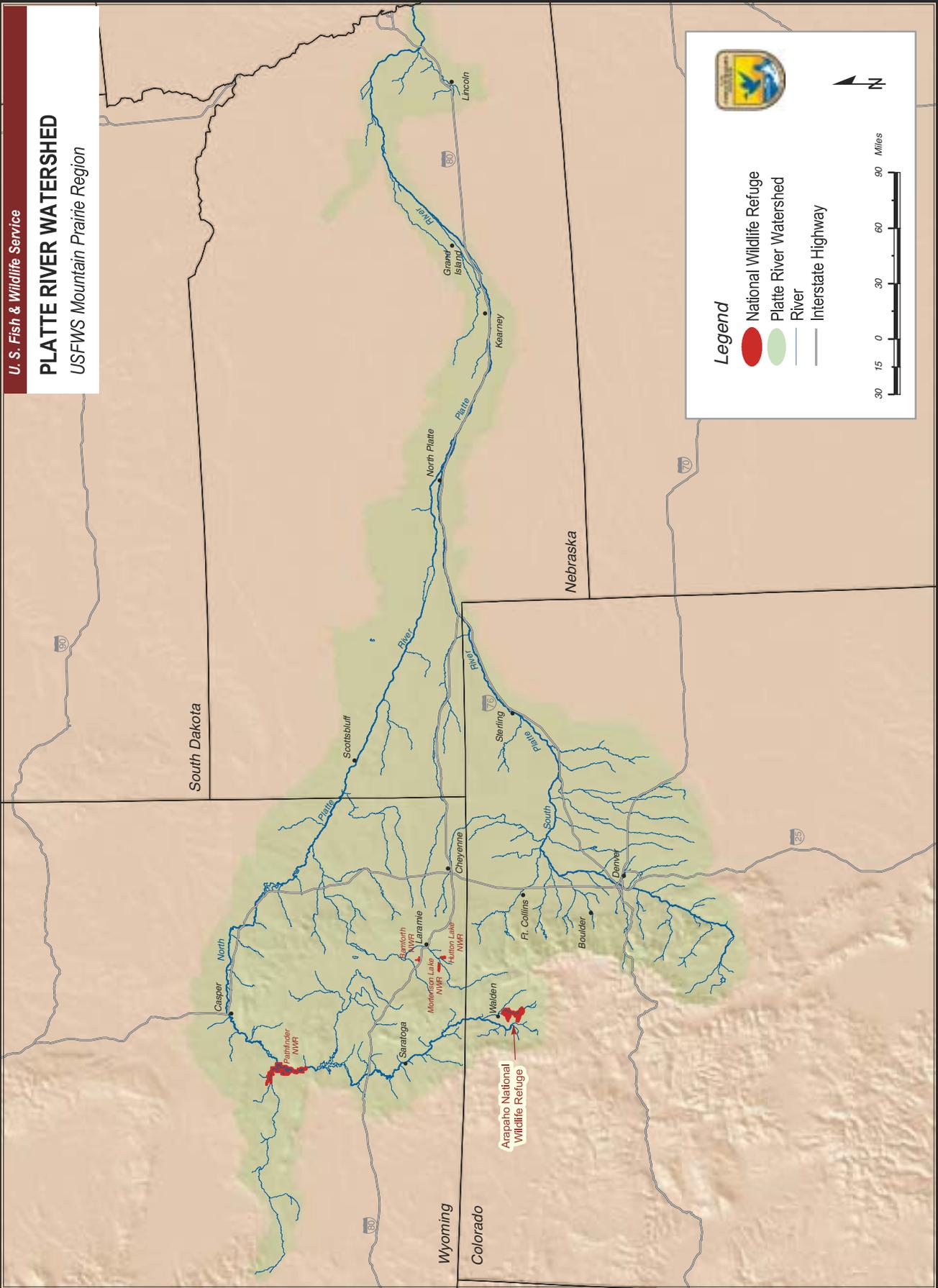
U. S. Fish and Wildlife Service

## Arapaho National Wildlife Refuge

Jackson County, Colorado



Map 4 - Physical Features of North Park, Colorado



Map 5 - Platte River Watershed

Prior to 1820, the Ute Indians spent their summers in North Park, living on mule deer, buffalo, pronghorn antelope, and many other kinds of game. The severity of the winters forced both the Indians and the game down to lower altitudes in the fall.

The Arapaho Indians also made frequent hunting trips into North Park coming in from the southwest over a pass described by Lt. John F. Fremont, as one of the most beautiful he had ever seen. The Utes and Arapaho's were bitter enemies, and many battles occurred when they chanced to meet. Besides their well worn trails, other mute evidence of Indian life of pre-settlement time still exists in North Park. A band of Utes who participated in the Meeker, Colorado massacre in 1879 fled to North Park after the incident and spent the winter in the north end of the Park. Several large log tepees left by this band of Utes, still stand in a sheltered and secluded spot in the north end of Jackson County.

The first Europeans to visit and explore North Park were probably trappers, who were in northwestern Colorado as early as 1819. Beaver were particularly abundant along North Park's streams. In 1820, Josephy Bijeau told of the good trapping he had experienced in North Park a few years prior, while with the Chateau and DeMunn Expedition. About the same time, 1820, Jacques Laramie trapped in the Park for the Northwest Fur Company. He was followed by a party of trappers headed by Alexander Sinclair and Robert Bean who trapped beaver in the Park in 1825. A number of trappers visited the Park into the 1840s including Peg Smith, John Gantt, Kit Carson, Henry Fraeb, Calvin Jones, Bill Williams, Jim Baker, Jim Bridger, Sublette, Gervais, and Vasquez. In 1855, the famous Irish hunter Sir George Gore made a spectacular hunting trip through North Park, killing thousands of mule deer, buffalo, and pronghorn antelope.

Miners and prospectors followed the trappers and hunters to North Park. James O. Pinkham was one of the first prospectors in North Park and began panning gold in the area in the early 1870s spending the long cold winters in Laramie, Wyoming, and the summers in North Park. He believed that North Park was the richest and finest country in the world, and built a home in the Park in 1874. Mr. Pinkham interested others in North Park through his tales of rich placer land, and by 1875, nearly 100 men were prospecting for placer gold around Rabbit Ears, Independence, and Owl Mountains.

During August and September 1879, George Bird Grinnell, naturalist, writer, and hunter entered the Park to collect museum specimens. Traveling by horse from the train station in Laramie, Wyoming, this 29-year-old Yale graduate entered the north end of the Park. "The country at this point had been burned over and was black and extremely desolate in appearance. I inquired the cause of the fire and learned from the owner of the ranch (Pinkham) that the burn had been made to clear off the sagebrush which takes up so much room that might be occupied by grass." Several days later, while camped on a meadow along the North Platte River, Grinnell writes: ". . . was perhaps a mile and a half wide, a superb level meadow, covered with fine grass, on which in the morning and evening from two to five hundred pronghorn antelope were in sight at one time. Sage and dusky grouse, ducks, and jack rabbits abounded here also . . . . It is only necessary to get back from the road to find both mule deer and elk."



*Beaver © Cindie Brunner*

The first settlers lived on wild game, and hunting was as much a business of the men as attending to their ranch work. North Park, in the late 1880s, was a paradise of game. Thousands of pronghorn antelope summered in the Park and migrated to the lower valleys in Wyoming during the winter. Also, hundreds of mule deer and elk were in the Park, but their numbers diminished after the arrival of settlers. Few buffalo were left in the Park when the first settlers came, but they soon disappeared. Many bears, mountain lions, mountain sheep, and beaver existed along with thousands of sage grouse, blue grouse, and ducks in the early days. No trout existed in any of the North Park streams when the first settlers came; however, in the 1880s, settlers stocked the streams with eastern brook trout and rainbow trout.

In 1880, cattle were introduced in large numbers, being driven down from the railroad lines in Laramie, Wyoming. However, the winter of 1883-84 was severe, and half of the stock died. As a result, most of the ranchers purchased mowers and rakes prior to the following summer's haying season in preparation for putting up the wild hay for winter feed. Hay has always been the main agricultural crop in Jackson County, with about 100,000 acres being in native mountain hay and only 370 acres in other crops. For years, all the hay was fed inside North Park, but in 1914, ranchers began to bale and sell the hay outside the Park.

By the early 1890s, North Park was fairly well settled in every direction, and a central point for securing supplies became necessary. As a result, the Town of Walden, elevation 8,100 feet, the present county seat, was established in the middle of North Park located in the vicinity of two wagon roads from Laramie to Teller City and from Albany to Granby. The town was named after Mark S. Walden who was postmaster of the nearby settlement, Sage Hen Springs.

The economy of Jackson County is based primarily on agriculture and recreation. Additionally, mining and logging have provided economic stimulus to the county. The economic base has been fairly stable throughout the history of Jackson County with some fluctuations caused by the instability of the mining and logging industry.

Recreation is becoming more and more of an economic importance to Jackson County. The county's many streams, lakes, uplands, timbered areas, and mountains, most with public access, offer unusual opportunities for outdoor recreational activities such as hunting, fishing, bird-watching, backpacking, camping, snowmobiling, cross-country skiing, bicycling, horseback riding, and many other activities.

## **Refuge Overview**

### ***History of Refuge Establishment, Acquisition, and Management***

Since the 1890s, North Park (Jackson County) Colorado has been known for high waterfowl productivity. Historically, high spring river flows flooded meadows providing suitable nesting habitat for a host of nesting bird species, especially waterfowl. Today, North Park serves as the second most productive waterfowl area in the State of Colorado. On August 15, 1967, the Migratory Bird Conservation Commission approved the first land acquisition project for the establishment of Arapaho NWR. The Refuge purpose was “for use as an inviolate sanctuary, or for other management purposes, for migratory birds” 16 U.S.C. (Migratory Bird Conservation Act). The original land purchase was the Allard Ranch of 4,433.07 acres. Subsequently, nine additional land tracts were purchased, and land exchanges completed with the U.S. Bureau of Land Management and the State of Colorado, for a current Refuge size of 23,243 acres.

Since 1967 the Refuge has been managed primarily for waterfowl nesting and production. Utilizing existing irrigation ditches for the water delivery system, the Refuge staff constructed or enhanced 78 wetland impoundments in the Illinois River. These impoundments, and associated wet-meadow habitats, provide the habitat necessary to produce waterfowl. The Refuge provides high quality habitat for many other mammals and birds common to high mountain sagebrush steppe environments. The willow riparian area alone supports over 40 species of songbird (neotropical migrants) during part of their migration or nesting cycle. Sage grouse are common on the Refuge, and wet-meadow habitats provide critical feeding areas for sage grouse young. Moose, mule deer, elk, and pronghorn antelope are common Refuge wildlife species. These big game species migrate on and off the Refuge; however, it is not uncommon for 1,200 elk, 200 pronghorn antelope, and 20 moose to inhabit the Refuge at any one time.

The Refuge headquarters is located 8 miles south of Walden on Highway 125. A full-time staff of six employees and three summer temporaries work to manage the Refuge wetlands and irrigation system, the wildlife habitats, and maintain visitor facilities. Grazing is the primary management tool used to manage meadow and upland habitats. Currently seven grazing cooperators are used to maintain and enhance Refuge grassland habitats. Water level manipulation, irrigation, fire, mowing, harrowing, and discing are additional tools used to improve grassland and wetland habitats on the Refuge.

The Refuge accommodates approximately 8,000 visitors annually. The 6-mile auto tour route, the walking trail, and Brocker Overlook account for the majority of visitor use. Approximately 500 recreation days are provided to hunters and anglers. The Refuge is currently open to limited small game, waterfowl, sage grouse, and pronghorn antelope hunting opportunities. The lower one-third of the Refuge provides brown and rainbow trout fishing opportunities to anglers.

Jackson County is rural and sparsely populated with only 1,577 individuals (2000 census data) residing there. Walden is the county seat, and approximately 900 individuals live within its city limits. At 8,200 feet in elevation, North Park is an intermountain glacial basin approximately 30 miles across and 45 miles long. Ranching, including both hay production and cattle, continues to be the dominant land use of North Park. Hunting, fishing, snowmobiling, and other outdoor recreational activities also promote the economy of the area. Fortunately, the traditional ranching history of North Park has not only produced hay and cattle, it has preserved and protected thousands of acres of wildlife habitat.

## Purpose of and Need for Comprehensive Conservation Plan

Initiated by the National Wildlife Refuge System Improvement Act of 1997, Comprehensive Conservation Plans (CCP) will be developed for all units of the National Wildlife Refuge System. Plans must include public involvement in their development, and must set forth strategies to fulfill the Refuge System mission, as well as the purposes for which the Refuge was established.

Wildlife has first priority in the management of Refuges. Recreation or other uses are allowed if they are compatible with wildlife conservation. Wildlife-dependent recreation activities such as hunting, fishing, wildlife observation, wildlife photography, environmental education, and interpretation will be emphasized.

This Comprehensive Conservation Plan provides a 15-year guidance for the management of Arapaho National Wildlife Refuge. Management goals and objectives developed for Arapaho National Wildlife Refuge are presented in the Management Direction Section. Based on the life requirements of selected wildlife species, these goals and objectives provide specific “targets” for Refuge staff to manage toward. Future management efforts will focus on achieving these goals and objectives for the benefit of wildlife and the American people.

To fulfill the U.S. Fish & Wildlife Service mission, Congress has charged the Service with conserving and managing migratory birds, endangered species, anadromous and inter-jurisdictional fish, and certain marine mammals. The Service operates more than 540 national wildlife refuges, 70 national fish hatcheries, 64 fishery resource offices, and 78 ecological services field stations. The agency enforces Federal wildlife laws, manages migratory bird populations, restores nationally significant fisheries, conserves and restores wildlife habitat such as wetlands, administers the Endangered Species Act, and helps foreign governments with their conservation efforts. It also oversees the Federal Aid Program which distributes hundreds of millions of dollars in excise taxes on hunting and fishing equipment to state wildlife agencies.

The National Wildlife Refuge System is the world’s largest collection of lands set-aside specifically for the protection of wildlife. The first unit of the Refuge System was created in 1903, when president Theodore Roosevelt designated 3-acre Pelican Island, a pelican and heron rookery in Florida, as a bird sanctuary. Today, the Refuge System consists of 540 national wildlife refuges and waterfowl production areas, encompassing more than 95-million acres and located in all 50 States and a number of U.S. Territories.

The Refuge System provides habitat for native mammals, birds, reptiles, amphibians, fishes, invertebrates, and plants “trust resources” for which the Federal government is ultimately responsible. It plays a vital role in preserving endangered and threatened species, preventing species from becoming endangered, and offers wildlife-dependent recreation for over 34 million visitors annually.

### ***U.S. Fish & Wildlife Service Mission***

“To work with others to conserve, protect and enhance fish and wildlife and plants and their habitats for the continuing benefit of the American people.”

### ***National Wildlife Refuge System Mission***

“To administer a network of lands and waters for the conservation, management, and where appropriate, restoration of fish and wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans” (National Wildlife Refuge System Improvement Act of 1997, Public Law 105-57).

### ***National Wildlife Refuge System Goals***

- 1) To fulfill our statutory duty to achieve Refuge purpose(s) and further the System mission;
- 2) Conserve, restore where appropriate, and enhance all species of fish, wildlife, and plants that are endangered or threatened with becoming endangered;
- 3) Perpetuate migratory bird, inter-jurisdictional fish and marine mammal populations;
- 4) Conserve a diversity of fish, wildlife, and plants;
- 5) Conserve and restore, where appropriate, representative ecosystems of the United States, including the ecological processes characteristic of those ecosystems;
- 6) To foster understanding and instill appreciation of fish, wildlife and plants and their conservation, by providing the public with safe, high-quality, and compatible wildlife-dependent public use. Such use includes hunting, fishing, wildlife observation, and photography, and environmental education and interpretation.

## ***Ecosystem Goals***

### ***Platte/Kansas Rivers Ecosystem Vision***

The vision of the Platte/Kansas Rivers ecoteam is to provide partnership based, landscape level conservation for the diversity and abundance of natural resources within the ecosystem. The team envisions landscapes which exhibit natural, healthy, ecological processes; ongoing protection of threatened, endangered and endemic species; protecting and promoting native prairie vegetation; involving all stakeholders in decision-making processes; and recognizes that partnerships are the key to success.

### ***Platte/Kansas Rivers Ecosystem Description***

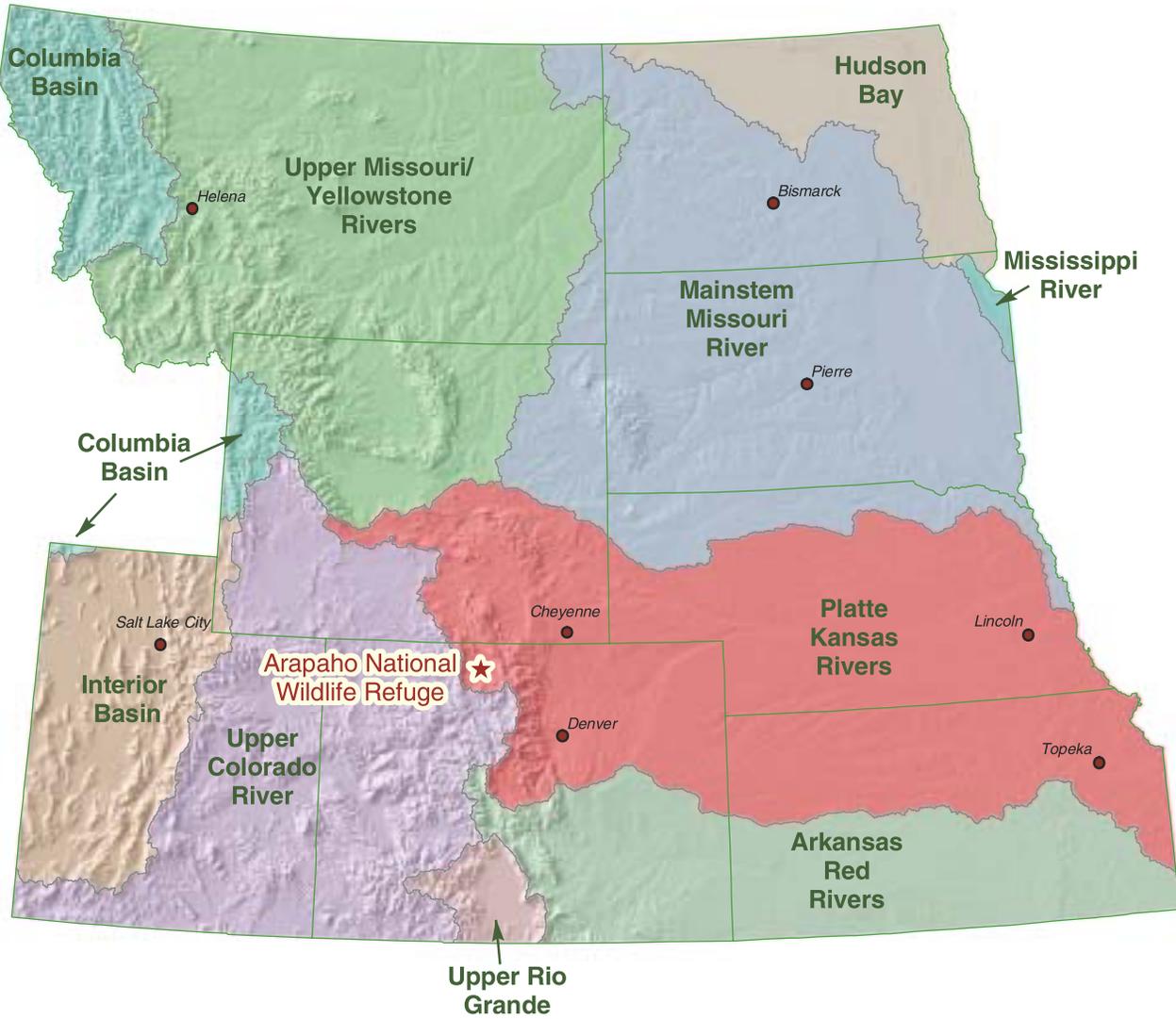
The U.S. Fish & Wildlife Service has divided the country into 53 watershed-based ecosystem management units. The Platte/Kansas Rivers ecosystem unit encompasses approximately 182,000 square miles of the central Great Plains of the United States (see Map 6 - Ecosystem Map). The Platte/Kansas Rivers Ecoregion includes the States of Colorado, Kansas, Nebraska, and Wyoming. The area is diverse, beginning at the headwaters of the North and South Platte River systems high in the Rocky Mountains, moving into sagebrush uplands of north-central Colorado and southeastern Wyoming, traversing across the shortgrass prairie regions of eastern Colorado, and the mixed-grass prairie regions of Nebraska and Kansas. The primary ecological processes affecting this system are climate, cultivation, grazing, and fire. The ecosystem is considered arid with an average annual precipitation between 8 and 16 inches per year. Approximately 85 percent of the Platte/Kansas Rivers Ecoregion is privately owned. The remainder is primarily owned and managed by State and Federal agencies.

The Platte/Kansas Rivers Ecosystem Planning Team, with input from current partners and field stations, identified and prioritized three primary geographic sub-units: mixed-grass prairie, mountain, and shortgrass prairie. Within each geographic sub-unit, priorities were established based on significance in the ecosystem, species diversity, risk/threat to the entire ecosystem area, public benefits, and trust resources. Also considered were legal mandates, opportunity for partnerships, likelihood of success, and cost effectiveness. Arapaho National Wildlife Refuge falls within the Mountain Sub-Unit of the Ecosystem Plan and plays a vital role in uplands management and protection.



# PLATTE/KANSAS RIVERS ECOSYSTEM

USFWS Mountain Prairie Region



Map 6 - Ecosystem Map

## Refuge Purposes

National wildlife refuges are established for a particular purpose. Formal establishment is generally based upon a statute or executive order that specifies a purpose for that Refuge. However, refuges can also be established by the U.S. Fish & Wildlife Service using the authorization found within laws such as the Endangered Species Act, Migratory Bird Conservation Act, and the Fish and Wildlife Act of 1956. Arapaho National Wildlife Refuge was established on September 26, 1967, for the following purposes:

“ . . . for uses as an inviolate sanctuary, or for any other management purpose, for migratory birds.” 16 U.S.C. § 715d (Migratory Bird Conservation Act).

“ . . . for the development, advancement, management, conservation, and protection of fish and wildlife resources . . . ” 16 U.S.C. § 742f (a)(4) “ . . . for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude . . . ” (Fish and Wildlife Act of 1956)

These two broad statements provide the “side-boards” to guide future management of Arapaho National Wildlife Refuge.

As part of the planning process, the Refuge staff and planning team reviewed past national, regional, and complex planning documents and current planning guidance. Using the legislation and plans, the planning team developed the following vision statement for the Refuge.

## Refuge Vision Statement

Arapaho National Wildlife Refuge is managed to benefit the diversity of plants and wildlife found in this high mountain valley of the southern Rocky Mountains. The Refuge and its resources are also managed for the benefit of the citizens of the United States.

The Refuge includes wetland, meadow, sagebrush uplands, and riparian communities that provide habitat for large animals, neotropical migratory birds, nesting waterfowl, fishes, and species of concern from national and regional conservation plans. In particular, efforts by Refuge staff to restore the Illinois River channel hydrology, riparian areas, sagebrush uplands, and to effectively manage wetlands and meadows, contribute to the ecological integrity of the Refuge, North Park, and the overall North Platte River system.

Through wildlife-dependent recreation and education, people have opportunities to learn of the wonder and significance of North Park’s fauna and flora. Firsthand experiences with the Refuge encourage people to participate as stewards, not only of the Refuge, but also of the natural resources in their own communities.

Working in collaboration with the local community and other agencies and organizations helps the U.S. Fish & Wildlife Service manage the Refuge as a contributing ecological, cultural, and economic component of the unique mountain valley within which it sits.

## Legal and Policy Guidance

National wildlife refuges are guided by: The mission and goals of the U.S. Fish & Wildlife Service and National Wildlife Refuge System; the legal purpose of the Refuge unit as described in the enabling legislation or executive orders; international treaties; Federal laws and regulations; and Service Policies (Appendix C).

The National Wildlife Refuge System Administration Act of 1966, as amended, provided guidelines and directives for administration of the National Wildlife Refuge System. Use of any area within the Refuge System was permitted, provided that such uses were compatible with the major purposes for which such areas were established.

The National Wildlife Refuge System Improvement Act of 1997 amends the Refuges System Administration Act by including a unifying mission for the Refuge System, a formal process for determining compatible uses on Refuges, and a requirement that each Refuge will be managed under a Comprehensive Conservation Plan. This Act states that wildlife conservation is the priority of Refuge System lands and that the Secretary of the Interior shall ensure that the biological integrity, diversity, and environmental health of the refuge lands are maintained. Each refuge must be managed to fulfill both the specific purposes for which it was established and the mission of the Refuge System.

Further, the Refuge Improvement Act defines the wildlife-dependent recreational uses as: hunting and fishing, wildlife observation and photography, environmental education and interpretation. (Specific details regarding additional amendments are available through the Refuge or Regional Fish and Wildlife Service offices).

Lands within the Refuge System are different from other public lands in that they are closed to all public uses unless specifically and legally opened. Unlike other Federal lands that are managed under a multiple use mandate (i.e. national forests administered by the U.S. Forest Service and public lands administered by the U.S. Bureau of Land Management), the Refuge System is managed specifically for the benefit of fish and wildlife resources.

Compatibility is a legal requirement of all refuge uses. By Federal law, all uses of national wildlife refuges, including wildlife-dependent recreational activities, must be formally determined to be compatible. A compatible use is defined as “a use that, in the sound professional judgement of the refuge manager, will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the Refuge.” Sound professional judgement is further defined as “a finding, determination, or decision that is consistent with the principles of sound fish and wildlife management and administration, available science and resources (funding, personnel, facilities, and other infrastructure), and adherence with applicable laws.” No use of a National Wildlife Refuge may be allowed unless determined to be compatible.

Uses that have been determined to be compatible for Arapaho National Wildlife Refuge include: hunting, fishing, environmental education and interpretation, wildlife observation and photography. Additionally, habitat management tools, including but not limited to, are fire, mowing, grazing, noxious weed control (chemical, mechanical, and physical methods), Dixie harrow, fencing, water management, routine Refuge maintenance activities, and public use related structures (Appendix F).

## **Existing Partnerships**

Arapaho National Wildlife Refuge currently promotes partnership opportunities to accomplish natural resource related goals both on and off the Refuge. Existing partnerships include the following groups and agencies:

**Colorado Division of Wildlife** - Wildlife and fishery habitat improvement, resource sharing, law enforcement.

**Colorado Scenic Byways** - Overlooks and roads development and interpretation.

**Colorado State Forest** - Natural resources improvement projects, forest management plans, fire management.

**Colorado State University** - Assist with planning, wildlife research, and habitat management.

**Habitat Partnership Program** - Reducing cattle and big game conflicts throughout North Park (Colorado Division of Wildlife (CDOW)).

**Jackson County** - Noxious weed management and fire support.

**Natural Resource Conservation Service** - Soils and vegetative management assistance.

**Owl Mountain Partnership** - Land health improvement projects on public and private lands. Includes developing grazing management plans, wildlife watering areas, and sagebrush management projects.

**Platte/Kansas Rivers Ecoteam** - Assist with funding and planning natural resource projects.

**National Center for Atmospheric Research** - Research snowpack characteristics to create reliable snowpack models.

**Sage Grouse Working Group** - Sage grouse habitat protection and enhancement.

**U.S. Bureau of Land Management** - Partner in several programs, equipment sharing, resource sharing.

**U.S. Forest Service** - Partner in several programs, equipment sharing, fire management, resource sharing.

**U.S. Geological Survey** - Cooperative wildlife research, planning, and water monitoring projects.

# *Planning Process*

## **Description of Planning Process**

The Arapaho National Wildlife Refuge Comprehensive Conservation Plan is guided by the mission of the U.S. Fish & Wildlife Service, the mission of the National Wildlife Refuge System, the established purposes of the Refuge, U.S. Fish & Wildlife Service compatibility standards, and other Service policies, plans, and laws related to Refuge management. This Plan establishes habitat-based goals, objectives, strategies, and monitoring priorities for Refuge management.

The Plan will be used to prepare more specific step-down management plans that address programs (hunting, fishing, environmental education, etc), annual priorities, and budgets. Projects completed by the Refuge will be monitored and documented to ensure progress toward achieving overall Refuge goals. Step-down plans also provide flexibility to accommodate annual changes in Refuge staff levels, funding, equipment, and other resources.

Key steps in the planning process include:

- 1) preplanning;
- 2) identifying issues and developing a vision;
- 3) gathering information;
- 4) assessing environmental effects;
- 5) developing alternatives;
- 6) identifying the proposed alternative;
- 7) publishing a Draft Plan and soliciting public comments;
- 8) reviewing the comments and making appropriate changes to the Draft;
- 9) preparing the Final Plan for approval by the U.S. Fish & Wildlife Service, Regional Director.

Issues addressed in this Plan were identified by the public, Refuge staff, and cooperating agencies. Public meetings were held on February 15, 2001, in Walden Colorado, and February 16, 2001, in Fort Collins, Colorado. Questionnaires and CCP summary handouts were distributed during these public events. News releases were published in the Jackson County Star and the Fort Collin's Coloradoan newspapers. Additionally, the public meeting presentation was delivered at a Fort Collins Chapter Audubon Society meeting in April of 2000. Public comments were received and utilized throughout the planning process.

Comprehensive Conservation Plans are initiated, developed, and published in a 2-year time frame. The Plan duration is 15 years; however, the Plan may be revised if necessary. The CCP will supercede current management plans.

**Table 1. Arapaho National Wildlife Refuge Planning Process Summary**

DATE	TITLE	OUTCOME
June 2000	CCP kick off meeting	Initiate CCP process
June 2000	Notice of intent for Federal Register	Intent filed
July 2000	Stake holder involvement plan	Stakeholder plan completed
August 2000	Significant issues development	Develop and refine list of issues
September 2000	Biological workshop	Develop draft focus areas
October 2000	Biological workshop	Develop draft riparian goals
December 2000	Biological workshop	Develop draft wetland goals
January 2001	Congressional tour	Tour Refuge, discuss CCP
January 2001	Commissioner tour	Tour Refuge, discuss CCP
January 2001	Biological workshop	Develop draft meadow goals
January 2001	Biological workshop	Develop draft upland goals
February 2001	Public Scoping - Walden	Develop Issues summary
February 2001	Public Scoping - Fort Collins	Develop Issues summary
February 2001	Biological Workshop	Develop riparian objectives
April 2001	Public Scoping	Develop Issues summary
April 2001	Decision support system	Develop timelines for DSS
May 2001	Biological Workshop	Refine goals and objectives
June 2001	Landscape scales issues meeting	Issues identification
June 2001	Riparian workshop	Field visit of riparian areas
July 2001	Alternatives development	Develop range alternatives
July 2001	Alternatives development	Refine alternatives
August 2001	Alternatives development	Refine Public Use Alternatives
September 2001	CCP process meeting	Evaluate CCP status
October 2001	CCP objectives	Refine biological objectives
October 2001	CCP objectives	Refine biological objectives
October 2001	CCP objectives	Refine biological objectives
October 2001	CCP objectives	Refine public use objectives
November 2001	CCP objectives	Refine public use objectives
November 2001	CCP objectives	Refine biological objectives
December 2001	Economic impact meeting	Evaluate economic issues
January 2003	CCP preparation	Writing draft CCP
February 2003	CCP preparation	Writing draft CCP
March 2003	Internal review	Complete internal review
June 2003*	Prepare Public review document	Document completed
July 2003*	Public review - comment period	Review completed
July 2003*	Public meeting draft CCP - Walden	Presentation
July 2003*	Public meeting draft CCP - Fort Collins	Presentation
August 2003*	Follow-up Landscape scale issues	Meeting completion
August 2003*	Incorporate public comments	Complete incorporation
September 2003*	Internal final review	Complete review
October 2003*	Publish final CCP	Publish
*proposed schedule		

## **Planning Issues**

Primary issues concerning future management of Arapaho NWR include: changing from a species-based management approach to a habitat-based management approach; sage grouse preservation and management; use of grazing as a wildlife management tool, and water management. Additionally, close coordination with the state wildlife management agency is critical to plan success.

## ***Pole Mountain***

### **History**

During 1993, the Service acquired lands formerly known as the Stelbar Ranch owned by E.B. Shawver. As part of the “all-or-nothing” purchase of lands adjacent to Arapaho NWR, this acquisition included an isolated tract of land known as Pole Mountain (T7N, R81W, Sec 33 and 34, 6PM), located approximately 6 miles southwest of the Refuge in Jackson County, Colorado. With a peak elevation of 9,200 feet, this 800-acre tract contains significantly different habitats than Arapaho Refuge proper. The site has private land on three sides and a piece of BLM land to the south that has no public access to it. Similarly, the Service does not own a permanent access easement to the property, and currently gains access across private land by virtue of a positive working relationship with a neighboring landowner.

The site is dominated by sagebrush uplands (50 percent) and mixed aspen/conifer forest (50 percent), which is common throughout the county where the uplands meet the forest edge. Currently, the Pole Mountain property is grazed annually, and invasive weeds are monitored and controlled. Minimal wildlife monitoring has been conducted at the site. Wildlife use includes mule deer, elk, blue grouse, porcupine, and a variety of passerines. Although the area has wildlife value, it does not match current or future objectives of the remainder of Arapaho NWR.

### **Issues**

The habitat does not meet purposes of Refuge establishment and is not unique in the area in terms of habitat or wildlife use. Few management options are available for habitat improvement.

Several entities are interested in the land for various reasons, including: members of the local Sage Grouse Working Group to trade these lands for others in the county to protect sage grouse habitat; the CDOW for big game management (however, they currently have a moratorium on acquiring new lands); local ranchers for use as grazing land; developers for home sites.

Lack of a legal access right-of-way. This makes any management effort tenuous, especially anything to do with public use as we do not want to encourage citizens to trespass on private lands to gain access to public grounds.

### **Considered Options**

1. Keep tract, survey, re-sign, change/add Refuge objectives to include this parcel;
2. Work with Colorado State Forest Service to develop and implement a forest management plan for the area;
3. Sell tract through government regulations to highest bidder;
4. Trade tract for (in priority order):
  - A. Refuge Inholdings
  - B. Lands and waters adjacent to Arapaho NWR that are manageable to reach objectives listed in this Plan
  - C. Lands and waters adjacent to other Refuges in:
    - a. Colorado
    - b. Region 6 of the FWS
    - c. any Refuge in the nation, which help these areas achieve their goals and objectives
  - D. Lands with a natural resource interest by other Federal land management agencies
5. Place a conservation easement on the property prior to divestment to limit or preclude development on the tract;
6. Secure a legal right-of-way easement to assure access to the property;
7. Open area to hunting of all species according to State regulations.

### **Proposed Action**

Divest of the Pole Mountain property within 5 years using the priority criteria listed above. Until that time, the Refuge staff will ensure proper stewardship of the land, but minimal management will occur.

### **Strategies:**

- Place a conservation easement on the property prior to sale/trade to ensure the wildlife benefits of the area remain intact.
- Continue grazing at recent levels as deemed appropriate by management.
- Continue weed control efforts as part of the Pest Management Agreement with the county.
- Obtain a right-of-way access to the property for management and public use.
- Open the tract to hunting by advertising such intentions in the Code of Federal Regulations.
- If the tract is not divested, create a forest and rangeland management plan for the area prior to update of this CCP.

## **Grazing**

The lands that now make up Arapaho National Wildlife Refuge had been grazed by cattle and sheep, prior to acquisition, for nearly a century. Since establishment of the Refuge in 1967, grazing has continued to be the most common management tool to manipulate Refuge habitats, especially the meadow areas. Immediately after land purchases, some grazing was permitted as part of purchase agreements, and some areas were rested to establish waterfowl nesting cover. From 1969 to 1982, 47 to 95 percent of the Refuge lands were grazed annually at a Refuge-wide rate varying between 0.4 and 1.2 Animal Unit Months (AUMs) per acre. Grazing records from 1982 to 1991 were destroyed by an office fire. From 1991 to 2001 (excepting 1993 for which data is unavailable) 46 to 74 percent of the Refuge lands were grazed annually at a Refuge-wide average rate between 0.52 and 0.71 AUMs per acre. Actual rates per field vary significantly depending on the site, with some upland areas being as low as 0.01 AUMs per acre and some meadow fields as high as 2.18 AUMs per acre.

Grazing in meadow/riparian areas has generally not commenced until after August 1 of a given year to minimize disturbance to nesting waterfowl. Uplands are sometimes grazed earlier, but as a general rule, grazing on the Refuge does not commence until June 1. Grazing systems used have included high intensity, short duration (Holistic Resource Management (HRM) type), rest-rotation, light annual grazing, and complete rest.

Livestock grazing has been the preferred management tool used on the Refuge because the effect on vegetative communities is more controllable and predictable than other management tools available at this time. All known and available management tools will be assessed for suitability of use in achieving defined habitat objectives. Other treatment options that will be considered include:

**Prescribed fire** - Some prescribed fires have occurred on the Refuge and others may be planned in the future. Burning could be used to accomplish efforts to remove excess decadent growth and reset successional stages; however, due to severe weather extremes including high winds, low humidities, and unpredictable water weather conditions, meeting burning prescriptions is difficult. Even though fire could accomplish habitat goals, manipulation may not have the chance to occur for years.

**Haying/mowing** - Minimal haying occurred on some parcels as agreements of purchase, but were short-lived. Haying would be effective in removal of vegetative growth, but the primary objective of haying would likely be to remove decadent growth. In this case, hay quality would probably be poor, so finding someone interested in doing the work may be difficult. Mowing would successfully remove decadent growth, and the cut grass would ultimately break down to form litter and duff needed for objectives. This could be very costly in time and energy compared to other tools.

**Fertilizing** - Applying fertilizers is an option to increase plant growth, and is used by many in the county to increase hay production. Cost, equipment, and time deter its use at present, but this tool should be considered if habitat objectives are not being met by other means.

**Mechanical treatments** - These are treatments typically associated with efforts to manipulate sagebrush and could include using a disc, aerator, roller/chopper, Dixie harrow, or similar implements. Several hundred acres around the county have been treated in recent years in an effort to open up and vary the age diversity of sagebrush stands, and increase plant diversity, but success of these projects is still being assessed.

There is little Refuge specific data available to assess how past Refuge grazing practices have or will effect proposed habitat objectives due to: 1) all data prior to April 1997 was destroyed in an office fire: 2) any available data from other studies was not necessarily looking for the objectives as defined in this document and, therefore, is of limited use for assessment purposes. With this said, it is the opinion of the Refuge staff based on their knowledge of the Refuge lands, that although grazing practices on the Refuge to-date have not harmed the habitat, current levels of grazing probably do not allow us to meet the objectives as defined, and some reduction in grazing will be required. With more intensive monitoring of habitats to assess how well objectives are being met, a better understanding of appropriate grazing levels should be developed. Anticipated grazing use of the different alternatives as identified in this CCP are as follows (refer to the Environmental Assessment for full discussion of alternatives):

#### **Alternative A**

Estimated grazing numbers are based on the 1996 to 2001 annual average AUMS of 8,470. This range of years was used because 1996 was the first year of grazing on the current Refuge acreage of 23,243 acres following the purchase of the Stelbar tract. The figures for 2002 were not included as they were considered an anomaly since one of the worst droughts on record significantly decreased use. Status quo, figuring what we have been doing is working.

#### **Alternative B**

Uses estimated grazing numbers of 3,050 to 7,650 AUMs annually, and represents approximately 36 to 90 percent of the 1996 to 2001 average. This assumes an average use of between 0.4 and 1.0 AUMs per acre of grazable acres for riparian and meadows, and 0.05 to 0.15 on uplands. Nothing is guaranteed; however, this alternative assumes some grazing will likely occur every year to help achieve objectives on and off the Refuge. Work closely with permittees to combine Refuge needs and permittees operational needs together as much as possible as far as timing, areas, and to a certain extent, numbers. Permittees in good standing have a reasonable expectation of how many AUMs will be available to them for the upcoming year - barring extenuating circumstances (drought, etc.).

#### **Alternative C**

Uses estimated grazing numbers of 3,050 to 7,650 AUMs per annual use based on the 1996 to 2001 average and a rate between 0.4 to 1.0 AUMs per acre of grazable acres for riparian and meadows, 0.05 to 0.15 on uplands. Since this alternative requires tighter decisions based solely on predicted habitat needs, there is the higher likelihood of significant variability in AUMs from year-to-year, and an increased possibility of no grazing under certain circumstances. The Refuge staff will set strict guidelines as to where, when, and how intense grazing will occur. Permittees in good standing should have some expectation of grazing to occur the next year, but with more variation possible. If the grazing program under this alternative proves to be too unreliable to maintain regular permittees, it may be necessary to institute a lottery or bid system. The Refuge staff would have to identify where grazing was to occur in the upcoming year, how many AUMs were being offered, and what level of stocking rate would be required, and then advertise that to any interested rancher.

#### **Alternative D (Preferred Alternative)**

Uses estimated grazing numbers of 3,050 to 7,650 AUMs annually, and represents approximately 36 to 90 percent of the 1996 to 2001 average. This assumes an average use of between 0.4 and 1.0 AUMs per acre of grazable acres for riparian and meadows, and 0.05 to 0.15 on uplands. Nothing is guaranteed; however, this alternative assumes some grazing will likely occur every year to help achieve objectives on and off the Refuge. Work closely with permittees to combine Refuge needs and permittees operational needs together as much as possible as far as timing, areas, and to a certain extent, numbers. Permittees in good standing have a reasonable expectation of how many AUMs will be available to them for the upcoming year - barring extenuating circumstances (drought, etc.).

**Options for implementing any needed changes to grazing program include:**

- 1) Attrition - As permittees drop out, they will not be replaced immediately - if at all. Fields that have historically been grazed by a permittee that drops out will be given to a new permittee after at least a year of rest - when assessment of ground indicates treatment is needed again. Or fields will be adjudicated among remaining permittees to better manage AUMs throughout the Refuge. Anticipated grazing needs will be identified by January 15 of each year for permittee planning purposes.
- 2) New grazing protocol is instituted immediately upon signing of the CCP. Refuge staff will establish AUMs to be used and where; and permittees will work with those numbers.
- 3) Permittees could be guaranteed a certain number of AUMs or range to expect from year-to-year. No guarantee will occur as to where these AUMs will be, so permittee must be willing to go anywhere on the Refuge. AUMs per permittee could be based on a ratio of past use, or a similar amount/range for all.
- 4) If no permittees drop out, decrease AUMs across the board a percentage (5 to 10 percent) every year until a predetermined threshold, or habitat objectives are met. Adjust annually, thereafter, based on habitat needs and outside projects.
- 5) If no permittees drop out, set a date - such as 5 years from signing of the CCP - when any changes will take effect. Refuge staff will have a chance to come up with firm numbers that will be communicated to permittees to aid them in long-term planning.
- 6) If a permittee drops out, rest all fields they grazed for 2 years to conduct intensive evaluations of fields. When it is deemed manipulation is needed, advertise the availability of a grazing permit allowing so many AUMs per year, for  $X$  out of the next  $Y$  years (e.g. 500 AUMs per year for 3 out of the next 6 years), with the permittee choosing which years to use. Permittee could be selected by lottery or bid. Permit would define available fields and maximum AUMS per year to be used in each.

**Proposed Action**

Continue working with existing permittees and adjust use to Refuge goals using attrition and across the board cuts in AUMS if needed. If a permittee has intentions of not grazing any longer on the Refuge, the fields they historically used will be utilized as they are in need of treatment to spread out use elsewhere on the Refuge. If all permittees are still interested in continued use in 2 years, all permits will be decreased annually approximately 5 to 10 percent from 1996 to 2001 averages until objective levels are met. Grazing levels will, from thereafter, be driven entirely by habitat needs based on identified objectives.

## **Elk**

### **History**

Until the mid-to-late 1980s, seeing elk on or around the Refuge at any time of year was a rarity. Then, for various known and unknown reasons, they began to show up regularly in the winter, until about 500 were common on and around the Refuge from December to March. Most of the animals would disperse for higher ground as the snow melted in the spring, but some began to stay along the Illinois River year-round. By the mid-1990s, a resident herd of approximately 150 elk had become established. The CDOW initiated a Distribution Management hunt on private lands to thin this resident herd to try and disperse some of its numbers off the private lands. This effort was successful in reducing the resident herd size for awhile. The wintering herd has continued to grow to the point that winter counts conducted by the CDOW in late December 2002 found about 2,400 elk on and near the Refuge. They typically are scattered into several herds that vary in size, but it is not unusual to see a herd of +/- 1,000 animals. Although a herd of this size is a magnificent wildlife resource to behold, other things need to be considered. The first is that the Refuge, though fairly large, cannot be all things for all wildlife. A point comes where too many individuals of one species (elk) can negatively impact the habitat for another species or group of species (waterfowl). With one of the purposes for establishing the Refuge being used as a sanctuary for migratory birds, too many elk could keep this purpose from being met. Also, elk by law are a state-owned resource, and high elk numbers may lead to resource or economic problems elsewhere in the county. The Refuge should, and will, work with the Colorado Division of Wildlife to address elk issues on the Refuge.

### **Elk Issues**

Historically, ranching was the primary use of North Park lands, and that continues to be the case in much of the county. Elk, as grazers and potential competitors with cattle, can get into hay harvested for livestock and cause damage to fences and other ranch structures. Elk will continue to concentrate in areas of the county, and depending on the landowner and the number of elk in the particular herd, the perspective of whether an elk “problem” exists or not changes. A landowner that does not rely on livestock for their livelihood may view 100 elk as a valuable resource, but may view 300 as a problem. Similarly, a landowner relying on the land to make a living might view the 100 animals as too many. The Refuge strives to find an elk population size that achieves refuge goals, and meets North Park herd management objectives. A large visible herd of elk can be a reminder that herd objectives have been surpassed, and when that herd is on the Refuge, it may seem to some that they are on a likely spot to reduce numbers.

As mentioned, elk are grazers. When on the Refuge they are foraging, trampling and eating grasses that the Refuge staff is trying to manage as habitat for other wildlife. Elk can also have a severe impact on willow stands. Habitat objectives within this document identify maintaining grasslands and willows to varying degrees to benefit wildlife. Although the elk do use the Refuge extensively during the winter months, they do not use it exclusively - making it more difficult to determine what the cumulative impact of their use may be. A method needs to be developed to estimate elk use and impact to Refuge lands.

The number of elk using the Refuge is continuing to grow, and with recent drought conditions, recent growth may be larger than usual. Is this a short-term gain in numbers with a decrease when conditions change, or have the animals found a new place and will stick with it? Also, is the increase in elk on the Refuge proportional to the increase throughout the county, or are a higher (or lower) proportion using the Refuge?

The Refuge is a good place for the elk, since it is a place set-aside for wildlife, and if they are on the Refuge, they are not on private lands potentially damaging property or consuming forage meant for livestock. The problem is that they do not stay just on the Refuge, so the potential exists for them to travel to adjoining private land and do damage. And as the numbers of animals using the Refuge grows, so will the possibility of damage to private resources grow.

### **Elk Hunting**

During the general rifle big game hunting seasons, the resident elk herd on and near the Refuge typically becomes more noticeable. As the later hunting seasons progress, more elk move onto the Refuge from the forested areas of the county. With the exception of some private lands scattered around the county, the Refuge is the only place on the south end of North Park where the elk are not pursued during the general seasons. But as more elk move onto the Refuge, an impression is created with some hunters that “all the elk are on the Refuge,” especially if the animals are hard to find in other locations. The Refuge is composed mainly of sagebrush uplands, meadow, and open areas, without many places for elk to hide (the elk typically are in large herds at this time). The lands surrounding the Refuge are very open and the hunting that occurs on these areas often includes radio use, pushing animals with vehicles and all-terrain-vehicles (ATVs), party hunting, and over limits of animals. In general, this does not fit Refuge System requirements as outlined in the Refuge Manual to offer a quality hunting experience that promotes “positive hunting values and hunter ethics such as fair chase and sportsmanship” on National Wildlife Refuges.

Chronic Wasting Disease (CWD) has been documented in white-tailed and mule deer and elk in Jackson County. Though these are typically State issues, the Refuge staff is also concerned, since elk use is high on the Refuge. The potential for other diseases and their risk of spread rises dramatically as a result of the large herd sizes.



*Elk © Cindie Brunner*

## **Elk Management Options**

- Eliminate livestock, and manage Refuge habitats with elk grazing. This would involve trying to haze the elk on or off various fields on the Refuge, or completely off the Refuge if habitat goals are thought to be met. The problems with this include the fact that elk are wild and getting them to move where you want them to is not an easy task, and elk moved off the Refuge could very well end up on private land, potentially causing problems there.
- Eliminate elk, and manage Refuge habitats with cows and other management tools. This would decrease the likelihood of disease problems such as CWD on the Refuge, and since management would be more controllable, this would seem an appropriate option. However, we would still be into a hazing program, and where the elk go when they are not on the Refuge should be a concern. Also, is it appropriate and within Refuge purposes to keep a species native to the area off a National Wildlife Refuge?
- Try and meet habitat objectives with range management practices including prescribed livestock grazing since it is a controllable tool. Monitor elk use and impact on Refuge habitats. Develop a protocol for action when management objectives are not being met, using management tools such as elk hazing, hunting, transplant, etc. Protocol should define what circumstances will trigger these actions and when. Coordination with CDOW will be critical to address potential impacts to other parts of the county.
- Open an elk hunting season. Objectives of a hunt would have to be defined. Opening the Refuge during the general seasons would not meet the guidelines set out in the Refuge Manual to provide a quality hunting experience. A limited quota hunt of just the Refuge with the aim at reducing overall herd size would be minimally successful as elk would quickly leave the Refuge for safer areas. Any hunt geared toward population management would have to incorporate adjacent BLM and private lands since the elk are not on the Refuge all the time, and they will not necessarily remain on the Refuge once the shooting begins. A limited, late season youth and/or disabled hunt could supply a quality learning experience for young and disabled hunters, while contributing to countywide efforts to control herd sizes. Other hunting options would include Coordinated Management hunts, or Limited Access hunts, through the CDOW and the local Habitat Partnership Program group.
- Calculate daily impact to forage by elk and develop a means to determine when elk use is stressing habitat objectives. Management decisions for elk, livestock, or any other manipulation could then be made with that impact in mind.
- Work with the State to monitor CWD and/or other disease issues, especially those on the Refuge.

- Initiate herbivory (elk, moose, cattle) studies to assess the independent and cumulative impacts to riparian, upland, and meadow habitats on the Refuge by these species. Willow regeneration along the Illinois River is slow, and small willow shoots are frequently grazed to one inch height. Elk damage to riparian areas is well documented in the scientific literature (see Riparian Summary - Appendix H). Currently, approximately 150 elk utilize the Refuge during the spring, summer, and fall. During winter months (November through March), elk numbers vary considerably but average 1,000 to 1,400 using the Refuge and surrounding area. Elk numbers and elk damage are not necessarily a linear relationship. Snow depth, temperature, duration of feeding, and a host of other factors may determine wintering elk impacts. Elk wintering on the Refuge may minimize game damage on adjacent private lands. Therefore, the Refuge proposes to evaluate herbivory impacts of elk, moose, and cattle. Studies will be conducted in conjunction with the State and other partners to evaluate impacts. Exclosures will be installed during 2004 to begin the evaluation process.

### **Proposed Action**

Initiate studies to determine elk impact to willow communities and impact on grasslands. The Refuge staff is concerned primarily with the lack of willow regeneration, the percent cover provided by willows, and willow density along the Illinois River channel. Develop protocol outlining actions to take when impacts become severe. Work with the State to develop a hunting strategy for land on and adjacent to the Refuge. Strategy could include a late season limited youth and disabled hunt, and protocol outlining the need and administration of additional hunts based on game damage, herd reduction, Refuge habitat degradation, etc.

### **Sage Grouse Hunting**

Greater sage-grouse are only found in sagebrush dominated rangelands in Western North America. Sage grouse are dependent on sagebrush for winter cover, nesting, and feeding habitat. Currently, North Park supports greater sage-grouse habitat and a viable grouse population. However, over the last 40 years, the population has exhibited extreme fluctuations. In 1998, because of increased local concerns about the status of sage grouse in North Park, a group of concerned citizens and agencies formed the North Park Sage Grouse Working Group. The mission of the group is to develop, implement, and monitor a conservation plan to maintain a viable sage grouse population in Jackson County, Colorado. Historically, the Refuge has supported sage grouse hunting in accordance with State regulations and seasons. The Refuge proposes to continue offering sport hunting opportunities for sage grouse in accordance with State regulations and seasons. Additionally, the Refuge staff will monitor and evaluate upland habitats to improve conditions for nesting and brood-rearing sage grouse (See Upland Habitats, Appendix H). Finally, the Refuge will support the purpose and guiding principals of the North Park greater sage-grouse conservation plan.

## ***Inholdings***

The following lands lie within the approved acquisition boundary of Arapaho National Wildlife Refuge.

These properties represent valuable wildlife habitat and are of interest to the Refuge. Following the Service acquisition policy and guidelines, the Refuge will attempt to acquire these properties on a willing-seller, willing-buyer basis only. Additionally, the Refuge will attempt to acquire mineral resource interests on lands within the existing acquisition boundary. Surface disturbance associated with minerals extraction may destroy wildlife habitats, and prevent Refuge goals and objectives from being met. The Refuge staff has not identified any additional lands or minerals for acquisition outside the approved boundary.

<u>Tract</u>	<u>Approximate Acreage</u>
Stephens	160
Anderson	480
Burr (Tract 1)	200
Burr (Tract 2)	2,960
Hwy 14 Tract	18
<u>Old RR grade (pieces)</u>	<u>24</u>
<b>Total</b>	<b>3,842</b>

# Summary Refuge and Resource Descriptions

## Geographic/Ecosystem Setting

Arapaho National Wildlife Refuge, situated at an elevation of 8,200 feet, is located in an intermountain glacial basin in north-central Colorado. The Refuge is situated along the western edge of the Central Waterfowl Flyway (Figure 1). Jackson County opens north into Wyoming and is rimmed on the west by the Park Range, on the south by the Rabbit Ears Range, and on the east by the Medicine Bow Range. The basin floor is locally known as North Park and encompasses approximately 600 square miles. The basin floor is relatively flat with an elevation range of 7,900 to 8,300 feet. Slow, meandering streams, which criss-cross the basin, flow toward the north-central part of the basin to form the North Platte River. Most of the floodplain is irrigated meadow, while the adjacent low rises are characterized by sagebrush grasslands.

Sagebrush uplands are the dominate vegetative community encompassing 80 percent of the Park. Sagebrush uplands are dominated by seven primary species of sagebrush, with a perennial bunchgrass and forb understory. Meadows are typically irrigated to produce a single hay crop per year. Meadow grasses typical include timothy, red top, garrison creeping foxtail, and foxtail barley. Riparian areas are dominated by willows (*Salix sp.*) and other low growing shrub species.

## Climate

The climate is semiarid which can be characterized as having short-cool summers, followed by long, cold winters. The mean rainfall in Walden is 10.83 inches of precipitation annually. Temperatures and precipitation vary greatly with elevation and location. Mean annual air temperature in Walden, near the center of the Park, is 36.4 degrees Fahrenheit. Temperature extremes are minus 39 degrees to 90 degrees Fahrenheit, based on the National Weather Bureau 30-year average. The average length of the growing season in Walden is 43 days. The average date for the last killing frost in Walden is July 1, and the average first killing frost is August 14, based on North Park weather station's 70-year average. The relatively short frost-free season inhibits any form of agriculture today except hay near floodplain areas. Generally, annual precipitation increases as elevation increases from the floor to the outer edge of North Park. Elevation ranges from slightly below 8,000 feet on the valley floor to 12,965 feet on Clarks Peak. Seventy percent of the annual precipitation falls as snow. Walden averages 53 inches of snow per year, the lowest of any point in the Park. The highest average monthly precipitation occurs in March, April, May, and August (Lischka et al. 1983).



## ***Geological Resources***

North Park is a structural basin between the Precambrian granites, gneisses and schists of the Medicine Bow and Park Ranges and Independence Mountain. The Surface geology of the Park floor is dominated by the sandstones, conglomerates, and shales of the Tertiary Coalmont Formation. Coal is found in the lower members of the formation (Hail, 1968). The North Park Formation overlies the Coalmont Formation and consists of white, calcareous conglomerates. The Coalmont Formation is exposed along a long narrow syncline ridge trending northwest from Owl Mountain to the confluence of Roaring Fork and Grizzly Creeks. The syncline includes Owl Ridge and Peterson Ridge. Pierre Shale underlies the Coalmont Formation and is exposed primarily in the northwestern and northeastern quadrants of North Park. Evidence of Tertiary volcanics is obvious along the south boundary of the Park. Quantities of breccia and other volcanics are common in the Rabbit Ears Range in the form of dikes, plugh, flows, and ash. Significant glacial activity occurred in North Park during the Pleistocene. Fluvial gravels, and interfluvial terraces are examples of the influence of glacial activity upon the current landscape of the Park floor. Several natural lakes in the area are thought to be remnants of Pleistocene glaciation. Winds also influenced the geology of the Park. Prevailing southwesterly winds, thought to be caused by the low ridge between Rabbit Ears Peak and Arapaho Pass, have deposited fine grains alluvium, some of which reaches thicknesses of 30 feet. Winds are suggested to have created several shallow lakes within the basin, including Hebron Sloughs, located just southwest of the Refuge (Lischka et al. 1983).

## ***Soil Resources***

Soils that have the capacity to reproduce the same kinds, amounts, and proportions of range plants are grouped into range sites. Fletcher (1981) defined 15 different range sites and two forest types within Jackson County. Five range sites are found on the Refuge: (Floodplain sites):

- 1) Randman - Blackwell-Dobrow association; deep, poorly drained, dominantly sandy soils;
- 2) Spicerton -Stumpp association: deep, well drained sandy loams and clay loams (bench and upland sites);
- 3) Fluetch - Bosler - Tealson association, deep and shallow well drained sandy loams;
- 4) Tiagos - Cabin association: deep, well drained fine sandy loams; and
- 5) Coalmont - Brinkerton - Aaberg association: moderately deep of soft shale and well drained sandy loams.

The Refuge contains 31 individual soil types within the five range sites (Fletcher, 1977). Dominate soil types include Spicerton sandy loam, Fluetsch -Tiagos association, Bosler sandy loam, and the Boettcher-Bundyman association. These soils are found on slopes less than 15 percent, and generally have slow to moderate permeability. Mean soil temperature at Walden is 58 degrees Fahrenheit.

## ***Ecosystem Setting***

Bailey (1995) described the Jackson County area as part of the southern Rocky Mountain Ecoregion. The Service has adopted an ecosystem approach to natural resource management and has identified 53 watershed-based ecoregions in the United States (Figure 2). Within the Service ecosystem organization, the Refuge lies within the boundaries of the Platte/Kansas Rivers Ecosystem. The Service is developing a nationally coordinated approach involving ecosystem teams, partners, and stakeholders to preserve natural resources for the American people. Ecosystem teams are fundamental to the Service in sustaining good land health. Ecosystem teams should be the primary delivery mechanism for establishing priorities and identifying areas of greatest conservation concern in their ecosystems (Fulfilling the Promise, 1999).



## **Refuge Resources, Cultural Resources, and Public Uses**

### ***Water Rights***

The Refuge is located on the Illinois River and its tributaries. The Illinois River is tributary to the Michigan River, which is tributary to the North Platte River. Prior to settlement, the bottoms and meadows of the Illinois River and its tributaries flooded annually with snowmelt and spring runoff, creating significant waterfowl nesting habitat. As the area became settled, much of the natural flooding and ponding were reduced and irrigated meadows replaced ponds and marshes. Since the Refuge's first land acquisition in 1967, the Service created new wetland habitat through the management of acquired irrigation and stock reservoirs; diversion of water into natural depressions; as well as diversion of water into Service-constructed ponds.

The Refuge has a decreed diversion rate of 515.05 cubic feet per second, most of which is diverted from the Illinois River, with lesser amounts diverted from the Big, Willow, Spring, Potter, and Antelope Creek tributaries. This water is either ditched for storage in 9 decreed reservoirs and 73 undecreed ponds, or ditched to meadows for direct irrigation. Currently, the Refuge has decreed rights to 7,626.4 acre-feet for reservoir/pond initial fills and refills, and is seeking an additional 2,582.5 acre-feet. The total capacity of Refuge storage units is 5,678.5 acre-feet. Approximately 814 surface acres are ponded, and approximately 9,499 acres are irrigated meadow grass.

Since 2001, the U.S. Geological Survey has measured Illinois River flow at gauging stations at the upstream and downstream ends of the Refuge in order to determine the effect of Refuge diversions, wildlife use, and return flow on river discharge.

Groundwater is present in an unconfined, sand and gravel alluvial aquifer which underlies the entire Refuge. The water table is shallow, with the elevation of the groundwater table approximating the water-surface elevations in nearby rivers, creeks, reservoirs, and ponds.

The Refuge's water rights are administered according to the prior appropriation doctrine by the Colorado Division of Water Resources, commonly referred to as the State Engineer's Office. Whereas much of the Refuge's acquired land has rather senior appurtenant water rights, conversion of ranch land to wildlife habitat has required obtaining junior water rights which cannot be exercised in dry or semidry years. The Refuge staff believes it holds sufficient water rights to implement Refuge goals and objectives. Water rights held by the Refuge are summarized in Table 2.

<b>Court</b>	<b>Admin #</b>	<b>Name</b>	<b>Flow, Storage, Use</b>	<b>Approp. Date</b>
11	12179	Home No. 1 and Upland Ditch	4.0 cfs (Refuge 2.0 cfs)	5/6/1883
81	13635	Dryer Ditch	5.2 cfs	5/1/1887
80	13635	North Park Ditch No. 6	9.0 cfs	5/1/1889
86	13642	Everhard Baldwin Ditch	10 cfs (Refuge 5 cfs)	5/8/1887
100	13686	Hubbard Ditch No. 1	1 cfs	6/21/1887
110	13849	Hubbard Ditch No. 1	3 cfs	6/21/1889
122	14015	Ward Ditch No. 1	3 cfs	5/15/1888
161	14148	Hill, Crouter Ditch	6 cfs	9/25/1888
167	14337	Hubbard Ditch No. 2	3 cfs	4/2/1889
170	14350	Oklahoma Ditch No. 1	41 cfs	4/15/1889
180	14370	Home No. 1 and Upland Ditch	2 cfs	5/5/1889
190	14403	Ward Ditch No. 2	.5 cfs	6/7/1889
196	14417	Hubbard Ditch No. 1	2 cfs	6/21/1889
195	14417	Ward Ditch No. 1	3 cfs	6/21/1889
217	14731	Hubbard Ditch No. 2	3 cfs	5/1/1890
229	14762	Everhard Baldwin Ditch	8 cfs	6/1/1890
232	14805	Home No. 1 and Upland Ditch	2 cfs	7/14/1890
243	15151	Oklahoma Ditch No. 1	10 cfs	6/25/1891
264	15891	Hubbard Ditch No. 2	8 cfs	7/4/1893
270	16215	Dryer Ditch	3.6 cfs	5/24/1894
275	16360	Boyce Bros Ditch No. 1	9.25 cfs	10/16/1894
276	16362	Oklahoma Ditch No. 2	9 cfs	10/18/1894
382	16942	Ish and Baldwin Ditch	1.6 cfs (Refuge .9 cfs)	5/20/1896
286	17420	Hubbard Ditch No. 2	15 cfs	9/10/1897
287	17496	Ward Ditch No. 1	13 cfs	11/25/1897
296	17806	Dryer Ditch	2.4 cfs	10/1/1898
302	18395	Ward Ditch No. 3	2.25 cfs	5/12/1900
306	18507	Midland Ditch	15 cfs (Refuge 5 cfs)	9/1/1900
329	20270	Potter Ditch No. 2	5 cfs	7/1/1905
344	21367.91160	North Park Ditch No. 6	6 cfs	5/1/1903
344	21367.91160	Oklahoma Ditch No. 1	10 cfs	5/1/1903
344	21367.91160	Oklahoma Ditch No. 2	4 cfs	5/1/1903
346.5	21367.93177	Hubbard Ditch No. 2	16 cfs	7/5/1904
349	21367.94726	Everhard Baldwin Ditch	5 cfs	10/17/1947
353	21367.99593	Riddle Ditch	3 cfs	4/6/1908
355	21367.99710	Midland Ditch	6 cfs	5/1/1908
357	21392	Hubbard Ditch No. 2	27 cfs	7/26/1908
364	22189	Howard Ditch	75 cfs	10/1/1910
375	23017.81853	Hubbard Ditch No. 1	6 cfs	8/1/1901
None	23017.92901	Hubbard Ditch No. 4	2 cfs	7/18/1908
378.2	23017.95734	Hubbard Ditch No. 2	31 cfs	5/1/1910
398	24008	Midland Ditch	20.5 cfs (Refuge 5 cfs)	9/24/1915
700	30281.61915	Boyce Bros Ditch No. 1	20.5 cfs	5/1/1901
707	30281.70359	Antelope Ditch No. 1	5.47 cfs	5/1/1908
726	30281.91011	State Walden Pipeline	.75 cfs	6/20/1939

**Table 2. Summary of Water Rights Held by the Refuge cont'd.**

<b>Court</b>	<b>Admin #</b>	<b>Name</b>	<b>Flow, Storage, Use</b>	<b>Approp. Date</b>
	49102	Howard Ditch	70 cfs (Refuge 35 cfs)	6/8/1984
2	22208	MacFarlane Reservoir	6507AF (Refuge3253.5AF)	10/20/1910
11	30281.70643	Case Reservoir #1	124 AF	7/26/1908
12	30281.70646	Case Reservoir #2	106 AF	7/27/1908
14	30281.75467	Case Reservoir #3	67 AF	7/26/1912
18	30281.91011	State Walden Reservoir	37.9 AF	6/20/1939
	48578.98394	Muskrat Pond	390 AF	11/12/1980
	51499.47542	Spring Creek Pond	93 AF	3/1/1980
	51499.47999	Fox Pond	140 AF	6/1/1981
	30280.21308	Antelope Well	.10 cfs	5/1/1908
	47481.33602	Arapaho NWR Domestic Well	.10 cfs	12/31/1941
	47481.33602	Arapaho NWR Stock Well	.10 cfs	12/31/1941

## ***Reserved Rights and Privately-Owned Mineral Estate***

Purchase of some of the land tracts on the Refuge were subject to existing rights-of-way at the time of purchase. Some of these existing rights-of-way include Jackson County Roads 32, 34, and 21. A 100 foot right-of-way on Highway 125 and a 50 foot right-of-way on Highway 14 are owned by the Colorado State Highway Department. Additional rights-of-way include buried telephone lines along Highway 125 and 14, and power lines along Highway 125, through the length of the east side of the Refuge and across the Case tract on the south side.

With the purchases of the land tracts, the Refuge acquired the surface mineral rights of all its land except the BLM transfers. The Refuge owns the majority of the subsurface mineral rights with the State of Colorado, BLM, and some private landowners holding the rest.

## ***Habitat Management Units***

Habitat on the Refuge can be divided into four broad types: riparian, wetland, meadow, and upland. Acreages for each habitat type were calculated using ArcView GIS software, with Refuge boundary topographic base maps, and National Wetland Inventory map layers. Width of the riparian area was determined by estimating width of the historic floodplain using topography and vegetative community changes as a guide. Meadow habitats were derived using primarily National Wetland Inventory Maps with corrections for recent wetland additions. Upland acreages were calculated by subtracting the other three habitat types from the Refuge base acreage. Descriptions of these habitat types follows:

### ***Riparian Habitat***

The riparian habitat contains 4,374 acres on Arapaho NWR and is composed of the channel, floodplain, and transitional upland fringe along portions of the Illinois River and Spring Creek. Historically, the Refuge staff has considered the floodplain and transitional fringe collectively as irrigated meadow. However, we have chosen to use channel, floodplain, and transitional fringe in this document because these components more appropriately represent the collective functions and processes of riparian habitats, and such a designation allows management potential of the entire area to be more thoroughly evaluated (Map 7 - Habitat Management Units).

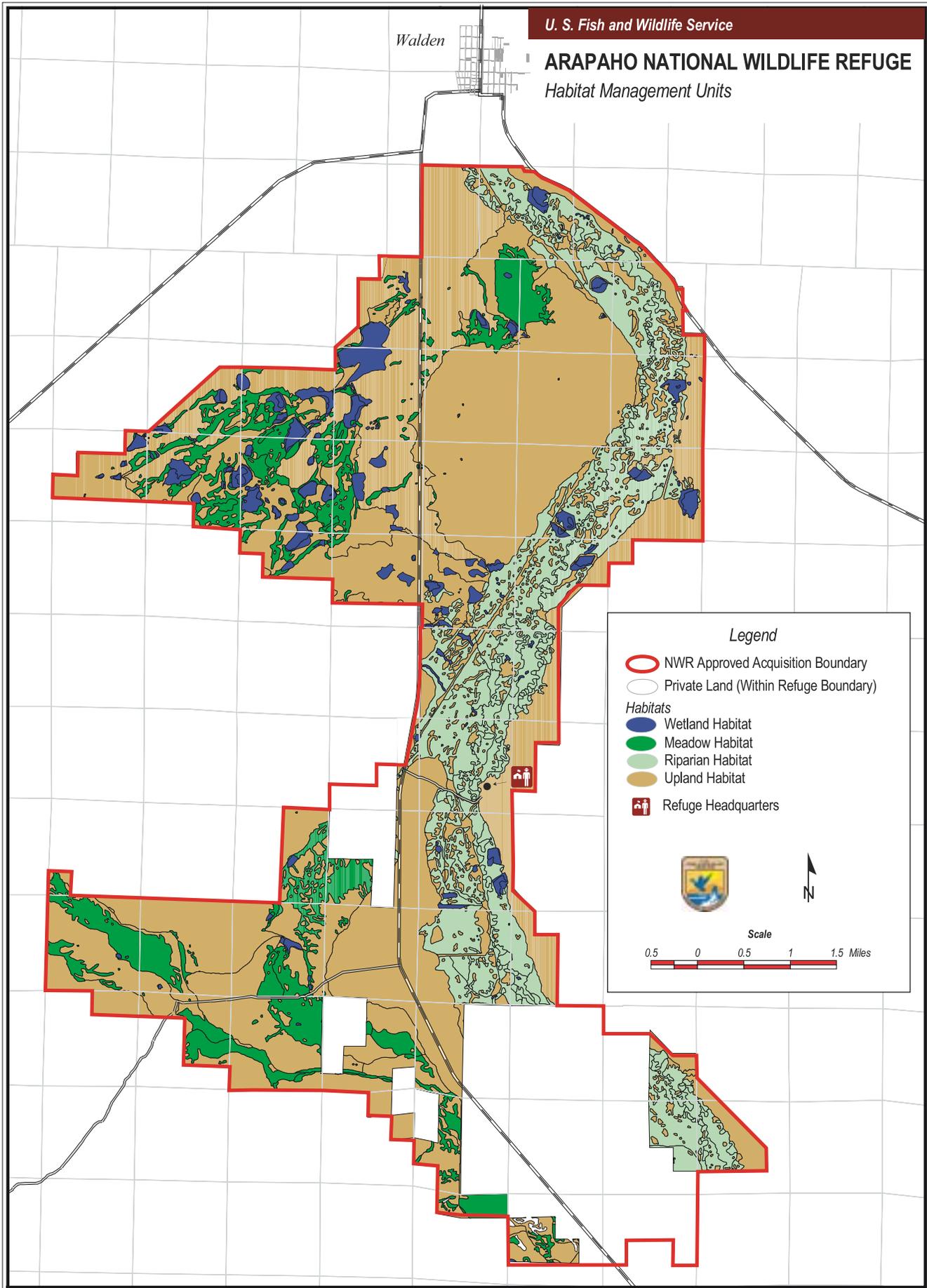
Plant species found along the Illinois River include: Drummonds's willow, coyote willow, Geyers willow, whiplash willow, mountain willow, and planeleaf willow. Grass species common to these moist soil areas include bluejoint reedgrass, Timothy, mannagrass, smooth brome, meadow foxtail, meadow barley, Nevada bluegrass, sloughgrass, rufted hairgrass, saltgrass, *Carex nebrascensis*, *Juncus* spp., nuttall alkaligrass, redtop, and winter bentgrass. The runs and pools in the river channel typically contain aquatic vegetation (*Elodea*, *Potamogeton*, and *filamentous algae*). Canada thistle is the main noxious weed in this area. Wildlife species that utilize the riparian habitat grasslands include waterfowl (northern pintail, mallard, gadwall, green-winged teal) and sage grouse broods in search of high protein invertebrates. Additionally, the willow complex supports at least 40 species of migrating songbirds (yellow warbler, willow flycatcher) along with moose, river otter, beaver, and wintering elk. Water birds, including common Wilson's snipe, spotted sandpiper, sora, American white pelican, and black-crowned night herons also extensively utilize this habitat type. Within the Illinois River, 7 species of native and nonnative fish and at least 17 taxa of aquatic invertebrates can be found in this cold water river system.

Walden

U. S. Fish and Wildlife Service

# ARAPAHO NATIONAL WILDLIFE REFUGE

Habitat Management Units



Map 7 - Habitat Management Units

## Wetland Habitat

Wetland habitat includes 824 acres of natural and created ponds and lakes up to the high water mark, excluding the surrounding meadows and riparian corridor. Ponds and lakes, henceforth referred to as basins or wetlands, were delineated using both National Wetland Inventory (NWI) maps and Refuge coverage maps. Currently, approximately 78 shallow wetlands exist within the Refuge boundary (Map 2 - Base Map). For management purposes, three wetland complexes were developed: the Case, Illinois, and Soap Creek Complexes (Map 8 - Wetland Complexes).

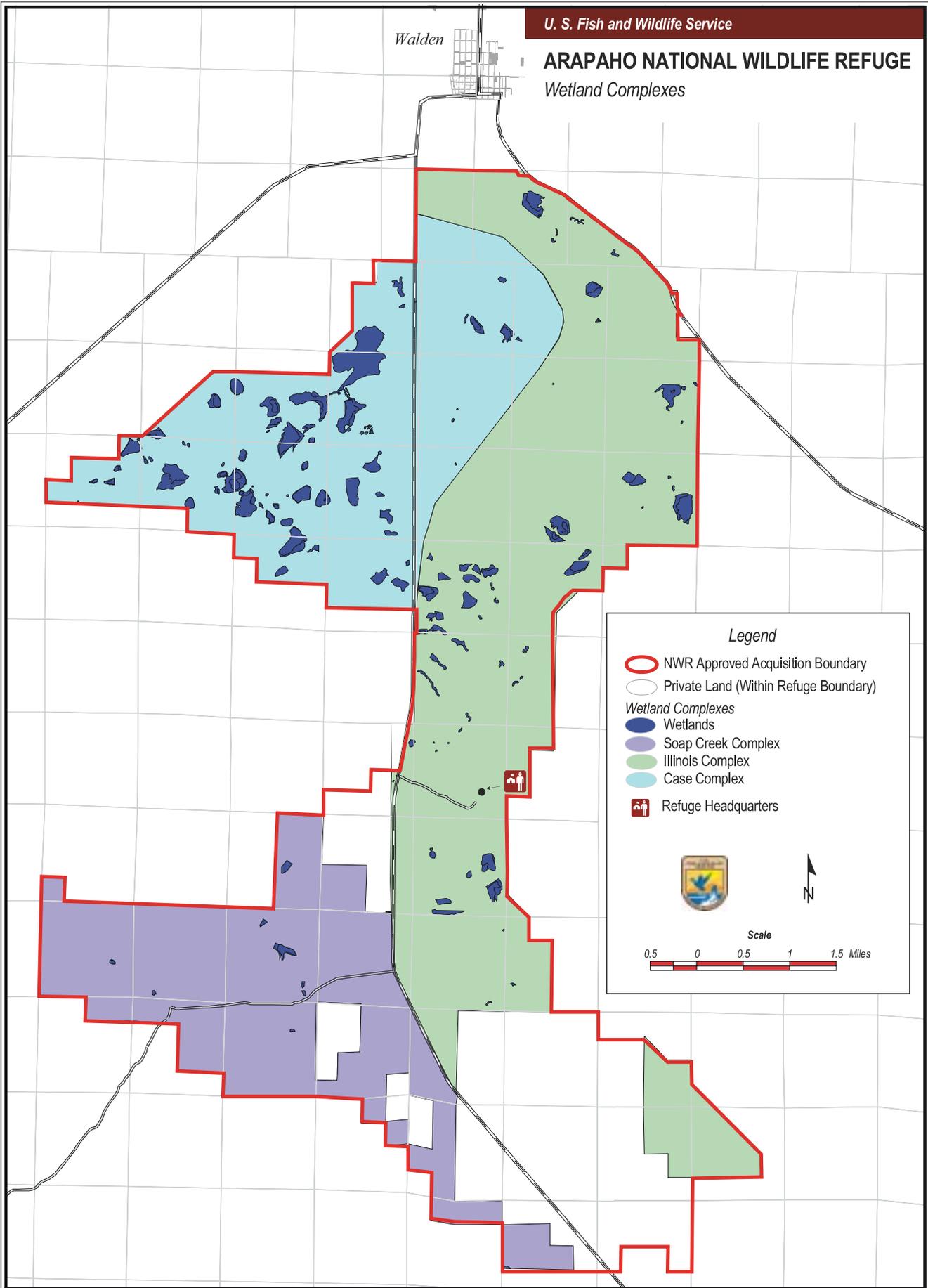
The majority (90 percent) of the wetland basins on the Refuge are man-made. Construction of these “artificial” wetlands is intended to offset wetland losses occurring elsewhere in the Central Flyway. Maintenance of these facilities provides benefits to a host of wetland-dependent species, including waterfowl. Specific wetland objectives only account for approximately 50 percent of the total wetland surface area to be managed in a given year. Drought, evaporative losses, periodic drawdowns for aquatic vegetation enhancement, dike maintenance activities, and fall migration drawdowns account for the remainder of the wetland surface area.

Aquatic vegetation of Refuge wetland habitats includes both emergent (cattail, spike rush, bulrush) and submerged (sago pondweed, leafy pondweed, widgeon grass) species. Invertebrate abundance is high in the wetland basins. Common invertebrates include *Hemiptera* (true bugs), and the families *Corixidae* (water boatman) and *Notonectidae* (backswimmers), *Dytiscidae* (predacious diving beetle), and *Haliplidae* (crawling water beetles). Invertebrates are a critical food source to many waterfowl shorebirds. Waterfowl species include both diving ducks (lesser scaup, canvasback, redhead, ring-necked) and puddle ducks (mallard, northern shoveler, gadwall, American wigeon). Over-water nesting birds (black-crowned night-heron, Wilson’s phalarope, white-faced ibis, marsh wrens, coots, rails, and blackbirds) also extensively utilize wetland habitats.

# ARAPAHO NATIONAL WILDLIFE REFUGE

Wetland Complexes

Walden

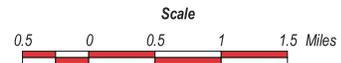


*Legend*

- NWR Approved Acquisition Boundary
- Private Land (Within Refuge Boundary)

- Wetland Complexes*
- Wetlands
  - Soap Creek Complex
  - Illinois Complex
  - Case Complex

- Refuge Headquarters



**Map 8 - Wetland Complexes**

## **Meadow Habitat**

Meadow habitat includes 2,683 acres of grasslands and old hay meadows on the Refuge except those along the riparian corridor (which are considered part of the “Riparian” habitat). These historically irrigated fields provide the majority of the Refuge nesting habitat for waterfowl, shorebirds, and songbird species. Meadow habitats represent common feeding, resting and loafing areas for most avian and mammal species found on the Refuge (Map 7 - Habitat Management Units).

Vegetation common to meadow habitat is primarily native plants including: rushes; Colorado rush, baltic rush, dagger-leaf rush, long-styled rush, tuberous rush, field woodrush, smallflowered woodrush; sedges: slenderbeaked sedge, capitate sedge, Hayden’s sedge, narrow-leaved sedge, elk sedge, wooly sedge, Nebraska sedge, dunhead sedge, beaked sedge, shortbeaked sedge, water sedge, golded sedge, soft-leaved sedge, new sedge, valley sedge. Grass species common to these moist soil areas include: bluejoint reedgrass, Timothy, mannagrass, smooth brome, meadow foxtail, meadow barley, Nevada bluegrass, sloughgrass, tufted hairgrass, saltgrass, Nuttall alkaligrass, redtop, and winter bentgrass; Common forbs include sulphur buckwheat, hoods phlox, longleaf phlox, rosy pussytoes, silvery lupine, prairie lupine, groundsels, narrow leaved maertensia, small bluebells, cinquefoil, early cinquefoil, stonecrop or wormleaf sedum, daisys, beard tongue. Canada thistle is the main noxious weed in this area. Wildlife species that utilize the meadow habitat include: waterfowl (pintail, shoveler, gadwall, green-winged teal) and sage grouse broods in search of high protein invertebrates. Snipe broods and other grassland nesting songbirds utilize this habitat type. Additionally, elk, pronghorn antelope, and coyote are common habitat users.

## Upland Habitat

The upland habitat consists of 14,285 acres of a shrub-steppe plant community dominated by sagebrush, drought tolerant perennial bunchgrasses, and forbs. Uplands are the dominate Refuge habitat type and include all lands not accounted for in the wetland, meadow, and riparian descriptions. Many upland habitats exhibit a mosaic pattern around meadows sites on the Refuge, these sites are generally managed as meadows (Map 7 - Habitat Management Units).

Historical reports of the sagebrush-steppe plant community are conflicting, and pre-settlement community conditions may never be fully known. Additionally, the focus of past Refuge management efforts have been devoted to wetland-dependent birds, therefore current Refuge upland plant community information is limited. Available information suggests that sagebrush historically was the dominate plant species, although perhaps taller >3m plants may have existed. Floristic diversity in North Park and on the Refuge has likely decreased, especially within the grasses and forbs. Management efforts for the past 50 years have attempted to increase grass and forb abundance through mechanical and chemical means. In general, the sagebrush plant community appears to be degraded, but given the lack of basic information, management alternatives are difficult to define. Therefore, Refuge upland management objectives center on developing an upland habitat database that defines plant species, location, abundance and characteristics. Secondly, the Refuge proposes to “experiment” with 4,000 acres of uplands habitats in an attempt to create a preferred plant community structure. Lessons learned will be applied to larger pieces of Refuge upland habitats.

Upland vegetation consists primarily of shrubs including: mountain big sagebrush, Wyoming big sagebrush, alkali sagebrush, fringed sage, rubber rabbitbrush, Douglas rabbitbrush, broom snakeweed, gray horsebrush, black greasewood, and winterfat. Dominant grasses include mutton grass, Nevada bluegrass, sandberg bluegrass, bottlebrush squirreltail, Idaho fescue, bluebunch wheatgrass, western wheatgrass, blue grama, elk sedge, needle and thread grass, and green needlegrass. Common forbs include sulphur buckwheat, hoods phlox, longleaf phlox, rosy pussytoes, silvery lupine, prairie Lupine, groundsels, narrow leaved maertensia, small bluebells, cinquefoil, early cinquefoil, stonecrop or wormleaf sedum, daisys, beard tongue. Noxious weeds included yellow toadflax and musk thistle, and occur primarily in disturbed sites. Sage-grouse are a sage-obligate species, and requires sagebrush plants for cover and food. Elk, mule deer, white-tailed deer, and pronghorn antelope are common big-game users of upland habitats. Additionally, vesper sparrow, brewers sparrow, and sage thrasher are songbirds common to Refuge uplands.

## **Wildlife Resources**

Arapaho NWR's habitat diversity is reflected in the broad diversity of wildlife found here. Only those species that are residents or frequent visitors to the Refuge are discussed in the following text. Many species, especially birds, may infrequently inhabit or migrate through the Refuge. Threatened, Endangered, and Candidate Species and Species of Special Concern are listed in Table 3. All species of birds, mammals, fish, amphibians, and reptiles are listed in Appendix A.

### **Avian**

**Waterfowl – ducks and Canada geese:** A large number of waterfowl depend on the Refuge's wetland, riparian, and meadow habitat for foraging, nesting, brood-rearing, and molting. The most common type of ducks breeding on the Refuge include lesser scaup, gadwall, American wigeon, Northern shoveler, and cinnamon teal.

Most of the ducks common to the Refuge use the three habitats listed above and occasionally some species use the upland habitat. These ducks include: green-winged teal, mallard, northern pintail, cinnamon teal, Northern shoveler, blue-winged teal, gadwall, and American wigeon. Redhead, ruddy duck, and lesser scaup depend on the wetlands for most of their life needs, with the scaup and redhead nesting in the meadows occasionally. Ring-necked duck, canvasback, and bufflehead are generally spring and fall migratory visitors but the canvasback does infrequently nest on the Refuge. Common merganser primarily inhabit the riparian areas to meet their life requirements.

Canada goose is an abundant species that is the first to arrive in the spring and the last to migrate in the fall. The geese use the wetland, riparian, and meadow habitats for foraging, nesting, and brood-rearing.

Wading birds are water birds that usually do not swim or dive for food, but wade in shallow edges of water for prey. The black-crowned night-heron, great blue heron, and white-faced ibis are the common breeding species on the Refuge. The ibis and black-crowned night-heron use wetlands with heavy cattail/hardstem bulrush vegetation for nesting and brood-rearing. They forage across the Refuge in riparian, meadow, and wetland areas. The great blue heron uses the riparian habitat primarily for nesting and foraging but can be observed in the wetlands.

Shorebirds are most often found foraging for food along the water margins, they use the Refuge as a migratory stop-over, and some nest here. American avocet, willet, killdeer, spotted sandpiper, common snipe, and Wilson's phalarope are the common nesters. Avocet and willet mainly use the wetland habitat for their needs, where the killdeer is more a generalist and can be found in all habitat sites. The spotted sandpiper and common snipe reside mostly in the riparian habitat. Wilson's phalarope use the meadow/riparian for nesting and forage and rear young in the wetlands. Black-necked stilt are an occasional nester in the Refuge wetlands. Dowitcher, yellowleg and other sandpipers use the area for a stop-over during spring and fall migration.

Other water birds are represented by a variety of species. Pied-billed grebe, eared grebe, and American coot use wetlands for nesting, foraging, and brood-rearing. Virginia rail and sora use the meadow/riparian habitats extensively. American white pelican, double-crested cormorant, and California gull do not nest on the Refuge but use the area for foraging. Black and forester's terns nest in areas of dense carex, cattail, and bulrush foraging in the wetlands.



*Black-crowned Night-Heron*  
© Cindie Brunner

Raptors consist of several families of hawks, falcons, and owls. The most common raptors of the Refuge include: northern harrier, swainson's hawk, rough-legged hawk, golden eagle, American kestrel, prairie falcon, short-eared owl, and great horned owl. Only the golden eagle and great horned owl are year-round residents. The rough-legged hawk is a winter visitor while the rest of the birds are present in the spring, summer, and fall. The raptors utilize all habitats for nesting and foraging. Red-tailed hawk, ferruginous hawk, sharp-shinned hawk, and cooper's hawk use the area occasionally.

Upland bird species rely on the uplands primarily to subsist. Several of the common upland birds are sage grouse, horned lark, sage thrasher, vesper sparrow, and brewer's sparrow. The sage grouse and horned lark are year-round residents, the sage grouse resides primarily in the upland but uses the edge areas of the riparian and meadow habitats. The sage thrasher, horned lark, and sparrows depend on the upland area for nesting but may forage in the other habitats.

Neotropical migrants are birds that breed in North America, north of Mexico, but winter in Mexico, Central and South America or the West Indies. The following species are found commonly on the Refuge either during migration or the nesting season. These birds rely heavily on the riparian habitat for foraging, cover, and nesting, they include: common nighthawk, belted kingfisher, willow flycatcher, warbling vireo, house wren, marsh wren, yellow warbler, MacGillivray's warbler, common yellowthroat, western kingbird, gray catbird, Wilson's warbler, savannah sparrow, fox sparrow, song sparrow, Lincoln's sparrow, and white-crowned sparrow. A few of these species also use the meadow and wetland habitat for nesting or foraging such as the savannah sparrow and the marsh wren. The cliff, barn, and tree swallows use a combination of habitats including wetland, riparian, and meadow.

Resident and migrant songbirds breed in North America and migrate throughout a limited North American range. This group includes mountain bluebird, American robin, dark-eyed junco, rosy finch, pine siskin, American goldfinch, and lark bunting. These birds use riparian, meadow, and upland habitats. Red-winged, yellow-headed, and brewer's blackbirds utilize both wetlands and riparian for nesting and foraging. Species like the black-capped chickadee, red-breasted nuthatch, and ruby-crowned kinglet use the riparian woody areas for foraging but tend to nest off the Refuge.

The Northern flicker is the most common woodpecker. This species inhabits the riparian willow habitat but also uses upland and meadow habitats. Other less common woodpeckers include downy, hairy, and red-naped sapsucker.



*Golden Eagle © Cindie Brunner*



*Northern Flicker © Cindie Brunner*

## Mammals

Big game animals common to the Refuge include: pronghorn antelope, mule deer, white-tailed deer, moose, and elk. Fifteen to 20 moose can be found on the Refuge at any one time, spending most of their time in the riparian habitat. The mule deer population is approximately 40 animals that roam on and off the Refuge spending time in the riparian, meadow, and upland habitats. White-tailed deer, population of about 20 animals, use the same areas as the mule deer. Pronghorn antelope utilize the upland habitat primarily but can be found in the riparian and meadow habitats. They use the Refuge in the spring, summer, and fall with a population of about 50 animals present at any one time. In the winter, the pronghorn antelope generally move north off the Refuge, making them a rare sight in the area. The Refuge has a resident herd of approximately 150 elk; these animals reside primarily in the riparian area in the southern half of the Refuge and on neighboring land. During the winter (November through March) the Refuge and surrounding area hosts about 1,400 elk, these animals are usually in several herds and can be found using riparian, meadow, and upland habitats.

The Refuge has many small mammals which utilize all habitat types, depending on their life requirements. Common species are Nuttall's cottontail, white-tailed jackrabbit, least chipmunk, Wyoming ground squirrel, white-tailed prairie dog, beaver, deer mouse, montane vole, muskrat, porcupine, coyote, long-tailed weasel, mink, badger, and striped skunk (Appendix A).

## Fish

The Illinois River and wetlands are two main types of aquatic communities present on the Refuge. The Illinois River is a transition stream beginning as a trout stream in the headwaters down to the southern end of the Refuge to a native species stream by the time it reaches the northern half of the Refuge. The splitting of the stream channel into two channels appears to be the basis of this fishery transition. The low flows of the split are ultimately responsible for trout giving way to the more tolerant native species. The following species are common in the Illinois River on Arapaho NWR: Brown trout, rainbow trout, Northern redbelly dace, fathead minnow, creek chub, long-nosed sucker, white sucker, and Johnny darter (Appendix A).

Potter and Spring Creeks are tributaries of the Illinois River on the Refuge. These creeks provide little fishery habitat with only a few native fish such as long-nosed dace, white sucker, fathead minnow, and creek chub found in them.

Many of the wetlands will not support a fishery, with water depth and winter survival being the limiting factors. The most common fish found in the wetlands is the fathead minnow, a native which has evolved in this type of habitat.



*Pronghorn antelope © Cindie Brunner*



*Brown Trout © Cindie Brunner*

## **Reptiles and Amphibians**

The wandering garter snake is the only reptile known to inhabit the Refuge. Sightings of this snake are rare with only one or two seen in a year.

Amphibians are slightly more numerous with the following species: barred tiger salamander, Western toad, wood frog, Northern leopard frog, and striped chorus frog. The salamanders are primarily associated with the wetlands but have been seen in all habitats. The wood frog has only been documented once on the Refuge, and that was in the riparian habitat. The toad is rare but should frequent all the habitat types. Leopard frogs have been observed in the riparian habitat and also in irrigation ditches in the meadow habitat. Chorus frogs can be found in the wetland, meadow, and riparian areas; they are the most abundant amphibian on the Refuge.

## **Invertebrates**

Some sampling of invertebrates has been done on Refuge wetland and riparian areas. Wetland invertebrates were the most diverse with 20 different families represented in the sampling. Stream sampling identified 17 different taxa in the Illinois River. Further sampling of invertebrates to establish a quantitative baseline would assist in identifying problems in wetlands and riparian areas in the future.

## Threatened, Endangered ,and Candidate Species and Other Wildlife Species of Special Concern

Table 3 lists special status wildlife, fish, amphibian species that are known to use habitat types on Arapaho NWR. This list includes Endangered Species, Threatened Species, Candidate Species, and Species of Concern (Source: Colorado Division of Wildlife and U.S. Fish & Wildlife Service).

<b>Table 3. Special Status Wildlife, Fish, Plant, and Amphibian Species Potentially Occurring on Arapaho NWR</b>			
<b>Common Name</b>	<b>Seasonal Occurrence<sup>1</sup></b>	<b>Federal and State Status<sup>2</sup></b>	<b>Date Last Observed<sup>3</sup></b>
<b>Birds</b>			
American Peregrine Falcon	SR	CDOW SC	WOL2001
Bald Eagle	YR	USFWS Threatened (proposed delisting)	WOL2002
Western Burrowing Owl	B, M	CDOW Threatened	WOL2002
Ferruginous Hawk	SR	CDOW SC	WOL2002
Northern Sage Grouse	B, YR	CDOW SC	WOL2002
Long-billed Curlew	M, SR	CDOW SC	WOL2000
White Pelican	SR	CDOW SC	WOL2002
<b>Mammals</b>			
River otter	YR, B	CDOW Endangered	WOL2001
<b>Fish</b>			
Northern Redbelly Dace	YR	CDOW Endangered	No Records
<b>Plants</b>			
North Park Phacelia	YR	USFWS Endangered	WOL 2002
<b>Amphibians</b>			
Northern Leopard Frog	YR	CDOW SC	WOL2002
Wood Frog	YR	CDOW SC	WOL1994

<sup>1</sup> Seasonal occurrence: B =breeding (assumes summer resident); SR = summer resident (no evidence of breeding); YR = year-round resident; M = migrant

<sup>2</sup> See Glossary for special status definitions

<sup>3</sup> WOL = Refuge Wildlife Observation Log. Includes data through 2002.

<sup>4</sup> CDOW = Colorado Division of Wildlife

<sup>5</sup> SC= Species of Concern

<sup>6</sup> Threatened - See Appendix B for definition

<sup>7</sup> Endangered - See appendix B for definition

The bald eagle, a federally-listed species, is an intermittent visitor on the Refuge; it is a year-round resident of the county. Nesting habitat does not exist on the Refuge but the eagle does use all habitat types for foraging. The peregrine falcon, which is proposed for Federal de-listing, is also an intermittent visitor on the Refuge using all the habitat types for foraging.

Burrowing owl, Ferruginous hawk, northern sage grouse, long-billed curlew, and white pelican are all listed as Colorado State Special Concern species. Burrowing owls have been documented as nesting on the Refuge with an occurrence of one nest found every 5 years. They are more commonly observed as a migrant in the fall of the year. Ferruginous hawk can be seen in the spring, summer, and fall foraging on Refuge habitats. Northern sage grouse are an abundant year-round resident of the Refuge. The grouse use the upland, riparian, and meadow habitats for breeding (one lek found on Refuge), nesting, foraging, and brood-rearing. Long-billed curlews are observed every few years on the Refuge. White pelicans nest off the Refuge on MacFarlane Reservoir, frequenting the Refuge to forage in the wetland and riparian habitats.

The river otter is a Colorado State Endangered Species, which was re-introduced into a watershed south of the Refuge. The Refuge staff has observed (average one a year) several otters in the southern half of the riparian habitat.

Little is known about the northern redbelly dace on the Refuge. This Colorado State Endangered Species is found in the Illinois River.

Northern leopard and wood frogs are listed as Colorado State Special Concern species. The leopard frog is fairly common and found in Refuge riparian and meadow habitats. Only one observation of the wood frog has occurred; this was in the Illinois River south of the Refuge Headquarters.

## **General Public Use**

Arapaho NWR annual number of visits is estimated at 7,200 which is an average of the past 6 years. This estimate is based broadly on a traffic counter on the auto tour route, visitors entering the Visitor Center/Office, and general observation. Table 4 summarizes estimated visits in five categories from 1997 to 2002.

<b>Table 4. Estimated Annual Visitors to Arapaho NWR</b>						
	<b>1997</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>
Total Estimated Visitors	7,248	6,805	6,797	7,107	7,575	7,710
Interpretation/Observation	6,762	6,361	6,263	6,360	7,220	7,496
Environmental Education	65	132	162	180	167	135
Hunters	357	228	302	522	152*	61*
Fishing	64	84	70	45	34*	18*

\* Severe drought conditions limited hunting and fishing opportunities.

The Refuge Visitor Center is open Monday through Friday (7:00 am to 4:30 pm). Information, regulations, and universally accessible rest rooms are available during the same hours.

The Refuge has a general leaflet which contains a Refuge map, describes the Refuge and its management, addresses habitats, lists wildlife interpretation / recreation activities and cites the Refuge regulations. The Refuge also provides three other leaflets: wildlife list, hunting guide, and self-guided auto tour. The leaflets are available in three dispensers (Auto Tour entrance, Headquarters entrance, Brocker Overlook) and at the Visitor Center.

## **Compatible Wildlife-Dependent Recreation**

Arapaho NWR offers visitors a variety of self-guided recreation opportunities. The Refuge Improvement Act (1997) states that public use of a refuge may be allowed only where the use is 'compatible' with the Refuge System mission and the purpose of the individual refuge. The Act also sets forth a current standard by which the Secretary of the Interior shall determine whether such uses are compatible. The term 'compatible use' means a proposed or existing 'wildlife-dependent recreational use' or any other use of a refuge, that in the sound professional judgement of the Service, will not materially interfere with or detract from, the fulfillment of the Refuge System's mission or the purpose of the refuge. Hunting, fishing, wildlife observation and photography, and environmental education and interpretation are the six priority general public uses of the National Wildlife Refuge System.

## **Wildlife Observation and Photography**

Wildlife observation with interpretation is the most popular public use on the Refuge (Table 4). Most of the observation activity occurs on the auto tour route and the interpretive nature trail. The auto tour route is on the west side of the Refuge and passes through meadow, wetland, and upland areas, offering a diversity of wildlife viewing [Map 9 - Public Use Map - Alternative B and D (Preferred)]. The wetlands on this route offer optimum waterfowl and water bird viewing. The interpretive nature trail is just south of the visitor center and meanders through a riparian area [Map 9 - Public Use Map - Alternative B and D (Preferred)]. This area is great for birding and also the chance to encounter mammals large and small.

## **Hunting**

Hunting seasons range between early September to mid-January. These seasons are in accordance with State regulations for this area. The most common species hunted are pronghorn antelope, sage grouse, ducks, and Canada geese. Other species which are open to hunting include Nuttall's cottontail, white-tailed jackrabbit, American coot, common snipe, Virginia rail, sora, and mourning dove.

Certain areas of the Refuge are closed to hunting to protect Refuge facilities, limit public use conflicts, and provide resting and feeding habitat for migratory birds (Map 9 - Public Use Map - Alternative B and D (Preferred)]. Closed areas, such as the Case tract (Unit A), are posted with signs and mapped in the hunting leaflet.

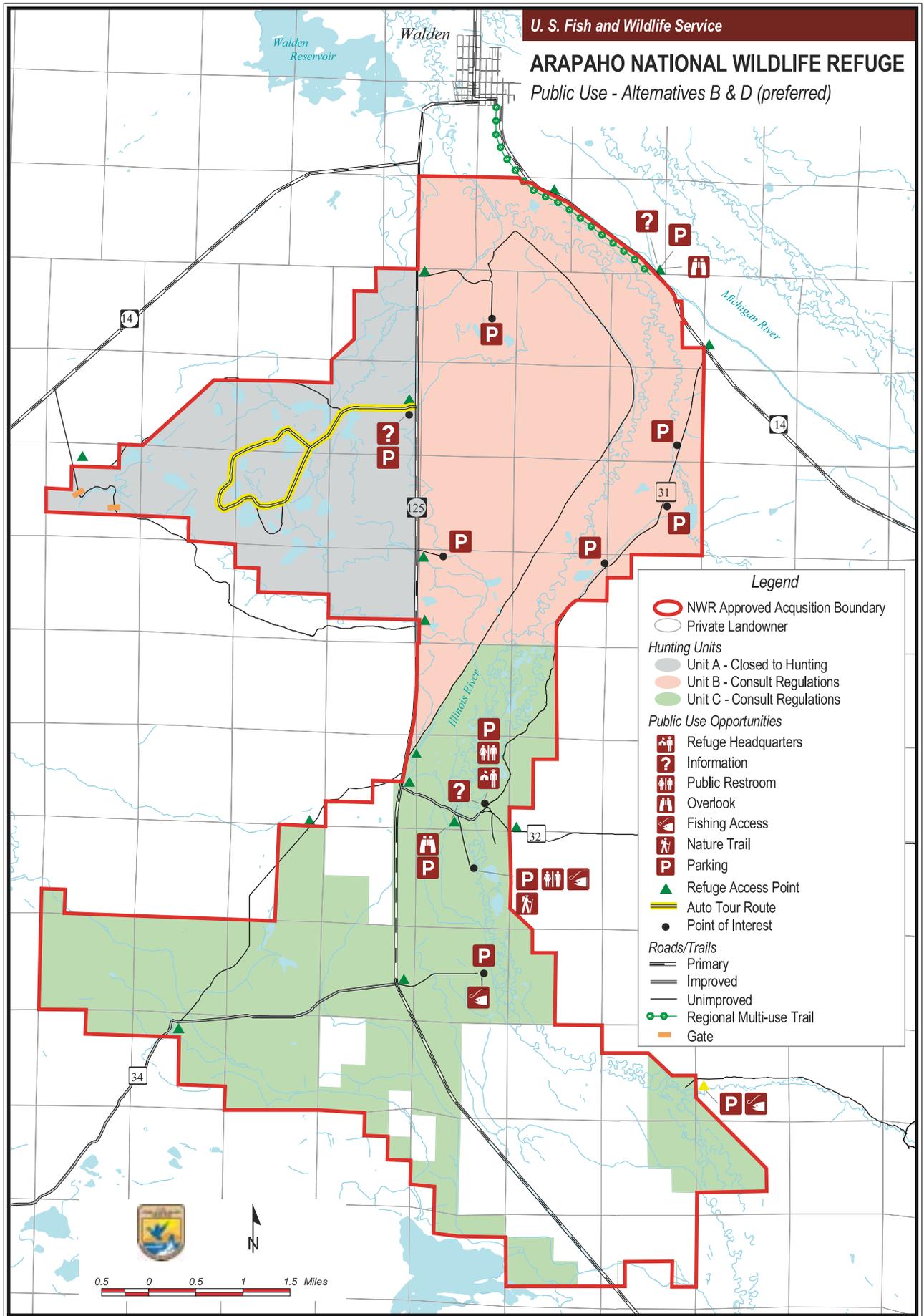
## **Fishing**

Fishing on the Refuge is limited to the Illinois River and focuses mainly on brown trout. The Illinois River runs north through the east side of the Refuge. Two parking areas are designated for fishing access. Fishing is in accordance with Colorado State fishing regulations for the Illinois River. The Refuge is closed to fishing from June 1 through July 31 each year to minimize disturbance to nesting waterfowl. Periodic stocking of trout in the Illinois River occurs to maintain and enhance the Refuge fishery.

## **Environmental Education**

Environmental education activities are limited at Arapaho NWR, with an on-demand type of approach. The Refuge staff has worked with various groups such as Boy/Girl Scouts, colleges, County Extension Office, and local elementary and Junior/Senior high schools.

Programs and talks that the Refuge staff has participated in include 'Day in the Woods,' 'Water Carnival,' Junior/Senior high school science class requirements, scout badge work, and summer hands-on environmental work for college students. In addition, the Refuge has conducted special programs for International Migratory Bird Day.



**Map 9 - Public Use - Alternative B and D (Preferred)**

## **Interpretation**

Three interpretive kiosk sites are on the Refuge: Auto Tour entrance, Headquarters entrance, and Brocker Overlook. These sites have panels ranging from Refuge management activities to specific wildlife species information. The Auto Tour route is self-guided with interpretive signs and a leaflet. The Interpretive Nature Trail is signed with information about management tools and wildlife species found in riparian/wetland habitats. The Refuge staff is in the process of contracting new interpretive information for the visitor center which will deal with water history and management and also the four Refuge habitats and associated wildlife.

The Refuge staff publishes several brochures. The wildlife brochure is a list of all wildlife species documented on the Refuge along with the best time of year for viewing each species. The hunting brochure contains regulations and a map of the hunting units. The self-guided auto tour brochure contains basic Refuge information and map, viewing tips, and interpretation for the auto tour route signs.

## **Non-wildlife-dependent Recreation**

Currently, some non-wildlife-dependent uses occur on the Refuge. These uses include biking, cross-county skiing, picnicking, camping, and horseback riding. These uses are infrequent, and not a major management concern. However, they are not an authorized use of a National Wildlife Refuge. Therefore, these inappropriate uses are handled by Refuge law enforcement personnel. The Refuge will strive to eliminate these non-wildlife-dependent uses by maintaining quality signage and brochures for all users.

## **Cultural Resources**

The Colorado mountains have been used by humans for thousands of years. Spears points dating to the Paleoindian Period have been recovered in North Park. The Paleoindian Period extends from 12,000 B.C. to around 5740 B.C. Although numerous other Paleoindian sites have been located in Middle Park, including evidence of bison hunting 10,000 years ago, known occurrences of Paleoindian occupation in North Park have been limited to small campsites. Some archaeologists think Paleoindian groups lived in the Parks year-round; others propose winter camps in the foothills with exploitation of various mountain resources during summer months. The Archaic Period followed the Paleoindian Period and lasted until A.D. 150. Hunters used darts and throwing sticks called atlatls. There is also a higher reliance on small game and plant resources. A major drought on the Plains (ca. 5,000 to 2500 B.C.) caused change to settlement and subsistence patterns. People moved into the mountains for longer periods of time and exploited a wider variety of plant and animal resources. Increased moisture during the latter part of the Archaic brought people back onto the Plains, but the mountains continued to be an important part of their subsistence. Activity increased in North Park during the Archaic. The Late Prehistoric Period (A.D. 150 to A.D. 1540) saw the introduction of the bow and arrow and ceramics. Bison hunting again became an important part of the economy, but the people of the Late Prehistoric continued to rely on a variety of available plant and animal resources. Researches have proposed a seasonal round of activities. People would leave their foothills winter camps and head north into the Laramie Basin, then south through North and Middle Park collecting and hunting until fall. From there, they would turn east hunting bighorn sheep along the Continental Divide on their way back to the foothills.

The Protohistoric Period starts with European contact around A.D. 1540. Of the modern tribes, the Utes are most often associated with the mountains and long-term utilization of the resources of North Park. There are also historic accounts of visits to North Park by the Shoshone, Arapaho, and Cheyenne.

Archaeological sites in North Park are generally small in size and associated with seasonal use of the area. They include open campsites and lithic scatters with stone circles (tipi rings) located along the ridges. Culturally scarred trees and wickiups representing Protohistoric Ute use may be found in the forested area. Rock art and bison kill sites, though uncommon, have been reported in North Park.

The first European visitors to New Park (now known as North Park) were probably trappers. The first known party of trappers was headed by Alexander Sinclair and Robert Bean in 1825. Several famous trappers, miners, and hunters made their way through North Park. Kit Carson, Jim Baker, Sublette, Gervais and Vasquez, Calvin Jones, Henry Fraeb, John Gantt, and Pegleg Smith all visited the Park in the 1840s. The second western expedition of John C. Fremont took him through the Park in 1844. Sir George Gore passed through the Park on a hunting expedition in 1855, and found mule deer, elk, beaver, bear, and mountain sheep. By 1917, most of the game species were gone. Cyrus Mendenhall began grazing cattle in North Park in 1879. By 1885 the beef industry was booming, and North Park had its share of large ranches. Overgrazing and severe winters decimated herd sizes in the Park, and by 1889, ranching was no longer as profitable as it had been. In the late 1800s, the economy of the North Park shifted to mining; mining of coal, gravel, fluorspar, copper, silver, and gold, along with logging and ranching, became the main economic developments of the area.

Cultural resource studies have been completed on approximately 50 percent of the Refuge lands. Significant cultural resources have been located on the Refuge including prehistoric stone circles and open campsites and historic ranches, graves, and other features associated with Euroamerican settlement of North Park. Future efforts will continue to identify existing cultural resources and protect them from degradation. A detailed cultural resource overview of North Park (Larson and Letts, 2003) is available from the Service Regional Archaeologist.

## Special Management Areas

Limited special management areas currently exist on the Refuge. The Refuge has no wilderness designation or other similar land use restriction beyond Refuge policy. This Refuge does not contain any area that qualifies for wilderness designation. All the lands within the Refuge have been highly manipulated, and contain roads, since this was a working ranch prior to its becoming a Refuge. The only specific historical or cultural areas include grave sites that will continue to be protected. The Refuge is operating under a 1982 habitat management plan that provides guidance for lands management. This plan will be replaced with guidance provided within the CCP. Additionally, the Refuge currently utilizes a hunting plan, and “zone” system (Management Units A, B, and C) to distribute hunters, anglers, and other public uses. This plan will remain in effect until completion of the step-down management plans for public use and hunting.

Other issues identified in this Plan which may require special management:

- **North Park Phacelia** - Preservation of this endangered plant may require fencing and/or plans to minimize disturbance, and ensure the survival and recovery of the species.
- **Elk Road Closures** - During winter months, the Refuge staff will continue to close roads to minimize disturbance to wintering elk. Coordination with the Colorado Division of Wildlife, and implementation of the revised hunting step-down management plan may alter this strategy.
- **Multi-use Trail** - Although this trail will be located on the Refuge boundary to minimize wildlife and habitat disturbance, the potential for litter and trespass will be higher. Signage and additional law enforcement patrols will be used to minimize these conflicts.
- **Moose Overlook** - Located ¼ mile south of the Headquarters, this site will facilitate moose, elk, and mule deer viewing. This site is located on an existing road, therefore, the potential for litter and trespass will be higher. Signage and additional law enforcement patrols will be used to minimize these conflicts.
- **Case Barn Interpretive Site** - Located along the Auto Tour Route, this site may facilitate historical interpretation of North Park and the role ranching has played to preserve wildlife habitats. The Refuge will pursue partners to rehabilitate and interpret these important structures. This site is located on an existing road, therefore, the potential for litter, vandalism, and trespass will be higher. Signage and additional law enforcement patrols will be used to minimize these conflicts.
- **Hampton Barn** - Depending on the outcome of the State Historical Preservation Office review, the site may be used to facilitate historical interpretation of North Park and the role ranching has played to preserve wildlife habitats. The Refuge anticipates only developing one barn interpretive site. The Case Barn will be first priority based on its proximity to the auto tour route. This site is located on an existing road, therefore, the potential for litter, vandalism, and trespass will be higher. Signage and additional law enforcement patrols will be used to minimize these conflicts.

# *Management Direction*

## **Refuge Management Direction:**

### **Goals, Objectives and Strategies/Projects**

Development of Refuge goals and objectives involved the melding of multiple sources of information including the review and interpretation of national plans, review and interpretation of existing scientific literature, an evaluation of existing habitat conditions on the Refuge, and the personal knowledge of planning team participants. Refuge objectives were derived using species-habitat requirements (See Appendix H). However, many of these species deemed important in national plans were used as “indicators” to prepare objectives that satisfy the needs of multiple species. Other consulted sources of information included Partners in Flight lists, Audubon Watch lists, Bird Conservation Region lists, and the Refuge wildlife observation log books. Constraints considered during plan formulation include number of employees, financial resources, equipment availability, harsh winter conditions, arid climate, lessons learned from previous management efforts, and the likelihood of success.

## **Riparian Habitats**

**Riparian Habitat Goal:** *Provide a riparian community representative of historic flora and fauna in a high valley of the southern Rocky Mountains to provide habitat for migratory birds, mammals, and river-dependent species.*

## **Riparian Habitats**

(Detailed biological justification is discussed in Appendix H.)

- 1. Objective:** Restore 50 to 100 acres of dense (40 to 100 percent) willow in patches >.2 ha and 20 m wide in the central third of the Illinois River (from the north end of the island to the confluence with Spring Creek) to connect existing willow patches and maintain 535 acres of dense willow in patches in the lower third of the Illinois River to benefit nesting neotropical migrant songbirds (yellow warbler, willow flycatcher) and resident moose, river otter, and beaver.

### **Strategies:**

- Willow plantings along the stream corridor combined with 8 foot fences to exclude large herbivores.
- Water manipulation Refuge-wide that may involve decreased diversions to maintain in-stream flows for willow establishment.
- Construction of small artificial dams in the river to raise water tables locally to aid in willow establishment.
- Establish a vegetation monitoring plan to assess health of established willow stands, and measure and document success or changes needed in reestablishment efforts. Plan should include herbivory and hydrology factors.
- Wildlife monitoring will occur to document changes in wildlife use and possible correlations to changes in habitat.
- Experiment with alternative willow restoration strategies.
- Consider hunting as a management tool.

**Rationale:** Sections of the Illinois River on the Refuge had willows removed prior to acquisition by the FWS, probably in an effort to increase hay yields. These open stretches of river have: less bank stability, resulting in potential for increased sedimentation; decreased shade over the stream, resulting in increased water temperatures for trout; and sparse woody vegetation for use by songbirds or other wildlife. A section of river further downstream from the proposed reestablishment site has had livestock grazing removed for 8 years, but has shown little willow regeneration. Given the growth characteristics of willows, these results lead to the conclusions that there is either significant herbivory other than livestock restraining willow expansion, and/or hydrology has been altered enough with upstream diversions and recent drought conditions that lack of groundwater is keeping willow establishment from occurring. With this in mind, willow plantings will only be done in association with fencing, and consideration of hydrological needs will be used as well. Possible methods of increasing groundwater needs will be: to divert less water upstream for other Refuge purposes; locate willow plantings adjacent to existing beaver dams to take advantage of higher water tables near these ponds; and place logs and other natural materials in the stream to create simulated beaver dams and raise water tables adjacent to areas to be planted. Monitoring will be essential to document reestablishment efforts, and to note any significant changes to existing willow communities.

2. **Objective:** Provide 3,630 to 3,845 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native plants (rushes, sedges, grasses, forbs) characterized by 10 to 30 cm visual obstruction reading, 0 to 10 cm duff layer and minimal (<5 percent) bare ground and less than 40 percent (canopy closure) willow to benefit nesting waterfowl (pintail, shoveler, gadwall, green-winged teal) and sage grouse broods.

**Strategies:**

- Utilize grazing, resting, and burning practices to stimulate or maintain meadow conditions.
- Irrigate areas as water is available to help stimulate vegetative growth.
- Develop a vegetation monitoring protocol.
- Develop a wildlife monitoring plan that correlates wildlife use and habitat condition.
- Consider hunting as a management tool.

**Rationale:** The grass:forb mix identified in the objective requires periodic manipulation of some sort to achieve the stated ranges of the objective. The combination of resting, grazing, and burning, combined with irrigation, where available and practical, are the best tools to accomplish this. It is anticipated that on average, 1/3 to 2/3 of this area will require grazing at an average rate of 0.4 to 1.0 AUMs per acre resulting in the removal of approximately 1,950 to 4,200 AUMs of forage. Vegetative monitoring combined with wildlife use data will be needed to document that objective levels are correct.

3. **Objective:** Provide 210 to 425 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native species (grasses, sedges, forbs, and rushes) characterized by >30 cm visual obstruction reading, 10 to 20 cm duff layer and minimal (<5 percent) bare ground, and less than 40 percent (canopy closure) willow from mid-April through August to benefit nesting waterfowl (mallard, gadwall, pintail, scaup), songbirds (savannah sparrow, meadowlark), and foraging shorebirds if flooded (snipe, phalarope, white-faced ibis, sora, curlew, willet).

**Strategies:**

- Utilize grazing, resting, and burning practices to stimulate or maintain meadow conditions.
- Irrigate areas as water is available to help stimulate vegetative growth.
- Develop a vegetation monitoring protocol.
- Develop a wildlife monitoring plan that correlates wildlife use and habitat condition.
- Consider hunting as a management tool.

**Rationale:** The grass:forb mix identified in the objective requires periodic manipulation of some sort to achieve the stated ranges of the objective. The combination of resting, grazing, and burning, combined with irrigation, where available and practical, are the best tools to accomplish this. To meet and maintain the taller vegetation and duff layers identified, it is anticipated that rest will be utilized more for this objective. It is anticipated that on average, 1/3 to 1/2 of this area will require grazing at an average rate of 0.4 to 1.0 AUMs per acre resulting in the removal of approximately 100 to 350 AUMs of forage. Vegetative monitoring combined with wildlife use data will be needed to document that objective levels are correct.

4. **Objective:** Given the altered river flow regime, provide a properly functioning river channel characterized by a well defined thalweg (deepest point in the river channel), outside river edges that are deeper than inside edges, a river sinuosity of 2.0 to 2.5, pool spacing every 7 to 9 channel widths, active point bar formation, and gradients in riffles that are higher than in pools to benefit willow establishment for neotropical migrants, and indirectly provide suitable habitat for native and nonnative fishes.

**Strategies:**

- Map river channel and identify problem areas. Prioritize stretches for rehabilitation.
- Alter irrigation diversions as needed to assist in-stream restoration.
- Install in-stream structures as necessary to adjust thalweg, create point bars, adjust depth ratios, increase sinuosity, and/or adjust pool spacing.
- Monitor wildlife and vegetative response to these strategies.

**Rationale:** Mapping the river to identify current characteristics is needed in order to define where restoration is needed. Increasing flows in the river by diverting less water on upstream Refuge water rights may assist in maintaining higher water tables, especially when used in conjunction with in-stream restoration projects. Documenting vegetative, fishery, and wildlife response is necessary to ensure that the projects are working.

5. **Objective:** Establish a private lands program to encourage restoration of degraded riparian zones through funding and technical assistance to accomplish similar objectives as those defined for the Refuge. High priority areas are those that have immediate influence on the Refuge because of drainage or proximity.

**Strategies:**

- Add a full-time private lands position to the staff.
- Work with local partners and willing landowners to identify, prioritize, and restore degraded areas in North Park.

6. **Objective:** Work with partners to address land health issues throughout Jackson County.

**Strategy:**

- Continue active Refuge participation in Sage Grouse Working Group, North Park Wetlands Focus Group, Owl Mountain Partnership, North Park Habitat Partnership Program, and any other group formed with the goals of improving land health and/or stewardship in Jackson County.
- Partner with Jackson County weed coordinator to manage and minimize noxious weeds on the Refuge.
- Variations in water diversions and/or grazing regimes.
- Use adaptive management techniques to implement new management ideas.

**Rationale:** The Refuge has the ability and resources available to restore and maintain a productive riparian area for the benefit of wildlife, fisheries, water quality, and a healthy landscape, while also utilizing local agriculture. The streams within the Refuge boundaries are a small fragment of those located within Jackson County, Colorado. By working with interested landowners and partners, the possibility exists of expanding the benefits of a healthy riparian zone throughout North Park.

From time-to-time, projects may be proposed within the county by other agencies, non-government organizations, or private landowners, that have a benefit to ecosystem health and wildlife outside of the Refuge boundary. There may be an occasion that in order to make an off-Refuge project succeed, resources normally reserved for Refuge purposes, such as water or vegetative cover, could be used to help make the off-Refuge project successful. These would not be long-term commitments of Refuge resources, but rather a management decision that a short-term diversion of these resources would better be served to benefit the ecosystem as a whole.

## **Wetland Habitats**

## **Wetland Habitats**

**Wetland Goal:** *Provide and manage natural and man-made permanent and semipermanent wetlands (in three wetland complexes) to provide habitat for migratory waterfowl, shorebirds, wading birds, and associated wetland-dependent wildlife.*

1. **Objective:** Maintain 10 acres of, and attempt to establish in one other wetland basin, tall ( $\geq 60$  cm visual obstruction reading) emergent vegetation in water depths  $>4$  cm over a 5-year period to provide nesting habitat for over-water nesting birds (black-crowned night-heron, white-faced ibis, waterfowl, marsh wrens, coots, rails, and blackbirds).

### **Strategies:**

- Water level manipulation, including drawdowns, and maintaining water levels in specific wetlands from spring to fall when possible.
- Develop and apply a plan for transplanting of cattail and hardstem bulrush into specific wetlands.
- Develop and use an over-water nesting bird monitoring plan.
- Develop and implement an annual water management plan as a component of an overall habitat management plan.

**Rationale:** Wetlands with tall dense vegetation provide a litter layer for use by nesting water birds as well as a flooded emergent litter for macroinvertebrate production. Manipulation of water levels will contribute to maintaining the existing wetlands with tall emergent vegetation. Transplanting cattail and hardstem bulrush in wetlands with the highest potential for success will help increase the availability of this type of habitat. The criteria for such wetlands would be based on such things as water control abilities, evaporation rates, and distribution. Timing of needed drawdowns for expansion of the tall dense vegetation will be planned in such a way as to get maximum benefit for all Refuge wetland objectives such as during shorebird migration or to stimulate submergent aquatic vegetation beds. Monitoring water bird species will help assess how successful habitat management is.

2. **Objective:** Provide 10 percent of the wetland acres, over a 5-year average, in short ( $<10$  cm), sparse ( $<10$  cm visual obstruction reading) emergent vegetation in water depths  $<4$  cm from April to August to provide foraging habitat for shorebirds and waterfowl, as well as nesting and brood-rearing habitat for shorebirds.

### **Strategies:**

- Water level manipulation, including full and partial drawdowns, and maintaining water levels in specific wetlands from spring to fall when possible.
- Tillage of dry wetlands as a management tool.
- Rehabilitation and maintenance of existing dikes and infrastructures.
- Conduct shorebird surveys on the Refuge.
- Monitor monthly wetland bird use.
- Develop and apply a wetland emergent/submergent vegetation monitoring plan.
- Develop and implement an annual water management plan as a component of an overall habitat management plan.

3. **Objective:** Provide 20 percent of the wetland acres, over a 5-year average, of emergent vegetation >25 cm tall with visual obstruction reading >80 percent of vegetation height in water depths 4 to 18 cm to provide escape cover and foraging habitat for dabbling duck broods and molting ducks and foraging habitat for water birds.

**Strategies:**

- Water level manipulation, including full and partial drawdowns, and maintaining water levels in wetlands from spring to fall when water is available and conditions are appropriate.
- Tillage of dry wetlands as a management tool.
- Rehabilitation and maintenance of existing dikes and infrastructures.
- Conduct waterfowl surveys on the Refuge.
- Monitor monthly wetland bird use.
- Develop and apply a wetland emergent/submergent vegetation monitoring plan.
- Develop and implement an annual water management plan as a component of an overall habitat management plan.

**Rationale:** The availability of a variety of wetland habitat conditions may benefit a greater diversity of wildlife species and/or support species for longer periods in their annual life cycle. The above two objectives contribute to habitats varying from shallowly flooded, short, sparse emergents to both shallow water and moderately dense cover. Water manipulation techniques including drawdowns and back flooding can be used to create these conditions. Using monitoring to evaluate the response of the flora and fauna will indicate success of management techniques. Short-term variations of habitat objectives may be considered, on a case-by-case basis, by Refuge management to promote other important ecosystem projects within North Park.

4. **Objective:** Provide 10 to 20 percent of the wetland acres within each wetland complex, over a 5-year average, with a 70 percent coverage of submergent aquatic vegetation species (*Potamogeton*, *Ruppia*) in wetlands of >18 cm water depth to provide invertebrates and seed sources for foraging water birds, especially waterfowl broods, and escape cover for diving ducks.

**Strategies:**

- Water level manipulation, including full and partial drawdowns, and maintaining water levels in wetlands from spring to fall when water is available and conditions are appropriate.
- Tillage of dry wetlands as a management tool.
- Rehabilitate and maintain existing dikes and infrastructures.
- Conduct waterfowl surveys and brood counts on the Refuge.
- Monitor monthly wetland bird use.
- Develop and apply a wetland submergent vegetation monitoring plan.
- Develop and implement an annual water management plan as a component of an overall habitat management plan.

**Rationale:** Submergent vegetation provides a complex structure for macroinvertebrate production and a seed source for foraging water birds. *Potamogeton* and *Ruppia* both produce a food resource (plant foods and invertebrates) for waterfowl and broods. These submergents are used by other wetland birds for nesting, foraging, and escape habitat. A variety of drawdown schedules and tillage are used to enhance the growth of these plants. Monitoring the responses of plant and wildlife will gauge the level of success in providing this habitat.

5. **Objective:** Enhance the existing private lands program to encourage creation and restoration of wetlands in North Park and surrounding areas through funding and technical assistance to accomplish the same objectives as on the Refuge.

**Strategies:**

- Obtain funding and full-time equivalency for a Partners for Fish and Wildlife position.
- Work with willing stakeholders to create and restore wetlands in North Park.
- Develop a plan to identify wetland habitats throughout North Park.
- Consider wetland development opportunities as they become available.
- Continue participation in the North Park Wetland Focus Group.
- Establish a monitoring plan for created habitats to ensure benefits are realized.

**Rationale:** Since the Refuge is only part of the total North Park landscape efforts, to look beyond the boundaries are important in an ecosystem approach. Many wetland potentials exist in North Park, and working to restore or create these wetlands will benefit not only wildlife but society as well. To achieve the most positive results, priority projects will be close to existing wetland complexes or reasonably well functioning segment of rivers or near the larger reservoirs. Wetland management would mimic above Refuge objectives when possible. Work would be completed with the help of others to identify wetland habitats throughout North Park, partnering with willing stakeholders to restore, protect, and improve wetland habitats for wildlife use. Set up demonstration areas practicing sound wetland habitat management, and improve water levels in wetlands from spring to fall when possible.

## **Meadow Habitats**

**Meadow Habitat Goal:** *Provide and manage irrigated, grassland dominated meadows historically developed for hay production, to support sage grouse broods, waterfowl nesting, and meadow-dependent migratory birds.*

## **Meadow Habitats**

Detailed biological justification is discussed in Appendix H.

- 1. Objective:** Provide 20 to 50 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native plants (rushes, sedges, grasses, forbs) characterized by <20 cm height, <10 cm visual obstruction reading, with dry to moist soils (no standing water), adjacent to (within 50 m) or intermingled with sagebrush (10 to 25 percent sage canopy cover), from early-June to late-July, to benefit sage grouse and snipe broods.

### **Strategies:**

- Utilize grazing, resting, and burning practices to stimulate or maintain meadow conditions.
- Irrigate areas as water is available to help stimulate vegetative growth.
- Working with partners, develop a vegetation monitoring protocol.
- Working with partners, develop a wildlife monitoring plan that correlates wildlife use and habitat condition.
- Consider hunting as a management tool.

- 2. Objective:** Provide 1,650 to 1,850 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native species (grasses, sedges, forbs, rushes) characterized by 10 to 30 cm visual obstruction reading, 0 to 10 cm duff layer and minimal (<5 percent) bare ground from mid-April to the end of July to benefit nesting waterfowl (gadwall, shoveler, pintail, green-winged teal) and sage grouse broods.

### **Strategies:**

- Utilize grazing, resting, and burning practices to stimulate or maintain meadow conditions.
- Irrigate areas as water is available to help stimulate vegetative growth.
- Working with partners, develop a vegetation monitoring protocol.
- Working with partners, develop a wildlife monitoring plan that correlates wildlife use and habitat condition.
- Consider hunting as a management tool.

**Rationale:** The grass:forb mix identified in the objective requires periodic manipulation of some sort to achieve the stated ranges of the objective. The combination of resting, grazing, and burning, combined with irrigation, where available and practical, are the best tools to accomplish this. It is anticipated that on average, 1/3 to 2/3 of this area will require grazing at an average rate of 0.4 to 1.0 AUMs per acre resulting in the removal of approximately 950 to 2,100 AUMs of forage. Vegetative monitoring combined with wildlife use data will be needed to document that objective levels are achieved, and whether or not objectives are correct.

3. **Objective:** Provide 630 to 790 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native plants (grasses, sedges, forbs, rushes) characterized by >30 cm visual obstruction reading, 10 to 20 cm duff layer and minimal (<5 percent) bare ground to benefit nesting waterfowl (mallard, gadwall, pintail, scaup), songbirds (savannah sparrow, meadowlark), and foraging shorebirds if flooded (snipe, phalarope, white-faced ibis, curlew, willet, sora).

**Strategies:**

- Utilize grazing, resting, and burning practices to stimulate or maintain meadow conditions.
- Irrigate areas, as water is available, to help stimulate vegetative growth.
- Working with partners, develop a vegetation monitoring protocol.
- Working with partners, develop a wildlife monitoring plan that correlates wildlife use and habitat condition.
- Consider hunting as a management tool.

**Rationale:** The grass:forb mix identified in the objective requires periodic manipulation of some sort to achieve the stated ranges of the objective. The combination of resting, grazing, and burning, combined with irrigation, where available and practical, are the best tools to accomplish this. To meet and maintain the taller vegetation and duff layers specified, it is anticipated that rest will be utilized more for this objective. It is anticipated that on average, 1/3 to 1/2 of this area will require grazing at an average rate of 0.4 to 1.0 AUMs per acre resulting in the removal of approximately 350 to 700 AUMs of forage. Vegetative monitoring combined with wildlife use data will be needed to document that objective levels are achieved, and whether results support species requirements.

4. **Objective:** Short-term variations of habitat objectives may be considered, on a case-by-case basis, by Refuge management for important ecosystem projects within North Park.

**Strategies:**

- Work with partners to identify potential projects in the county.
- Implement variations in water diversion, grazing regimes or other Refuge management strategies as deemed appropriate.

**Rationale:** From time-to-time, projects may be proposed within the county by other agencies, non-government organizations, or private landowners, that have a benefit to ecosystem health and wildlife outside of the Refuge boundary. In order to make an off-Refuge project succeed, resources normally reserved for Refuge purposes, such as water or vegetative cover, could be used occasionally to help make a project successful. These would not be long-term commitments of resources, but rather a cooperative management decision that a short-term diversion of these resources would better be served to benefit the ecosystem as a whole.

5. **Objective:** Establish a private lands program to provide funding and technical assistance to encourage wildlife-compatible land management practices in meadow habitats to accomplish objectives similar to those of the Refuge.

**Strategies:**

- Add a full-time private lands position to the staff.
- Work with local partners and willing landowners to identify, prioritize, and restore degraded areas and create new wildlife habitat in North Park.

6. **Objective:** Work with partners to address land health issues throughout the county.

**Strategy:**

- Continue active Refuge participation in Sage Grouse Working Group, North Park Wetlands Focus Group, Owl Mountain Partnership, North Park Habitat Partnership Program, and any other group formed with the goals of improving land health and/or stewardship in Jackson County.
- Partner with Jackson County weed coordinator to manage and minimize noxious weeds on the Refuge.

**Rationale:** The Refuge has the ability and resources available to maintain productive meadows for the benefit of wildlife, water quality and a healthy landscape, while also utilizing local agriculture. The meadows within the Refuge boundary were used to produce hay prior to Refuge establishment, and proposed management practices vary little from thousands of similar acres throughout the county that are still in hay production. By working with interested landowners and partners, the possibility exists of expanding the wildlife benefits of Refuge meadows and/or maintaining the benefits that are occurring on these off-Refuge sites.

## **Upland Habitats**

**Upland Habitats Goal:** *Provide a sagebrush/grassland upland community representative of the historic flora and fauna in a high valley of the southern Rocky Mountains to provide habitat for sage grouse, large mammals, and other shrub associated species.*

## **Upland Habitats**

Detailed biological justification is discussed in Appendix H.

- 1. Objective:** Provide 2,000 acres, over a 5-year average, of uplands composed of shrubs (>70 percent sage) >25 cm height and 20 to 30 percent canopy cover, >20 percent grass cover, and >10 percent forbs (native species preferred) to benefit sage grouse, vesper sparrow, brewers sparrow, elk, and pronghorn antelope.

### **Strategies:**

- Complete a sagebrush/grassland upland habitat inventory of the Refuge by 2008.
- Use cattle grazing at varying stock rates, seasons, and intensities as a management tool for uplands.
- Use 'rest' (free from biological, mechanical, or chemical manipulation) of varying lengths of time as a management tool for uplands.
- Develop and implement an integrated pest management plan.
- Use a variety of mechanical treatments of the habitat as a management tool for uplands.
- Develop and implement a vegetation monitoring plan.
- Develop and implement a wildlife monitoring program.

2. **Objective:** Provide 2,000 acres, over a 5-year average, of uplands composed of shrubs (>70 percent sage) >40 cm height and >30 percent canopy cover, <20 percent grass cover, and >5 percent forbs (native species preferred) to benefit brewer's sparrow, sage thrasher, and pronghorn antelope.

**Strategies:**

- Complete a sagebrush/grassland upland habitat inventory of the Refuge by 2008.
- Use cattle grazing at varying stock rates, seasons, and intensities as a management tool for uplands.
- Use 'rest' of varying lengths of time as a management tool for uplands.
- Develop and implement an integrated pest management plan.
- Use a variety of mechanical treatments of the habitat as a management tool for uplands.
- Develop and implement a vegetation monitoring plan.
- Develop and implement a wildlife monitoring program.

**Rationale:** The Refuge has five primary range sites that support sagebrush/grassland uplands. The 2,000 acres of each of the above objectives are scattered within several of these range types and intermingled with meadow areas. A completed inventory of the uplands will assist in specifically defining these areas. Sagebrush/grassland uplands in a mosaic of patchy sagebrush with openings of grasses and forbs across the landscape reflect the needs of most wildlife species. Moderate livestock grazing, ranging from .05 AUM per acre to .15 AUM per acre in intensity, combined with rest will help maintain these acres. This rest rotational coverage will promote plant diversity, nutrient cycling, and cover. Controlling or eliminating noxious weeds that reduce the abundance and diversity of native forbs in the sagebrush/grassland habitats is important. Mechanical treatments will be considered in small areas to increase grass and forb components of the site. Monitoring the response of the flora and fauna will aid in assessing the success of the tools applied and help improve these methods.

3. **Objective:** Manage the remaining 10,225 acres of sagebrush/grassland uplands based on a better understanding of Refuge habitats, wildlife usages, and affected variables using best management practices.

**Strategies:**

- Complete upland habitat inventory by 2008 if financial resources are available.
- Conduct research and monitor outcomes of Refuge upland habitats over the next 15 years.
- Develop habitat based goals and objectives for the remaining Refuge upland acres (10,000) by 2017.
- Establish upland research plots by 2012 to investigate and monitor upland habitats on the Refuge.
- Use cattle grazing at varying stock rates, seasons, and intensities as a management tool for uplands.
- Use 'rest' of varying lengths of time as a management tool for uplands.
- Develop and implement an integrated pest management plan.
- Use a variety of mechanical treatments of the habitat as a management tool for uplands.
- Develop and implement a prescribed burning program.
- Coordinate with existing projects and research and monitoring efforts in the area.
- Establish research plots to test strategies for habitat manipulations.
- Short-term variations of habitat objectives may be considered, on a case-by-case basis, by Refuge management for important ecosystem projects within North Park.

**Rationale:** In an effort to manage the sagebrush/grassland uplands, an inventory of what the Refuge has is essential. A variety of tools are available to provide a structurally diverse shrub community, with a grass:forb component to support migratory birds and other wildlife species. Livestock grazing, used in moderation, at rates ranging from .05 to .15 AUMs per acre will be used. It is anticipated that approximately 1/3 to 1/2 of the upland areas will be grazed annually, resulting in 450 to 1,200 AUMs of forage being removed. Rest also needs to be used in moderation; too much rest can result in dominate brush communities that prevent herbaceous species from recovering. Grazing used in conjunction with rest can enhance the nutrient cycles, plant regrowth, and plant community diversity. Efforts to control and/or eradicate noxious weeds will help maintain the diversity of plant life required to provide wildlife habitat needs. Mechanical treatments break up the soil and remove a variable percent of the brush species, depending on the coverage, to promote grasses and forbs growth. Historically, frequencies of fire in the upland were low, and they were small, patchy fires. Prescribed burns may be beneficial in some upland sites to control dense stands of sagebrush so that herbaceous species can increase. The use of other upland habitat projects in the area, with range types similar to the Refuge, will help to identify successful methods for manipulation the habitat to reach the objectives. A portion of these sagebrush/grassland upland acres will be used to establish research plots to get a better understanding of how to increase sage height and grass:forb abundance to benefit nesting and wintering sage grouse, songbirds (vesper sparrow, sage thrasher, brewer's sparrow, swainson's hawk) and pronghorn antelope. This information will focus on the tools that might get more acres of uplands into the first two objectives. In working with the entire North Park landscape, some habitat objectives may change to accommodate actions deemed essential elsewhere in the upland habitats of the Park to improve the overall quality of wildlife habitat.

4. **Objective:** Manage North Park Phacelia (*Phacelia formosula*) populations currently known to exist on the Refuge to ensure its continued existence.

**Strategies:**

- Initiate research to understand the plant's life history and develop a management plan.
- Protect and develop a monitoring plan for the existing and future new populations.
- Work with other entities to preserve North Park Phacelia populations throughout North Park.

**Rationale:** The North Park Phacelia is the only known federally-listed endangered plant species on the Refuge. The plant is only found in North Park with several populations scattered across the area. Only two known populations of the plant exist on Refuge lands. Little is known about its life history, so management is limited. Research on the life history of the plant is essential. As part of a partnership approach, information and management techniques will be shared to help ensure the continued existence of the Phacelia and eventually the down listing of the species.

## ***Public Use***

### **General Information**

The 1997 National Wildlife Refuge System Improvement Act (P.L. 105-57) requires that each Refuge be managed to fulfill the Refuge System mission as well as the specific purpose(s) for which the Refuge was established. The Act also declares that compatible wildlife-dependent recreational uses are legitimate and appropriate priority general public uses of the Refuge System. These six uses (hunting, fishing, wildlife observation, photography, environmental education, and interpretation) are to receive enhanced consideration in planning and management over all other general public uses of the Refuge System. These activities receive a special focus because they help foster an appreciation and understanding of wildlife and the outdoors. Wildlife conservation is always the top obligation of national wildlife refuges. However, when compatible, these wildlife-dependent recreational uses are to be strongly encouraged on Refuges. Consequently, these six activities are first in line for the Refuge's available staff and financial resources. Although other public uses may be allowed on Refuges, the process for considering proposed uses, other than priority uses, is more stringent, and these uses must be reevaluated more frequently.

A compatibility determination is required for a wildlife-dependent recreational use or any other public use of a Refuge. A compatible use is one which, in the sound professional judgement of the refuge manager, will not materially interfere with or detract from fulfillment of the Refuge System Mission or Refuge purposes. Compatibility determinations for public uses can be found in Appendix F.

Arapaho public use opportunities are combined into five categories and include:

1. Hunting
2. Fishing
3. Wildlife observation and photography
4. Environmental education and interpretation
5. Other uses

Additionally, cultural resources, research, and partnerships are evaluated. Each public use evaluation contains a specific list of objectives, a list of strategies, and a supporting rationale statement.

***Public Use Goal:** Through wildlife-dependent recreation and education, people of a range of abilities and interests are able to learn of and appreciate the natural resources of this unique high mountain park. Thereby, citizens become better stewards of nature in their own communities and stronger supporters of the Refuge specifically and National Wildlife Refuge System generally.*

## **Hunting**

<b>Public Use - Hunting</b>
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- 1. Objective:** Provide recreational hunting opportunities consistent with Refuge goals and objectives, and that facilitate North Park wildlife management objectives.

### **Strategies:**

- Working with the State, develop a hunting step-down management plan that provides hunting (big game, small game, and waterfowl) opportunities to meet North Park and Refuge objectives.
- Working with the State, provide limited small game and furbearer hunting opportunities depending on Refuge habitat objectives and/or population objectives North Park-wide.
- Hunting of predators will not be authorized in order to minimize disturbance to wildlife. The hunting step-down management plan will reevaluate the role of predator hunting on the Refuge.

- 2. Objective:** The Refuge will work with the State in promoting sound hunting practices as a wildlife management tool.

### **Strategies:**

- The Refuge will partner with the State and North Park Chamber of Commerce for the dissemination of information about hunting opportunities on the Refuge and throughout North Park.
- Hunting brochures and hunting information will be provided to hunters at the headquarters building.
- Assist Colorado Division of Wildlife off-Refuge with law enforcement, hunter recruitment, and hunter education when requested.

3. **Objective:** Facilities will be maintained, and improved as necessary, to provide a quality recreational hunting experience while minimizing resource damage.

**Strategies:**

- Develop five parking areas [Map 9 - Public Use - Alternative B and D (Preferred)] using post and cable methods and minimize resource damage caused by vehicles. Parking areas also provide opportunities to inform the hunting public about rules and regulations.
- Develop two permanent gates that can be locked to minimize resource damage caused by vehicles [Map 9 - Public Use - Alternative B and D (Preferred)].
- Develop a travel management plan that will revegetate two track roads [Map 9 - Public Use - Alternative B and D (Preferred)] not needed for maintenance, law enforcement, hunting access, or other management purposes.
- Develop a signage plan that facilitates the public use, enhances the public's understanding of Refuge management, provides public information and safety, and the Refuge System.

**Rationale:** This alternative recognizes that the Refuge is part of a larger system of lands known as North Park. Given that many wildlife species in North Park migrate on and off the Refuge (waterfowl, elk, mule deer, pronghorn antelope, sage grouse), the Refuge hunting program effects more than just Refuge lands. The key to success is a strong working relationship with sportsman and with the State, and incorporation of Refuge hunting goals and objectives into a hunting step-down management plan. Additional Refuge hunting opportunities (i.e. moose, elk, mule deer) will be determined in conjunction with the community and the State. The Refuge will continue to work with the State in promoting sound hunting practices as a wildlife management tool. Additionally, this alternative suggests we modify and possibly expand existing public use facilities to include emphasis on hunting both on the Refuge and in North Park. The Refuge will engage in partnerships to disseminate information on hunting opportunities throughout North Park. The Refuge may continue to utilize habitat management units A, B, C to provide resting areas for migratory birds and to minimize conflicts between hunters and visitors, and to distribute hunting pressure. However, the A, B, C system may be modified during the development of a hunting step-down management plan.

## **Fishing**

*Public Use Goal: Through wildlife-dependent recreation and education, people of a range of abilities and interests are able to learn of and appreciate the natural resources of this unique high mountain park. Thereby, citizens become better stewards of nature in their own communities and stronger supporters of the Refuge specifically and National Wildlife Refuge System generally.*

1. **Objective:** Where compatible, opportunities for fishing will be provided based on Refuge goals and objectives.

### **Strategies:**

- Encourage brown and rainbow trout fishing opportunities on the Refuge in accordance with State seasons and regulations and Refuge management objectives. Fishing is closed during June and July to protect nesting waterfowl and other riparian nesting species.
- Evaluate angler impacts to Refuge goals and objectives by 2008.
- Work with the State to develop a sport fish step-down management plan by 2008.

2. **Objective:** Where possible, expand fishing opportunities throughout North Park and help promote fishing as a recreational activity.

### **Strategies:**

- Provide fishing information and fishing regulations to Refuge visitors when requested.
- Utilize the Service Partners for Fish and Wildlife Program to improve fishery habitats on public and private lands when requested.
- When requested, assist the State with fisheries planning issues in North Park.
- Assist the State with law enforcement, fishery management, fisheries sampling, fisheries habitat projects, and spawning throughout North Park when requested.
- Partner with others to enhance fishery habitats in North Park.
- Install and monitor Illinois River gauges on the upstream and downstream end of the Refuge to evaluate river flows.

**Rationale:** The above objectives encourage the Refuge staff to not only provide sport fishing opportunities on the Illinois river, but also to partner with the State and others to improve fishery habitats and promote sport fishing opportunities throughout North Park. The Illinois River fishery is influenced by management actions that occur upstream of the Refuge. Logically, it is important that the Refuge assist, when requested, with habitat projects that impact the Illinois River upstream of the Refuge, and when deemed valuable to Refuge wildlife resources. Similarly, habitats throughout North Park are connected through a system of waterways. Refuge efforts to improve aquatic habitats, when requested, benefit all in North Park. The downside to this strategy involves using very limited personnel and resources on areas other than strictly Refuge grounds that may result in Refuge goals and objectives being delayed or not being met. Partnerships are the key to success when funds and personnel are limited. The Refuge strives to be included as a partner on fishery related habitat improvement projects in North Park.

## Wildlife Observation and Photography

*Public Use Goal: Through wildlife-dependent recreation and education, people of a range of abilities and interests are able to learn of and appreciate the natural resources of this unique high mountain park. Thereby, citizens become better stewards of nature in their own communities and stronger supporters of the Refuge specifically and the National Wildlife Refuge System generally.*

**Public Use - Wildlife  
Observation and Photography**

1. **Objective:** Enhance opportunities for wildlife observation and photography based on Refuge habitat goals and objectives by 2017.

### Strategies:

- Rebuild Brocker Overlook by 2004.
- Construct multi-use trail from Walden to Brocker overlook by 2008.
- Enhance auto tour route road.
- Maintain Refuge Visitor Center for distribution of information.
- Keep brochures current with updated information.
- Complete and maintain boardwalk section of interpretive nature trail.
- Build moose observation platform by 2005.
- Construct wildlife photography blinds on the auto tour route by 2006.
- Establish use limitations for wildlife observation and photography based on habitat goals and objectives.
- Maintain and potentially modify existing facilities to reflect new management strategies.

**Rationale:** Current visitation to the Refuge ranges from 7,000 to 9,000 visits (visit is defined as a person crossing the Refuge boundary). Many opportunities to enhance viewing and photography of wildlife while maintaining habitat goals are available. Each strategy should be designed to facilitate a quality experience for the visitor while fulfilling Refuge goals and objectives.

2. **Objective:** Assist with funding, construction, and program development to enhance wildlife photography and observation in North Park.

### Strategies:

- Develop and disseminate information on the best wildlife observation and photography opportunities throughout North Park.
- Partner with the CDOW plus others to construct and provide observation facilities for moose and other desirable species.
- Pursue funding and partners to assist with the construction of viewing/photography blinds at various other locations in North Park.
- Assist partners with revising the "Watching Wildlife in North Park" guide by 2006.
- Create partnerships with other wildlife-oriented organizations and individuals.

**Rationale:** Recreation plays a major role in the economy of North Park. Wildlife viewing and photography are key factors in the recreational opportunities available. Enhancing these uses will be beneficial to the economy as well as creating a better understanding of wildlife and its habitats.

## **Environmental Education/Interpretation**

*Public Use Goal: Through wildlife-dependent recreation and education, people of a range of abilities and interests are able to learn of and appreciate the natural resources of this unique high mountain park. Thereby, citizens become better stewards of nature in their own communities and stronger supporters of the Refuge specifically and National Wildlife Refuge System generally.*

**Public Use -  
Environmental Education /  
Interpretation**

1. **Objective:** Work with partners, including the North Park School District, to provide opportunities and facilities to conduct five environmental education programs a year, based on Refuge habitat goals and objectives.

### **Strategies:**

- Work with partners to develop specific environmental education programs covering:
  - ✓ habitat management practices and principles;
  - ✓ the natural history of North Park;
  - ✓ agricultural and wildlife;
  - ✓ the life history of various local species including waterfowl, sage grouse, elk, and moose;
  - ✓ North Park and its importance to Colorado waterfowl;
  - ✓ how a Refuge comes into existence and what its role is;
  - ✓ water issues and needs.
- Use existing environmental education opportunities as they occur, such as the water carnival, bird banding, Refuge field trips, and Day in the Woods.
- Create programs for students and volunteers to assist in management tasks for service learning.

2. **Objective:** Incorporate the Refuge and its niche in the North Park landscape in other environmental education messages developed in the county.

### **Strategies:**

- Partner with other land management agencies, non-government organizations, local schools and private individuals to expand the network of environmental education programs and facilities in North Park.
- Hire an outdoor recreation planner to conduct outreach and education activities on the Refuge and North park.

3. **Objective:** Update Refuge interpretive message to reflect recent wildlife issues and concerns (elk, sage grouse), habitat based decision-making, local agricultural uses and how they are not mutually exclusive on or off the Refuge.

***Public Use -  
Environmental Education /  
Interpretation cont'd.***

**Strategies:**

- Replace signs on the kiosks, overlooks, trails and visitor center, and pamphlets, and update the Refuge website to reflect a message of the Refuge working for wildlife and county-wide environmental interests.
- Rehabilitate the Case Barn and develop an interpretive site there presenting the relationship between the county's ranching history and wildlife.
- Interpret prehistoric cultural resources of the Refuge in relation to natural resources found in North Park.

4. **Objective:** Incorporate the Refuge and its niche in the North Park landscape in other interpretive messages developed in the county.

**Strategy:**

- Partner with other entities in the development of interpretive material involving the land management of North Park to identify the role of the Refuge.

**Rationale:** Arapaho National Wildlife Refuge is located almost in the geographic center of North Park. It is known to most residents as a major part of the county landscape, but exactly what the Refuge does and how it contributes to that landscape is not fully understood. Similarly, most out-of-county visitors do not understand how the lands surrounding the Refuge compliment its wildlife-oriented goals. An outdoor recreation planner position will facilitate integration of environmental education at the Refuge and in Jackson County schools. Articulating the story of history of North Park and how the Refuge and the surrounding lands benefit each other will be beneficial to all interests.

## **Other Uses**

1. **Objective:** Compatible, non-wildlife-dependent uses will be allowed, but limited to less sensitive areas based on habitat goals and objectives.

### **Strategies:**

- Eliminate walking leashed dogs, picnicking, horseback riding, and bicycling along roads.
- Use law enforcement, signs, information, and brochures to minimize impacts of other non-wildlife-dependent public uses.
- Prepare and implement a travel management plan to minimize vehicle impacts to Refuge habitats by 2006.

2. **Objective:** Consider non-wildlife-dependent public uses and their benefits to North Park and its residents.

### **Strategies:**

- With Partners, design and construct the Case Barn interpretive loop by 2008. Incorporate North Park and Refuge history and the preservation of wildlife habitats as a theme in the interpretation.
- Encourage partners to be sensitive to wildlife needs when developing recreational opportunities in North Park.
- Continue to allow the Colorado Department of Transportation to plow snow windbreak along Highway 125, subject to a compatibility determination.

3. **Objective:** Allow compatible, non-wildlife-dependent uses that support the Refuge mission.

### **Strategies:**

- Continue operation of the rifle range to facilitate law enforcement firearms requalification for Refuge officers, Colorado Division of Wildlife officers, and other local law enforcement agencies on request.
- Identify and prioritize non-Refuge mineral rights within Refuge boundaries by January 2005.
- Acquire, on a willing-seller basis, priority mineral rights by 2010.
- Continue operation of the Allard gravel pit to support both Refuge and county roads (on-Refuge) requirements.

**Rationale:** Compatible, non-wildlife-dependent uses should be limited to less sensitive areas based on habitat goals and objectives. The Refuge views mineral resource development as having negative impacts on wildlife habitat. Non-federally owned minerals within the Refuge boundary must be identified and purchased, on a willing-seller basis, to minimize future resource damage. The rifle range will continue to operate as it already facilitates Refuge and North Park law enforcement needs. The travel management plan must meet Refuge compatibility determination standards, facilitate management and public use requirements. The Allard gravel pit supports Refuge and county roads (on Refuge) and will remain active to support Refuge goals and objectives.

## **Cultural Resources**

**Cultural Resources Goal:** *The cultural resources of the Refuge are preserved, protected, and interpreted for the benefit of present and future generations.*

## **Cultural Resources**

1. **Objective:** Identify existing Refuge cultural resources and protect from degradation.

### **Strategies:**

- Complete a cultural resources survey, as needed, for management purposes.
- Determine National Register of Historic Places status for the Hampton, Allard, and Case Barns by 2003.
- Protect cultural resources located on the Refuge by minimizing disturbance in sensitive areas.
- When possible, preserve historical records by conducting oral interviews with local residents.
- Apply for monies (grants, maintenance management funds, etc.) to restore and preserve the Case Barn by 2007.
- Support provisions within the Archaeological Resources Protection Act by developing a plan for managing Refuge archaeological resources.

2. **Objective:** Encourage interpretation and protection of cultural resources and their importance to North Park wildlife resources.

### **Strategies:**

- Interpret the Case Barn by extending the tour route to include the barn. Develop an interpretive area adjacent to the Case Barn that discusses its regional significance by 2007. Consider adaptive re-use of the Case Barn in fulfilling the mission of the Refuge.
- Determine historic status of Hampton Barn; make decision to keep or eliminate barn by 2005.
- Interpret history of North Park at the Brocker overlook site by 2004.
- By 2004, develop an interpretive area within the headquarters building that demonstrates connectivity of the Refuge with the remainder of North Park.
- When requested, and dependent on available funding, partner with other individuals and agencies to protect and preserve cultural resources that relate to wildlife throughout North Park.

**Rationale:** A broader cultural resource role needs to be described for the Refuge. The philosophy is to comply with existing cultural resource related laws and policies and to protect Refuge cultural resources from degradation. Additionally, protection and interpretation of cultural resources that relate to North Park wildlife is encouraged. Interpreting the role of ranches in the preservation of habitat can serve as an example for visitors to learn and gain a greater appreciation for wildlife and their habitats.

## Research

**Research Goal:** *The Refuge is a learning platform for compatible research that assists management and science of high mountain park sage-steppe communities.*

1. **Objective:** Identify and promote the biological research needed to help achieve the Refuge's habitat goals and objectives.

### Strategies:

- Identify and prioritize habitat management research needs by 2004.
- Conduct in-house research on priority needs.
- Promote the Refuge research needs within the scientific community. Encourage research that focuses directly on the Refuge's habitat management goals.

2. **Objective:** Identify and promote non-biological research as it relates and contributes to achieving habitat goals and objectives on the Refuge and within North Park.

### Strategies:

- Identify and prioritize research related to Refuge and North Park wildlife in other disciplines needs by 2004.
- Encourage research in non-biological disciplines that facilitates the Refuge and achieve goals and objectives.
- Allow and encourage research that focuses on natural resource management goals throughout North Park.

**Rationale:** These objectives and strategies focus on identifying and implementing the biological research needs of the Refuge and North Park. Research will focus on achieving the habitat goals and objectives outlined in this Plan. Identified research needs can then be promoted within the scientific community and actively encouraged by Refuge staff. Proposed research, not falling within the categories identified, would generally not be allowed. Conversely, research meeting identified Refuge needs could be supported with funding, lodging, equipment sharing, etc. Disturbance to resident wildlife and habitat is the primary concern. Limiting non-Refuge identified projects will minimize unnecessary disturbance and habitat damage.

## Partnerships

**Partnerships Goals:** *A wide range of partners join with the Fish and Wildlife Service in promoting and implementing the Refuge vision.*

## Partnerships

1. **Objective:** The Refuge will participate in partnerships that promote sound wildlife management.

### Strategies:

- Engage in partnerships that result in wildlife and/or land-health improvements.
- Participate in Habitat Partnership Program, Owl Mountain Partnership, Sage Grouse Working Group, Colorado Wetlands Initiative, Platte/Kansas Rivers Ecosystem team, and others to protect, enhance, or restore wildlife habitats.
- Work with partners to achieve the Refuge goals and objectives.
- Work with the Colorado Historical Society and other partners to restore / rehabilitate the Case Barn Interpretive Site.
- Develop a conservation easement on Pole Mountain property.
- Work with Colorado Land Trust and others to help acquire lands and mineral rights within the Refuge's approved boundaries. Minerals extraction may cause habitat disturbance within the Refuge.

2. **Objective:** Maintain or form partnerships to achieve the wildlife related goals and objectives on the Refuge and within North Park.

### Strategies:

- Promote new partnerships (consider partnering with Ducks Unlimited, Trout Unlimited, Safari Club International, Audubon, Sierra Club, and others) to assist with achieving the Refuge and North Park natural resource goals.
- Strive to develop a Refuge Friends group over the next 15 years.
- Establish a full-time Private Lands Coordinator position to be stationed at the Refuge to assist in wildlife habitat enhancement throughout North Park.

**Rationale:** These objectives and strategies describe the potential level of partnership activity that will improve wildlife habitats throughout North Park. The Refuge staff will form partnerships to promote sound wildlife management within and outside the Refuge. The Refuge will actively participate in partnerships that result in improvements to land health and provide appropriate wildlife habitat in North Park. The Refuge will collaborate with partners on management of critical wildlife habitats in North Park. The private lands position will enable the Service to contribute its biological expertise and resources to private and public landowners when requested.

# Implementation and Monitoring

## Funding and Personnel

Current staffing at the Refuge consists of six permanent and four seasonal employees. Additional permanent and seasonal staff will be required to implement the strategies in the CCP and effectively monitor the flora and fauna to determine if the goals and objectives in the Plan are being met.

At this time, the Refuge has an annual base budget of \$381,700, based on fiscal year 2002 figures (fiscal year 2003 figures were not available due to continuing resolution) to maintain salaries for six permanent personnel and annual operating expenses for the Refuge Complex. The current budget represents the minimum needed to maintain current annual activities and does not adequately support Complex habitat management, biological monitoring, maintenance, public use, and education programs, and all Complex facilities and structures.

Table 5 shows the current staff and the proposed additional staff required to fully implement the CCP. If all positions are funded, the Refuge Complex staff will be able to carry out all aspects of this Plan. This would provide maximum benefits to wildlife, maximum efficiency, improve facilities and provide for increased public use. Projects that have adequate funding and staffing will receive priority for accomplishment. Staffing and funding are requested for the 15-year period of the Plan.

<b>Table 5. Current and Proposed Staff</b>		
	<b>Current</b>	<b>Proposed</b>
Management Staff	Project Leader, GS-12 Refuge Operations Specialist, GS-11	Complex Project Leader, GS-13 Supervisory Refuge Operations Specialist, GS-12 Refuge Operations Specialist, GS-9/11* Private Lands Refuge Operations Specialist, GS-9/11
Biological Staff	Wildlife Biologist, GS-9/11 Career Seasonal Wildlife Biological Technician, GS-6 Seasonal Biological Technicians, GS-4 to GS-5 (3-4)	Complex Wildlife Biologist, GS-11 Wildlife Biologist, GS-9* Career Seasonal Wildlife Biological Technician, GS-6 Seasonal Biological Technicians, GS-3 to GS-5 (4-5)* GIS Coordinator/Data Manager, GS-9/11*
Public Use Staff		Outdoor Recreation Planner, GS-9/11*
Administrative Staff	Administrative Assistant, GS-8	Administrative Officer, GS-9* Administrative Assistant, GS-5/6*
Maintenance Staff	Equipment Operator, WG-8	Equipment Operator, WG-10 Career Seasonal Maintenance Worker, WG-8 (Irrigator) Career Seasonal Maintenance Worker, WG-8*
*Shared with other stations in Wyoming under Arapaho's Complex Management		

## Economic Impact Analysis

For Refuge CCP planning, an economic impact analysis describes how current (No Action Alternative) and proposed management activities (Alternatives B, C, and D) affect the local economy. This type of analysis provides two critical pieces of information: 1) it illustrates a refuge's true value to the local community; and 2) it can help in determining whether local economic effects are or are not a real concern in choosing among management alternatives. Economic impacts are typically measured in terms of number of jobs lost or gained, and the associated result on income. Economic input-output models are commonly used to determine how economic sectors will and will not be affected by demographic, economic, and policy changes. The economic impacts of the management alternatives for Arapaho NWR were estimated using IMPLAN, a regional input-output modeling system developed by the USDA Forest Service.

The Refuge management activities of economic concern in this analysis are Refuge personnel staffing and Refuge spending within the local community, livestock grazing activities on the Refuge, and spending in the local community by Refuge visitors. The detailed report is provided in Appendix G. Table 6 summarizes the direct and total economic impacts for all Refuge management activities by management alternative.

Current Refuge staffing and budgeting (Alternative A) generates 11.3 jobs and \$398,839 in personal income in Jackson County and accounts for 1 percent of total employment in Jackson County. Due to increased staffing levels, Alternatives B, C, and D would generate more jobs and income than Alternative A.

Total annual revenue of \$484,779 is associated with permittees that use the Refuge as part of their grazing operation. This accounts for an estimated 3.4 jobs and \$67,780 in labor income in the Range Fed Cattle Industry and a total of 6.9 jobs (0.61 percent of total county employment) and \$131,959 in labor income throughout the Jackson County economy. It is important to note that the permittees use the Refuge as part of their overall grazing operation, the economic values presented in this analysis represent the value of the overall operation not just the value of grazing on the Refuge. For reduced Refuge grazing below the levels identified in Alternative A, the key issue is to identify how permittees will respond to being able to graze fewer head on the Refuge. Several options are available including transferring to private land, purchasing additional hay, or reducing the number of animals in their operation. Because it is not known how each permittee will respond, this analysis encompassed the best (transferring to private land) and worst (cut in permittee operations by the associated reduction in Refuge AUMs) case scenarios to frame the possible impact range. For alternatives B, C, and D, the anticipated reduction in AUMs is 10 percent to 64 percent, the 64 percent reduction impacts are reported in Table 6 as one end of the impact range to represent the absolute worst case scenario. Total annual revenue associated with the worst case scenario is \$174,566. The sales associated with a 64 percent reduction from the current level would result in a decrease of 2.2 jobs and \$43,373 in labor income in the Range Fed Cattle Industry and would decrease countywide employment by 4.4 jobs (-0.39 percent of total county employment) and labor income by \$84,441. The other end of the impact range reported in Table 6 represents the best case scenario of transferring head to private land. Because no economic impacts are expected, the economic impacts for the best case scenario are the same as Alternative A. Which scenario (transfer to private land or cut production) a permittee chooses will depend on their level of dependence on the Refuge for their overall operation and the actual reduction in Refuge AUMs.

Current Refuge visitors spend about \$160,500 annually in the Jackson County economy which directly generates \$29,918 in personal income and 2.1 jobs for local businesses accommodating visitors (hotels, restaurants, supply stores, and gas stations) and generates a total of \$39,308 in personal income and 2.5 jobs (0.2 percent of total county employment) throughout the local economy. At this time no significant change is expected in current visitation levels for Alternatives B, C, and D. Therefore, the economic impacts reported in Table 6 are the same across all alternatives.

Under current Refuge management (Alternative A), total economic activity directly related to all Refuge operations generate an estimated 14.7 jobs and \$458,634 in Jackson County. Including direct, indirect, and induced effects, all Refuge activities account for 20.7 jobs (1.8 percent of total county employment) and \$570,106 in personal income in Jackson County. Due to the increased staffing levels for Alternatives B, C, and D, the associated economic effects generate more jobs and income than Alternative A.

**Table 6. Summary of all Refuge Management Activities by Alternative**

Jackson County	Alternative			
	A	B	C	D
<b>Total Refuge Staffing and Budgeting Impacts</b>				
<b>Direct Effects</b>				
Income (\$/year)	\$360,936	\$736,625	\$643,864	\$736,625
Jobs	9.2	18.2	16.1	18.2
<b>Total Effects</b>				
Income (\$/year)	\$398,839	\$811,883	\$710,274	\$811,883
Jobs	11.3	22.4	19.8	22.4
<b>Refuge Grazing Activities</b>				
<i>Range from a 64% reduction in AUMs (option 2) to no impact expected (Option 1)</i>				
<b>Direct Effects</b>				
Income (\$/year)	\$67,780	\$24,407 to \$67,780	\$24,407 to \$67,780	\$24,407 to \$67,780
Jobs	3.4	1.2 to 3.4	1.2 to 3.4	1.2 to 3.4
<b>Total Effects</b>				
Income (\$/year)	\$131,959	\$47,518 to \$131,959	\$47,518 to \$131,959	\$47,518 to \$131,959
Jobs	6.9	2.5 to 6.9	2.5 to 6.9	2.5 to 6.9
<b>Recreation Activities</b>				
<b>Direct Effects</b>				
<i>No change in visitation expected across alternatives</i>				
Income (\$/year)	\$29,918	\$29,918	\$29,918	\$29,918
Jobs	2.1	2.1	2.1	2.1
<b>Total Effects</b>				
Income (\$/year)	\$39,308	\$39,308	\$39,308	\$39,308
Jobs	2.5	2.5	2.5	2.5
<b>Aggregate Impacts</b>				
<b>Direct Effects</b>				
Income (\$/year)	\$458,634	\$790,950 to \$834,323	\$698,189 to \$741,562	\$790,950 to \$834,323
Jobs	14.7	21.5 to 23.7	19.4 to 21.6	21.5 to 23.7
<b>Total Effects</b>				
Income (\$/year)	\$570,106	\$898,709 to \$983,150	\$797,100 to \$881,541	\$898,709 to \$983,150
Jobs	20.7	27.4 to 31.8	24.8 to 29.2	27.4 to 31.8
<i>% of Total County Employment</i>	1.8%	2.4% to 2.8%	2.2% to 2.6%	2.4% to 2.8%

## **Funding Needed to Implement This Plan**

Projects required to implement the Arapaho CCP are listed in Appendices D and E. These Appendices show the funding needed to implement the CCP through two different systems. The first system is the Refuge Operations Needs System (RONS). This document requests to Congress for funding and staffing needed to carry out projects above the existing base budget. Amounts shown include a start-up cost of implementing each program with actual yearly costs that are significantly less. The other system is the Maintenance Management System (MMS) which documents the equipment, buildings, and other existing property that require repair or replacement. All of the current RONS projects directly support the implementation of the CCP. Below is a summary of funding needed to fully implement the CCP based on the RONS Projects in Appendix D.

	<b>Recurring</b>	
	<b>First Year</b>	<b>Annual Need</b>
Personnel/Staffing	\$792,000	\$430,000
Facilities	\$541,000	\$ 000
Habitat Projects	\$192,000	\$ 36,000
Research/Studies	\$383,000	\$ 10,000

Other funding needs include the maintenance or replacement of existing equipment and facilities. In the past, the Complex has had a large backlog of these funding needs. However, in recent years, much of the funding has been provided to eliminate a large number of the backlog projects. Below is a list of remaining needs required to implement the CCP and maintain the structures and equipment to a safe and productive standard for the 15 years of the Plan.

Water Control Structures and Dikes	\$146,000
Road, Gates, and Fences	\$2,341,000
Buildings and Facilities	\$516,000
Public Use Facilities	\$276,000
Equipment	\$531,000
Vehicles	\$60,000

A list of the top 18 prioritized items are located in the MMS list in Appendix E. The remaining MMS projects do not directly impact the CCP implementation and were not included in this Plan. These were generally projects that were required to be included in MMS, such as equipment / vehicle replacement, etc., for an additional \$1,964,000 in funding.

## Step-Down Management Plans

Service managers have traditionally used the Refuge Manual to guide field station management actions. The policy direction given through the manual has provided direction for developing a wide variety of plans which are used to prepare annual work schedules, budgets, public use, and land management actions. The CCP is intended as a broad umbrella plan which provides general concepts and specific wildlife, habitat, endangered species, public use and partnership objectives, and examples of strategies that might be used to complete the objectives. The purpose of step-down management plans is to provide greater detail to managers and employees who will implement the strategies described in the CCP.

Under the guidance provided within the CCP, the Refuge staff will revise or develop several step-down management plans to be implemented over the next 15 years. Step-down management plans to be revised or developed include:

Habitat Management Plan	Hunting Management Plan
Public Use Plan	Water Management Plan
Fisheries Management Plan	Fire Management Plan
Illinois River Rehabilitation Plan	Habitat Monitoring Plan
Integrated Pest Management Plan	Wildlife Monitoring Plan
Archaeological Resources Protection Plan	Station Safety Plan

## Partnership Opportunities

Partnerships are an integral part of the existing Refuge management and are viewed as the key to successful management in the future. The staff recognize that the Refuge is not an ecosystem, rather it represents merely an island of wildlife habitat. The Refuge is dependent on wildlife and habitats provided by other land managers throughout North Park and throughout the Central Flyway. “The Refuge is not sustainable alone, in fact it is dependent on other habitats and lands that surround it to be functional, and by itself may serve little wildlife value” (quote, Dr. Richard Knight). The CCP strives to recognize this connection to, and dependence on, other lands. Past and current agricultural practices have provided benefits for wildlife in North Park. The livelihood of ranchers largely has been dependent on maintaining a healthy plant community. As a result, many plant and wildlife species have benefitted from these practices. Further, ranching has impeded urban development which adversely impacts natural communities. Ranchers are one of the land stewards that have protected and preserved wildlife habitats for the past 125 years. We believe sustainable ranching is one key to continued protection of North Park natural resources.

The message for new and existing partners is “we need you.” The Refuge will cooperate and partner with other land managers in North Park to improve wildlife habitats. The Refuge has identified a new Private Lands Coordinator position within the CCP to facilitate partnering. The CCP recommends that short-term variations in management be considered to accommodate other wildlife related projects within North Park. For example, the Refuge would consider allowing additional grazing AUMs to accommodate a 2-year rest following Dixie harrow treatment on adjacent BLM lands. The down-side to this approach is that the Refuge will achieve its habitat objects at a slower pace because resources are diverted away from Refuge lands. However, the benefits of combining Refuge resources with other land managers will result in improved land health for North Park and the Refuge. Additionally, the Plan will encourage other partners to come join Refuge habitat improvement efforts. Through partnering, we envision the Refuge serving as a demonstration site for sound land management practices.

## **Monitoring and Evaluation**

Monitoring is essential to successful implementation of the CCP. The new habitat-based goals and objectives will change the past monitoring practices at the Refuge. Vegetative community function and structure will drive the management actions of the Refuge. Adaptive management will be used to incorporate new information into existing monitoring techniques. Periodic evaluations of vegetation community progress will be used to direct future management strategies.

Refuge goals, objectives, and strategies have been identified within the CCP. Monitoring strategies have also been evaluated and are included within this Plan. Required step-down management plans have been identified. Step-down management plans will further refine monitoring, methods, techniques, and locations. Additionally, the step-down plan will identify how, when, and who will conduct the monitoring.

All habitat management activities will be monitored to assess whether the desired effect of wildlife and habitat components has been achieved. Baseline surveys will continue for waterfowl, big game, and small game species. Baseline surveys will also be conducted for wildlife species for which existing or historical numbers and occurrence is not well known. It is also important to conduct studies to monitor wildlife responses to increased public use (multi-use trail, moose overlook) to assess impacts of these activities on Refuge wildlife.

Refuge habitat monitoring methods and frequency are currently being developed cooperatively with wildlife researchers within the U.S. Geological Survey. Evaluation of those methods will occur periodically, and the Refuge will consult with U.S. Geological Survey, Universities, and other professionals to ensure proper data collection and analysis.

Wildlife research will be encouraged at the Refuge. The Refuge staff will actively pursue research opportunities, especially those that advance, or answer questions, related to Refuge management. Research that enhances monitoring (techniques or data analysis) on the Refuge will also be encouraged. Refuge staff will work with researchers to ensure that the studies are applicable and compatible with Refuge objectives. Research that does not relate to Refuge goals and objectives will be discouraged.

This CCP is designed to be effective for a 15-year period. Periodic reviews (5 year minimum) of the CCP will ensure established goals and objectives are being met. Monitoring and evaluation will be an important part of this process.

## **Plan Amendment and Revision**

The CCP will guide management on the Refuge for the next 15 years. CCPs are signed by the Regional Director, Mountain-Prairie Region 6, thus providing the regional direction to the station project leader. A project leader at the station will review the CCP every 5 years to determine if it needs revision. In the case of severe circumstances, the project leader has the authority to modify management actions to respond appropriately. The Plan will be revised no later than 2018.

## **Comprehensive Conservation Plan Preparers**

The planning team was comprised of:

- Pam Bilbeisi, Wildlife Biologist, Arapaho NWR
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- Paul Hellmund, Professor of Landscape Architecture, Colorado State University
- Bernardo Garza, Planner, USFWS - Division of Planning
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- Mark Lanier, Refuge Operations Specialist, Arapaho NWR
- Murray Laubhan, Biologist, U.S. Geological Survey
- Todd Stefanic, Biological Science Technician, Arapaho NWR
- J. Wenum, District Wildlife Manager, Colorado Division of Wildlife

The Draft CCP and Environmental Assessment were written by Refuge staff and the Refuge planner with input from the above mentioned individuals. The documents were reviewed by Refuge Staff, Regional offices, other Service offices, U.S. Geological Survey, the Colorado Division of Wildlife, and the Bureau of Land Management. The Refuge staff recognizes and appreciates all input received from the individuals noted in the acknowledgments section and the input derived from public scoping meetings.



**ENVIRONMENTAL ASSESSMENT**  
**FOR THE PREPARATION OF THE**  
**COMPREHENSIVE CONSERVATION PLAN**  
**FOR THE MANAGEMENT OF**  
**ARAPAHO NATIONAL WILDLIFE REFUGE**

*Walden, Colorado*

*Prepared by*  
*U.S. Fish & Wildlife Service*  
*Region 6 Division of Refuge Planning*  
*and*  
*Arapaho NWR Staff*

*July 2003*

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## *I: Purpose and Need for Action*

### **Purpose for Taking Action**

To manage riparian, wetland, meadow, and upland habitats, for the benefit of their associated wildlife and plant resources and the availability of compatible public uses at Arapaho NWR for the present and future generations of Americans, in accordance with:

- a) the establishing purposes of the Refuge, which are:
  1. “. . . for use as an inviolate sanctuary, or for any other management purpose, for migratory birds.” 16 U.S.C. 715d (Migratory Bird Conservation Act)
  2. “. . . for the development, advancement, management, conservation, and protection of fish and wildlife resources . . . .” 16 U.S.C. 742f(a)(4) “. . . for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude . . . . “ 16 U.S.C. 742f(b)(1) (Fish and Wildlife Act of 1956)
- b) the goals of the National Wildlife Refuge System:
  1. To fulfill our statutory duty to achieve Refuge purpose(s) and further the System mission;
  2. Conserve, restore where appropriate, and enhance all species of fish, wildlife, and plants that are endangered or threatened with becoming endangered;
  3. Perpetuate migratory bird, inter-jurisdictional fish and marine mammal populations;
  4. Conserve a diversity of fish, wildlife, and plants;
  5. Conserve and restore, where appropriate, representative ecosystems of the United States, including the ecological processes characteristic of those ecosystems;
  6. To foster understanding and instill appreciation of fish, wildlife and plants and their conservation, by providing the public with safe, high-quality, and compatible wildlife-dependent public use. Such use includes hunting, fishing, wildlife observation, and photography, and environmental education and interpretation.

c) the goals set forth by the staff of the Arapaho NWR, which are:

Riparian Habitats Goal :*“Provide a riparian community representative of historic flora and fauna in a high valley of the southern Rocky Mountains to provide habitat for migratory birds, mammals and river dependent species.”*

Meadow Habitats Goal: *“Provide and manage irrigated, grassland dominated meadows historically developed for hay production, to support sage grouse broods, waterfowl nesting, and meadow dependent migratory birds.”*

Wetland Habitats Goal: *“Provide and manage natural and man-made permanent and semipermanent wetlands (in three wetland complexes) to provide habitat for migratory waterfowl, shorebirds, wading birds and associated wetland-dependent wildlife.”*

Upland Habitats Goal: *“Provide a sagebrush/grassland upland community representative of the historic flora and fauna in a high valley of the southern Rocky Mountains to provide habitat for sage grouse, large mammals and other shrub associated species.”*

Public Uses Goal: *“Through wildlife-dependent recreation and education, people of a range of abilities and interests are able to learn of and appreciate the natural resources of this unique high mountain park. Thereby, citizens become better stewards of nature in their own communities and stronger supporters of the Refuge specifically and National Wildlife Refuge System generally.”*

Cultural Resources Goal: *“The cultural resources of the Refuge are preserved, protected, and interpreted for the benefit of present and future generations.”*

Research Goal: *“The Refuge is a learning platform for compatible research that assists management and science of high mountain park sage-steppe communities.”*

\_\_\_\_ Partnerships Goal: *“A wide range of partners join with the Fish and Wildlife Service in promoting and implementing the Refuge vision.”*

## **Need for Taking Action**

Congress passed in 1997 the National Wildlife Refuge System Improvement Act (Public Law 105-57) amending the National Wildlife Refuge System Administration Act of 1966 to improve the management of the System and for other purposes. With the passage of this Act, Congress made it mandatory for each station of the System to prepare a Comprehensive Conservation Plan (CCP) and its associated Environmental Assessment (EA) and/or Environmental Impact Statement (EIS).

Passage of the 1997 Improvement Act created the need and opened the opportunity for the staff at Arapaho NWR to prepare a CCP with which to review its current management strategies, assess possible improvements to the management of the Refuge, and implement the new management plan.

Thus, Arapaho NWR is compelled, by the Improvement Act of 1997, to prepare a CCP and this EA to assess impacts to the environment as a result of the implementation of the preferred alternative (i.e., the CCP).

## **Decisions that Need to be Made**

The Refuge Manager, in concert with the rest of the Refuge staff and the Refuge Supervisor, needs to choose the management alternative that best meets the goals of the Refuge and of the System, and helps to achieve the congressionally mandated purposes of the Refuge (preferred alternative) from among all the action alternatives developed. The Refuge Manager is also required to determine whether the preferred alternative could have a significant impact on the quality of the physical, biological, and human environment.

## **Issues Identified and Selected for Analysis During the Project Planning and Public Scoping**

The Service, in collaboration with Colorado State University, prepared a stakeholder involvement plan to optimize public involvement in the CCP process, especially in the collection of preliminary public comments during the scoping process. Then the Service organized and publicized public scoping meetings in 2001. The first one took place in Walden (Colorado) on February 15 in Walden; the second was held in Fort Collins (Colorado) on February 16. Additionally, the Service held several meetings with the Colorado Division of Wildlife and the Bureau of Land Management at or in the area of the Refuge. Furthermore, the Service established contact with three Native American tribal governmental organizations with stake at the site where Arapaho NWR is located to solicit comments and request their participation in the CCP process. The following is a compilation of all the concerns raised as a result of the Service's effort to reach out to all possible stakeholders, which included the public in general, local landowners, local government agencies, conservation groups, and elected State and Federal representatives.

### *Habitat Management*

Refuge staff, local Colorado Division of Wildlife (CDOW) representatives, and personnel from the Region 6 Planning Division, other Federal agencies (i.e., USGS-BRD, BLM) and local universities (i.e., CSU) agreed that the Refuge habitats should be managed to achieve their maximum biological potential, with their whole array of associated species, rather than emphasizing only the production of a certain number of target waterfowl species. They also felt that while fire is an important ecological management tool and component of a healthy ecosystem, it is really not readily applicable as a habitat management tool in Arapaho NWR given the prevalent climatological conditions in North Park. Further concerns of the Refuge and CDOW personnel included the increasing numbers of elk present at the Refuge, and North Park mainly in the winter, the impact these ungulates might be having on Refuge habitats and other wildlife, and possible ways of controlling their numbers and impacts on adjacent lands. Concerns were also expressed by Refuge personnel, local ranchers and locally elected officials, as well as by conservation groups, as to the future of the grazing program, as a habitat management tool, in Arapaho NWR if the habitats are to be managed to for a larger diversity of species by seeking to achieve a maximum biological potential. Finally, there were concerns from conservation groups regarding the level of management or manipulation of habitats by Refuge personnel and questioning how much management is good and necessary.

### *Wildlife and Fisheries*

Refuge and CDOW expressed concern as to the status of sage grouse populations in North Park and the need to manage them more closely. Some groups expressed a need to enhance sage grouse habitats and stop hunting of this species to protect the populations. Several groups expressed interest in knowing how and if beavers, predators, and weeds are controlled in the Refuge and whether this control might continue in the future. Some groups also expressed interest in finding out what are the fisheries resources in the Refuge and whether there might be ways to preserve and improve this resource. Some people expressed that some kinds of wildlife (e.g. elk) should receive “sanctuary” from hunting pressure while on the Refuge. Some in the Refuge expressed that while the management emphasis of the Refuge had been waterfowl since the creation of the Refuge, in response to declining waterfowl numbers in the 1960s and 1970s, that the Refuge should now be managed to also provide necessary habitats and elements to other declining species, mainly neotropical migratory birds and shorebirds.

### *Public Uses*

Refuge and CDOW personnel see the CCP as a good opportunity to analyze the full range hunting opportunities for the public. Some people want to know more about public uses and opportunities in the Refuge, how Refuge compatibility works, and why certain uses are not permitted on the Refuge. Some expressed disappointment at current fishing restrictions and others wanted to find out if the Refuge could provide more environmental education and interpretation, especially being so close to Walden and the Front Range of Colorado.

### *Socio-Economic Issues*

Among local residents, considerable interest exists in finding out how the Refuge existence and activities contribute to the local (county and town) economy, and whether the CCP could be a vehicle to stimulate economic development in the area of the Refuge, especially for local entrepreneurs, such as developing infrastructure outside of the Refuge. Many concerns were expressed both with the Refuge staff and the local ranchers as to what economic and social impacts could occur as a result of modifications to the current grazing program in the Refuge. Local ranchers and other stakeholders expressed their support for grazing as a valuable habitat management tool, especially in light of the limited opportunities to use prescribed fire in North Park. Many stakeholders want to see the CCP address the Refuge’s grazing program in detail to assess its role in habitat management for wildlife. Furthermore, many stakeholders also want to see the CCP address in detail the Refuge’s water management and its impacts to the North Park sub-ecosystem, especially in light of current drought conditions in Colorado, and maybe explore the possibility of establishing another reservoir for water storage and wildlife use in the Refuge.

### *Miscellaneous Issues*

Some stakeholders want to know if the Refuge is planning on expanding its boundaries and what the history is of the establishment of the Refuge. Some other stakeholders want the CCP to address issues such as: opportunities for research at the Refuge; federally-listed species or species of special concern occurring at the Refuge and their management/protection; historical management of the Refuge lands; use compatibility - what is it and how is it determined; what type of development is likely to occur in North Park and how the Refuge can contribute to the preservation of North Park’s ranching heritage; interactions between Refuge personnel and North Park residents; historical and archaeological resources and studies at the Refuge - what is the current status.

## *II: Alternatives Evaluated, Including Preferred Alternative*

### **Focus of Evaluated Alternatives**

#### *Alternative A: No Action*

The No Action alternative would continue management of existing habitats, wildlife, programs, and facilities at current levels and would not include active management and restoration of riparian and upland habitats or extensive management of wetland habitats. Interpretive, educational, and administrative programs and facilities would not change.

Refuge management would continue at current levels. The main management tool for the meadows, riparian, and uplands would be grazing. Grazing would take between 8,000 to 9,500 Animal Unit Months (AUMs) used each year through various grazing practices including year rotational, high intensity, and rest. Fire would continue to play a very minimal part in habitat management. Noxious weed control would continue at the same level but would not be expanded. Water management would consist of flood irrigation of the meadows and filling of wetlands as early as possible in the spring.

The No Action alternative would not involve restoration of riparian habitats or expansion of existing dense cattail/bulrush habitat. Existing riparian habitat would support the nesting neotropical birds they have in the past. No new effort would be made to manage and improve riparian habitat for neotropical birds. River flows would continue to be diverted for wetlands without regard for possible improvements to existing riparian habitat if flow levels were altered.

Wetland management emphasis would continue to focus on waterfowl production. All wetlands would be filled each spring and kept full as long as water conditions allowed to create pair, brood, and molt water for waterfowl. No new actions would be planned to improve the water use, wetland submergent vegetation, or shore bird habitat.

Access roads would be managed as they currently are with minor upgrades and regular maintenance. Recreational opportunities would include current programs available under existing approved plans. Fishing would be allowed on the Illinois River from August 1 through June 1. Pronghorn antelope, sage grouse, small game, and waterfowl hunting would be allowed but no trapping.

Public use facilities would remain essentially the same and would be maintained. No new interpretive signs, exhibits or viewing opportunities would be developed. Refuge law enforcement would continue at existing levels. Environmental education and outreach would continue at the current level. No additional partners or funding would be pursued.

Complex funding would remain at the level needed to support current staffing and programs.

## *Alternative B*

The focus of this alternative is Arapaho National Wildlife Refuge's role in the North Park "sub-ecosystem." This includes acknowledging Arapaho's role as not only a part of the natural systems of North Park, but also the social, cultural, recreational, and economic systems of the region. This means giving consideration to the idea that Arapaho NWR, in addition to providing quality habitat for migratory birds and other wildlife, can provide educational and recreational opportunities for local residents and other visitors, which could report an economic benefit to the local economy. This alternative never loses sight of the fact that Arapaho is a wildlife refuge first and foremost, meaning it cannot provide for every possible use. It can, however, take advantage of its distinction as a wildlife refuge to provide opportunities that may not be available elsewhere in the Park. Conversely, it may choose not to provide some opportunities that are available elsewhere.

Under this alternative, the habitat management decisions are made with the entire North Park landscape in mind. The Refuge cannot be all things to all wildlife. It can, however, determine its best role given habitat conditions and potential and management constraints on other lands within the Park, both public and private. With this landscape, or ecosystem approach, the management of some habitats on the Refuge may change in order to accommodate actions elsewhere in the Park that will improve the overall quality of wildlife habitat in North Park. These off-Refuge actions may take place through the Service's already established Private Lands program (Partners for Fish and Wildlife) or new and existing partnerships with Federal, State, and local agencies, organizations, and individuals. For instance, Service resources devoted to one habitat type on the Refuge may be reduced if it finds that same habitat type may be provided more efficiently and with higher quality elsewhere in the Park by working with a willing partner. Or, conversely, it may decide to invest more resources into a Refuge habitat if good opportunities for providing that habitat elsewhere in the Park are limited or impractical. In essence, this alternative looks to spread the 'biological good' across the North Park landscape instead of placing all the emphasis on Refuge lands only. The benefit to this approach is that wildlife habitat across the landscape is optimized as resources available to the Service and its partners will be directed to where they can do the most good for wildlife and habitat.

This alternative would also look for ways to contribute to North Park's "story" through activities that are compatible with the Refuge's purpose and mission. Wildlife and their habitats are, without doubt, the Refuge's primary management foci. Within this context are opportunities to help convey information about the historical and current uses of the Refuge, their impacts on the land and people of North Park, and how land management and uses elsewhere in the Park affect the Refuge.

Key to this alternative's success is partnering with other State and Federal agencies, private and public organizations, and individuals to achieve mutually beneficial goals for the Refuge and North Park. For instance, the Service may enter into a partnership with the Bureau of Land Management, the Forest Service, and area ranchers to determine a grazing strategy for North Park that meets both cattle production and wildlife habitat goals, acknowledging that grazing can be a beneficial habitat management tool if applied appropriately.

### *Alternative C*

This alternative represents achieving the goals, vision, and purposes of the Refuge by manipulating Refuge habitats so that these habitats reach the apogee of biological potential, and thus support a well balanced and diverse flora and fauna representative of the North Park region. This alternative de-emphasizes the previous management emphasis on numbers of wildlife “produced” by the Refuge and expands the Refuge’s biodiversity focus beyond waterfowl only.

### *Alternative D: Preferred Alternative*

This alternative could be named the “modified B” alternative as it encompasses most of the objectives and strategies of Alternative B, with some additions from Alternatives A and C. The Preferred Alternative (proposed action) places great importance in the role that Arapaho NWR has in the North Park “sub-ecosystem,” both for the environment and the residents of North Park. Under this alternative, wildlife and the habitats upon which they depend, come first in the management of the Refuge and all other uses are subordinate to the needs of wildlife. Under this alternative, the Refuge provides wildlife-dependent compatible public uses that are not available elsewhere in North Park. Under this alternative, many habitat management decisions take into account the entire North Park landscape and not only the lands within the Refuge boundaries. Under this alternative, the Refuge seeks to participate fully in the future of the entire North Park landscape and be a conservation force that promotes sound wildlife and habitat management as well as help in the preservation of the North Park historical heritage. In order for this alternative to be successfully implemented, the Refuge relies heavily on partnerships with State and Federal agencies, private and public organizations, and individuals.

Under this alternative, the focus of the Refuge is to achieve its congressionally designated purposes by devoting staff, equipment, and partnership resources solely within the Refuge boundaries. Compatible priority public uses continue and are moderately expanded where personnel and funding allow and where Refuge habitats, plants, and wildlife resources are not adversely impacted by public use. Cultural resources under this alternative will continue to be protected but no interpretation will occur beyond what is already in place. The environmental education programs under this alternative would focus solely on how and why the Refuge intensively manages its habitats to achieve Refuge goals.

## Alternative A (No Action):

### *Riparian Habitats*

<b>Alternative A (No Action)</b>
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1. Objective: Protect foraging and roosting habitat for occasional use by peregrine falcons and bald eagles to ensure that these federally-listed species are adequately protected and remain relatively undisturbed on Refuge lands.

Strategies:

- Protect existing cottonwoods along the Illinois River as perch poles for eagles.
- Maintain diverse Refuge habitats to offer prey base for eagles and falcons.

Rationale: Bald eagles and peregrine falcons utilize the Refuge on an occasional basis, with falcons typically seen in the spring through fall and eagles fall through spring. The Refuge has little tall woody vegetation, which makes the few cottonwoods along the Illinois River and utility poles the only high perches available on the Refuge. These birds do not nest on the Refuge, so their only use is for foraging. Maintaining a prey base allows for potential use when the animals pass through.

2. Objective: Develop and manage nesting and brood-rearing habitat contributing to the production of 11,000 to 12,000 ducks and 500 Canada geese throughout the Refuge annually.

Strategies:

- Utilize grazing, prescribed fire, and rest to invigorate and maintain adequate nesting habitat in riparian associated grasslands and for brood-rearing benefits along streambanks.
- Develop a monitoring protocol to determine condition of grasslands within riparian zones.
- Monitor waterfowl production annually and correlate to habitat conditions to help confirm or refute habitat objectives.
- Utilize existing ditches to irrigate meadows within riparian zones to invigorate vegetative growth.

Rationale: The Refuge was purchased with Duck Stamp funds to benefit migratory birds and has a goal of providing high quality breeding habitat for waterfowl. Most waterfowl require large expanses of grasses of medium to tall height with a component of dead vegetative material, or duff, mixed in. The hydrology, combined with irrigation in the riparian zones, produces vigorous grass and forb growth in good water years. These areas can become decadent with too much dead material and require periodic disturbance in the form of grazing or fire. Similarly, thick grasses and willows associated with streambanks are important as escape cover for waterfowl broods. Monitoring vegetative characteristics and waterfowl use and production will aid in deciding when manipulation is required. It is anticipated that on average  $\frac{1}{2}$  to  $\frac{3}{4}$  of the area will be grazed annually by cattle at an average rate of 1.0 AUM per acre resulting in removal of 2,475 to 3,700 AUMS of forage. Irrigation aids in producing grass and forb growth and maintaining higher water tables for stream bank vegetation.

3. Objective: Manage predator populations to help ensure an annual Refuge-wide minimum of 40 percent Mayfield nesting success for waterfowl.

Strategies:

- Monitor waterfowl nest success by conducting nest searches and calculating nest success using the Mayfield method.
- Monitor predator use of the Refuge with predator surveys.
- Write a predator management plan outlining steps to take when Mayfield nest success is below 40 percent on the Refuge.

Rationale: A 40 percent nest success using the Mayfield calculation method will indicate a general population increase of waterfowl on the Refuge. The only way to properly calculate this number is by monitoring nest success. A predator survey and management plan are necessary to work in-kind with nest studies to identify steps needed to address decreased nest success if causes are due to predation.

4. Objective: Improve, restore, and protect the Illinois River riparian habitat for the benefit of brown trout, mule deer, elk, moose, and various other species of wildlife that utilize the area.

Strategies:

- Utilize grazing, prescribed fire, and rest to maintain/enhance riparian areas.
- Develop a riparian monitoring plan to identify condition of willows, streambanks, and hydrology issues associated with riparian zones.
- Willow and cottonwood plantings may be used by themselves or in combination with fenced exclosures to reestablish or expand woody vegetation where needed.

Rationale: Grasslands within riparian floodplains are used by a variety of wildlife including elk and various migratory birds. These areas can become decadent and require treatment to invigorate them. A healthy woody component in the riparian area is critical to maintaining diverse wildlife, serving as cover, food, streambank stability, and shade for the stream. Planting willows will help extend existing willow stands, and will likely require construction of 8 foot fences to exclude all large herbivore use for at least 3 to 5 years. Monitoring is important to identify condition of these habitats and management actions that may be necessary.

## **Wetland Habitats**

### **Alternative A (No Action)**

1. Objective: Protect foraging habitat for occasional use by peregrine falcons and bald eagles to ensure that these and other federally-listed species are adequately protected and remain relatively undisturbed on Refuge lands.

#### Strategies:

- Water level manipulation.
- Rehabilitate and maintain existing dikes and infrastructures.
- Develop and implement annual water management plan.

Rationale: Refuge wetlands are managed to provide diverse habitats which offer a potential forage base for peregrine falcons and bald eagles.

2. Objective: Develop and manage approximately 839 acres of foraging, pairing, nesting, and brood-rearing habitat contributing to the production of 11,000 to 12,000 ducks and 500 Canada geese throughout the Refuge annually.

#### Strategies:

- Water level manipulation, including full and partial drawdowns, spring fillings, and maintaining water levels during summer and fall when possible.
- Use tilling of dry wetlands as a habitat management tool.
- Wetland construction.
- Rehabilitate and maintain existing dikes and infrastructures.
- Conduct brood counts of waterfowl and geese.
- Maintain approximately 100 goose nesting structures within the wetlands.
- Monthly surveys of waterfowl and goose use of wetlands.
- Develop and implement a submergent/emergent vegetation monitoring plan.
- Establish a wetland database including the surface acres and acre-feet of all Refuge wetlands.
- Develop and implement an annual water management plan.
- Acquire legal storage rights on all Refuge wetlands.

Rationale: The Refuge is managing these wetlands primarily for waterfowl and goose production. Water management is key to providing the habitat needs for waterfowl foraging, escape cover, nesting, and brood-rearing. Filling wetlands in the spring attracts birds to the area and maintaining these levels with flowing water provides forage, brood, and molting habitat for waterfowl. Drawdowns are used to produce a variety of wetlands interspersed with open water and emergent vegetation. Tilling the wetland loosens the soil crust and combines the soil and vegetation to enhance the nutrient cycle. Drawdowns and tilling of the wetlands helps to stimulate submergent/emergent vegetation growth which provides seeds and the substrate necessary for invertebrate populations to grow for foraging waterfowl and geese. The emergent vegetation is also critical in raising broods, providing foraging habitat, and escape cover. Monitoring water birds and the vegetation is fundamental to understanding the affects of management practices. Legal storage water rights are essential in maintaining existing wetlands.

3. Objective: Improve the condition, vigor, and productivity of Refuge wetlands for the benefit of shorebirds, wading birds, and other wetland dependent species.

Strategies:

- Water level manipulation, including partial and full drawdowns, and maintaining water levels in wetlands from spring to fall when possible.
- Rehabilitate and maintain existing dikes and infrastructure.
- Transplant cattail and hardstem bulrush into wetlands.
- Monitor shorebird numbers to estimate use.
- Conduct colonial nesting surveys.
- Monthly wetland bird use surveys.
- Develop and implement an annual water management plan.

Rationale: Maintaining a diversity of habitats throughout the annual cycle will provide food, nesting, and brood-rearing for many wetland associated wildlife. A variety of water manipulation strategies are useful in this endeavor. Partial drawdowns provide nesting, foraging, and brood-rearing areas for shorebirds. Full drawdowns stimulate the emergent vegetation providing nesting substrate, brood-rearing, foraging, and cover for wetland dependent species such as eared grebes, pied-billed grebes, and American coots. Efforts to keep most wetlands full from spring to fall and maintaining the wetlands offers protection for nesting areas, the water levels needed for tall emergent vegetation to grow and other habitat needs for shorebirds, wading birds, and other wetland dependent species. To promote larger stands of tall emergent vegetation to enhance cover and nesting areas for black-crowned night herons, white-faced ibis, wrens, blackbirds and waterfowl, transplanting of hardstem bulrush and cattail can be used. Monitoring is used to estimate production, use and peaks of shorebirds, colonial nesting birds, and other wetland birds.

## **Meadow Habitats**

1. Objective: Protect foraging habitat for occasional use by peregrine falcons and bald eagles to ensure that these federally-listed species are adequately protected and remain relatively undisturbed on Refuge lands.

### Strategy:

- Maintain diverse meadow habitat for the production of waterfowl and other grassland dependent species.

Rationale: Bald eagles and peregrine falcons utilize the Refuge on an occasional basis, with falcons typically seen in the spring through fall and eagles fall through spring. Productive and diverse meadows will ensure an ample food source is available for falcons and eagles on these habitats and throughout the Refuge.

2. Objective: Develop and manage nesting habitat contributing to the production of 11,000 to 12,000 ducks and 500 Canada geese throughout the Refuge annually.

### Strategies:

- Utilize grazing, prescribed fire, and rest to invigorate and maintain adequate nesting habitat in meadows for various waterfowl species.
- Develop a monitoring protocol to determine condition of meadows.
- Monitor waterfowl production annually and correlate to habitat conditions to help confirm or refute habitat objectives.
- Utilize existing ditches to irrigate meadows to invigorate vegetative growth.
- Use photo points and vegetative transects to document habitat changes over time.

Rationale: The Refuge was purchased with Duck Stamp funds to benefit migratory birds and has a goal of providing high quality breeding habitat for waterfowl. Most waterfowl require large expanses of grasses of medium to tall height with a component of dead vegetative material, or duff, mixed in. The hydrology, combined with irrigation in the meadow zones, produces vigorous grass and forb growth in good water years. These areas can become decadent with too much dead material and require periodic disturbance in the form of grazing or fire. Monitoring vegetative characteristics and waterfowl use and production will aid in deciding when manipulation is required. Periodic grazing is anticipated to average 3,150 AUMs per year, at an average rate of 1.0 AUMs per acre. Prescribed fire may also be used at times, but is limited by extreme weather and fuel conditions common to the area. Irrigation aids in producing grass and forb growth on this otherwise arid landscape.

3. Objective: Manage predator populations to help ensure an annual Refuge-wide minimum of 40 percent Mayfield nesting success for waterfowl.

Strategies:

- Monitor waterfowl nest success by conducting nest searches and calculating nest success using the Mayfield method.
- Monitor predator use of the Refuge with predator surveys.
- Write a predator management plan outlining steps to take when Mayfield nest success is below 40 percent on the Refuge.

Rationale: A 40 percent nest success using the Mayfield calculation method will indicate a general population increase of waterfowl on the Refuge. The only way to properly calculate this number is by monitoring nest success. A predator survey and management plan are necessary to work in-kind with nest studies to identify steps needed to address decreased nest success if causes are due to predation.

4. Objective: Improve the condition, vigor, and productivity of Refuge meadows for the benefit of phalarope, snipe, meadowlark, savannah sparrow, sage grouse broods, and other meadow-dependent species.

Strategies:

- Utilize irrigation, grazing, rest, and fire to maintain healthy and diverse meadows.
- Monitor wildlife use and meadow conditions, and correlate the two to guide management decisions.

Rationale: Irrigation, grazing, rest, and fire are the most reliable tools available for manipulation of the meadow areas on the Refuge. Monitoring the wildlife using the area, and how they adjust to changing habitat conditions, is critical to ensuring techniques are being properly applied.

## ***Upland Habitats***

<b>Alternative A (No Action)</b>
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1. Objective: Protect foraging habitat for occasional use by peregrine falcons and bald eagles to ensure that these, the North Park Phacelia (*Phacelia formosula*) and other federally-listed species are adequately monitored, protected, and remain relatively undisturbed on Refuge lands.

### Strategies:

- Use cattle grazing at varying stock rates, seasons, and intensities as a management tool for uplands.
- Use 'rest' of varying lengths of time as a management tool for uplands.
- Develop and implement an integrated pest management plan.
- Monitor of North Park Phacelia populations on the Refuge.
- Fund and initiate research of the life history of North Park Phacelia to facilitate future management.

Rationale: Sagebrush/grassland uplands are an important source of food and cover for wildlife. Creating a mosaic of native plant communities across the landscape promotes habitat health. Livestock grazing can be an effective sagebrush/grassland upland management tool if used in moderation to foster habitat health. Noxious weeds pose a threat to sagebrush/grassland habitats by reducing the abundance and diversity of native forbs. Efforts to control or eliminate these weeds are important in the overall health of the habitat. The federally-listed endangered North Park Phacelia is found in only two locations on the Refuge. Little is known about the plants life history. Research and effective monitoring techniques are needed to adequately manage this species.

2. Objective: Improve the condition, vigor, and productivity of approximately 14,000 acres of Refuge sagebrush/grassland uplands for the benefit of sage grouse, waterfowl, pronghorn antelope, song birds, and raptors.

Strategies:

- Use cattle grazing at varying stock rates, seasons, and intensities as a management tool for uplands.
- Use 'rest' of varying lengths of time as a management tool for uplands.
- Develop and implement an integrated pest management plan.
- Use the Dixie harrow and monitoring as a management tool for uplands.
- Install photo points at various locations to document changes over the years.
- Install permanent upland transects in areas representing the main sagebrush/grassland upland soil types of the Refuge.

Rationale: Uplands can provide nesting sites, cover, and forage for many wildlife species. Maintaining a mosaic of native plant communities across the landscape supplies these requirements. Livestock grazing can be an effective sagebrush/grassland upland management tool if used in moderation to foster habitat health. Grazing intensities to maintain the above objectives averaged 1,355 AUMs from 1996 to 2001. Rest, if used in moderation, can promote seed production, plant reproduction, and plant health and vigor (recovering lost stored food reserves and reestablishing root systems). Noxious weeds pose a threat to sagebrush/grassland habitats by reducing the abundance and diversity of native forbs; efforts to control or eliminate these weeds are important in the overall health of the habitat. Promoting the growth of grasses and forbs in a sagebrush dominate areas is beneficial for sage grouse, elk, and songbirds. Perennial grasses and forbs provide food and cover for these species. The Dixie harrow has been used to remove some sagebrush in a mosaic pattern and to prepare a good seedbed for revegetation. Monitoring flora response to land management treatments provides crucial information to determine effectiveness of the treatments.

## ***Public Uses***

### **General Information**

The 1997 National Wildlife Refuge System Improvement Act (P.L.105-57) requires that each Refuge be managed to fulfill the Refuge System mission as well as the specific purpose(s) for which the Refuge was established. The Act also declares that compatible wildlife-dependent recreational uses are legitimate and appropriate priority general public uses of the Refuge System. These six uses (hunting, fishing, wildlife observation, photography, environmental education, and interpretation) are to receive enhanced consideration in planning and management over all other general public uses of the Refuge System. These activities receive a special focus because they help foster an appreciation and understanding of wildlife and the outdoors. Wildlife conservation is always the top obligation of National Wildlife Refuges. However, when compatible, these wildlife-dependent recreational uses are to be strongly encouraged on Refuges. Consequently, these six activities are first in line for the Refuge's available staff and financial resources. Although other public uses may be allowed on Refuges, the process for considering proposed uses other than priority uses is more stringent, and these uses must be reevaluated more frequently (Map 10 - Public Use - Alternative A).

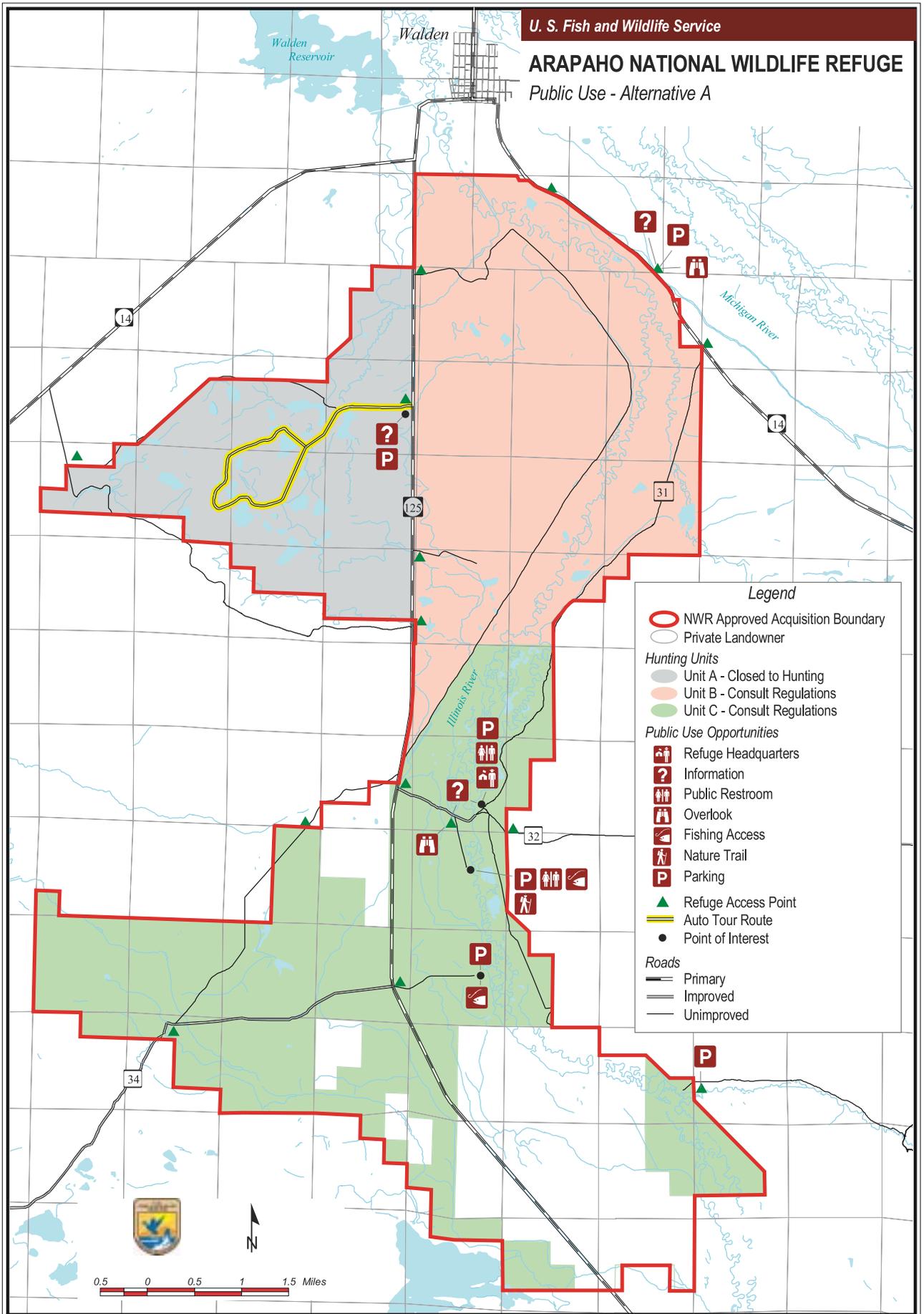
A compatibility determination is required for a wildlife-dependent recreational use or any other public use of a Refuge. A compatible use is one which, in the sound professional judgement of the refuge manager, will not materially interfere with or detract from fulfillment of the Refuge System mission or Refuge purposes. Compatibility determinations for public uses that appear within the preferred alternative can be found in Appendix F.

Arapaho public use opportunities are combined into five categories and include:

1. hunting,
2. fishing,
3. wildlife observation and photography,
4. environmental education and interpretation, and
5. other uses.

Additionally, cultural resources, research, and partnerships are evaluated. Each public use evaluation contains a specific list of objectives, a list of strategies, and a supporting rationale statement.

**Alternative A (No Action)**



**Map 10 - Public Use - Alternative A**

## Hunting

### Alternative A (No Action)

1. Objective: Provide high quality hunting recreational opportunities (1,972 hunting activity hours) on portions of the Refuge that are compatible with available natural resources.

#### Strategies:

- Continue working with the State to develop a hunting step-down management plan that provides hunting opportunities to meet North Park and Refuge objectives. Include Pole Mountain in the hunting plan and submit all hunting changes to the Code of Federal Regulations.
- Continue to allow high quality recreational hunting opportunities (estimated number of hunter visits is 450 to 550 annually) of migratory birds, waterfowl, small game, and pronghorn antelope, in accordance with State seasons and regulations, on designated portions of the Refuge.
- Continue to utilize habitat management units A, B, C to distribute hunters, provide resting areas for migratory birds, and to minimize conflicts between hunters and other visitors.

Rationale: A public hunting plan and accompanying environmental assessment which authorized the opening of the Refuge to big game, upland game, and migratory birds was prepared and approved in 1977, with pertinent regulations published in the Code of Federal Regulations. Subsequently, a pronghorn antelope hunting program was initiated in the fall of 1977 and a sage grouse season the following year. During 1988 a hunting management plan was developed that specifies an objective of 1,972 hunting activity hours, and divided the Refuge into habitat management units known as A, B, and C. Management Unit A, 4,544 acres (20 percent of the Refuge) located on the Case tract, is closed to all hunting. Unit A contains the auto tour route which facilitates safe, undisturbed wildlife viewing for Refuge visitors, and provides resting areas for migratory birds. The migratory game bird hunting area (Habitat Management Unit B) consists of 8,242 acres (35 percent) of the Refuge and provides hunting opportunities for small game, migratory birds, and big game. Unit B is managed consistent with national policy allowing approximately 40 percent of the Refuge to be open for migratory bird hunting. The remaining 10,458 acres (45 percent) in habitat management Unit C is open to small and big game hunting activities. Predator hunting has not been authorized at the Refuge. The National Wildlife Refuge System Improvement Act encourages Refuges to provide recreational hunting opportunities where compatible with the Refuges establishing legislation. Therefore, Alternative A proposes to continue the existing recreational hunting program in its present form. The Service will continue to work closely with the State to determine season dates, regulations, and assist with law enforcement issues when requested. Additionally, the Service will work cooperatively to implement the Colorado Division of Wildlife's Strategic Plan of 2002. This may include offering limited elk and mule deer hunting opportunities on the Refuge. Details of future Refuge hunting opportunities will be addressed in a hunting step-down management plan. The isolated tract, Pole Mountain, will be included in hunting step-down plans and included in Title 50 Code of Federal Regulations to conform with Service policy.

## **Fishing**

1. Objective: Provide high quality fishing recreational opportunities on portions of the Refuge that are compatible with available natural resources.

### Strategies:

- Provide brown and rainbow trout fishing opportunities (estimate 50 to 100 angler visits currently) on the Illinois River from August 1 through May 31. Fishing is closed during June and July to protect nesting waterfowl.
- Continue working with the State to develop a sport fish step-down management plan that provides fishing opportunities and meets Refuge objectives by 2007.
- Monitor Illinois River gauges on the upstream and downstream end of the Refuge to evaluate river flows and effects on the fishery resources by 2003.

Rationale: The Refuge fishery resource is limited to the Illinois River. Other aquatic sites, including Potter Creek, Spring Creek, and Refuge ponds, represent poor fishery habitat. The largest factor effecting the fishery resource is limited water quantity. In recent years, drought severely limited flows in the Illinois, and the stream channel at the Allard bridge was dry during August 2002. Stream gauges at the upstream and downstream ends of the Illinois River channel will assist the Refuge staff in monitoring Refuge water use, and enable the Refuge to maximize benefits of limited water resources. Fishing is viewed as a compatible use that will be encouraged during non-waterfowl nesting seasons. This alternative continues that philosophy and permits sport fishing as a recreational use of Arapaho NWR.

## **Wildlife Observation and Photography**

1. Objective: Provide wildlife observation and photography opportunities on the Refuge especially along overlooks, auto tour route, and nature trail.

### Strategies:

- Maintain existing Refuge facilities, such as overlooks, nature trail, and auto tour route.
- Maintain Refuge Visitor Center for distribution of information.
- Keep brochures current with updated information.
- Participate in the preparation of a North Park wildlife viewing brochure.
- Issue special use permits for professional photographers.
- Rebuild the Brocker overlook by 2004.

Rationale: Current visitation to the Refuge ranges from 7,000 to 9,000 visits (visit is defined as a person crossing the Refuge boundary). These visitors are looking for a variety of wildlife related opportunities. By providing wildlife observation, photography facilities, and information, the Refuge meets the visitors goals and promotes wildlife stewardship and Refuge support. Maps of the Refuge and a list of wildlife species help the visitor find the right viewing time, season, and place. Permits are issued with specific restrictions to limit wildlife harassment when a photographer requests access for close-up shots or use of a blind in areas that could potentially interfere with wildlife needs.

## Environmental Education/Interpretation

<b>Alternative A (No Action)</b>
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1. Objective: Provide an average of five environmental education opportunities annually, focusing on requested topics for a total of 150 to 250 participants.

Strategy:

- Conduct environmental education programs when requested and on the topics requested.

Rationale: With one school system in the county, low local population and minimal visitation numbers, a reactionary approach to environmental education requests is appropriate at this time.

2. Objective: Provide interpretive opportunities to Refuge visitors - approximately 7,000 to 10,000 annually on the Refuge primarily at the visitor center and overlooks, and along the auto tour route and nature trail.

Strategies:

- Maintain existing facilities including visitor center, overlooks, and auto tour to disseminate interpretation message.
- Replace and update all interpretive signs and brochures that are more than 5 years old or no longer provide an appropriate message.

Rationale: It is estimated that less than 10 percent of Refuge visitors stop by the office for information, so it is important that our signs and brochures are accurate and up-to-date so that visitors receive the most pertinent information available about the Refuge and the Refuge System. Environmental Education will be a reactionary Refuge function and topics will be tailored to the needs of the requesting entity.

## Other Uses

1. Objective: Allow current non-wildlife-dependent uses to continue on Refuge lands.

### Strategies:

- Continue to allow walking leashed dogs, picnicking, horseback riding, and bicycling along roads.
- Continue operation of the rifle range to facilitate law enforcement firearms requalification for Refuge officers, Colorado Division of Wildlife officers, and other local law enforcement agencies on request.
- Continue operation of the Allard gravel pit to support both Refuge and county roads (on-Refuge) requirements.
- Continue to allow the Colorado Department of Transportation to plow snow windbreak along Highway 125, subject to a compatibility determination.

Rationale: The existing non-wildlife-dependent public uses include walking leashed dogs, picnicking, horseback riding, and bicycling along roads would be allowed to continue. These uses are generally local individuals, and use is low and infrequent. Near the headquarters, the Refuge supports a rifle range used by Refuge officers, Colorado Division of Wildlife officers, and other local law enforcement agencies. The range is not open to the general public because the Bureau of Land Management provides a public range located 4 miles east of Walden. The Refuge range is uniquely designed to facilitate requalification of law enforcement officers. This action proposes to maintain the range in its current size, location, condition, and use. The Allard gravel pit supports Refuge, and county roads (on Refuge) and will remain active to support Refuge goals and objectives. The Refuge will continue to allow the Colorado Department of Transportation to plow snow breaks along Highway 125 to collect snow, prevent drifting across the highway, and increase safety of travelers.

1. Objective: Identify existing Refuge cultural resources and protect them from degradation.

Strategies:

- Prior to any Federal action, complete a cultural resources survey, in compliance with Section 106 of the NHPA, for those areas of the Refuge that have not been surveyed.
- Request the State of Colorado to determine the historical status of the Hampton and Case barns by 2003.
- Protect cultural resources found on the Refuge by minimizing disturbance in sensitive areas.
- Apply for monies (grants, maintenance management funds) and develop partnerships to restore and preserve the Case barn by 2007.
- Support provisions within the Archaeological Resources Protection Act by developing a plan for managing Refuge and archaeological resources.

Rationale: This alternative describes the current level of management activity being conducted by the FWS since acquiring the Refuge in 1967. It represents status quo management and includes current management objectives and strategies. The philosophy of this alternative is to comply with existing cultural resource related laws and policies, and to protect Refuge cultural resources from degradation. Under this alternative, the Refuge does not plan to interpret cultural resources for the visiting public.

## **Research**

1. Objective: When requested by investigators, allow natural resource related research opportunities on the Refuge.

Strategies:

- Evaluate submitted research proposals for conflicts with the current Refuge objectives, and with existing research efforts.
- Issue special use permits to investigators working on the Refuge, outline limitations, techniques to minimize disturbance, and duration of the work.
- Minimize damage to cultural resources and to sensitive wildlife habitats.

Rationale: This alternative describes the current level of research management being conducted by the FWS. The philosophy of this alternative is to provide research opportunities and access to Refuge lands when requested by investigators. Preferably, the research study falls within the natural resource field, and will have some applicability to Refuge management needs. All studies are evaluated for conflicts with the current Refuge mission, with ongoing studies, and must be compatible with Refuge establishment purposes.

## ***Partnerships***

<b>Alternative A (No Action)</b>
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1. Objective: The Refuge will participate in partnerships that promote sound wildlife management.

### Strategies:

- Engage in partnerships that result in wildlife and/or land-health improvements.
- Participate in Habitat Partnership Program, Owl Mountain Partnership, Sage Grouse Working Group, Colorado Wetlands Initiative, Platte/Kansas Rivers Ecosystem team, and others to protect enhance or restore wildlife habitats.

Rationale: This alternative describes the current level of partnership activity being conducted by the Service. The Refuge will continue to participate in partnerships that promote sound wildlife management. Participating in partnerships will result in improvements to land health, and provide appropriate wildlife habitat on the Refuge and in North Park.

## Alternative B

## Alternative B

### *Riparian Habitats*

1. Objective: Restore 50 to 100 acres of dense (40 to 100 percent) willow in patches >.2 ha and 20 m wide in the central third of the Illinois River (from the north end of the island to the confluence with Spring Creek) to connect existing willow patches and maintain 535 acres of dense willow in patches in the lower third of the Illinois River to benefit nesting neotropical migrant songbirds (yellow warbler, willow flycatcher) and resident moose, river otter, and beaver.

#### Strategies:

- Willow plantings along the stream corridor combined with 8 foot fences to exclude large herbivores.
- Water manipulation Refuge-wide that may involve decreased diversions to maintain in-stream flows for willow establishment.
- Construction of small artificial dams in the river to raise water tables locally to aid in willow establishment.
- Establish a vegetation monitoring plan to assess health of established willow stands, and measure and document success or changes needed in reestablishment efforts. Plan should include herbivory and hydrology factors.
- Wildlife monitoring will occur to document changes in wildlife use and possible correlations to changes in habitat.

Rationale: Sections of the Illinois River on the Refuge had willows removed prior to acquisition by the FWS, probably in an effort to increase hay yields. These open stretches of river have: less bank stability resulting in potential for increased sedimentation; decreased shade over the stream resulting in increased water temperatures for trout; and sparse woody vegetation for use by songbirds or other wildlife. A section of river further downstream from the proposed reestablishment site has had livestock grazing removed for 8 years, but has shown little willow regeneration. Given the growth characteristics of willows, these results lead to the conclusions that there is either significant herbivory other than livestock restraining willow expansion, and/or hydrology has been altered enough with upstream diversions and recent drought conditions that lack of groundwater is keeping willow establishment from occurring. With this in mind, willow plantings will only be done in association with fencing, and consideration of hydrological needs will be used as well. Possible methods of increasing groundwater needs will be: to divert less water upstream for other Refuge purposes; locate willow plantings adjacent to existing beaver dams to take advantage of higher water tables near these ponds; and place logs and other natural materials in the stream to create simulated beaver dams and raise water tables adjacent to areas to be planted. Monitoring will be essential to document reestablishment efforts and to note any significant changes to existing willow communities.

2. Objective: Provide 3,630 to 3,845 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native plants (rushes, sedges, grasses, forbs), characterized by 10 to 30 cm visual obstruction reading, 0 to 10 cm duff layer and minimal (<5 percent) bare ground, and less than 40 percent (canopy closure) willow to benefit nesting waterfowl (pintail, shoveler, gadwall, green-winged teal) and sage grouse broods.

Strategies:

- Utilize grazing, resting, and burning practices to stimulate or maintain meadow conditions.
- Irrigate areas as water is available to help stimulate vegetative growth.
- Develop a vegetation monitoring protocol.
- Develop a wildlife monitoring plan that correlates wildlife use and habitat conditions.

Rationale: The grass:forb mix identified in the objective requires periodic manipulation of some sort to achieve the stated ranges of the objective. The combination of resting, grazing, and burning, combined with irrigation, where available and practical, are the best tools to accomplish this. It is anticipated that on average, 1/3 to 2/3 of this area will require grazing at an average rate of 0.4 to 1.0 AUMs per acre resulting in the removal of approximately 1,950 to 4,200 AUMs of forage. Vegetative monitoring combined with wildlife use data will be needed to document that objective levels are correct.

3. Objective: Provide 210 to 425 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily native species (grasses, sedges, forbs, rushes) characterized by >30 cm visual obstruction reading, 10 to 20 cm duff layer and minimal (<5 percent) bare ground, and less than 40 percent (canopy closure) willow from mid-April through August to benefit nesting waterfowl (mallard, gadwall, pintail, scaup), songbirds (savannah sparrow, meadowlark), and foraging shorebirds if flooded (snipe, phalarope, white-faced ibis, sora, curlew, willet).

Strategies:

- Utilize grazing, resting, and burning practices to stimulate or maintain meadow conditions.
- Irrigate areas, as water is available, to help stimulate vegetative growth.
- Develop a vegetation monitoring protocol.
- Develop a wildlife monitoring plan that correlates wildlife use and habitat condition.

Rationale: The grass:forb mix identified in the objective requires periodic manipulation of some sort to achieve the stated ranges of the objective. The combination of resting, grazing, and burning, combined with irrigation, where available and practical, are the best tools to accomplish this. To meet and maintain the taller vegetation and duff layers identified, it is anticipated that rest will be utilized more for this objective. It is anticipated that on average, 1/3 to 1/2 of this area will require grazing at an average rate of 0.4 to 1.0 AUMs per acre resulting in the removal of approximately 100 to 350 AUMs of forage. Vegetative monitoring combined with wildlife use data will be needed to document that objective levels are correct.

4. Objective: Given the altered river flow regime, provide a properly functioning river channel characterized by a well defined thalweg, outside river edges that are deeper than inside edges, a river sinuosity of 2.0 to 2.5, pool spacing every 7 to 9 channel widths, active point bar formation, and gradients in riffles that are higher than in pools to benefit willow establishment for neotropical migrants, and indirectly provide suitable habitat for native and nonnative fishes.

Strategies:

- Map river channel and identify problem areas. Prioritize stretches for rehabilitation.
- Alter irrigation diversions as needed to assist in-stream restoration.
- Install in-stream structures, as necessary, to adjust thalweg, create point bars, adjust depth ratios, increase sinuosity, and/or adjust pool spacing.
- Monitor wildlife and vegetative response to these strategies.

Rationale: Mapping the river to identify current characteristics is needed in order to define where restoration is needed. Increasing flows in the river by diverting less water on upstream Refuge water rights may assist in maintaining higher water tables, especially when used in conjunction with in-stream restoration projects. Documenting vegetative, fishery, and wildlife response is necessary to ensure that the projects are working.

5. Objective: Short-term variations of habitat objectives may be considered, on a case-by-case basis, by Refuge management for important ecosystem projects within North Park.

Strategy:

- Variations in water diversions and/or grazing regimes.

Rationale: From time-to-time, projects may be proposed within the county by other agencies, non-government organizations, or private landowners that have a benefit to ecosystem health and wildlife outside of the Refuge boundary. In order to make an off-Refuge project succeed, resources normally reserved for Refuge purposes, such as water or vegetative cover, could occasionally be used to help make the off-Refuge project successful. These would not be long-term commitments of Refuge resources, but rather a management decision that a short-term diversion of these resources would better be served to benefit the ecosystem as a whole.

6. Objective: Establish a private lands program to encourage restoration of degraded riparian zones through funding and technical assistance to accomplish similar objectives as those defined for the Refuge. High priority areas are those that have immediate influence on the Refuge because of drainage or proximity.

Strategies:

- Add a full-time private lands position to the staff.
- Work with local partners and willing landowners to identify, prioritize, and restore degraded areas in North Park .

7. Objective: Work with partners to address land health issues throughout the county.

**Alternative B**

Strategy:

- Continue active Refuge participation in Sage Grouse Working Group, North Park Wetlands Focus Group, Owl Mountain Partnership, North Park Habitat Partnership Program, and any other group formed with the goals of improving land health and/or stewardship in Jackson County.

Rationale: The Refuge has the ability and resources available to restore and maintain a productive riparian area for the benefit of wildlife, fisheries, water quality, and a healthy landscape, while also utilizing local agriculture. The streams within the Refuge boundaries are a small fragment of those located within Jackson County, Colorado. By working with interested landowners and partners, the possibility exists of expanding the benefits of a healthy riparian zone throughout North Park.

## ***Wetland Habitats***

1. Objective: Maintain 10 acres of, and attempt to establish in one other wetland basin, tall ( $\geq 60$  cm visual obstruction reading) emergent vegetation in water depths  $>4$  cm over a 5-year period to provide nesting habitat for over-water nesting birds (black-crowned night-heron, white-faced ibis, waterfowl, marsh wrens, coots, rails, blackbirds).

### Strategies:

- Water level manipulation, including drawdowns, and maintaining water levels in specific wetlands from spring to fall when possible.
- Develop and implement a plan for transplanting of cattail and hardstem bulrush into specific wetlands.
- Develop and use an over-water nesting bird monitoring plan.
- Develop and implement an annual water management plan.

Rationale: Wetlands with tall dense vegetation provide a litter layer for use by nesting water birds as well as a flooded emergent litter for macroinvertebrate production. Manipulation of water levels will contribute to maintaining the existing wetlands with tall emergent vegetation. Transplanting cattail and hardstem bulrush in wetlands with the highest potential for success will help increase the availability of this type of habitat. The criteria for such wetlands would be based on such things as water control abilities, evaporation rates, and distribution. Timing of needed drawdowns for expansion of the tall dense vegetation will be planned in such a way as to get maximum benefit for all Refuge wetland objectives such as during shorebird migration or to stimulate submerged aquatic vegetation beds. Monitoring water bird species will help assess how successful habitat management is.

2. Objective: Provide 10 percent of the wetland acres, over a 5-year average, in short ( $<10$  cm), sparse ( $<10$  cm visual obstruction reading) emergent vegetation in water depths  $<4$  cm from April to August to provide foraging habitat for shorebirds and waterfowl, as well as nesting and brood-rearing habitat for shorebirds.

### Strategies:

- Water level manipulation, including full and partial drawdowns, and maintaining water levels in specific wetlands from spring to fall when possible.
- Tillage of dry wetlands as a management tool.
- Rehabilitation and maintenance of existing dikes and infrastructures.
- Conduct shorebird surveys on the Refuge.
- Monitor monthly wetland bird use.
- Develop and apply a wetland emergent/submergent vegetation monitoring plan.
- Develop and implement an annual water management plan.

3. Objective: Provide 20 percent of the wetland acres, over a 5-year average, of emergent vegetation >25 cm tall with visual obstruction reading >80 percent of vegetation height in water depths 4 to 18 cm to provide escape cover and foraging habitat for dabbling duck broods and molting ducks and foraging habitat for water birds.

Strategies:

- Water level manipulation, including full and partial drawdowns, and maintaining water levels in wetlands from spring to fall when possible.
- Tillage of dry wetlands as a management tool.
- Rehabilitation and maintenance of existing dikes and infrastructures.
- Conduct waterfowl surveys on the Refuge.
- Monitor monthly wetland bird use.
- Develop and implement a wetland emergent/submergent vegetation monitoring plan.
- Develop and implement an annual water management plan.

Rationale: The availability of a variety of wetland habitat conditions may benefit a greater diversity of wildlife species and/or support species for longer periods in their annual life cycle. The above two objectives contribute to habitats varying from shallowly flooded, short, sparse emergents to both shallow water and moderately dense cover. Water manipulation techniques, including drawdowns and back flooding, can be used to create these conditions. Using monitoring to evaluate the response of the flora and fauna will indicate success of management techniques. Short-term variations of habitat objectives may be considered, on a case-by-case basis, by Refuge management to promote other important ecosystem projects within North Park.

4. Objective: Provide 10 to 20 percent of the wetland acres within each wetland complex, over a 5-year average, with a 70 percent coverage of submergent aquatic vegetation species (*Potamogeton*, *Ruppia*) in wetlands of >18 cm water depth to provide invertebrates and seed sources for foraging water birds, especially waterfowl broods, and escape cover for diving ducks.

Strategies:

- Water level manipulation, including full and partial drawdowns, and maintaining water levels in wetlands from spring to fall when possible.
- Tillage of dry wetlands as a management tool.
- Rehabilitate and maintain existing dikes and infrastructures.
- Conduct waterfowl surveys and brood counts on the Refuge.
- Monitor monthly wetland bird use.
- Develop and implement a wetland submergent vegetation monitoring plan.
- Develop and implement an annual water management plan.

Rationale: Submergent vegetation provides a complex structure for macroinvertebrate production and a seed source for foraging water birds. *Potamogeton* and *Ruppia* both produce a food resource (plant foods and invertebrates) for waterfowl and broods. These submergents are used by other wetland birds for nesting, foraging, and escape habitat. A variety of drawdown schedules and tillage are used to enhance the growth of these plants. Monitoring the responses of plant and wildlife will gauge the level of success in providing this habitat.

5. Objective: Enhance the existing private land programs to encourage creation and restoration of wetlands in North Park and surrounding areas through funding and technical assistance to accomplish the same objectives as on the Refuge.

Strategies:

- Obtain funding and full-time equivalency for a Partners for Fish and Wildlife position.
- Working with willing stakeholders to create and restore wetlands in North Park.
- Develop a plan to identify wetland habitats throughout North Park.
- Consider wetland development opportunities as they become available.
- Continue participation in the North Park Wetland Focus Group.

Rationale: Since the Refuge is only part of the total North Park landscape, efforts to look beyond the boundaries are important in an ecosystem approach. Many wetland potentials exist in North Park, and working to restore or create these wetlands will benefit not only wildlife, but society too. To achieve the most positive results, priority projects will be close to existing wetland complexes or reasonably well functioning segment of rivers or near the larger reservoirs. Wetland management would mimic above Refuge objectives when possible. Work would be completed with the help of others to identify wetland habitats throughout North Park, partnering with willing stakeholders to restore, protect, and improve wetland habitats for wildlife use. Set up demonstration areas practicing sound wetland habitat management and improvement.

## **Meadow Habitats**

1. Objective: Provide 20 to 50 acres, over a 5-year, average of a grass:forb (75:25) plant community composed primarily of native plants (rushes, sedges, grasses, forbs) characterized by <20 cm height, <10 cm visual obstruction reading, with dry to moist soils (no standing water), adjacent to (within 50 m) or intermingled with sagebrush (10 to 25 percent sage canopy cover), from early June to late July, to benefit sage grouse and snipe broods.

### Strategies:

- Utilize grazing, resting, and burning practices to stimulate or maintain meadow conditions.
- Irrigate areas, as water is available, to help stimulate vegetative growth.
- Working with partners, develop a vegetation monitoring protocol.
- Working with partners, develop a wildlife monitoring plan that correlates wildlife use and habitat condition.

2. Objective: Provide 1,650 to 1,850 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native species (grasses, sedges, forbs, rushes) characterized by 10 to 30 cm visual obstruction reading, 0 to 10 cm duff layer and minimal (<5 percent) bare ground from mid-April to the end of July to benefit nesting waterfowl (gadwall, shoveler, pintail, green-winged teal) and sage grouse broods.

### Strategies:

- Utilize grazing, resting, and burning practices to stimulate or maintain meadow conditions.
- Irrigate areas, as water is available, to help stimulate vegetative growth.
- Working with partners, develop a vegetation monitoring protocol.
- Working with partners, develop a wildlife monitoring plan that correlates wildlife use and habitat condition.

Rationale: The grass:forb mix identified in the objective requires periodic manipulation of some sort to achieve the stated ranges of the objective. The combination of resting, grazing, and burning, combined with irrigation, where available and practical, are the best tools to accomplish this. It is anticipated that on average, 1/3 to 2/3 of this area will require grazing at an average rate of 0.4 to 1.0 AUMs per acre resulting in the removal of approximately 950 to 2,100 AUMs of forage. Vegetative monitoring, combined with wildlife use data, will be needed to document that objective levels are achieved, and whether or not objectives are correct.

3. Objective: Provide 630 to 790 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native plants (grasses, sedges, forbs, rushes) characterized by >30 cm visual obstruction reading, 10 to 20 cm duff layer and minimal (<5 percent) bare ground to benefit nesting waterfowl (mallard, gadwall, pintails, scaup), songbirds (savannah sparrow, meadow lark), and foraging shorebirds if flooded (snipe, phalarope, white-faced ibis, curlew, willet, sora).

Strategies:

- Utilize grazing, resting, and burning practices to stimulate or maintain meadow conditions.
- Irrigate areas, as water is available, to help stimulate vegetative growth.
- Working with partners, develop a vegetation monitoring protocol.
- Working with partners, develop a wildlife monitoring plan that correlates wildlife use and habitat condition.

Rationale: The grass:forb mix identified in the objective requires periodic manipulation of some sort to achieve the stated ranges of the objective. The combination of resting, grazing, and burning, combined with irrigation, where available and practical, are the best tools to accomplish this. To meet and maintain the taller vegetation and duff layers specified, it is anticipated that rest will be utilized more for this objective. It is anticipated that on average, 1/3 to 1/2 of this area will require grazing at an average rate of 0.4 to 1.0 AUMs per acre resulting in the removal of approximately 350 to 700 AUMs of forage. Vegetative monitoring, combined with wildlife use data, will be needed to document that objective levels are achieved, and whether or not objectives are correct.

4. Objective: Short-term variations of habitat objectives may be considered, on a case-by-case basis, by Refuge management for important ecosystem projects within North Park.

Strategies:

- Work with partners to identify potential projects in the county.
- Implement variations in water diversion, grazing regimes or other Refuge management strategies, as deemed appropriate.

Rationale: From time-to-time, projects may be proposed within the county by other agencies, non-government organizations, or private landowners, that have a benefit to ecosystem health and wildlife outside of the Refuge boundary. In order to make an off-Refuge project succeed, resources normally reserved for Refuge purposes, such as water or vegetative cover, could occasionally be used to help make a project successful. These would not be long-term commitments of resources, but rather a cooperative management decision that a short-term diversion of these resources would better be served to benefit the ecosystem as a whole.

5. Objective: Establish a private lands program to provide funding and technical assistance to encourage wildlife-compatible land management practices in meadow habitats to accomplish objectives similar to those of the Refuge.

Strategies:

- Add a full-time private lands position to the staff.
- Work with local partners and willing landowners to identify, prioritize, and restore degraded areas, and create new wildlife habitat in North Park .

6. Objective: Work with partners to address land health issues throughout Jackson County.

Strategy:

- Continue active Refuge participation in Sage Grouse Working Group, North Park Wetlands Focus Group, Owl Mountain Partnership, North Park Habitat Partnership Program, and any other group formed with the goals of improving land health and/or stewardship in Jackson County.

Rationale: The Refuge has the ability and resources available to maintain productive meadows for the benefit of wildlife, water quality and a healthy landscape, while also utilizing local agriculture. The meadows within the Refuge boundary were used to produce hay prior to Refuge establishment, and proposed management practices vary little from thousands of similar acres throughout the county that are still in hay production. By working with interested landowners and partners, the possibility exists of expanding the wildlife benefits of Refuge meadows and/or maintaining the benefits that are occurring on these off-Refuge sites.

## ***Upland Habitats***

<b>Alternative B</b>
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1. Objective: Provide 2,000 acres, over a 5-year average, of uplands composed of shrubs (>70 percent sagebrush) >25 cm height and 20 to 30 percent canopy cover, >20 percent grass cover, and >10 percent forbs (native species preferred) to benefit sage grouse, vesper sparrow, brewers sparrow, and elk.

### Strategies:

- Complete a sagebrush/grassland upland habitat inventory of the Refuge by 2008.
  - Use cattle grazing at varying stock rates, seasons, and intensities as a management tool for uplands.
  - Use 'rest' of varying lengths of time as a management tool for uplands.
  - Develop and implement an integrated pest management plan.
  - Use a variety of mechanical treatments of the habitat as a management tool for uplands.
  - Develop and implement a vegetation monitoring plan.
  - Develop and implement a wildlife monitoring program.
2. Objective: Provide 2,000 acres, over a 5-year average, of uplands composed of shrubs (>70 percent sage) >40 cm height and >30 percent canopy cover, <20 percent grass cover, and >5 percent forbs (native species preferred) to benefit brewer's sparrow, sage thrasher, and pronghorn antelope.

### Strategies:

- Complete upland habitat inventory by 2008.
- Use cattle grazing at varying stock rates, seasons, and intensities as a management tool for uplands.
- Use 'rest' of varying lengths of time as a management tool for uplands.
- Develop and implement an integrated pest management plan.
- Use a variety of mechanical treatments of the habitat as a management tool for uplands.
- Develop and implement a vegetation monitoring plan.
- Develop and implement a wildlife monitoring program.

Rationale: The Refuge has five primary range sites that support sagebrush/grassland uplands. The 2,000 acres of each of the above objectives are scattered within several of these range types and intermingled with meadow areas. A completed inventory of the uplands will assist in specifically defining these areas. Sagebrush/grassland uplands in a mosaic of patchy sagebrush with openings of grasses and forbs across the landscape reflect the needs of most wildlife species. Moderate livestock grazing, ranging from .05 AUM per acre to .15 AUM per acre in intensity, combined with rest will help maintain these acres. This rest rotational coverage will promote plant diversity, nutrient cycling, and cover. Controlling or eliminating noxious weeds that reduce the abundance and diversity of native forbs in the sagebrush/grassland habitats is important. Mechanical treatments will be considered in small areas to increase grass and forb components of the site. Monitoring the response of the flora and fauna will aid in assessing the success of the tools applied and help improve these methods.

3. Objective: Manage the remaining 10,000 acres of sagebrush/grassland uplands based on a better understanding of Refuge habitats, wildlife usages, and affected variables using best management practices.

Strategies:

- Complete upland habitat inventory by 2008.
- Conduct research and monitor outcomes of Refuge upland habitats over the next 15 years.
- Develop habitat based goals and objectives for the remaining Refuge upland acres (10,000) by 2017.
- Use cattle grazing at varying stock rates, seasons, and intensities as a management tool for uplands.
- Use 'rest' of varying lengths of time as a management tool for uplands.
- Develop and implement an integrated pest management plan.
- Use a variety of mechanical treatments of the habitat as a management tool for uplands.
- Develop and implement a prescribed burning program.
- Coordinate with existing projects and research and monitoring efforts in the area.
- Establish research plots to test strategies for habitat manipulations.
- Short-term variations of habitat objectives may be considered, on a case-by-case basis, by Refuge management for important ecosystem projects within North Park.

Rationale: In an effort to manage the sagebrush/grassland uplands, an inventory of what the Refuge has is essential. A variety of tools are available to provide a structurally diverse shrub community with a grass:forb component to support migratory birds and other wildlife species. Livestock grazing used in moderation at rates ranging from .05 to .15 AUMs per acre will be used. It is anticipated that approximately 1/3 to 1/2 of the upland areas will be grazed annually, resulting in 450 to 1,200 AUMs of forage being removed. Rest also needs to be used in moderation; too much rest can result in dominate brush communities that prevent herbaceous species from recovering. Grazing, used in conjunction with rest, can enhance the nutrient cycles, plant regrowth, and plant community diversity. Efforts to control and/or eradicate noxious weeds will help maintain the diversity of plant life required to provide wildlife habitat needs. Mechanical treatments break up the soil and remove a variable percent of the brush species, depending on the coverage, to promote grasses and forbs growth. Historically, frequencies of fire in the upland were low, and they were small, patchy fires. Prescribed burns may be beneficial in some upland sites to control dense stands of sagebrush so that herbaceous species can increase. The use of other upland habitat projects in the area, with range types similar to the Refuge, will help to identify successful methods for manipulating the habitat to reach the objectives. A portion of these sagebrush/grassland upland acres will be used to establish research plots to get a better understanding of how to increase sage height and grass:forb abundance to benefit nesting and wintering sage grouse, songbirds (vesper sparrow, sage thrasher, Brewer's sparrow, Swainson's hawk) and pronghorn antelope. This information will focus on the tools that might get more acres of uplands into the first two objectives. In working with the entire North Park landscape, some habitat objectives may change to accommodate actions deemed essential elsewhere in the upland habitats of the Park to improve the overall quality of wildlife habitat.

4. Objective: Manage North Park Phacelia (*Phacelia formosula*) populations currently known to exist on the Refuge to ensure its continued existence.

Strategies:

- Initiate research to understand the plant's life history and develop a management plan.
- Protect and develop a monitoring plan for the existing and future new populations.
- Work with other entities to preserve North Park Phacelia populations throughout North Park.

Rationale: The North Park Phacelia is the only known federally-listed endangered plant species on the Refuge. The plant is only found in North Park with several populations scattered across the area. Only two known populations of the plant exist on Refuge lands. Little is known about its life history, so management is limited. Research on the life history of the plant is essential. As part of a partnership approach, information and management techniques will be shared to help ensure the continued existence of the Phacelia and eventually the down-listing of the species.

5. Objective: Establish a private lands program to encourage restoration of degraded upland habitats in North Park through funding and technical assistance to accomplish the same objectives as on the Refuge.

Strategies:

- Working with other stakeholders, search out funding sources for the program.
- Develop a plan to identify upland habitats throughout North Park.
- Partner with willing stakeholders to restore, protect, and improve upland habitats.
- Initiate demonstration projects displaying various sound upland habitat management and improvement practices.
- Continue participation in North Park Habitat Protection Partnership and Owl Mountain Partnership programs.

Rationale: The Refuge plays a role in the natural systems of North Park landscape. The benefit of working with the entire North Park area is that wildlife habitat across this landscape is optimized. Resources available to the Refuge and its partners will be directed as to where they can do the most good for wildlife and habitat. Demonstrations are a good way to show how sound management can be beneficial for land stewards, wildlife, and the habitat.

## ***Public Uses***

### **Hunting**

1. Objective: Provide recreational hunting opportunities consistent with Refuge goals and objectives, and that facilitate North Park wildlife management objectives.

Strategies:

- Working with the State, develop a hunting step-down management plan that provides hunting (big game, small game and waterfowl) opportunities to meet North Park and Refuge objectives.
- Working with the State, provide limited small game and furbearer hunting opportunities depending on Refuge habitat objectives and/or population objectives North Park-wide.

2. Objective: The Refuge will work with the State in promoting sound hunting practices as a wildlife management tool.

Strategies:

- The Refuge will partner with the State and North Park Chamber of Commerce for the dissemination of information about hunting opportunities on the Refuge and throughout North Park.
- Hunting brochures and hunting information will be provided to hunters at the headquarters building.
- Assist Colorado Division of Wildlife off-Refuge with law enforcement, hunter recruitment, and hunter education when requested.

3. Objective: Facilities will be maintained, and improved as necessary, to provide a quality recreational hunting experience while minimizing resource damage.

Strategies:

- Develop five parking areas (Map 9 - Public Use - Alternative B) using post and cable methods and minimize resource damage caused by vehicles. Parking areas also provide opportunities to inform the hunting public about rules and regulations.
- Develop three permanent gates that can be locked to minimize resource damage caused by vehicles (Map 9 - Public Use - Alternative B).
- Develop a travel management plan that will revegetate two track roads (Map 9 - Public Use - Alternative B) not needed for maintenance, law enforcement, hunting access or other management purposes.
- Develop a signage plan that facilitates the public use, enhances the public's understanding of Refuge management, and the Refuge System.

Rationale: This alternative recognizes that the Refuge is part of a larger system of lands known as North Park. Given that many wildlife species in North Park migrate on and off the Refuge (waterfowl, elk, mule deer, pronghorn antelope, sage grouse), the Refuge hunting program effects more than just Refuge lands. The key to success is a strong working relationship with sportsman, the State, and incorporation of Refuge hunting goals and objectives into a hunting step-down management plan. Additional Refuge hunting opportunities (i.e. moose, elk, mule deer) will be determined in conjunction with the community and the State. The Refuge will continue to work with the State in promoting sound hunting practices as a wildlife management tool. Additionally, this alternative suggests we modify and possibly expand existing public use facilities to include emphasis on hunting both on the Refuge and in North Park. The Refuge will engage in partnerships to disseminate information on hunting opportunities throughout North Park. The Refuge would continue to utilize habitat management units A, B, C to distribute hunters, provide resting areas for migratory birds, and to minimize conflicts between hunters and other visitors.

**Fishing**

1. Objective: Where compatible, opportunities for fishing will be provided based on Refuge goals and objectives.

## Strategies:

- Encourage brown and rainbow trout fishing opportunities on the Refuge in accordance with State seasons and regulations and Refuge management objectives.
- Evaluate angler impacts to Refuge goals and objectives by 2008.
- Work with the State to develop a sport fish management plan by 2008.

2. Objective: Where possible, expand fishing opportunities throughout North Park and help promote fishing as a recreational activity.

## Strategies:

- Provide fishing information and fishing regulations to Refuge visitors when requested.
- Utilize the Service Partners for Fish and Wildlife program to improve fishery habitats on public and private lands when requested.
- When requested, assist the State on fisheries planning issues.
- Assist the State with law enforcement, fishery management, fisheries sampling, fisheries habitat projects, and spawning throughout North Park when requested.
- Partner with others to enhance fishery habitats in North Park.

Rationale: Alternative B encourages the Refuge to not only provide sport fishing opportunities on the Illinois River, but also to partner with the State and others to improve fishery habitats and promote sport fishing opportunities throughout North Park. The Illinois River fishery is influenced by management actions that occur upstream of the Refuge. Logically, it is important that the Refuge assist, when requested, with habitat projects that impact the Illinois River upstream of the Refuge. Similarly, habitats throughout North Park are connected through a system of waterways. Refuge efforts to improve aquatic habitats, when requested, benefit all in North Park. The downside to this strategy involves using very limited personnel and resources on areas other than strictly Refuge grounds that may result in Refuge goals and objectives being delayed or not being met. Partnerships are the key to success when funds and personnel are limited. This alternative strives to include the Refuge as a partner on fishery related habitat improvement projects in North Park.

## Wildlife Observation and Photography

### Alternative B

1. Objective: Enhance Refuge opportunities for wildlife observation and photography based on Refuge habitat goals and objectives by 2017.

#### Strategies:

- Rebuild Brocker Overlook by 2004.
- Construct Brocker trail to homestead site by 2006.
- Construct hiking trail from Walden to Brocker overlook by 2008.
- Enhance auto tour route road.
- Maintain Refuge Visitor Center for distribution of information.
- Keep brochures current with updated information.
- Complete and maintain boardwalk section of interpretive nature trail.
- Build moose observation platform by 2005.
- Construct wildlife photography blinds on the auto tour route by 2006.
- Establish use limitations for wildlife observation and photography based on habitat goals and objectives.
- Maintain and potentially modify existing facilities to reflect new management strategies.

Rationale: Current visitation to the Refuge ranges from 7,000 to 9,000 visits (visit is defined as a person crossing the Refuge boundary). Many opportunities to enhance viewing and photography of wildlife while maintaining habitat goals are available. Each strategy should be designed to facilitate a quality experience for the visitor while fulfilling Refuge goals and objectives.

2. Objective: Assist with funding, construction, and program development to enhance wildlife photography and observation in North Park.

#### Strategies:

- Develop and disseminate information on the best wildlife observation and photography opportunities throughout North Park.
- Partner with the State and others to construct and provide observation facilities for moose and other desirable species.
- Pursue funding and partners to assist with the construction of viewing/photography blinds at Walden Reservoir.
- Assist partners with revising the "Watching Wildlife in North Park" guide by 2006.
- Create partnership with other wildlife-oriented organizations and individuals.

Rationale: Recreation plays a major role in the economy of North Park. Wildlife viewing and photography are key factors in the recreational opportunities available. Enhancing these uses will be beneficial to the economy as well as creating a better understanding of wildlife and its habitats.

## **Environmental Education/Interpretation**

1. Objective: Work with partners, including the North Park School District, to provide opportunities and facilities to conduct 5 environmental education programs a year, based on Refuge habitat goals and objectives.

### Strategies:

- Work with partners to develop specific environmental education programs covering: habitat management practices and principles; the natural history of North Park; agricultural and wildlife; the life history of various local species including waterfowl, sage grouse, elk and moose; North Park and its importance to Colorado waterfowl; how a Refuge comes into existence and what its role is; water issues and needs.
  - Use existing environmental education opportunities as they occur, such as the water carnival, bird banding, Refuge field trips, and Day in the Woods.
  - Create programs for students and volunteers to assist in management tasks for service learning.
2. Objective: Incorporate the Refuge and its niche in the North Park landscape in other environmental education messages developed in the county.

### Strategies:

- Partner with other land management agencies, non-government organizations, local schools, and private individuals to expand the network of environmental education programs and facilities in North Park.
  - Hire an outdoor recreation planner to conduct outreach and education activities on the Refuge and North park.
3. Objective: Update Refuge interpretive message to reflect recent wildlife issues and concerns (elk, sage grouse), habitat based decision-making, local agricultural uses and how they are not mutually exclusive on or off the Refuge.

### Strategies:

- Replace signs on the kiosks, overlooks, trails and visitor center, and pamphlets, and update the Refuge website to reflect a message of the Refuge working for wildlife and county-wide environmental interests.
- Rehabilitate the Case Barn and develop an interpretive site there presenting the relationship between the county's ranching history and wildlife.

4. Objective: Incorporate the Refuge and its niche in the North Park landscape in other interpretive messages developed in the county.

**Alternative B**

Strategy:

- Partner with other entities in the development of interpretive material involving the land management of North Park to identify the role of the Refuge.

Rationale: Arapaho National Wildlife Refuge is located almost in the geographic center of North Park. It is known to most residents as a major part of the county landscape, but exactly what the Refuge does and how it contributes to that landscape is not fully understood. Similarly, most out-of-county visitors do not understand how the lands surrounding the Refuge compliment its wildlife-oriented goals. An outdoor recreation planner position will facilitate integration of environmental education at the Refuge and in Jackson County schools. Articulating the story of history of North Park and how the Refuge and the surrounding lands benefit each other will be beneficial to all interests.

## Other Uses

1. Objective: Compatible, non-wildlife-dependent uses will be allowed, but limited to less sensitive areas based on habitat goals and objectives.

### Strategies:

- Continue operation of the rifle range to facilitate law enforcement firearms requalification for Refuge officers, Colorado Division of Wildlife officers, and other local law enforcement agencies on request.
- Prepare and implement a travel management plan to minimize vehicle impacts to Refuge habitats by 2006.
- Use law enforcement, signs, information, and brochures to minimize impacts of non-wildlife-dependent public uses.
- Identify and prioritize non-Refuge mineral rights within Refuge boundaries by January 2005.
- Acquire, on a willing-seller basis, priority mineral rights by 2010.
- With Partners, design and construct the Brocker overlook site (Phase 1) by 2004; incorporate Refuge goals and objectives.
- Continue operation of the Allard gravel pit to support both Refuge and county roads (on-Refuge) requirements.

2. Objective: Consider non-wildlife-dependent public uses and their benefits to North Park and its residents.

### Strategies:

- With Partners, design and construct the Case Barn interpretive loop by 2008. Incorporate North Park and Refuge history and the preservation of wildlife habitats as a theme in the interpretation.
- Encourage partners to be sensitive to wildlife needs when developing recreational opportunities in North Park.

Rationale: Alternative B encourages compatible, non-wildlife-dependent uses be limited to less sensitive areas based on habitat goals and objectives. Mineral resource development impacts wildlife habitat. This alternative seeks to identify non-federally owned minerals within the Refuge boundary and purchase those rights on a willing seller basis to minimize future resource damage. The rifle range will continue to operate as it already facilitates Refuge and North Park law enforcement needs. The travel management plan must meet Refuge compatibility determination, facilitate management, and public use requirements. The Allard gravel pit supports Refuge and county roads (on Refuge) and will remain active to support Refuge goals and objectives.

## **Cultural Resources**

<b>Alternative B</b>
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1. Objective: Identify existing Refuge cultural resources and protect from degradation.

Strategies:

- Prior to any Federal action, complete a cultural resources survey, in compliance with Section 106 of the NHPA, for those areas of the Refuge that have not been surveyed.
- Request the State of Colorado determine the historical status of the Hampton and Case Barns by 2003.
- Protect cultural resources found on the Refuge by minimizing disturbance in sensitive areas.
- When possible, preserve historical records by conducting oral interviews with local historians.
- Apply for monies (grants, maintenance management funds, etc.) to restore and preserve the Case Barn by 2007.
- Support provisions within the Archaeological Resources Protection Act by developing a plan for managing Refuge and archaeological resources.

2. Objective: Encourage interpretation and protection of cultural resources and their importance to North Park wildlife resources.

Strategies:

- Interpret the Case Barn by extending the tour route to include the barn. Develop an interpretive area adjacent to the Case Barn that discusses its regional significance by 2007.
- Protect the Hampton Barn with fencing, and develop a single interpretive sign that discusses the barn's significance as the first dairy barn in North Park by 2007.
- Interpret history of North Park at the Brocker overlook site by 2004.
- By 2004, develop an interpretive area within the headquarters building that demonstrates connectivity of the Refuge with the remainder of North Park.
- When requested, and dependent on a available funding, partner with other individuals and agencies to protect and preserve cultural resources that relate to wildlife throughout North Park.

Rationale: This alternative describes a broader cultural resource role for the Refuge. The philosophy of this alternative is to comply with existing cultural resource related laws and policies, and to protect Refuge cultural resources from degradation. Additionally, this alternative encourages protection and interpretation of cultural resources that relate to North Park wildlife. Interpreting the role of ranches in the preservation of habitat can serve as an example for visitors to learn and gain a greater appreciation for wildlife and their habitats.

## **Research**

1. Objective: Identify and promote the biological research needed to help achieve the Refuge's habitat goals and objectives.

### Strategies:

- Identify and prioritize habitat management research needs by 2004.
- Conduct in-house research on priority needs.
- Promote the Refuge research needs within the scientific community. Encourage research that focuses directly on the Refuge's habitat management goals.

2. Objective: Identify and promote research in other disciplines (e.g. how to lessen the impacts of public uses) as it relates and contributes to achieving habitat goals and objectives on the Refuge and within North Park.

### Strategies:

- Identify and prioritize research related to the Refuge and North Park wildlife in other disciplines needs by 2004.
- Encourage research in other disciplines that facilitates the Refuge and achieve goals and objectives.
- Allow and encourage research that focuses on natural resource management goals throughout North Park.

Rationale: This alternative focuses on identifying and implementing the biological research needs of the Refuge and North Park. Research will focus on achieving the habitat goals and objectives outlined in this plan. Identified research needs can then be promoted within the scientific community and actively encouraged by Refuge staff. Proposed research, not falling within the categories identified, would generally not be allowed. Conversely, research meeting identified Refuge needs could be supported with funding, lodging, equipment sharing, etc. Disturbance to resident wildlife and habitat is the primary concern. Limiting non-Refuge identified projects will minimize unnecessary disturbance and habitat damage.

## **Partnerships**

<b>Alternative B</b>
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1. Objective: The Refuge will participate in partnerships that promote sound wildlife management.

### Strategies:

- Engage in partnerships that result in wildlife and/or land-health improvements.
- Participate in Habitat Partnership Program, Owl Mountain Partnership, Sage Grouse Working Group, Colorado Wetlands Initiative, Platte/Kansas Rivers Ecosystem team, and others to protect enhance or restore wildlife habitats.
- Work with partners to achieve the Refuge goals and objectives.
- Work with Colorado Land Trust and others to help acquire lands and mineral rights within the Refuge's approved boundaries. Minerals extraction may cause habitat disturbance within the Refuge.

2. Objective: Maintain or form partnerships to achieve the wildlife related goals and objectives on the Refuge and within North Park.

### Strategies:

- Promote new partnerships (consider partnering with Ducks Unlimited, Trout Unlimited, Safari Club International, Audubon, Sierra Club, and others) to assist with achieving the Refuge and North Park natural resource goals.
- Establish a full-time Private Lands Coordinator position to be stationed at the Refuge to assist in wildlife habitat enhancement throughout North Park.

Rationale: This alternative describes the potential level of partnership activity that will improve wildlife habitats throughout North Park. The Refuge will form partnerships to promote sound wildlife management within and outside the Refuge. The Refuge staff will actively participate in partnerships that result in improvements to land health and provide appropriate wildlife habitat in North Park. The Refuge will collaborate with partners on management of critical wildlife habitats in North Park. The private lands position will enable the Service to contribute its biological expertise and resources to private and public landowners when requested.

## **Alternative C**

### ***Riparian Habitats***

## **Alternative C**

1. Objective: Restore 50 to 100 acres of dense (40 to 100 percent) willow in patches >0.2 ha and 20 m wide in the central third of the Illinois River (from the north end of the Island to the confluence of Spring Creek) to connect existing willow patches and maintain 535 acres of dense willow in patches in the upper third of the Illinois River to benefit nesting neotropical migratory songbirds (yellow warbler, willow flycatcher) and resident moose, river otter, and beaver.

#### Strategies:

- Willow plantings along the stream corridor combined with 8 foot fences to exclude large herbivores.
- Water manipulation Refuge-wide that may involve decreased diversions to maintain in-stream flows for willow establishment.
- Construction of small artificial dams in the river to raise water tables locally to aid in willow establishment.
- Establish a vegetation monitoring plan to assess health of established willow stands, and measure and document success or changes needed in reestablishment efforts. Plan should include herbivory and hydrology factors.
- Wildlife monitoring will occur to document changes in wildlife use and possible correlations to changes in habitat.

Rationale: Sections of the Illinois River on the Refuge had willows removed prior to acquisition by the FWS, probably in an effort to increase hay yields. These open stretches of river have: less bank stability resulting in potential for increased sedimentation; decreased shade over the stream resulting in increased water temperatures for trout; and sparse woody vegetation for use by songbirds or other wildlife. A section of river further downstream from the proposed reestablishment site has had livestock grazing removed for 8 years, but has shown little willow regeneration. Given the growth characteristics of willows, these results lead to the conclusions that there is either significant herbivory other than livestock restraining willow expansion, and/or hydrology has been altered enough with upstream diversions that lack of groundwater is keeping willow establishment from occurring. With this in mind, willow plantings will only be done in association with fencing, and consideration of hydrological needs will be used as well. Possible methods of increasing groundwater needs will be: to divert less water upstream for other Refuge purposes; locate willow plantings adjacent to existing beaver dams to take advantage of higher water tables near these ponds; place logs in the stream to create simulated beaver dams and raise water tables adjacent to areas to be planted. Monitoring will be essential to document reestablishment efforts and to note any significant changes to existing willow communities.

2. Objective: Provide 3,630 to 3,845 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native plants (rushes, sedges, grasses, forbs) characterized by 10 to 30 cm visual obstruction reading, 0 to 10 cm duff layer and minimal (<5 percent) bare ground and less than 40 percent (canopy closure) willow to benefit nesting waterfowl (pintail, shoveler, gadwall, green-winged teal) and sage grouse broods.

Strategies:

- Utilize grazing, resting, and burning practices to stimulate or maintain meadow conditions.
- Irrigate areas, as water is available, to help stimulate vegetative growth.
- Develop a vegetation monitoring protocol.
- Develop a wildlife monitoring plan that correlates wildlife use and habitat conditions.

Rationale: The grass:forb mix identified in the objective requires periodic manipulation of some sort to achieve the stated ranges of the objective. The combination of resting, grazing, and burning, combined with irrigation, where available and practical, are the best tools to accomplish this. It is anticipated that on average, 1/3 to 2/3 of this area will require grazing at an average rate of 0.4 to 1.0 AUMs per acre resulting in the removal of approximately 1,950 to 4,200 AUMs of forage. Vegetative monitoring combined with wildlife use data will be needed to document that objective levels are correct.

3. Objective: Provide 210 to 425 acres, over a 5-year average, of a grass:forb (75:25) plant community composed of primarily native species (grasses, sedges, forbs, rushes) characterized by <30 cm visual obstruction reading, 10 to 20 cm duff layer and minimal (<5 percent) bare ground, and less than 40 percent (canopy closure) willow from mid-April through August to benefit nesting waterfowl (mallard, pintail, gadwall, scaup), songbirds (savannah sparrow, meadowlark), and foraging shorebirds if flooded (snipe, phalarope, white-faced ibis, sora, long-billed curlew, willet).

Strategies:

- Utilize grazing, resting, and burning practices to stimulate or maintain meadow conditions.
- Irrigate areas, as water is available, to help stimulate vegetative growth.
- Develop a vegetation monitoring protocol.
- Develop a wildlife monitoring plan that correlates wildlife use and habitat conditions.

Rationale: The grass:forb mix identified in the objective requires periodic manipulation of some sort to achieve the stated ranges of the objective. The combination of resting, grazing, and burning, combined with irrigation, where available and practical, are the best tools to accomplish this. To meet and maintain the taller vegetation and duff layers identified, it is anticipated that rest will be the primary tool for this objective. It is anticipated that on average, 1/3 to 1/2 of this area will require grazing at an average rate of 0.4 to 1.0 AUMs per acre resulting in the removal of approximately 100 to 350 AUMs of forage. Vegetative monitoring, combined with wildlife use data, will be needed to document that objective levels are correct.

4. Objective: Given the altered river flow regime, provide a properly functioning river channel characterized by a well defined thalweg, outside river edges that are deeper than inside edges, a river sinuosity of 2.0 to 2.5, pool spacing every 7 to 9 channel widths, active point bar formation, and gradients in riffles that are higher than in pools to benefit willow establishment for neotropical migrant, and indirectly provide suitable habitat for native and nonnative fishes.

Strategies:

- Map river channel and identify problem areas. Prioritize stretches for rehabilitation.
- Alter irrigation diversions, as needed, to assist in-stream restoration.
- Install in-stream structures, as necessary, to adjust thalweg, create point bars, adjust depth ratios, increase sinuosity, and/or adjust pool spacing.
- Monitor wildlife and vegetative response to these strategies.

Rationale: Mapping the river to identify current characteristics is needed in order to define where restoration is needed. Increasing flows in the river by diverting less water on upstream Refuge water rights may assist in maintaining higher water tables, especially when used in conjunction with in-stream restoration projects. Documenting vegetative, fishery, and wildlife response is necessary to ensure that the improvements are supplying the sought after benefits.

## **Wetland Habitats**

1. Objective: Maintain 10 acres of, and attempt to establish in one other wetland basin, tall ( $\geq 60$  cm visual obstruction reading) emergent vegetation in water depths  $>4$  cm over a 5-year period to provide nesting habitat for over-water nesting birds (black-crowned night heron, white-faced ibis, waterfowl, marsh wrens, coots, rails, blackbirds).

### Strategies:

- Water level manipulation including drawdowns and maintaining water levels in specific wetlands from spring to fall when possible.
- Develop and apply a plan for transplanting of cattail and hardstem bulrush into specific wetlands.
- Develop and implement an over-water nesting bird monitoring plan.
- Develop and use an annual water management plan.

Rationale: Wetlands with tall dense vegetation provide a litter layer for use by nesting water birds as well as a flooded emergent litter for macroinvertebrate production. Manipulation of water levels will contribute to maintaining the existing wetlands with tall emergent vegetation. Transplanting cattail and hardstem bulrush in wetlands with the highest potential for success will help increase the availability of this type of habitat. The criteria for such wetlands would be based on such things as water control abilities, evaporation rates, and distribution. Timing of needed drawdowns for expansion of the tall dense vegetation will be planned in such a way as to get maximum benefit for all Refuge wetland objectives such as during shorebird migration or to stimulate submerged aquatic vegetation beds. Monitoring water bird species will help rate how successful habitat management is.

2. Objective: Provide 10 percent of the wetland acres, over a 5-year average, in short ( $<10$  cm), sparse ( $<10$  cm visual obstruction reading), emergent vegetation in water depths  $<4$  cm from April to August to provide foraging habitat for shorebirds and waterfowl, as well as nesting and brood-rearing habitat for shorebirds.

### Strategies:

- Water level manipulation, including full and partial drawdowns, and maintaining water levels in specific wetlands from spring to fall when possible.
- Tillage of dry wetlands as a management tool.
- Rehabilitation and maintenance of existing dike and infrastructures.
- Conduct shorebird surveys on the Refuge.
- Monitor monthly wetland bird use.
- Develop and apply a wetland emergent/submergent vegetation monitoring plan.
- Develop and implement an annual water management plan.

2. Objective: Provide 20 percent of the wetland acres, over a 5-year average, of emergent vegetation >25 cm tall with visual obstruction reading >80 percent of vegetation height in water depths 4 to 18 cm to provide escape cover and foraging habitat for dabbling duck broods and molting ducks and foraging habitat for water birds.

Strategies:

- Water level manipulation, including full and partial drawdowns, and maintaining water levels in specific wetlands from spring to fall when possible.
- Tillage of dry wetlands as a management tool.
- Rehabilitation and maintenance of existing dike and infrastructures.
- Conduct shorebird surveys on the Refuge.
- Monitor monthly wetland bird use.
- Develop and apply a wetland emergent/submergent vegetation monitoring plan.
- Develop and implement an annual water management plan.

Rationale: The availability of a variety of wetland habitat conditions may benefit a greater diversity of wildlife species and/or support species for longer periods in their annual life cycle. The above two objectives contribute to habitats varying from shallowly flooded, short, sparse emergents to both shallow water and moderately dense cover. Water manipulation techniques, including drawdowns and back flooding, can be used to create these conditions. The use of monitoring to evaluate the response of the flora and fauna will indicate success of management techniques.

3. Objective: Provide 10 to 20 percent of the wetland acres within each wetland complex, over a 5-year average, with a 70 percent coverage of submergent aquatic vegetation species (*Potamogeton*, *Ruppia*) in wetlands of >18 cm water depth to provide invertebrates and seed sources for foraging water birds, especially waterfowl broods, and escape cover for diving ducks.

Strategies:

- Water level manipulation, including full and partial drawdowns, and maintaining water levels in wetlands from spring to fall when possible.
- Tillage of dry wetlands as a management tool.
- Rehabilitate and maintain existing dikes and infrastructures.
- Conduct waterfowl surveys and brood counts on the Refuge.
- Monitor monthly wetland bird use.
- Develop and apply a wetland submergent vegetation monitoring plan.
- Develop and implement an annual water management plan.

Rationale: Submergent vegetation provides a complex structure for macroinvertebrate production and a seed source for foraging water birds. *Potamogeton* and *Ruppia* both produce a food resource (plant foods and invertebrates) for waterfowl and broods. These submergents are used by other wetland birds for nesting, foraging, and escape habitat. A variety of drawdown schedules and tillage are used to enhance the growth of these plants. Monitoring the responses of plant and wildlife will gauge the level of success in providing this habitat.

## **Meadow Habitats**

1. Objective: Provide 20 to 50 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native plants (rushes, sedges, grasses, forbs) characterized by <20 cm height, <10 cm visual obstruction reading, with dry to moist soils (no standing water), adjacent to (within 50 m) or intermingled with sagebrush (10 to 25 percent sage canopy cover), from early June to late July, to benefit sage grouse and snipe broods.

### Strategies:

- Utilize grazing, resting, and burning practices to stimulate or maintain meadow conditions.
- Irrigate areas as water is available to help stimulate vegetative growth.
- Develop a vegetation monitoring protocol.
- Develop a wildlife monitoring plan that correlates wildlife use and habitat condition.

2. Objective: Provide 1,650 to 1,850 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native species (grasses, sedges, forbs, rushes) characterized by 10 to 30 cm visual obstruction reading, 0 to 10 cm duff layer and minimal (<5 percent) bare ground from mid-April to the end of July to benefit nesting waterfowl (gadwall, shoveler, pintail, green-winged teal) and sage grouse broods.

### Strategies:

- Utilize grazing, resting, and burning practices to stimulate or maintain meadow conditions.
- Irrigate areas as water is available to help stimulate vegetative growth.
- Develop a vegetation monitoring protocol.
- Develop a wildlife monitoring plan that correlates wildlife use and habitat condition.

Rationale: The grass:forb mix identified in the objective requires periodic manipulation of some sort to achieve the stated ranges of the objective. The combination of resting, grazing, and burning, along with irrigation, where available and practical, are the best tools to accomplish this. It is anticipated that on average, 1/3 to 2/3 of this area will require grazing at an average rate of 0.4 to 1.0 AUMs per acre resulting in the removal of approximately 950 to 2,100 AUMs of forage. Vegetative monitoring, combined with wildlife use data, will be needed to document that objective levels are correct.

3. Objective: Provide 630 to 790 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native plants (grasses, sedges, forbs, rushes) characterized by >30 cm visual obstruction reading, 10 to 20 cm duff layer and minimal (<5 percent) bare ground to benefit nesting waterfowl (mallard, gadwall, pintails, scaup), songbirds (savannah sparrow, meadow lark), and foraging shorebirds if flooded (snipe, phalarope, white-faced ibis, curlew, willet, sora).

Strategies:

- Utilize grazing, resting, and burning practices to stimulate or maintain meadow conditions.
- Irrigate areas as water is available to help stimulate vegetative growth.
- Develop a vegetation monitoring protocol.
- Develop a wildlife monitoring plan that correlates wildlife use and habitat condition.

Rationale: The grass:forb mix identified in the objective requires periodic manipulation of some sort to achieve the stated ranges of the objective. The combination of resting, grazing, and burning, along with irrigation, where available and practical, are the best tools to accomplish this. To meet and maintain the taller vegetation and duff layers specified, it is anticipated that rest will be the utilized more for this objective. It is anticipated that on average, 1/3 to 1/2 of this area will require grazing at an average rate of 0.4 to 1.0 AUMs per acre resulting in the removal of approximately 350 to 700 AUMs of forage. Vegetative monitoring, combined with wildlife use data, will be needed to document that objective levels are correct.

## ***Upland Habitats***

<b>Alternative C</b>
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1. Objective: Provide 2,000 acres, over a 5-year average, of uplands composed of shrubs (>70 percent sage) >25 cm height and 20 to 30 percent canopy cover, >20 percent grass cover, and >10 percent forbs (native species preferred) to benefit sage grouse, vesper sparrow, brewers sparrow, elk, and pronghorn antelope.

### Strategies:

- Complete a sagebrush/grassland upland habitat inventory of the Refuge by 2008.
  - Use cattle grazing at varying stock rates, seasons, and intensities as a management tool for uplands.
  - Use 'rest' of varying lengths of time as a management tool for uplands.
  - Develop and implement an integrated pest management plan.
  - Use a variety of mechanical treatments of the habitat as a management tool for uplands.
  - Develop and implement a vegetation monitoring plan.
  - Develop and implement a wildlife monitoring program.
2. Objective: Provide 2,000 acres, over a 5-year average, of uplands composed of shrubs (>70 percent sage) >40 cm height and >30 percent canopy cover, <20 percent grass cover, and >5 percent forbs (native species preferred) to benefit brewer's sparrow, sage thrasher, and pronghorn antelope.

### Strategies:

- Complete upland habitat inventory by 2008.
- Use cattle grazing at varying stock rates, seasons, and intensities as a management tool for uplands.
- Use 'rest' of varying lengths of time as a management tool for uplands.
- Develop and implement an integrated pest management plan.
- Use a variety of mechanical treatments of the habitat as a management tool for uplands.
- Develop and implement a vegetation monitoring plan.
- Develop and implement a wildlife monitoring program.

Rationale: The Refuge has five primary range sites that support sagebrush/grassland uplands. The 2,000 acres of each of the above objectives are scattered within several of these range types and intermingled with meadow areas. A completed inventory of the uplands will assist in specifically defining these areas. Sagebrush/grassland uplands in a mosaic of patchy sagebrush with openings of grasses and forbs across the landscape reflect the needs of most wildlife species. Moderate livestock grazing, ranging from .05 AUM per acre to .15 AUM per acre in intensity, combined with rest will help maintain these acres. This rest rotational coverage will promote plant diversity, nutrient cycling, and cover. Controlling or eliminating noxious weeds that reduce the abundance and diversity of native forbs in the sagebrush/grassland habitats is important. Mechanical treatments will be considered in small areas to increase grass and forb components of the site. Monitoring the response of the flora and fauna will aid in assessing the success of the tools applied and help improve these methods.

3. Objective: Manage the remaining 10,000 acres of sagebrush/grassland uplands based on a better understanding of Refuge habitats, wildlife uses, and affected variables using best management practices.

Strategies:

- Complete upland habitat inventory by 2008.
- Use cattle grazing at varying stock rates, seasons, and intensities as a management tool for uplands.
- Use 'rest' of varying lengths of time as a management tool for uplands.
- Develop and implement an integrated pest management plan.
- Use a variety of mechanical treatments of the habitat as a management tool for uplands.
- Develop and implement a prescribed burning program.
- Coordinate with existing projects and research and monitoring efforts in the area.
- Establish research plots to test strategies for habitat manipulations.

Rationale: In an effort to manage the sagebrush/grassland uplands, an inventory of what the Refuge has is essential. A variety of tools are available to provide a structurally diverse shrub community, with a grass:forb component to support migratory birds and other wildlife species. Periodic grazing by livestock is the main tool anticipated to maintain these acres but this may vary annually from complete rest to high intensity to using another tool. The rates used to obtain desired results will most likely range from .05 to .15 AUMs per acre. Rest will be used in moderation as too much rest can result in dominate brush communities that prevent herbaceous species from recovering. Moderate grazing used in conjunction with rest can enhance the nutrient cycles, plant regrowth, and plant community diversity. Efforts to control and/or eradicate noxious weeds will help maintain the diversity of plant life required to provide wildlife habitat needs. Mechanical treatments break up the soil and remove a variable percent of the brush species, depending on the coverage, to promote grasses and forbs growth. Historically, frequencies of fire in the upland were low, and they were small, patchy fires. Prescribed burns may be beneficial in some upland sites to control dense stands of sagebrush so that herbaceous species can increase. The use of other upland habitat projects in the area, with range types similar to the Refuge, will help to identify successful methods for manipulation the habitat to reach the objectives. A portion of these sagebrush/grassland upland acres will be used to establish research plots to get a better understanding of how to increase sage height and grass:forb abundance to benefit nesting and wintering sage grouse, songbirds (vesper sparrow, sage thrasher, Brewer's sparrow, Swainson's hawk) and pronghorn antelope. This information will focus on the tools that might get more acres of uplands into the first two objectives.

4. Objective: Manage North Park Phacelia populations currently known to exist on the Refuge to ensure its continued existence.

**Alternative C**

Strategies:

- Initiate research to understand the plant's life history and develop a management plan.
- Protect and develop a monitoring plan for the existing and future new populations.

Rationale: The North Park Phacelia is the only known federally-listed endangered plant species on the Refuge. Two known populations of the plant exist on Refuge lands, but little is known about its life history. To properly manage the North Park Phacelia, research on its life history is essential. Monitoring the plant will aid in evaluating management techniques and help ensure the continued existence of the Phacelia and eventually the down-listing of the species.

## **Public Uses**

(See Map 11 - Public Use - Alternative C)

### **Hunting**

1. Objective: Working with the State, provide hunting opportunities to meet the Refuges habitat goals and objectives.

#### Strategies:

- If huntable populations are not impacting goals, continue to promote existing recreational hunting program (450 to 550 hunter visits annually) of migratory birds, waterfowl, small game, and pronghorn antelope, in accordance with State seasons and regulations.
- Develop a hunting step-down management plan that provides limited small and big game hunting opportunities. Include Pole Mountain in the plan, and submit a Notice of Change to the Federal Register by 2006.

2. Objective: Use hunting as a tool to minimize impacts of herbivory (elk, moose, cattle) on habitat based goals and objectives.

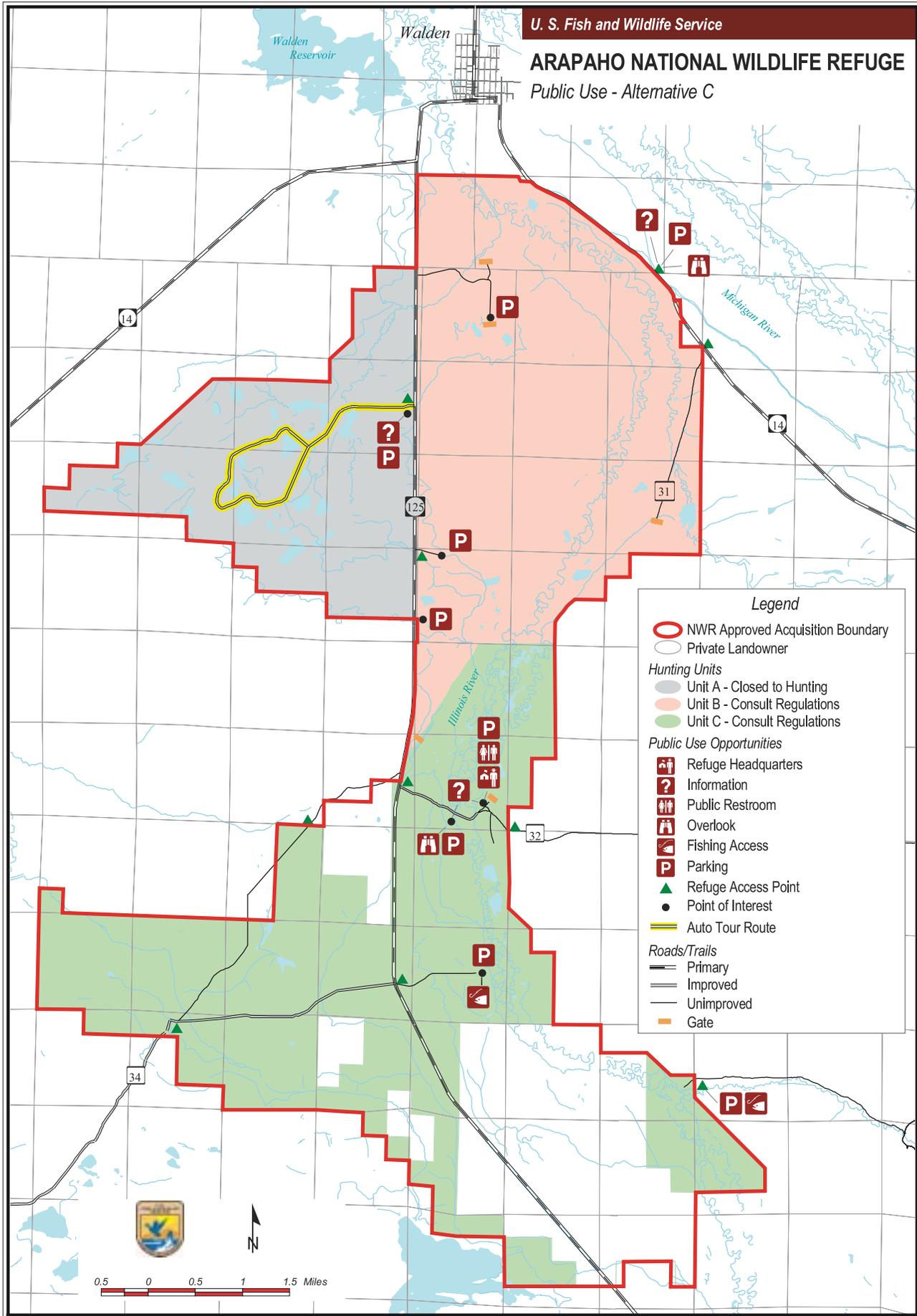
#### Strategies:

- Evaluate impacts of herbivory on habitat based goals and objectives.
- Install exclosures in uplands, riparian, and meadow habitat types; evaluate herbivory impacts to each habitat.
- Work with partners (see Partnership Section) to investigate the impacts of herbivory on goals and objectives. Develop methods to minimize or mitigate herbivory impacts.
- Develop a wintering elk carrying capacity for the Refuge by 2006.

3. Objective: Facilities (parking areas, roads, signs) will be improved to accommodate hunting and minimize impacts on the Refuge.

#### Strategies:

- Infrastructure will be limited to minimize habitat impacts.
- Develop parking areas, close roads, promote walk-in access, improve information signs to better inform hunters, and minimize hunter impacts.
- Continue to utilize habitat management units A, B, C to distribute hunters, provide resting areas for migratory birds, and to minimize conflicts between hunters and other visitors.



**Map 11 - Public Use - Alternative C**

4. Objective: Working with the State, provide big game hunting opportunities on the Refuge to meet Refuge habitat goals and objectives.

**Alternative C**

Strategies:

- When the elk numbers exceed 1,500 animals for a period of 10 or more days, utilize limited elk hunting to remove and distribute elk to minimize impacts to Refuge habitats.
- Additional huntable species (i.e. moose, elk, mule deer) will be determined in conjunction with the State and guided by Refuge goals and objectives.
- Conduct public outreach to explain the Refuge hunting program and habitat based goals and objectives.

Rationale: Alternative C utilizes hunting simply as a tool to achieve Refuge goals and objectives. Existing hunting programs will be evaluated and impacts minimized or mitigated. Refuge facilities will be modified to provide information on the Refuge hunt program. Parking areas and roads will be evaluated and reconstructed to minimize hunter impacts to Refuge habitats. Walk-in hunts will be promoted provided hunters can still accomplish hunting goals. The Refuge will eliminate interior roads, facilities, and other infrastructure not needed for habitat management purpose. A wintering elk carrying capacity will be developed by 2006. Prior to 2006, and working with the State, the Refuge will consider elk hunting when elk numbers exceed 1,500 animals for a period of 10 or more days. This tool will be used to reduce elk numbers and distribute elk away from sensitive Refuge habitats.

## **Fishing**

1. Objective: Allow recreational fishing only when it does not conflict with habitat based goals and objectives.

### Strategies:

- By 2005, evaluate angler numbers and impacts to nesting waterfowl and riparian-dependent species.
- Limit fishing opportunities to smaller areas of the Refuge, and focus on efforts of fishery habitat restoration.
- Fishing is closed during June and July to protect nesting waterfowl and other riparian nesting species.
- Sport fishing opportunities will only be allowed in the Refuge on areas where habitat restoration has been completed and where determined to be compatible with Refuge goals and objectives.
- Modify Refuge signs to reflect any new fishing regulations.
- Promote fishing in other parts of North Park to minimize impacts to Refuge resources.
- Encourage brown and rainbow trout fishing opportunities on the Refuge in accordance with State seasons and regulations and Refuge management objectives.
- Work with the State to develop a Refuge sport fishery management plan by 2006.

Rationale: Alternative C focuses Refuge resources on improving Refuge fishery habitats and evaluating angler impacts. Thorough evaluation of angler impacts, and minimizing those impacts to nesting waterfowl and riparian species is critical to successful implementation of this alternative. Limited brown and rainbow trout fishing opportunities on the Refuge would be authorized, in accordance with State seasons and regulations, only if compatible with current goals and objectives. At a minimum, fishing is closed during June and July to protect nesting waterfowl. Habitat improvement projects are focused on Refuge lands, thus, achieving goals will be realized much faster than Alternative B.

## **Wildlife Observation and Photography**

1. Objective: Encourage wildlife observation and photography from Refuge edge only by 2010.

### Strategies:

- Eliminate existing public facilities, or move them to the Refuge edge, to minimize impacts of public use by 2015.
- Provide information on wildlife observation and photography opportunities elsewhere in North Park by 2004.
- Cooperatively develop wildlife observation and photography brochures with Colorado Division of Wildlife, Chamber of Commerce, and other interested parties.

Rationale: Refuge objectives under this alternative are strictly addressing the habitat needs of wildlife. Roads, trails, and blinds have the potential to interfere with meeting these objectives. If all public use facilities are moved to the edge of the Refuge, this potential is removed.

**Environmental Education/Interpretation**

1. Objective: Modify environmental education and interpretation programs to focus on how and why the Refuge intensively manages habitats to achieve Refuge goals and purposes by 2005.

## Strategies:

- Work with the North Park School District, Colorado Division of Wildlife, and other interested entities to design and provide two environmental education programs per year.
- Modify signs and printed material to reflect intensive habitat management efforts and minimal visitor use.

2. Objective: Redesign Refuge interpretation and environmental education programs to minimize disturbance to Refuge lands.

## Strategies:

- Concentrate messages/signage to perimeter of Refuge.
- Environmental education programs will emphasize classroom work. Any on-the-ground environmental education will be in designated areas only to limit impact to habitat.
- Eliminate public use facilities not immediately adjacent to highways, county roads, or primary Refuge roads.
- Create virtual access to many parts of the Refuge using cameras and the Internet, and also at the visitor facility.
- Close the auto tour route by 2003 and revegetate by 2010.
- Any proposed additions or changes to facilities used for environmental education or interpretation will only be completed if they are within Refuge habitat goals and objectives.

Rationale: This alternative stresses the idea that wildlife comes first on the Refuge and that even minimal disturbances must be minimized. To this end, environmental education and interpretation efforts will be designed to take place either off-Refuge or in predesignated areas where it has been determined by management that the potential habitat impact is negligible. Messages developed will emphasize habitat management, and the importance of keeping human impact to the habitat as low as possible.

## Other Uses

1. Objective: Eliminate all non-wildlife-dependent public uses that could have a negative impact on wildlife and their habitat. Eliminate or prevent natural resource damaging uses by 2010. If not possible to eliminate or prevent, then minimize or mitigate.

### Strategies:

- Eliminate walking leashed dogs, picnicking, horseback riding, and bicycling along roads.
- Close, remediate, regrade, and revegetate the rifle range by 2006.
- Identify and prioritize non-Refuge mineral rights within Refuge boundaries by January 2005.
- Acquire, on a willing-seller basis, priority mineral rights by 2010.
- Eliminate the Allard gravel pit, and use strictly off-site mineral resources.
- Keep new and existing facilities near Refuge edge to minimize impact to Refuge resources.
- Prepare and implement a travel management plan to minimize impacts to habitat by 2005.
- Eliminate all roads or parking areas not needed for habitat management.

Rationale: Alternative C will eliminate all non-wildlife-dependent public uses that could have a negative impact on wildlife and their habitat. Mineral resource development impacts wildlife habitat. This alternative seeks to identify non-federally owned minerals within the Refuge boundary, and purchase those rights on a willing-seller, willing-buyer basis to minimize future resource damage. The rifle range will be closed or moved to an off-site location by 2006. The Allard gravel pit will be eliminated, and all mineral needs would be purchased from off-site sources. The existing Brocker Overlook will be redesigned and constructed focusing on Refuge goals and objectives. No additional public use facilities or opportunities will be planned.

## Cultural Resources

1. Objective: Identify and protect existing Refuge cultural resources from degradation.

### Strategies:

- Prior to any Federal action, complete a cultural resources survey, in compliance with Section 106 of the NHPA, for those areas of the Refuge that have not been surveyed.
- Protect cultural resources found on the Refuge by minimizing disturbance in sensitive areas.
- Support provisions within the Archaeological Resources Protection Act by developing a plan for managing Refuge archaeological resources.

Rationale: Cultural resource activities under Alternative C will be limited to actions required by law or Service policy. The philosophy of this alternative is to maintain existing cultural resources and protect them from degradation. No additional funds or effort will be expended to protect or interpret Refuge sites.

**Research**

1. Objective: Identify and promote the biological research needed to help achieve the Refuge's habitat goals and objectives.

## Strategies:

- Identify and prioritize habitat management research needs by 2004.
- Conduct in-house research on priority needs.
- Promote the Refuge research needs within the scientific community. Encourage research that focuses directly on the Refuge's habitat management goals.

2. Objective: Identify and promote research in other disciplines as it relates and contributes to achieving habitat goals and objectives (e.g. how to lessen the impacts of public uses).

## Strategies:

- Identify and prioritize research related to Refuge wildlife in other discipline needs by 2004.
- Encourage research in other disciplines that facilitates the Refuge and achieve goals and objectives.

Rationale: This alternative focuses on identifying and implementing the biological research needs of the Refuge. Research will focus on achieving the habitat goals and objectives outlined in this Plan. Identified research needs can then be promoted within the scientific community, and actively encouraged by Refuge staff. Proposed research, not falling within the categories identified, would generally not be allowed. Conversely, research meeting identified Refuge needs could be supported with funding, lodging, equipment sharing, etc. Disturbance to resident wildlife and habitat is the primary concern. Limiting non-Refuge identified projects will minimize unnecessary disturbance and habitat damage.

## **Partnerships**

<b>Alternative C</b>
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1. Objective: The Refuge will participate in partnerships that promote sound wildlife management.

### Strategies:

- Engage in partnerships that result in wildlife and/or land-health improvements on the Refuge.
- Work with partners to achieve the Refuge goals and objectives.
- Participate in Habitat Partnership Program, Owl Mountain Partnership, Sage Grouse Working Group, Colorado Wetlands Initiative, Platte/Kansas Rivers Ecosystem team, and others to protect enhance or restore wildlife habitats.

2. Objective: Maintain or form partnerships to assist with achieving the Refuge's habitats goals and objectives.

### Strategy:

- Work with Colorado Land Trust and others to help acquire lands and mineral rights within the Refuge's approved boundaries. Mineral extraction may cause habitat disturbance within the Refuge.

Rationale: This alternative describes a level of partnership activity that would focus on fulfilling Refuge habitat goals and objectives. The Refuge will form partnerships to promote sound wildlife management within the Refuge. The Refuge will actively participate in partnerships that result in improvements to land health and provide appropriate wildlife habitat on the Refuge.

## **Alternative D: Preferred Alternative**

### ***Riparian Habitats***

Detailed biological justification for the preferred alternative is discussed in Appendix H.

**Alternative D:  
Preferred Alternative**

1. Objective: Restore 50 to 100 acres of dense (40 to 100 percent) willow in patches >.2 ha and 20 m wide in the central third of the Illinois River (from the north end of the island to the confluence with Spring Creek) to connect existing willow patches and maintain 535 acres of dense willow in patches in the lower third of the Illinois River to benefit nesting neotropical migrant songbirds (yellow warbler, willow flycatcher) and resident moose, river otter, and beaver.

#### Strategies:

- Willow plantings along the stream corridor combined with 8 foot fences to exclude large herbivores.
- Water manipulation Refuge-wide that may involve decreased diversions to maintain in-stream flows for willow establishment.
- Construction of small artificial dams in the river to raise water tables locally to aid in willow establishment.
- Establish a vegetation monitoring plan to assess health of established willow stands, and measure and document success or changes needed in reestablishment efforts. Plan should include herbivory and hydrology factors.
- Wildlife monitoring will occur to document changes in wildlife use and possible correlations to changes in habitat.
- Experiment with alternative willow restoration strategies.
- Consider hunting as a management tool.

Rationale: Sections of the Illinois River on the Refuge had willows removed prior to acquisition by the FWS, probably in an effort to increase hay yields. These open stretches of river have: less bank stability, resulting in potential for increased sedimentation; decreased shade over the stream, resulting in increased water temperatures for trout; and sparse woody vegetation for use by songbirds or other wildlife. A section of river further downstream from the proposed reestablishment site has had livestock grazing removed for 8 years, but has shown little willow regeneration. Given the growth characteristics of willows, these results lead to the conclusions that there is either significant herbivory other than livestock restraining willow expansion, and/or hydrology has been altered enough with upstream diversions and recent drought conditions that lack of groundwater is keeping willow establishment from occurring. With this in mind, willow plantings will only be done in association with fencing, and consideration of hydrological needs will be used as well. Possible methods of increasing groundwater needs will be: to divert less water upstream for other Refuge purposes; locate willow plantings adjacent to existing beaver dams to take advantage of higher water tables near these ponds; and place logs and other natural materials in the stream to create simulated beaver dams and raise water tables adjacent to areas to be planted. Monitoring will be essential to document reestablishment efforts, and to note any significant changes to existing willow communities.

2. Objective: Provide 3,630 to 3,845 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native plants (rushes, sedges, grasses, forbs) characterized by 10 to 30 cm visual obstruction reading, 0 to 10 cm duff layer and minimal (<5 percent) bare ground and less than 40 percent (canopy closure) willow to benefit nesting waterfowl (pintail, shoveler, gadwall, green-winged teal) and sage grouse broods.

Strategies:

- Utilize grazing, resting, and burning practices to stimulate or maintain meadow conditions.
- Irrigate areas as water is available to help stimulate vegetative growth.
- Develop a vegetation monitoring protocol.
- Develop a wildlife monitoring plan that correlates wildlife use and habitat condition.
- Consider hunting as a management tool.

Rationale: The grass:forb mix identified in the objective requires periodic manipulation of some sort to achieve the stated ranges of the objective. The combination of resting, grazing, and burning, combined with irrigation, where available and practical, are the best tools to accomplish this. It is anticipated that on average, 1/3 to 2/3 of this area will require grazing at an average rate of 0.4 to 1.0 AUMs per acre resulting in the removal of approximately 1,950 to 4,200 AUMs of forage. Vegetative monitoring combined with wildlife use data will be needed to document that objective levels are correct.

3. Objective: Provide 210 to 425 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native species (grasses, sedges, forbs, and rushes) characterized by >30 cm visual obstruction reading, 10 to 20 cm duff layer and minimal (<5 percent) bare ground, and less than 40 percent (canopy closure) willow from mid-April through August to benefit nesting waterfowl (mallard, gadwall, pintail, scaup), songbirds (savannah sparrow, meadowlark), and foraging shorebirds if flooded (snipe, phalarope, white-faced ibis, sora, curlew, willet).

Strategies:

- Utilize grazing, resting, and burning practices to stimulate or maintain meadow conditions.
- Irrigate areas as water is available to help stimulate vegetative growth.
- Develop a vegetation monitoring protocol.
- Develop a wildlife monitoring plan that correlates wildlife use and habitat condition.
- Consider hunting as a management tool.

Rationale: The grass:forb mix identified in the objective requires periodic manipulation of some sort to achieve the stated ranges of the objective. The combination of resting, grazing, and burning, combined with irrigation, where available and practical, are the best tools to accomplish this. To meet and maintain the taller vegetation and duff layers identified, it is anticipated that rest will be utilized more for this objective. It is anticipated that on average, 1/3 to 1/2 of this area will require grazing at an average rate of 0.4 to 1.0 AUMs per acre resulting in the removal of approximately 100 to 350 AUMs of forage. Vegetative monitoring combined with wildlife use data will be needed to document that objective levels are correct.

4. Objective: Given the altered river flow regime, provide a properly functioning river channel characterized by a well defined thalweg (deepest point in the river channel), outside river edges that are deeper than inside edges, a river sinuosity of 2.0 to 2.5, pool spacing every 7 to 9 channel widths, active point bar formation, and gradients in riffles that are higher than in pools to benefit willow establishment for neotropical migrants, and indirectly provide suitable habitat for native and nonnative fishes.

Strategies:

- Map river channel and identify problem areas. Prioritize stretches for rehabilitation.
- Alter irrigation diversions as needed to assist in-stream restoration.
- Install in-stream structures as necessary to adjust thalweg, create point bars, adjust depth ratios, increase sinuosity, and/or adjust pool spacing.
- Monitor wildlife and vegetative response to these strategies.

Rationale: Mapping the river to identify current characteristics is needed in order to define where restoration is needed. Increasing flows in the river by diverting less water on upstream Refuge water rights may assist in maintaining higher water tables, especially when used in conjunction with in-stream restoration projects. Documenting vegetative, fishery, and wildlife response is necessary to ensure that the projects are working.

5. Objective: Establish a private lands program to encourage restoration of degraded riparian zones through funding and technical assistance to accomplish similar objectives as those defined for the Refuge. High priority areas are those that have immediate influence on the Refuge because of drainage or proximity.

Strategies:

- Add a full-time private lands position to the staff.
- Work with local partners and willing landowners to identify, prioritize, and restore degraded areas in North Park.

6. Objective: Work with partners to address land health issues throughout Jackson County.

**Alternative D:  
Preferred Alternative**

Strategy:

- Continue active Refuge participation in Sage Grouse Working Group, North Park Wetlands Focus Group, Owl Mountain Partnership, North Park Habitat Partnership Program, and any other group formed with the goals of improving land health and/or stewardship in Jackson County.
- Variations in water diversions and/or grazing regimes.
- Partner with Jackson County weed coordinator to manage and minimize noxious weeds on the Refuge.
- Use adaptive management techniques to implement new management ideas.

Rationale: The Refuge has the ability and resources available to restore and maintain a productive riparian area for the benefit of wildlife, fisheries, water quality, and a healthy landscape, while also utilizing local agriculture. The streams within the Refuge boundaries are a small fragment of those located within Jackson County, Colorado. By working with interested landowners and partners, the possibility exists of expanding the benefits of a healthy riparian zone throughout North Park.

From time-to-time, projects may be proposed within the county by other agencies, non-government organizations, or private landowners, that have a benefit to ecosystem health and wildlife outside of the Refuge boundary. There may be an occasion that in order to make an off-Refuge project succeed, resources normally reserved for Refuge purposes, such as water or vegetative cover, could be used to help make the off-Refuge project successful. These would not be long-term commitments of Refuge resources, but rather a management decision that a short-term diversion of these resources would better be served to benefit the ecosystem as a whole.

## ***Wetland Habitats***

1. Objective: Maintain 10 acres of, and attempt to establish in one other wetland basin, tall ( $\geq 60$  cm visual obstruction reading) emergent vegetation in water depths  $>4$  cm over a 5-year period to provide nesting habitat for over-water nesting birds (black-crowned night-heron, white-faced ibis, waterfowl, marsh wrens, coots, rails, and blackbirds).

### Strategies:

- Water level manipulation, including drawdowns, and maintaining water levels in specific wetlands from spring to fall when possible.
- Develop and apply a plan for transplanting of cattail and hardstem bulrush into specific wetlands.
- Develop and use an over-water nesting bird monitoring plan.
- Develop and implement an annual water management plan as a component of an overall habitat management plan.

Rationale: Wetlands with tall dense vegetation provide a litter layer for use by nesting water birds as well as a flooded emergent litter for macroinvertebrate production. Manipulation of water levels will contribute to maintaining the existing wetlands with tall emergent vegetation. Transplanting cattail and hardstem bulrush in wetlands with the highest potential for success will help increase the availability of this type of habitat. The criteria for such wetlands would be based on such things as water control abilities, evaporation rates, and distribution. Timing of needed drawdowns for expansion of the tall dense vegetation will be planned in such a way as to get maximum benefit for all Refuge wetland objectives such as during shorebird migration or to stimulate submergent aquatic vegetation beds. Monitoring water bird species will help assess how successful habitat management is.

2. Objective: Provide 10 percent of the wetland acres, over a 5-year average, in short ( $<10$  cm), sparse ( $<10$  cm visual obstruction reading) emergent vegetation in water depths  $<4$  cm from April to August to provide foraging habitat for shorebirds and waterfowl, as well as nesting and brood-rearing habitat for shorebirds.

### Strategies:

- Water level manipulation, including full and partial drawdowns, and maintaining water levels in specific wetlands from spring to fall when possible.
- Tillage of dry wetlands as a management tool.
- Rehabilitation and maintenance of existing dikes and infrastructures.
- Conduct shorebird surveys on the Refuge.
- Monitor monthly wetland bird use.
- Develop and apply a wetland emergent/submergent vegetation monitoring plan.
- Develop and implement an annual water management plan as a component of an overall habitat management plan.

3. Objective: Provide 20 percent of the wetland acres, over a 5-year average, of emergent vegetation >25 cm tall with visual obstruction reading >80 percent of vegetation height in water depths 4 to 18 cm to provide escape cover and foraging habitat for dabbling duck broods and molting ducks and foraging habitat for water birds.

Strategies:

- Water level manipulation, including full and partial drawdowns, and maintaining water levels in wetlands from spring to fall when water is available and conditions are appropriate.
- Tillage of dry wetlands as a management tool.
- Rehabilitation and maintenance of existing dikes and infrastructures.
- Conduct waterfowl surveys on the Refuge.
- Monitor monthly wetland bird use.
- Develop and apply a wetland emergent/submergent vegetation monitoring plan.
- Develop and implement an annual water management plan as a component of an overall habitat management plan.

Rationale: The availability of a variety of wetland habitat conditions may benefit a greater diversity of wildlife species and/or support species for longer periods in their annual life cycle. The above two objectives contribute to habitats varying from shallowly flooded, short, sparse emergents to both shallow water and moderately dense cover. Water manipulation techniques including drawdowns and back flooding can be used to create these conditions. Using monitoring to evaluate the response of the flora and fauna will indicate success of management techniques. Short-term variations of habitat objectives may be considered, on a case-by-case basis, by Refuge management to promote other important ecosystem projects within North Park.

4. Objective: Provide 10 to 20 percent of the wetland acres within each wetland complex, over a 5-year average, with a 70 percent coverage of submergent aquatic vegetation species (*Potamogeton*, *Ruppia*) in wetlands of >18 cm water depth to provide invertebrates and seed sources for foraging water birds, especially waterfowl broods, and escape cover for diving ducks.

Strategies:

- Water level manipulation, including full and partial drawdowns, and maintaining water levels in wetlands from spring to fall when water is available and conditions are appropriate.
- Tillage of dry wetlands as a management tool.
- Rehabilitate and maintain existing dikes and infrastructures.
- Conduct waterfowl surveys and brood counts on the Refuge.
- Monitor monthly wetland bird use.
- Develop and apply a wetland submergent vegetation monitoring plan.
- Develop and implement an annual water management plan as a component of an overall habitat management plan.

Rationale: Submergent vegetation provides a complex structure for macroinvertebrate production and a seed source for foraging water birds. *Potamogeton* and *Ruppia* both produce a food resource (plant foods and invertebrates) for waterfowl and broods. These submergents are used by other wetland birds for nesting, foraging, and escape habitat. A variety of drawdown schedules and tillage are used to enhance the growth of these plants. Monitoring the responses of plant and wildlife will gauge the level of success in providing this habitat.

5. Objective: Enhance the existing private lands program to encourage creation and restoration of wetlands in North Park and surrounding areas through funding and technical assistance to accomplish the same objectives as on the Refuge.

Strategies:

- Obtain funding and full-time equivalency for a Partners for Fish and Wildlife position.
- Work with willing stakeholders to create and restore wetlands in North Park.
- Develop a plan to identify wetland habitats throughout North Park.
- Consider wetland development opportunities as they become available.
- Continue participation in the North Park Wetland Focus Group.
- Establish a monitoring plan for created habitats to ensure benefits are realized.

Rationale: Since the Refuge is only part of the total North Park landscape efforts, to look beyond the boundaries are important in an ecosystem approach. Many wetland potentials exist in North Park, and working to restore or create these wetlands will benefit not only wildlife but society as well. To achieve the most positive results, priority projects will be close to existing wetland complexes or reasonably well functioning segment of rivers or near the larger reservoirs. Wetland management would mimic above Refuge objectives when possible. Work would be completed with the help of others to identify wetland habitats throughout North Park, partnering with willing stakeholders to restore, protect, and improve wetland habitats for wildlife use. Set up demonstration areas practicing sound wetland habitat management, and improve water levels in wetlands from spring to fall when possible.

## **Meadow Habitats**

Detailed biological justification for the preferred alternative is discussed in Appendix H.

**Alternative D:  
Preferred Alternative**

1. Objective: Provide 20 to 50 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native plants (rushes, sedges, grasses, forbs) characterized by <20 cm height, <10 cm visual obstruction reading, with dry to moist soils (no standing water), adjacent to (within 50 m) or intermingled with sagebrush (10 to 25 percent sage canopy cover), from early-June to late-July, to benefit sage grouse and snipe broods.

### Strategies:

- Utilize grazing, resting, and burning practices to stimulate or maintain meadow conditions.
- Irrigate areas as water is available to help stimulate vegetative growth.
- Working with partners, develop a vegetation monitoring protocol.
- Working with partners, develop a wildlife monitoring plan that correlates wildlife use and habitat condition.
- Consider hunting as a management tool.

2. Objective: Provide 1,650 to 1,850 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native species (grasses, sedges, forbs, rushes) characterized by 10 to 30 cm visual obstruction reading, 0 to 10 cm duff layer and minimal (<5 percent) bare ground from mid-April to the end of July to benefit nesting waterfowl (gadwall, shoveler, pintail, green-winged teal) and sage grouse broods.

### Strategies:

- Utilize grazing, resting, and burning practices to stimulate or maintain meadow conditions.
- Irrigate areas as water is available to help stimulate vegetative growth.
- Working with partners, develop a vegetation monitoring protocol.
- Working with partners, develop a wildlife monitoring plan that correlates wildlife use and habitat condition.
- Consider hunting as a management tool.

Rationale: The grass:forb mix identified in the objective requires periodic manipulation of some sort to achieve the stated ranges of the objective. The combination of resting, grazing, and burning, combined with irrigation, where available and practical, are the best tools to accomplish this. It is anticipated that on average, 1/3 to 2/3 of this area will require grazing at an average rate of 0.4 to 1.0 AUMs per acre resulting in the removal of approximately 950 to 2,100 AUMs of forage. Vegetative monitoring combined with wildlife use data will be needed to document that objective levels are achieved, and whether or not objectives are correct.

3. Objective: Provide 630 to 790 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native plants (grasses, sedges, forbs, rushes) characterized by >30 cm visual obstruction reading, 10 to 20 cm duff layer and minimal (<5 percent) bare ground to benefit nesting waterfowl (mallard, gadwall, pintail, scaup), songbirds (savannah sparrow, meadow lark), and foraging shorebirds if flooded (snipe, phalarope, white-faced ibis, curlew, willet, sora).

Strategies:

- Utilize grazing, resting, and burning practices to stimulate or maintain meadow conditions.
- Irrigate areas, as water is available, to help stimulate vegetative growth.
- Working with partners, develop a vegetation monitoring protocol.
- Working with partners, develop a wildlife monitoring plan that correlates wildlife use and habitat condition.
- Consider hunting as a management tool.

Rationale: The grass:forb mix identified in the objective requires periodic manipulation of some sort to achieve the stated ranges of the objective. The combination of resting, grazing, and burning, combined with irrigation, where available and practical, are the best tools to accomplish this. To meet and maintain the taller vegetation and duff layers specified, it is anticipated that rest will be utilized more for this objective. It is anticipated that on average, 1/3 to 1/2 of this area will require grazing at an average rate of 0.4 to 1.0 AUMs per acre resulting in the removal of approximately 350 to 700 AUMs of forage. Vegetative monitoring combined with wildlife use data will be needed to document that objective levels are achieved, and whether results support species requirements.

4. Objective: Short-term variations of habitat objectives may be considered, on a case-by-case basis, by Refuge management for important ecosystem projects within North Park.

Strategies:

- Work with partners to identify potential projects in the county.
- Implement variations in water diversion, grazing regimes or other Refuge management strategies as deemed appropriate.

Rationale: From time-to-time, projects may be proposed within the county by other agencies, non-government organizations, or private landowners, that have a benefit to ecosystem health and wildlife outside of the Refuge boundary. In order to make an off-Refuge project succeed, resources normally reserved for Refuge purposes, such as water or vegetative cover, could be used occasionally to help make a project successful. These would not be long-term commitments of resources, but rather a cooperative management decision that a short-term diversion of these resources would better be served to benefit the ecosystem as a whole.

5. Objective: Establish a private lands program to provide funding and technical assistance to encourage wildlife-compatible land management practices in meadow habitats to accomplish objectives similar to those of the Refuge.

Strategies:

- Add a full-time private lands position to the staff.
- Work with local partners and willing landowners to identify, prioritize, and restore degraded areas and create new wildlife habitat in North Park.

6. Objective: Work with partners to address land health issues throughout the county.

Strategy:

- Continue active Refuge participation in Sage Grouse Working Group, North Park Wetlands Focus Group, Owl Mountain Partnership, North Park Habitat Partnership Program, and any other group formed with the goals of improving land health and/or stewardship in Jackson County.
- Partner with Jackson County weed coordinator to manage and minimize noxious weeds on the Refuge.

Rationale: The Refuge has the ability and resources available to maintain productive meadows for the benefit of wildlife, water quality and a healthy landscape, while also utilizing local agriculture. The meadows within the Refuge boundary were used to produce hay prior to Refuge establishment, and proposed management practices vary little from thousands of similar acres throughout the county that are still in hay production. By working with interested landowners and partners, the possibility exists of expanding the wildlife benefits of Refuge meadows and/or maintaining the benefits that are occurring on these off-Refuge sites.

## ***Upland Habitats***

Detailed biological justification for the preferred alternative is discussed in Appendix H.

**Alternative D:  
Preferred Alternative**

1. Objective: Provide 2,000 acres, over a 5-year average, of uplands composed of shrubs (>70 percent sage) >25 cm height and 20 to 30 percent canopy cover, >20 percent grass cover, and >10 percent forbs (native species preferred) to benefit sage grouse, vesper sparrow, brewers sparrow, elk, and pronghorn antelope.

### Strategies:

- Complete a sagebrush/grassland upland habitat inventory of the Refuge by 2008.
- Use cattle grazing at varying stock rates, seasons, and intensities as a management tool for uplands.
- Use 'rest' (free from biological, mechanical, or chemical manipulation) of varying lengths of time as a management tool for uplands.
- Develop and implement an integrated pest management plan.
- Use a variety of mechanical treatments of the habitat as a management tool for uplands.
- Develop and implement a vegetation monitoring plan.
- Develop and implement a wildlife monitoring program.

2. Objective: Provide 2,000 acres, over a 5-year average, of uplands composed of shrubs (>70 percent sage) >40 cm height and >30 percent canopy cover, <20 percent grass cover, and >5 percent forbs (native species preferred) to benefit brewer's sparrow, sage thrasher, and pronghorn antelope.

Strategies:

- Complete a sagebrush/grassland upland habitat inventory of the Refuge by 2008.
- Use cattle grazing at varying stock rates, seasons, and intensities as a management tool for uplands.
- Use 'rest' of varying lengths of time as a management tool for uplands.
- Develop and implement an integrated pest management plan.
- Use a variety of mechanical treatments of the habitat as a management tool for uplands.
- Develop and implement a vegetation monitoring plan.
- Develop and implement a wildlife monitoring program.

Rationale: The Refuge has five primary range sites that support sagebrush/grassland uplands. The 2,000 acres of each of the above objectives are scattered within several of these range types and intermingled with meadow areas. A completed inventory of the uplands will assist in specifically defining these areas. Sagebrush/grassland uplands in a mosaic of patchy sagebrush with openings of grasses and forbs across the landscape reflect the needs of most wildlife species. Moderate livestock grazing, ranging from .05 AUM per acre to .15 AUM per acre in intensity, combined with rest will help maintain these acres. This rest rotational coverage will promote plant diversity, nutrient cycling, and cover. Controlling or eliminating noxious weeds that reduce the abundance and diversity of native forbs in the sagebrush/grassland habitats is important. Mechanical treatments will be considered in small areas to increase grass and forb components of the site. Monitoring the response of the flora and fauna will aid in assessing the success of the tools applied and help improve these methods.

3. Objective: Manage the remaining 10,225 acres of sagebrush/grassland uplands based on a better understanding of Refuge habitats, wildlife usages, and affected variables using best management practices.

Strategies:

- Complete upland habitat inventory by 2008 if financial resources are available.
- Conduct research and monitor outcomes of Refuge upland habitats over the next 15 years.
- Develop habitat based goals and objectives for the remaining Refuge upland acres (10,000) by 2017.
- Establish upland research plots by 2012 to investigate and monitor upland habitats on the Refuge.
- Use cattle grazing at varying stock rates, seasons, and intensities as a management tool for uplands.
- Use 'rest' of varying lengths of time as a management tool for uplands.
- Develop and implement an integrated pest management plan.
- Use a variety of mechanical treatments of the habitat as a management tool for uplands.
- Develop and implement a prescribed burning program.
- Coordinate with existing projects and research and monitoring efforts in the area.
- Establish research plots to test strategies for habitat manipulations.
- Short-term variations of habitat objectives may be considered, on a case-by-case basis, by Refuge management for important ecosystem projects within North Park.

Rationale: In an effort to manage the sagebrush/grassland uplands, an inventory of what the Refuge has is essential. A variety of tools are available to provide a structurally diverse shrub community, with a grass:forb component to support migratory birds and other wildlife species. Livestock grazing, used in moderation, at rates ranging from .05 to .15 AUMs per acre will be used. It is anticipated that approximately 1/3 to 1/2 of the upland areas will be grazed annually, resulting in 450 to 1,200 AUMs of forage being removed. Rest also needs to be used in moderation; too much rest can result in dominate brush communities that prevent herbaceous species from recovering. Grazing used in conjunction with rest can enhance the nutrient cycles, plant regrowth, and plant community diversity. Efforts to control and/or eradicate noxious weeds will help maintain the diversity of plant life required to provide wildlife habitat needs. Mechanical treatments break up the soil and remove a variable percent of the brush species, depending on the coverage, to promote grasses and forbs growth. Historically, frequencies of fire in the upland were low, and they were small, patchy fires. Prescribed burns may be beneficial in some upland sites to control dense stands of sagebrush so that herbaceous species can increase. The use of other upland habitat projects in the area, with range types similar to the Refuge, will help to identify successful methods for manipulation the habitat to reach the objectives. A portion of these sagebrush/grassland upland acres will be used to establish research plots to get a better understanding of how to increase sage height and grass:forb abundance to benefit nesting and wintering sage grouse, songbirds (vesper sparrow, sage thrasher, brewer's sparrow, swainson's hawk) and pronghorn antelope. This information will focus on the tools that might get more acres of uplands into the first two objectives. In working with the entire North Park landscape, some habitat objectives may change to accommodate actions deemed essential elsewhere in the upland habitats of the Park to improve the overall quality of wildlife habitat.

4. Objective: Manage North Park Phacelia (*Phacelia formosula*) populations currently known to exist on the Refuge to ensure its continued existence.

**Alternative D:  
Preferred Alternative**

Strategies:

- Initiate research to understand the plant's life history and develop a management plan.
- Protect and develop a monitoring plan for the existing and future new populations.
- Work with other entities to preserve North Park Phacelia populations throughout North Park.

Rationale: The North Park Phacelia is the only known federally-listed endangered plant species on the Refuge. The plant is only found in North Park with several populations scattered across the area. Only two known populations of the plant exist on Refuge lands. Little is known about its life history, so management is limited. Research on the life history of the plant is essential. As part of a partnership approach, information and management techniques will be shared to help ensure the continued existence of the Phacelia and eventually the down listing of the species.

## **Public Use Hunting**

**Alternative D:  
Preferred Alternative**

1. Objective: Provide recreational hunting opportunities consistent with Refuge goals and objectives, and that facilitate North Park wildlife management objectives.

### Strategies:

- Working with the State, develop a hunting step-down management plan that provides hunting (big game, small game, and waterfowl) opportunities to meet North Park and Refuge objectives.
- Working with the State, provide limited small game and furbearer hunting opportunities depending on Refuge habitat objectives and/or population objectives North Park-wide.
- Hunting of predators will not be authorized in order to minimize disturbance to wildlife. The hunting step-down management plan will reevaluate the role of predator hunting on the Refuge.

2. Objective: The Refuge will work with the State in promoting sound hunting practices as a wildlife management tool.

### Strategies:

- The Refuge will partner with the State and North Park Chamber of Commerce for the dissemination of information about hunting opportunities on the Refuge and throughout North Park.
- Hunting brochures and hunting information will be provided to hunters at the headquarters building.
- Assist Colorado Division of Wildlife off-Refuge with law enforcement, hunter recruitment, and hunter education when requested.

3. Objective: Facilities will be maintained, and improved as necessary, to provide a quality recreational hunting experience while minimizing resource damage.

Strategies:

- Develop five parking areas [Map 9 - Public Use - Alternative B and D (Preferred)] using post and cable methods and minimize resource damage caused by vehicles. Parking areas also provide opportunities to inform the hunting public about rules and regulations.
- Develop two permanent gates that can be locked to minimize resource damage caused by vehicles [Map 9 - Public Use - Alternative B and D (Preferred)].
- Develop a travel management plan that will revegetate two track roads [Map 9 - Public Use - Alternative B and D (Preferred)] not needed for maintenance, law enforcement, hunting access, or other management purposes.
- Develop a signage plan that facilitates the public use, enhances the public's understanding of Refuge management, provides public information and safety, and the Refuge System.

Rationale: This alternative recognizes that the Refuge is part of a larger system of lands known as North Park. Given that many wildlife species in North Park migrate on and off the Refuge (waterfowl, elk, mule deer, pronghorn antelope, sage grouse), the Refuge hunting program effects more than just Refuge lands. The key to success is a strong working relationship with sportsman and with the State, and incorporation of Refuge hunting goals and objectives into a hunting step-down management plan. Additional Refuge hunting opportunities (i.e. moose, elk, mule deer) will be determined in conjunction with the community and the State. The Refuge will continue to work with the State in promoting sound hunting practices as a wildlife management tool. Additionally, this alternative suggests we modify and possibly expand existing public use facilities to include emphasis on hunting both on the Refuge and in North Park. The Refuge will engage in partnerships to disseminate information on hunting opportunities throughout North Park. The Refuge may continue to utilize habitat management units A, B, C to provide resting areas for migratory birds and to minimize conflicts between hunters and visitors, and to distribute hunting pressure. However, the A, B, C system may be modified during the development of a hunting step-down management plan.

## **Fishing**

1. Objective: Where compatible, opportunities for fishing will be provided based on Refuge goals and objectives.

### Strategies:

- Encourage brown and rainbow trout fishing opportunities on the Refuge in accordance with State seasons and regulations and Refuge management objectives. Fishing is closed during June and July to protect nesting waterfowl and other riparian nesting species.
- Evaluate angler impacts to Refuge goals and objectives by 2008.
- Work with the State to develop a sport fish step-down management plan by 2008.

2. Objective: Where possible, expand fishing opportunities throughout North Park and help promote fishing as a recreational activity.

### Strategies:

- Provide fishing information and fishing regulations to Refuge visitors when requested.
- Utilize the Service Partners for Fish and Wildlife Program to improve fishery habitats on public and private lands when requested.
- When requested, assist the State with fisheries planning issues in North Park.
- Assist the State with law enforcement, fishery management, fisheries sampling, fisheries habitat projects, and spawning throughout North Park when requested.
- Partner with others to enhance fishery habitats in North Park.
- Install and monitor Illinois River gauges on the upstream and downstream end of the Refuge to evaluate river flows.

Rationale: The above objectives encourage the Refuge staff to not only provide sport fishing opportunities on the Illinois river, but also to partner with the State and others to improve fishery habitats and promote sport fishing opportunities throughout North Park. The Illinois River fishery is influenced by management actions that occur upstream of the Refuge. Logically, it is important that the Refuge assist, when requested, with habitat projects that impact the Illinois River upstream of the Refuge, and when deemed valuable to Refuge wildlife resources. Similarly, habitats throughout North Park are connected through a system of waterways. Refuge efforts to improve aquatic habitats, when requested, benefit all in North Park. The downside to this strategy involves using very limited personnel and resources on areas other than strictly Refuge grounds that may result in Refuge goals and objectives being delayed or not being met. Partnerships are the key to success when funds and personnel are limited. The Refuge strives to be included as a partner on fishery related habitat improvement projects in North Park.

## Wildlife Photography and Observation

**Alternative D:  
Preferred Alternative**

1. Objective: Enhance opportunities for wildlife observation and photography based on Refuge habitat goals and objectives by 2017.

### Strategies:

- Rebuild Brocker Overlook by 2004.
- Construct multi-use trail from Walden to Brocker overlook by 2008.
- Enhance auto tour route road.
- Maintain Refuge Visitor Center for distribution of information.
- Keep brochures current with updated information.
- Complete and maintain boardwalk section of interpretive nature trail.
- Build moose observation platform by 2005.
- Construct wildlife photography blinds on the auto tour route by 2006.
- Establish use limitations for wildlife observation and photography based on habitat goals and objectives.
- Maintain and potentially modify existing facilities to reflect new management strategies.

Rationale: Current visitation to the Refuge ranges from 7,000 to 9,000 visits (visit is defined as a person crossing the Refuge boundary). Many opportunities to enhance viewing and photography of wildlife while maintaining habitat goals are available. Each strategy should be designed to facilitate a quality experience for the visitor while fulfilling Refuge goals and objectives.

2. Objective: Assist with funding, construction, and program development to enhance wildlife photography and observation in North Park.

### Strategies:

- Develop and disseminate information on the best wildlife observation and photography opportunities throughout North Park.
- Partner with the CDOW plus others to construct and provide observation facilities for moose and other desirable species.
- Pursue funding and partners to assist with the construction of viewing/photography blinds at various other locations in North Park.
- Assist partners with revising the "Watching Wildlife in North Park" guide by 2006.
- Create partnerships with other wildlife-oriented organizations and individuals.

Rationale: Recreation plays a major role in the economy of North Park. Wildlife viewing and photography are key factors in the recreational opportunities available. Enhancing these uses will be beneficial to the economy as well as creating a better understanding of wildlife and its habitats.

## **Environmental Education/Interpretation**

1. Objective: Work with partners, including the North Park School District, to provide opportunities and facilities to conduct five environmental education programs a year, based on Refuge habitat goals and objectives.

### Strategies:

- Work with partners to develop specific environmental education programs covering:
  - ✓ habitat management practices and principles;
  - ✓ the natural history of North Park;
  - ✓ agricultural and wildlife;
  - ✓ the life history of various local species including waterfowl, sage grouse, elk, and moose;
  - ✓ North Park and its importance to Colorado waterfowl;
  - ✓ how a Refuge comes into existence and what its role is;
  - ✓ water issues and needs.
- Use existing environmental education opportunities as they occur, such as the water carnival, bird banding, Refuge field trips, and Day in the Woods.
- Create programs for students and volunteers to assist in management tasks for service learning.

2. Objective: Incorporate the Refuge and its niche in the North Park landscape in other environmental education messages developed in the county.

### Strategies:

- Partner with other land management agencies, non-government organizations, local schools and private individuals to expand the network of environmental education programs and facilities in North Park.
- Hire an outdoor recreation planner to conduct outreach and education activities on the Refuge and North park.

3. Objective: Update Refuge interpretive message to reflect recent wildlife issues and concerns (elk, sage grouse), habitat based decision-making, local agricultural uses and how they are not mutually exclusive on or off the Refuge.

### Strategies:

- Replace signs on the kiosks, overlooks, trails and visitor center, and pamphlets, and update the Refuge website to reflect a message of the Refuge working for wildlife and county-wide environmental interests.
- Rehabilitate the Case Barn and develop an interpretive site there presenting the relationship between the county's ranching history and wildlife.
- Interpret prehistoric cultural resources of the Refuge in relation to natural resources found in North Park.

4. Objective: Incorporate the Refuge and its niche in the North Park landscape in other interpretive messages developed in the county.

Strategy:

- Partner with other entities in the development of interpretive material involving the land management of North Park to identify the role of the Refuge.

Rationale: Arapaho National Wildlife Refuge is located almost in the geographic center of North Park. It is known to most residents as a major part of the county landscape, but exactly what the Refuge does and how it contributes to that landscape is not fully understood. Similarly, most out-of-county visitors do not understand how the lands surrounding the Refuge compliment its wildlife-oriented goals. An outdoor recreation planner position will facilitate integration of environmental education at the Refuge and in Jackson County schools. Articulating the story of history of North Park and how the Refuge and the surrounding lands benefit each other will be beneficial to all interests.

**Alternative D:  
Preferred Alternative**

## Other Uses

1. Objective: Compatible, non-wildlife-dependent uses will be allowed, but limited to less sensitive areas based on habitat goals and objectives.

### Strategies:

- Eliminate walking leashed dogs, picnicking, horseback riding, and bicycling along roads.
- Use law enforcement, signs, information, and brochures to minimize impacts of other non-wildlife-dependent public uses.
- Prepare and implement a travel management plan to minimize vehicle impacts to Refuge habitats by 2006.

2. Objective: Consider non-wildlife-dependent public uses and their benefits to North Park and its residents.

### Strategies:

- With Partners, design and construct the Case Barn interpretive loop by 2008. Incorporate North Park and Refuge history and the preservation of wildlife habitats as a theme in the interpretation.
- Encourage partners to be sensitive to wildlife needs when developing recreational opportunities in North Park.
- Continue to allow the Colorado Department of Transportation to plow snow wind break along Highway 125, subject to a compatibility determination.

3. Objective: Allow compatible, non-wildlife-dependent uses that support the Refuge mission.

### Strategies:

- Continue operation of the rifle range to facilitate law enforcement firearms requalification for Refuge officers, Colorado Division of Wildlife officers, and other local law enforcement agencies on request.
- Identify and prioritize non-Refuge mineral rights within Refuge boundaries by January 2005.
- Acquire, on a willing-seller basis, priority mineral rights by 2010.
- Continue operation of the Allard gravel pit to support both Refuge and county roads (on-Refuge) requirements.

Rationale: Alternative D encourages compatible, non-wildlife-dependent uses should be limited to less sensitive areas based on habitat goals and objectives. The Refuge views mineral resource development as having negative impacts on wildlife habitat. Non-federally owned minerals within the Refuge boundary must be identified and purchased on a willing-seller basis, to minimize future resource damage. The rifle range will continue to operate as it already facilitates Refuge and North Park law enforcement needs. The travel management plan must meet Refuge compatibility determination standards, facilitate management and public use requirements. The Allard gravel pit supports Refuge and county roads (on Refuge) and will remain active to support Refuge goals and objectives.

## **Cultural Resources**

**Alternative D:  
Preferred Alternative**

1. Objective: Identify existing Refuge cultural resources and protect from degradation.

### Strategies:

- Complete a cultural resources survey, as needed, for management purposes.
- Determine National Register of Historic Places status for the Hampton, Allard, and Case Barns by 2003.
- Protect cultural resources located on the Refuge by minimizing disturbance in sensitive areas.
- When possible, preserve historical records by conducting oral interviews with local residents.
- Apply for monies (grants, maintenance management funds, etc.) to restore and preserve the Case Barn by 2007.
- Support provisions within the Archaeological Resources Protection Act by developing a plan for managing Refuge archaeological resources.

2. Objective: Encourage interpretation and protection of cultural resources and their importance to North Park wildlife resources.

### Strategies:

- Interpret the Case Barn by extending the tour route to include the barn. Develop an interpretive area adjacent to the Case Barn that discusses its regional significance by 2007. Consider adaptive re-use of the Case Barn in fulfilling the mission of the Refuge.
- Determine historic status of Hampton Barn; make decision to keep or eliminate barn by 2005.
- Interpret history of North Park at the Brocker overlook site by 2004.
- By 2004, develop an interpretive area within the headquarters building that demonstrates connectivity of the Refuge with the remainder of North Park.
- When requested, and dependent on available funding, partner with other individuals and agencies to protect and preserve cultural resources that relate to wildlife throughout North Park.

Rationale: A broader cultural resource role needs to be described for the Refuge. The philosophy is to comply with existing cultural resource related laws and policies and to protect Refuge cultural resources from degradation. Additionally, protection and interpretation of cultural resources that relate to North Park wildlife is encouraged. Interpreting the role of ranches in the preservation of habitat can serve as an example for visitors to learn and gain a greater appreciation for wildlife and their habitats.

## **Research**

1. Objective: Identify and promote the biological research needed to help achieve the Refuge's habitat goals and objectives.

### Strategies:

- Identify and prioritize habitat management research needs by 2004.
- Conduct in-house research on priority needs.
- Promote the Refuge research needs within the scientific community. Encourage research that focuses directly on the Refuge's habitat management goals.

2. Objective: Identify and promote non-biological research as it relates and contributes to achieving habitat goals and objectives on the Refuge and within North Park.

### Strategies:

- Identify and prioritize research related to Refuge and North Park wildlife in other disciplines needs by 2004.
- Encourage research in non-biological disciplines that facilitates the Refuge and achieve goals and objectives.
- Allow and encourage research that focuses on natural resource management goals throughout North Park.

Rationale: These objectives and strategies focus on identifying and implementing the biological research needs of the Refuge and North Park. Research will focus on achieving the habitat goals and objectives outlined in this Plan. Identified research needs can then be promoted within the scientific community and actively encouraged by Refuge staff. Proposed research, not falling within the categories identified, would generally not be allowed. Conversely, research meeting identified Refuge needs could be supported with funding, lodging, equipment sharing, etc. Disturbance to resident wildlife and habitat is the primary concern. Limiting non-Refuge identified projects will minimize unnecessary disturbance and habitat damage.

## **Partnerships**

**Alternative D:  
Preferred Alternative**

1. Objective: The Refuge will participate in partnerships that promote sound wildlife management.

### Strategies:

- Engage in partnerships that result in wildlife and/or land-health improvements.
- Participate in Habitat Partnership Program, Owl Mountain Partnership, Sage Grouse Working Group, Colorado Wetlands Initiative, Platte/Kansas Rivers Ecosystem team, and others to protect, enhance, or restore wildlife habitats.
- Work with partners to achieve the Refuge goals and objectives.
- Work with the Colorado Historical Society and other partners to restore / rehabilitate the Case Barn Interpretive Site.
- Develop a conservation easement on Pole Mountain property.
- Work with Colorado Land Trust and others to help acquire lands and mineral rights within the Refuge's approved boundaries. Minerals extraction may cause habitat disturbance within the Refuge.

2. Objective: Maintain or form partnerships to achieve the wildlife related goals and objectives on the Refuge and within North Park.

### Strategies:

- Promote new partnerships (consider partnering with Ducks Unlimited, Trout Unlimited, Safari Club International, Audubon, Sierra Club, and others) to assist with achieving the Refuge and North Park natural resource goals.
- Strive to develop a Refuge Friends group over the next 15 years.
- Establish a full-time Private Lands Coordinator position to be stationed at the Refuge to assist in wildlife habitat enhancement throughout North Park.

Rationale: These objectives and strategies describe the potential level of partnership activity that will improve wildlife habitats throughout North Park. The Refuge staff will form partnerships to promote sound wildlife management within and outside the Refuge. The Refuge will actively participate in partnerships that result in improvements to land health and provide appropriate wildlife habitat in North Park. The Refuge will collaborate with partners on management of critical wildlife habitats in North Park. The private lands position will enable the Service to contribute its biological expertise and resources to private and public landowners when requested.

## *Section III: Affected Environment and Environmental Consequences*

### **Affected Environment**

For a description of the affected environment, please refer to the Summary Refuge and Resource Descriptions Section in the CCP.

### **Environmental Consequences**

This section will describe how the biological, social, economic, and cultural resources in the area of the Refuge are likely to be affected by the implementation of the Arapaho NWR CCP.

#### *Alternative A (No Action): Continuation of Current Management*

##### *Refuge Habitats and Wildlife*

The No Action alternative does not include active management and restoration of riparian and upland habitats or extensive management of wetland habitats. The main management tool for the meadows, riparian, and uplands would be grazing. Grazing would take between 8,000 to 9,500 AUMs used each year through various grazing practices including year rotational, high intensity, and rest. Fire would continue to play a very minimal part in habitat management. Noxious weed control would continue at the same level but would not be expanded. Water management would consist of flood irrigation of the meadows and filling of wetlands as early as possible in the spring. Existing riparian habitat would support the nesting neotropical birds they have in the past. No new effort would be made to manage and improve riparian habitat for neotropical birds. River flows would continue to be diverted for wetlands without regard for possible improvements to existing riparian habitat if flow levels were altered. Wetland management emphasis would continue to focus on waterfowl production. All wetlands would be filled each spring and kept full as long as water conditions allowed to create pair, brood, and molt water for waterfowl. No new actions would be planned to improve the water use, wetland submergent vegetation, or shorebird habitat.

##### *Public Uses*

Interpretive, educational, and administrative programs and facilities would not change. Levels of public use would not vary as access roads would be managed as they currently are with minor upgrades and regular maintenance. Recreational opportunities would include current programs available under existing approved plans. Fishing would be allowed on the Illinois River from August 1 through June 1. Pronghorn antelope, sage grouse, small game, and waterfowl hunting would be allowed but no trapping. Public use facilities would remain essentially the same and would be maintained. No new interpretive signs, exhibits, or viewing opportunities would be developed. Refuge law enforcement would continue at existing levels. Environmental education and outreach would continue at the current level. No additional partners or funding would be pursued.

##### *Cultural Resources*

Under this alternative, the cultural resources of the Refuge would be identified and evaluated under section 106 of the National Historic Preservation Act. No interpretation of these resources would occur under this alternative.

### *Air and Water Quality*

Air quality in the area of the Refuge would continue to be excellent and no changes in quality would occur as a result of implementing existing management activities. Water quality would continue to be good, and there would be no improvement to siltation and channel cutting to the Illinois River as a result of the continuation of current management strategies.

### *Socio-Economic Conditions*

The North Park, and specifically the City of Walden, would not experience any changes in their current socio-economic structure as the Service would continue managing the Refuge as it has for many years. Complex funding would remain at the level needed to support current staffing and programs.

## *Alternative B*

### *Refuge Habitats and Wildlife*

Under this alternative, the Refuge would directly manipulate its habitats: restoring riparian habitats, studying uplands, and instituting more natural regimes to the meadow and wetland habitats, and would promote sound habitat and wildlife management throughout North Park. This manipulation would directly impact the Refuge's wildlife by providing them with all the requirements of their life cycles and improving habitats that had undergone degradation. The rest of North Park would also benefit from partnerships with the Refuge that promote sound habitat and wildlife management. The Refuge's riparian and meadow habitats would be managed in such a way as to provide a wide variety of structures, densities, and vegetative diversity so as to benefit a wider range of wildlife species as the Refuge currently benefits. Not only will waterfowl benefit under this alternative, but also neotropical migratory birds and shorebirds, together with a large variety of insects, mammals, and large ungulates.

### *Public Uses*

Under this alternative, the Refuge would continue to promote hunting of many species in the Refuge as a sound wildlife management activity to achieve the Refuge goals, and would improve some of the facilities necessary for this activity. The Refuge would attempt to improve fisheries resources and promote fishing activities throughout the Refuge. The Refuge would actively participate with local schools to develop and implement a diverse environmental education program at the Refuge that not only focuses on the ecology of the Refuge, but of the entire North Park "sub-ecosystem." The Refuge would utilize its interpretive facilities to promote sound wildlife management and to exemplify the role that agriculture and ranching have had in the conservation of habitats and wildlife. The Refuge will participate and encourage the development of resources to improve wildlife photography and observation not only within the Refuge but throughout North Park. The Refuge would look at other compatible, wildlife-dependent uses and allow them in areas of the Refuge where these activities do not detract from the goals and objectives of the Refuge.

### *Cultural Resources*

Under this alternative, the cultural resources would be identified and evaluated under sections 106 and 110 of the National Historic Preservation Act, the Archaeological Resources Protection Act, and Executive Order 13287: Preserve America. The Refuge would also encourage interpretation and protection of cultural resources and their relationship to North Park wildlife resources.

### *Air and Water Quality*

Under this alternative, a noticeable increase would occur in the quality of the water of the Illinois River as it crosses the Refuge as the riparian and meadow habitats of the Refuge are improved, and, consequently, are able to better trap sediments and provide shade to the stream. The improvement of the riparian corridor would also arrest, or at least slow down, the stream cutting action of the stream on its banks, thus providing for an improved fisheries resource. The air quality under this alternative would continue to be excellent as prescribed fires would rarely be used to manage the habitats, given the prevailing climatological conditions in North Park. The increase in visitation and its associated increase in use of Refuge roads is not expected to adversely impact in the long run the quality of the air in North Park.

### *Socio-Economic Conditions*

Under this alternative, the Refuge would expect that the current socio-economic conditions of North Park (especially in the City of Walden) would improve as the different activities that the Refuge promotes within the Refuge and throughout North Park would increase visitation to and recreation in North Park. The different public uses that would be promoted under this alternative would not only educate and promote appreciation of wildlife with the residents and visitors to North Park, but would encourage visitors to return to North Park and, thus, contribute to the North Park economy through sales of various types of equipment, lodging, meals, etc. This alternative also seeks to contribute to non-economic well-being factors, such as the preservation of the open landscape of North Park and its historical and rich agricultural and ranching way of life. Furthermore, this alternative would contribute to the well-being of many entrepreneurial activities in North Park as this alternative relies heavily in the creation of partnerships to accomplish the Refuge goals.

Further positive socio-economic effects (direct and indirect) from implementation of this alternative would come from creation of new jobs within Jackson County (11) translating into gains to the local economy from new salaries (over \$400,000 per year). Adverse impacts to the local socio-economic conditions from implementing this alternative would come from a decrease in cattle grazing opportunities in order to meet habitat goals and objectives. It is estimated that this reduction in current cattle grazing levels would be as low as 10 percent but could go as high 64 percent, depending on habitat requirements and response to the strategies applied to reach the objectives of the Refuge. These reductions would be achieved gradually (5 to 10 percent per year), mainly through attrition in current grazing permit numbers from retiring cattlemen, until habitat goals are met. A maximum (64 percent) reduction from current grazing levels on Refuge lands would result in a loss of 2.2 grazing-related jobs with a total income of approximately \$43,373 per year. It is estimated that the total effects (direct and indirect) of a 64 percent reduction in grazing pressure would result in a loss of 4.4 jobs, for a total income of \$84,441 per year.

## *Alternative C*

### *Refuge Habitats and Wildlife*

Under this alternative, the Refuge would directly manipulate its habitats: restoring riparian habitats, studying uplands, and instituting more natural regimes to the meadow and wetland habitats, and would promote sound habitat and wildlife management throughout North Park. The aim of this alternative is, through intense habitat manipulation, to bring forth the fullness of the biological potential for the habitats of the Refuge.

Manipulation would directly impact the Refuge's wildlife by providing them with all the requirements of their life cycles and improving habitats that had undergone degradation. The Refuge's riparian and meadow habitats would be managed in such a way as to provide a wide variety of structures, densities, and vegetative diversity so as to benefit a wider range of wildlife species as the Refuge currently benefits. Not only will waterfowl benefit under this alternative, but also neotropical migratory birds and shorebirds, together with a large variety of insects, mammals, and large ungulates. The Refuge would no longer be constrained by desired numbers of target-species to be produced per unit, but would let the natural carrying capacity of the habitats dictate the kinds and levels of wildlife use. Under this alternative, the current use and level of habitat management tools, as well as public uses, would be modified so as to achieve the maximum biological potential of the habitats to benefit wildlife, and all other uses would be subordinate to this need to reach the maximum biological potential.

### *Public Uses*

Under this alternative, hunting activities would be provided not only as a legitimate wildlife-dependent public use, but also to reduce herbivory that might preclude attaining the goals of the Refuge. Fishing opportunities would only be available where they do not conflict with habitat management goals. The focus of the environmental education and interpretation would be on the techniques utilized by the Refuge to attain its habitat goals and how to avoid adversely impacting these habitats. Under this alternative, all non-wildlife-dependent public uses in the Refuge would be prohibited and wildlife observation would be limited at observations made from the edge of the Refuge to minimize disturbance to habitats and to wildlife. This alternative would be the one that would impact most seriously the availability of public uses in the Refuge by placing substantial restrictions on public uses, times, and areas of the Refuge where public uses could occur.

### *Cultural Resources*

Under this alternative, cultural resources would be identified and protected fulfilling Federal requirements that seek to protect these valuable resources for future generations from impacts resulting from human activities. No interpretation would occur.

### *Air and Water Quality*

Under this alternative, a noticeable increase would occur in the quality of the water of the Illinois River as it crosses the Refuge as the riparian and meadow habitats of the Refuge are improved, and, consequently, are able to better trap sediments and provide shade to the stream. The improvement of the riparian corridor would also arrest, or at least slow down, the stream cutting action of the stream on its banks, thus providing for an improved fisheries resource. The air quality under this alternative would continue to be excellent as prescribed fires would rarely be used to manage the habitats given the prevailing climatological conditions in North Park.

### *Socio-Economic Conditions*

This alternative has the highest potential to adversely impact the current socio-economic conditions of North Park (especially in the City of Walden) as it would discourage many currently existing public uses and has a high potential to substantially reduce the levels of grazing as a habitat management tool.

Further positive socio-economic effects (direct and indirect) from implementation of this alternative would come from creation of new jobs within Jackson County (8.5) translating into gains to the local economy from new salaries (over \$310,000 per year). Adverse impacts to the local socio-economic conditions from implementing this alternative would come from a decrease in cattle grazing opportunities in order to meet habitat goals and objectives. It is estimated that this reduction in current cattle grazing levels would be as low as 10 percent but could go as high 64 percent, depending on habitat requirements and response to the strategies applied to reach the objectives of the Refuge. These reductions would be achieved gradually (5 to 10 percent per year), mainly through attrition in current grazing permit numbers from retiring cattlemen, until habitat goals are met. A maximum (64 percent) reduction from current grazing levels on Refuge lands would result in a loss of 2.2 grazing-related jobs with a total income of approximately \$43,373 per year. It is estimated that the total effects (direct and indirect) of a 64 percent reduction in grazing pressure would result in a loss of 4.4 jobs, for a total income of \$84,441 per year.

This alternative has a high possibility of disrupting current visitation levels at the Refuge, except for hunting activity numbers that could potentially go up as the hunting plan of the Refuge is expanded to accommodate for further harvest of large ungulates that impact the habitats through herbivory.

## *Alternative D (Preferred Alternative)*

### *Refuge Habitats and Wildlife*

Under this alternative, the Refuge would directly manipulate its habitats: restoring riparian habitats, studying uplands, and instituting more natural regimes to the meadow and wetland habitats, and would promote sound habitat and wildlife management throughout North Park. This manipulation (i.e., adjusting grazing and prescribed fire levels where needed, water manipulation, etc.) would directly impact the Refuge's wildlife by providing them with all the requirements of their life cycles and improving habitats that had undergone degradation. The rest of North Park would also benefit from partnerships with the Refuge that promote sound habitat and wildlife management. The Refuge's riparian and meadow habitats would be managed in such a way as to provide a wide variety of structures, densities, and vegetative diversity so as to benefit a wider range of wildlife species as the Refuge currently benefits. Not only will waterfowl benefit under this alternative, but also neotropical migratory birds and shorebirds, together with a large variety of insects, mammals, and large ungulates.

### *Public Uses*

Under this alternative, the Refuge would continue to promote hunting of many species in the Refuge as a sound wildlife management activity to achieve the Refuge goals, and would improve some of the facilities necessary for this activity. The Refuge would attempt to improve fisheries resources and promote fishing activities throughout the Refuge. The Refuge would actively participate with local schools to develop and implement a diverse environmental education program at the Refuge that not only focuses on the ecology of the Refuge, but of the entire North Park "sub-ecosystem." The Refuge would utilize its interpretive facilities to promote sound wildlife management and to exemplify the role that agriculture and ranching have had in the conservation of habitats and wildlife. The Refuge will participate and encourage the development of resources to improve wildlife photography and observation not only within the Refuge but throughout North Park. The Refuge would look at other compatible, wildlife-dependent uses and allow them in areas of the Refuge where these activities do not detract from the goals and objectives of the Refuge.

### *Cultural Resources*

Under this alternative, the Service would identify and evaluate the cultural resources and protect them from degradation. The Refuge would also encourage interpretation and protection of cultural resources and their importance to North Park wildlife resources.

### *Air and Water Quality*

Under this alternative, a noticeable increase would occur in the quality of the water of the Illinois River as it crosses the Refuge as the riparian and meadow habitats of the Refuge are improved, and, consequently, are able to better trap sediments and provide shade to the stream. The improvement of the riparian corridor would also arrest, or at least slow down, the stream cutting action of the stream on its banks, thus providing for an improved fisheries resource. The air quality under this alternative would continue to be excellent as prescribed fires would rarely be used to manage the habitats, given the prevailing climatological conditions in North Park. The increase in visitation and its associated increase in use of Refuge roads is not expected to adversely impact in the long run the quality of the air in North Park.

### *Socio-Economic Conditions*

Under this alternative, the Refuge would expect that the current socio-economic conditions of North Park (especially in the City of Walden) would improve as the different activities that the Refuge promotes within the Refuge and throughout North Park would increase visitation to and recreation in North Park. The different public uses that would be promoted under this alternative would not only educate and promote appreciation of wildlife with the residents and visitors to North Park, but would encourage visitors to return to North Park and, thus, contribute to the North Park economy through sales of various types of equipment, lodging, meals, etc. This alternative also seeks to contribute to non-economic well-being factors, such as the preservation of the open landscape of North Park and its historical and rich agricultural and ranching way of life. Furthermore, this alternative would contribute to the well-being of many entrepreneurial activities in North Park as this alternative relies heavily in the creation of partnerships to accomplish the Refuge goals.

Further positive socio-economic effects (direct and indirect) from implementation of this alternative would come from creation of new jobs within Jackson County (11) translating into gains to the local economy from new salaries (over \$400,000 per year). Adverse impacts to the local socio-economic conditions from implementing this alternative would come from a decrease in cattle grazing opportunities in order to meet habitat goals and objectives. It is estimated that this reduction in current cattle grazing levels would be as low as 10 percent but could go as high 64 percent, depending on habitat requirements and response to the strategies applied to reach the objectives of the Refuge. These reductions would be achieved gradually (5 to 10 percent per year), mainly through attrition in current grazing permit numbers from retiring cattlemen, until habitat goals are met. A maximum (64 percent) reduction from current grazing levels on Refuge lands would result in a loss of 22 grazing-related jobs with a total income of approximately \$43,373 per year. It is estimated that the total effects (direct and indirect) of a 64 percent reduction in grazing pressure would result in a loss of 4.4 jobs, for a total income of \$84,441 per year.

**Table 1. Impacts Associated with Implementing Alternatives A-D**

Issues	Alternative A (No Action)	Alternative B	Alternative C	Alternative D (Preferred)
<b>Wildlife and Habitats</b>	<ul style="list-style-type: none"> <li>maintain current upland, riparian, wetland, and meadow habitats management strategies using water levels, flooding, and cattle grazing as the main tools</li> <li>provide for existing wildlife with an emphasis on waterfowl production</li> </ul>	<ul style="list-style-type: none"> <li>Refuge will shift from wildlife species-specific and production-oriented management toward habitat-enhancement and natural carrying-capacity management</li> <li>Refuge management emphasis will be on restoring, to the highest possible degree, the natural processes and functions of meadows, riparian corridor, wetlands, and uplands to provide for the life cycle needs of all resident and migratory species</li> </ul>	<ul style="list-style-type: none"> <li>Refuge will shift from wildlife species-specific and production-oriented management toward habitat-enhancement and natural carrying-capacity management</li> <li>Refuge management emphasis will be on achieving maximum biological potential of the Refuge habitats to provide for the life cycle needs of all resident and migratory species</li> </ul>	<ul style="list-style-type: none"> <li>Refuge will shift from wildlife species-specific and production-oriented management toward habitat-enhancement and natural carrying-capacity management</li> <li>Refuge management emphasis will be on restoring, to the highest possible degree, the natural processes and functions of meadows, riparian corridor, wetlands, and uplands to provide for the life cycle needs of all resident and migratory species</li> </ul>
<b>Public Uses</b>	<ul style="list-style-type: none"> <li>provide for existing public uses</li> <li>no addition to educational activities and/or interpretation</li> </ul>	<ul style="list-style-type: none"> <li>Great emphasis on EE/Interpretation to promote sound habitat and wildlife management techniques; this is done in collaboration with local educational institutions and may also take place outside of the Refuge</li> <li>Hunting and fishing are highly encouraged given the improved habitats and wildlife using the Refuge</li> <li>Other public uses are studied and permitted as long as they are compatible and do not detract from goals of the Refuge</li> </ul>	<ul style="list-style-type: none"> <li>Hunting would continue to be encouraged and hunter numbers could increase to control herbivory</li> <li>Fishing would only occur in limited numbers</li> <li>EE/Interpretation would serve to inform the public on Refuge management and how to protect wildlife</li> <li>Other public uses disappear and observation is very limited</li> </ul>	<ul style="list-style-type: none"> <li>Great emphasis on EE/Interpretation to promote sound habitat and wildlife management techniques; this is done in collaboration with local educational institutions and may also take place outside of the Refuge</li> <li>Hunting and fishing are highly encouraged given the improved habitats and wildlife using the Refuge</li> <li>Other public uses are studied and permitted as long as they are compatible and do not detract from goals of the Refuge</li> </ul>

**Table 1. Impacts Associated with Implementing Alternatives A-D**

<b>Issues</b>	<b>Alternative A (No Action)</b>	<b>Alternative B</b>	<b>Alternative C</b>	<b>Alternative D (Preferred)</b>
<b>Cultural Resources</b>	<ul style="list-style-type: none"> <li>maintain current level of identification and protection</li> </ul>	<ul style="list-style-type: none"> <li>identify and evaluate cultural resources during systematic inventories</li> <li>interpretation of resources to show the history of the Refuge and North Park</li> </ul>	<ul style="list-style-type: none"> <li>identify and evaluate cultural resources during systematic inventories</li> </ul>	<ul style="list-style-type: none"> <li>identify and evaluate cultural resources during systematic inventories</li> <li>interpretation of resources to show the history of the Refuge and North Park</li> </ul>
<b>Air and Water Quality</b>	<ul style="list-style-type: none"> <li>No changes to current air and water quality</li> </ul>	<ul style="list-style-type: none"> <li>no changes in air quality but marked improvements in water quality from restored habitats</li> </ul>	<ul style="list-style-type: none"> <li>no changes in air quality but marked improvements in water quality from restored habitats</li> </ul>	<ul style="list-style-type: none"> <li>no changes in air quality but marked improvements in water quality from restored habitats</li> </ul>
<b>Species of Special Concern (including federally-listed)</b>	<ul style="list-style-type: none"> <li>maintain current levels of protection of resident as well as migratory species of special concern</li> </ul>	same as Alternative A	same as Alternative A	same as Alternative A
<b>Land Acquisition, Leases, and Boundary Consolidation</b>	<ul style="list-style-type: none"> <li>maintain current status of purchasing inholdings on a willing-seller basis only</li> <li>Obtain leases to access Refuge lands</li> </ul>	same as Alternative A	same as Alternative A	same as Alternative A

**Table 1. Impacts Associated with Implementing Alternatives A-D**

Issues	Alternative A (No Action)	Alternative B	Alternative C	Alternative D (Preferred)
<p><b>Socio-Economic Conditions</b></p> <p>(for further information please see Appendix G., specifically Table 21)</p>	<ul style="list-style-type: none"> <li>No changes; maintain current economic involvement in the local community and economy</li> </ul>	<ul style="list-style-type: none"> <li>Direct and indirect effects from increased Refuge-related and other jobs throughout Jackson County (+11.1) as a result of implementation of this alternative result positive gains to the local economy from increased salaries (+413,044/year)</li> <li>Grazing pressure on Refuge habitats may be reduced from 10% to 64% depending on habitat conditions, goals and objectives. If this reduction occurs, it would be achieved gradually (5% to 10% per year) until habitat goals are met. A 64% reduction in grazing on Refuge lands would result in a loss of 2.2 grazing-related jobs with a total income of \$43,373/year. The total effects (direct and indirect) of a 64% in grazing pressure would result in a loss of 4.4 jobs, for a total income of \$84,441/year.</li> <li>Socio-Economic conditions improve throughout North Park from increased visitation</li> </ul>	<ul style="list-style-type: none"> <li>Direct and indirect effects from increased Refuge-related and other jobs throughout Jackson County (+8.5) as a result of implementation of this alternative result positive gains to the local economy from increased salaries (+311,435/year)</li> <li>Grazing pressure on Refuge habitats may be reduced from 10% to 64% depending on habitat conditions, goals and objectives. If this reduction occurs, it would be achieved gradually (5% to 10% per year) until habitat goals are met. A 64% reduction in grazing on Refuge lands would result in a loss of 2.2 grazing-related jobs with a total income of \$43,373/year. The total effects (direct and indirect) of a 64% in grazing pressure would result in a loss of 4.4 jobs, for a total income of \$84,441/year.</li> <li>Socio-Economic conditions may worsen from decreased public visitation to the Refuge</li> <li>Increased hunting could ameliorate negative impacts from decreased visitation from the public</li> </ul>	<ul style="list-style-type: none"> <li>Direct and indirect effects from increased Refuge-related and other jobs throughout Jackson County (+11.1) as a result of implementation of this alternative result positive gains to the local economy from increased salaries (+413,044/year)</li> <li>Grazing pressure on Refuge habitats may be reduced from 10% to 64% depending on habitat conditions, goals and objectives. If this reduction occurs, it would be achieved gradually (5% to 10% per year) until habitat goals are met. A 64% reduction in grazing on Refuge lands would result in a loss of 2.2 grazing-related jobs with a total income of \$43,373/year. The total effects (direct and indirect) of a 64% in grazing pressure would result in a loss of 4.4 jobs, for a total income of \$84,441/year.</li> <li>Socio-Economic conditions improve throughout North Park from increased visitation</li> </ul>

## Cumulative Impacts

Cumulative impacts include impacts on the environment which result from incremental effects of the preferred alternative (proposed action) when these are added to additional past, present, and future actions (that are foreseeable). These cumulative impacts can be the result of individually minor impacts which can become significant when added over a period of time. The implementation of the preferred alternative (Alternative D) would reduce the likelihood for cumulative impacts because of the approach (incremental) in which the habitats and other programs in the Refuge will be implemented.

The new approach (proposed action) that the Refuge seeks to implement will change from the waterfowl-production scheme to a more ecologically-oriented, habitat based management. This new approach will alleviate some of the impacts caused by target-specific species.

The National Environmental Policy Act requires mitigation measures when the NEPA process detects possible significant impacts to habitats, wildlife, or the human environment. All the activities proposed under Alternative D are not expected nor intended to produce significant levels of environmental impacts that would require mitigation measures. Nevertheless, the CCP contains measures that would preclude significant environmental impacts from occurring:

- 1) federally-listed species will be protected from intentional or unintended impacts by having activities banned where these species occur;
- 2) hunting safety regulations are closely coordinated with and enforced by Refuge and CDOW personnel;
- 3) the Refuge will regulate all proposed activities so as to lessen potential impacts to wildlife and plant species, especially during the sensitive reproductive cycles;
- 4) monitoring protocols will be established to determine goal achievement levels and possible unforeseen impacts to Refuge resources, so that adaptive management may be applied to ensure wildlife and habitat resources, as well as the human environment, are preserved;
- 5) the CCP can be revised and amended after 5 years of implementation so that, if unforeseen impacts showed up during the first years of the plan, adaptive management can correct the impacts.

## **Consultation and Coordination**

The Refuge Manager of Arapaho NWR was assigned primary responsibility for planning in the summer of 2000. Several meetings and workshops have been conducted to date with personnel of CDOW and BLM (whose lands adjoin the Refuge) to ensure that proposed management activities not only benefit the Refuge's habitats and wildlife, but complement efforts by these agencies and to solicit their input in crucial habitat and wildlife management decisions. The Refuge, with the help of a consultant, prepared a Stakeholder Involvement Plan to ensure all interested parties and stakeholders could have opportunities to express their concerns and raise issues that would be addressed in the CCP. Public meetings were held in the City of Walden (adjacent to the Refuge) and Fort Collins (in the Front Range of Colorado) in February 2001 to try to reach out to as many stakeholders as possible.

During these open house meetings Refuge personnel gave a succinct audio-visual presentation (PowerPoint) of the history and resources of the Refuge as well as the need for the CCP and NEPA process, followed by a question-answer session, and request for comments and issues. The issues raised were inscribed on easel paper and the attendees were invited to submit further issues or questions in writing to the Refuge. Besides the CDOW, the Refuge Manager contacted the Jackson County Commissioners and invited them to a tour of the Refuge on January 22, 2001, where he provided them with briefing packets and gave them an overview of the CCP process and purpose. This meeting served also to obtain comments from the attending commissioners and answer their questions on the Refuge and the CCP process.

**Arapaho NWR Draft Comprehensive Conservation Plan Alternatives  
(Goals and Objectives) Matrix**

**PUBLIC USE GOAL:** *“Through wildlife-dependent recreation and education, people of a range of abilities and interests are able to learn of and appreciate the natural resources of this unique high mountain park. Thereby, citizens become better stewards of nature in their own communities and stronger supporters of the Refuge specifically and National Wildlife Refuge System generally.”*

<b>Alternative A (No Action Alternative)</b>	<b>Alternative B</b>	<b>Alternative C</b>	<b>Alternative D (Preferred Alternative)</b>
<u>HUNTING</u>	<u>HUNTING</u>	<u>HUNTING</u>	<u>HUNTING</u>
<ul style="list-style-type: none"> <li>• Provide high quality hunting recreational opportunities (1,972 hunting activity hours) on portions of the Refuge that are compatible with available natural resources.</li> </ul>	<ul style="list-style-type: none"> <li>• Provide recreational hunting opportunities consistent with Refuge goals and objectives, and that facilitate North Park wildlife management objectives.</li> <li>• The Refuge will work with the State in promoting sound hunting practices as a wildlife management tool.</li> <li>• Facilities will be maintained, and improved as necessary, to provide a quality recreational hunting experience while minimizing resource damage.</li> </ul>	<ul style="list-style-type: none"> <li>• Working with the State, provide hunting opportunities to meet the Refuges habitat goals and objectives.</li> <li>• Use hunting as a tool to minimize impacts of herbivory on habitat based goals and objectives.</li> <li>• Facilities (parking areas, roads, signs) will be improved to accommodate hunting and minimize impacts on Refuge.</li> <li>• Working with the State, provide big game hunting opportunities on the Refuge to meet Refuge habitat goals and objectives.</li> </ul>	<ul style="list-style-type: none"> <li>• Provide recreational hunting opportunities consistent with Refuge goals and objectives, and that facilitate North Park wildlife management objectives.</li> <li>• The Refuge will work with the State in promoting sound hunting practices as a wildlife management tool.</li> <li>• Facilities will be maintained, and improved as necessary, to provide a quality recreational hunting experience while minimizing resource damage.</li> </ul>
<u>FISHING</u>	<u>FISHING</u>	<u>FISHING</u>	<u>FISHING</u>
<ul style="list-style-type: none"> <li>• Provide high quality fishing recreational opportunities on portions of the Refuge that are compatible with available natural resources.</li> </ul>	<ul style="list-style-type: none"> <li>• Where compatible, opportunities for fishing will be provided based on and Refuge goals and objectives.</li> <li>• Where possible, expand fishing opportunities throughout North Park, and help promote fishing as a recreational activity.</li> </ul>	<ul style="list-style-type: none"> <li>• Allow recreational fishing only when it does not conflict with habitat based goals and objectives.</li> </ul>	<ul style="list-style-type: none"> <li>• Where compatible, opportunities for fishing will be provided based on and Refuge goals and objectives.</li> <li>• Where possible, expand fishing opportunities throughout North Park, and help promote fishing as a recreational activity.</li> </ul>

**PUBLIC USE GOAL:** "Through wildlife-dependent recreation and education, people of a range of abilities and interests are able to learn of and appreciate the natural resources of this unique high mountain park. Thereby, citizens become better stewards of nature in their own communities and stronger supporters of the Refuge specifically and National Wildlife Refuge System generally."

<p><b>Alternative A (No Action Alternative)</b></p>	<p><b>Alternative B</b></p>	<p><b>Alternative C</b></p>	<p><b>Alternative D (Preferred Alternative)</b></p>
<p><u>ENVIRONMENTAL EDUCATION and INTERPRETATION</u></p> <ul style="list-style-type: none"> <li>• Provide an average of 5 environmental education opportunities annually, focusing on requested topics, for 150 to 250 participants.</li> <li>• Provide interpretive opportunities to Refuge visitors - approximately 7,000 to 10,000 annually on the Refuge primarily at the visitor center and overlooks, and along the auto tour route and nature trail.</li> </ul>	<p><u>ENVIRONMENTAL EDUCATION and INTERPRETATION</u></p> <ul style="list-style-type: none"> <li>• Work with partners, including the North Park School District, to provide opportunities and facilities to conduct 5 environmental education programs a year, based on Refuge habitat goals and objectives.</li> <li>• Incorporate the Refuge and its niche in the North Park landscape in other environmental education messages developed in the county.</li> <li>• Update Refuge interpretive message to reflect recent wildlife issues and concerns (elk, sage grouse), habitat based decision-making, local agricultural uses, and how they are not mutually exclusive on or off the Refuge.</li> <li>• Incorporate the Refuge and its niche in the North Park landscape in other interpretive messages developed in the county.</li> </ul>	<p><u>ENVIRONMENTAL EDUCATION and INTERPRETATION</u></p> <ul style="list-style-type: none"> <li>• Modify environmental education and interpretation programs to focus on how and why the Refuge intensively manages habitats to achieve Refuge goals and purposes by 2005.</li> <li>• Redesign Refuge interpretation and environmental education programs to minimize disturbance to Refuge lands.</li> </ul>	<p><u>ENVIRONMENTAL EDUCATION and INTERPRETATION</u></p> <ul style="list-style-type: none"> <li>• Work with partners, including the North Park School District, to provide opportunities and facilities to conduct 5 environmental education programs a year, based on Refuge habitat goals and objectives.</li> <li>• Incorporate the Refuge and its niche in the North Park landscape in other environmental education messages developed in the county.</li> <li>• Update Refuge interpretive message to reflect recent wildlife issues and concerns (elk, sage grouse), habitat based decision-making, local agricultural uses, and how they are not mutually exclusive on or off the Refuge.</li> <li>• Incorporate the Refuge and its niche in the North Park landscape in other interpretive messages developed in the county.</li> </ul>
<p><u>WILDLIFE OBSERVATION and PHOTOGRAPHY</u></p> <ul style="list-style-type: none"> <li>• Provide wildlife observation and photography opportunities on the Refuge especially along overlooks, auto tour route, and nature trail.</li> </ul>	<p><u>WILDLIFE OBSERVATION and PHOTOGRAPHY</u></p> <ul style="list-style-type: none"> <li>• Enhance opportunities for wildlife observation and photography based on Refuge habitat goals and objectives by 2017.</li> <li>• Assist with funding, construction, and program development to enhance wildlife photography and observation in North Park.</li> </ul>	<p><u>WILDLIFE OBSERVATION and PHOTOGRAPHY</u></p> <ul style="list-style-type: none"> <li>• Encourage wildlife observation and photography from Refuge edge only by 2010.</li> </ul>	<p><u>WILDLIFE OBSERVATION and PHOTOGRAPHY</u></p> <ul style="list-style-type: none"> <li>• Enhance opportunities for wildlife observation and photography based on Refuge habitat goals and objectives by 2017.</li> <li>• Assist with funding, construction, and program development to enhance wildlife photography and observation in North Park.</li> </ul>

**PUBLIC USES GOAL:** *“Through wildlife-dependent recreation and education, people of a range of abilities and interests are able to learn of and appreciate the natural resources of this unique high mountain park. Thereby, citizens become better stewards of nature in their own communities and stronger supporters of the Refuge specifically and National Wildlife Refuge System generally.”*

<b>Alternative A (No Action Alternative)</b>	<b>Alternative B</b>	<b>Alternative C</b>	<b>Alternative D (Preferred Alternative)</b>
<p><u>OTHER USES</u></p> <ul style="list-style-type: none"> <li>Allow current non-wildlife-dependent uses to continue on Refuge lands.</li> </ul>	<p><u>OTHER USES</u></p> <ul style="list-style-type: none"> <li>Compatible, non-wildlife-dependent uses will be allowed, but limited to less sensitive areas based on habitat goals and objectives.</li> <li>Consider non-wildlife-dependent public uses and their benefits to North Park and its residents.</li> </ul>	<p><u>OTHER USES</u></p> <ul style="list-style-type: none"> <li>Eliminate all non-wildlife-dependent public uses that could have a negative impact on wildlife and their habitat. Eliminate or prevent natural resource damaging uses by 2010. If not possible to eliminate or prevent, then minimize or mitigate.</li> </ul>	<p><u>OTHER USES</u></p> <ul style="list-style-type: none"> <li>Compatible, non-wildlife-dependent uses will be allowed, but limited to less sensitive areas based on habitat goals and objectives.</li> <li>Consider non-wildlife-dependent public uses and their benefits to North Park and its residents.</li> </ul>

**PARTNERSHIPS GOAL:** *“A wide range of partners join with the Fish and Wildlife Service in promoting and implementing the Refuge vision.”*

<b>Alternative A (No Action Alternative)</b>	<b>Alternative B</b>	<b>Alternative C</b>	<b>Alternative D (Preferred Alternative)</b>
<ul style="list-style-type: none"> <li>The Refuge will participate in partnerships that promote sound wildlife management.</li> </ul>	<ul style="list-style-type: none"> <li>The Refuge will participate in partnerships that promote sound wildlife management.</li> <li>Maintain or form partnerships to achieve the wildlife related goals and objectives on the Refuge and within North Park.</li> </ul>	<ul style="list-style-type: none"> <li>The Refuge will participate in partnerships that promote sound wildlife management.</li> <li>Maintain or form partnerships to assist with achieving the Refuge’s habitats goals and objectives.</li> </ul>	<ul style="list-style-type: none"> <li>The Refuge will participate in partnerships that promote sound wildlife management.</li> <li>Maintain or form partnerships to achieve the wildlife related goals and objectives on the Refuge and within North Park.</li> </ul>

**CULTURAL RESOURCES GOAL:** *“The cultural resources of the Refuge are preserved, protected, and interpreted for the benefit of present and future generations.”*

<b>Alternative A (No Action Alternative)</b>	<b>Alternative B</b>	<b>Alternative C</b>	<b>Alternative D (Preferred Alternative)</b>
<ul style="list-style-type: none"> <li>Limit cultural resources surveys and protection of cultural resources on Refuge lands to those tracts that will undergo a Federal action.</li> </ul>	<ul style="list-style-type: none"> <li>Identify existing Refuge cultural resources and protect from degradation.</li> <li>Encourage interpretation and protection of cultural resources and their importance to North Park wildlife resources.</li> </ul>	<ul style="list-style-type: none"> <li>Identify and protect existing Refuge cultural resources from degradation.</li> </ul>	<ul style="list-style-type: none"> <li>Identify existing Refuge cultural resources and protect from degradation.</li> <li>Encourage interpretation and protection of cultural resources and their importance to North Park wildlife resources.</li> </ul>

**RESEARCH GOAL:** *“The Refuge is a learning platform for compatible research that assists management and science of high mountain in park sage-steppe communities.”*

<b>Alternative A (No Action Alternative)</b>	<b>Alternative B</b>	<b>Alternative C</b>	<b>Alternative D (Preferred Alternative)</b>
<ul style="list-style-type: none"> <li>When requested by investigators, allow natural resource related research opportunities on the Refuge.</li> </ul>	<ul style="list-style-type: none"> <li>Identify and promote the biological research needed to help achieve the Refuge’s habitat goals and objectives.</li> <li>Identify and promote research in other disciplines (e.g. how to lessen the impacts of public uses) as it relates and contributes to achieving habitat goals and objectives on the Refuge and within North Park.</li> </ul>	<ul style="list-style-type: none"> <li>Identify and promote the biological research needed to help achieve the Refuge’s habitat goals and objectives.</li> <li>Identify and promote research in other disciplines as it relates and contributes to achieving habitat goals and objectives (e.g. how to lessen the impacts of public uses.).</li> </ul>	<ul style="list-style-type: none"> <li>Identify and promote the biological research needed to help achieve the Refuge’s habitat goals and objectives.</li> <li>Identify and promote research in other disciplines (e.g. how to lessen the impacts of public uses) as it relates and contributes to achieving habitat goals and objectives on the Refuge and within North Park.</li> </ul>

**RIPARIAN HABITATS GOAL:** "Provide a riparian community representative of historic flora and fauna in a high valley of the southern Rocky Mountains to provide habitat for migratory birds, mammals and river dependent species."

<b>Alternative A (No Action Alternative)</b>	<b>Alternative B</b>	<b>Alternative C</b>	<b>Alternative D (Preferred Alternative)</b>
<ul style="list-style-type: none"> <li>• Protect foraging and roosting habitat for occasional use by peregrine falcons and bald eagles to ensure that these federally-listed species are adequately protected and remain relatively undisturbed on Refuge lands.</li> <li>• Develop and manage nesting and brood-rearing habitat contributing to the production of 11,000 to 12,000 ducks and 500 Canada geese throughout the Refuge annually.</li> <li>• Manage predator populations to help ensure an annual Refuge-wide minimum of 40% Mayfield nesting success for waterfowl.</li> <li>• Improve, restore, and protect the Illinois River riparian habitat for the benefit of brown trout, mule deer, elk, moose, and various other species of wildlife that utilize the area.</li> </ul>	<ul style="list-style-type: none"> <li>• Restore 50 to 100 acres of dense (40 to 100%) willow in patches &gt;.2 ha and 20 m wide in the central third of the Illinois River (from the north end of the island to the confluence with Spring Creek) to connect existing willow patches and maintain 535 acres of dense willow in patches in the lower third of the Illinois River to benefit nesting neotropical migrant songbirds (yellow warbler, willow flycatcher) and resident moose, river otter, and beaver.</li> <li>• Provide 5,919 to 6,269 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native plants (rushes, sedges, grasses, forbs) characterized by 10 to 30 cm visual obstruction reading, 0 to 10 cm duff layer and minimal (&lt;5%) bare ground and less than 40% (canopy closure) willow to benefit nesting waterfowl (pintail, shoveler, gadwall, green-winged teal) and sage grouse broods.</li> </ul>	<ul style="list-style-type: none"> <li>• Restore 50 to 100 acres of dense (40 to 100%) willow in patches &gt;0.2 ha and 20 m wide in the central third of the Illinois River (from the north end of the Island to the confluence of Spring Creek) to connect existing willow patches and maintain 535 acres of dense willow in patches in the upper third of the Illinois River to benefit nesting neotropical migratory songbirds (yellow warbler, willow flycatcher) and resident moose, river otter, and beaver.</li> <li>• Provide 5,919 to 6,269 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native plants (rushes, sedges, grasses, forbs) characterized by 10 to 30 cm visual obstruction reading, 0 to 10 cm duff layer and minimal (&lt;5%)bare ground and less than 40%(canopy closure) willow to benefit nesting waterfowl (pintail, shoveler, gadwall, green-winged teal) and sage grouse broods.</li> </ul>	<ul style="list-style-type: none"> <li>• Restore 50 to 100 acres of dense (40 to 100%) willow in patches &gt;.2 ha and 20 m wide in the central third of the Illinois River (from the north end of the island to the confluence with Spring Creek) to connect existing willow patches and maintain 535 acres of dense willow in patches in the lower third of the Illinois River to benefit nesting neotropical migrant songbirds (yellow warbler, willow flycatcher) and resident moose, river otter, and beaver.</li> <li>• Provide 5,919 to 6,269 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native plants (rushes, sedges, grasses, forbs) characterized by 10 to 30 cm visual obstruction reading, 0 to 10 cm duff layer and minimal (&lt;5%) bare ground and less than 40% (canopy closure) willow to benefit nesting waterfowl (pintail, shoveler, gadwall, green-winged teal) and sage grouse broods.</li> </ul>

**RIPARIAN HABITATS GOAL:** "Provide a riparian community representative of historic flora and fauna in a high valley of the southern Rocky Mountains to provide habitat for migratory birds, mammals and river dependent species."

<b>Alternative A (No Action Alternative)</b>	<b>Alternative B</b>	<b>Alternative C</b>	<b>Alternative D (Preferred Alternative)</b>
	<ul style="list-style-type: none"> <li>• Provide 350 to 700 acres, over a 5-year average, of a grass:forb (75:25) plant community composed of primarily native species (grasses, sedges, forbs, rushes) characterized by &gt;30 cm visual obstruction reading, 10 to 20 cm duff layer and minimal (&lt;5%) bare ground, and less than 40% (canopy closure) willow from mid-April through August to benefit nesting waterfowl (mallard, gadwall, pintail, scaup), songbirds (savannah sparrow, meadowlark), and foraging shorebirds if flooded (snipe, phalarope, white-faced ibis, sora, curlew, willet).</li> <li>• Given the altered river flow regime, provide a properly functioning river channel characterized by a well defined thalweg, outside river edges that are deeper than inside edges, a river sinuosity of 2.0 to 2.5, pool spacing every 7 to 9 channel widths, active point bar formation, and gradients in riffles that are higher than in pools to benefit willow establishment for neotropical migrants, and indirectly provide suitable habitat for native and nonnative fishes.</li> </ul>	<ul style="list-style-type: none"> <li>• Provide 350 to 700 acres, over a 5-year average, of a grass:forb (75:25) plant community composed of primarily native species (grasses, sedges, forbs, rushes) characterized by &lt;30 cm visual obstruction reading, 10 to 20 cm duff layer and minimal (&lt;5%) bare ground, and less than 40% (canopy closure) willow from mid-April through August to benefit nesting waterfowl (mallard, pintail, gadwall, scaup), songbirds (savannah sparrow, meadowlark), and foraging shorebirds if flooded (snipe, phalarope, white-faced ibis, sora, long-billed curlew, willet).</li> <li>• Given the altered river flow regime, provide a properly functioning river channel characterized by a well defined thalweg, outside river edges that are deeper than inside edges, a river sinuosity of 2.0 to 2.5, pool spacing every 7 to 9 channel widths, active point bar formation, and gradients in riffles that are higher than in pools to benefit willow establishment for neotropical migrant, and indirectly provide suitable habitat for native and nonnative fishes.</li> </ul>	<ul style="list-style-type: none"> <li>• Provide 350 to 700 acres, over a 5-year average, of a grass:forb (75:25) plant community composed of primarily native species (grasses, sedges, forbs, rushes) characterized by &gt;30 cm visual obstruction reading, 10 to 20 cm duff layer and minimal (&lt;5%) bare ground, and less than 40% (canopy closure) willow from mid-April through August to benefit nesting waterfowl (mallard, gadwall, pintail, scaup), songbirds (savannah sparrow, meadowlark), and foraging shorebirds if flooded (snipe, phalarope, white-faced ibis, sora, curlew, willet).</li> <li>• Given the altered river flow regime, provide a properly functioning river channel characterized by a well defined thalweg, outside river edges that are deeper than inside edges, a river sinuosity of 2.0 to 2.5, pool spacing every 7 to 9 channel widths, active point bar formation, and gradients in riffles that are higher than in pools to benefit willow establishment for neotropical migrants, and indirectly provide suitable habitat for native and nonnative fishes.</li> </ul>

**RIPARIAN HABITATS GOAL:** *“Provide a riparian community representative of historic flora and fauna in a high valley of the southern Rocky Mountains to provide habitat for migratory birds, mammals and river dependent species.”*

<b>Alternative A (No Action Alternative)</b>	<b>Alternative B</b>	<b>Alternative C</b>	<b>Alternative D (Preferred Alternative)</b>
	<ul style="list-style-type: none"> <li>• Short-term variations of habitat objectives may be considered, on a case-by-case basis, by Refuge management for important ecosystem projects within North Park.</li> <li>• Establish a private lands program to encourage restoration of degraded riparian zones through funding and technical assistance to accomplish similar objectives as those defined for the Refuge. High priority areas are those that have immediate influence on the Refuge because of drainage or proximity.</li> <li>• Work with partners to address land health issues throughout Jackson County.</li> </ul>		<ul style="list-style-type: none"> <li>• Short-term variations of habitat objectives may be considered, on a case-by-case basis, by Refuge management for important ecosystem projects within North Park.</li> <li>• Establish a private lands program to encourage restoration of degraded riparian zones through funding and technical assistance to accomplish similar objectives as those defined for the Refuge. High priority areas are those that have immediate influence on the Refuge because of drainage or proximity.</li> <li>• Work with partners to address land health issues throughout Jackson County.</li> </ul>

**MEADOW HABITATS GOAL:** "Provide and manage irrigated, grassland dominated meadows historically developed for hay production, to support sage grouse broods, waterfowl nesting, and meadow dependent migratory birds."

<b>Alternative A (No Action Alternative)</b>	<b>Alternative B</b>	<b>Alternative C</b>	<b>Alternative D (Preferred Alternative)</b>
<ul style="list-style-type: none"> <li>• Protect foraging habitat for occasional use by peregrine falcons and bald eagles to ensure that these federally-listed species are adequately protected and remain relatively undisturbed on Refuge lands.</li> <li>• Develop and manage nesting habitat contributing to the production of 11,000 to 12,000 ducks and 500 Canada geese throughout the Refuge annually.</li> <li>• Manage predator populations to help ensure an annual Refuge-wide minimum of 40% Mayfield nesting success for waterfowl.</li> <li>• Improve the condition, vigor and productivity of Refuge meadows for the benefit of phalarope, snipe, meadowlark, Savannah sparrow, sage grouse broods, and other meadow-dependent species.</li> </ul>	<ul style="list-style-type: none"> <li>• Provide 20 to 50 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native plants (rushes, sedges, grasses, forbs) characterized by &lt;20 cm height, &lt;10 cm visual obstruction reading, with dry to moist soils (no standing water), adjacent to (within 50 m) or intermingled with sagebrush (10 to 25% sage canopy cover), from early June to late July, to benefit sage grouse and snipe broods.</li> <li>• Provide 2,830 to 3,120 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native species (grasses, sedges, forbs, rushes) characterized by 10 to 30 cm visual obstruction reading, 0 to 10 cm duff layer and minimal (&lt;5%) bare ground from mid-April to the end of July to benefit nesting waterfowl (gadwall, shoveler, pintail, green-winged teal) and sage grouse broods.</li> </ul>	<ul style="list-style-type: none"> <li>• Provide 20 to 50 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native plants (rushes, sedges, grasses, forbs) characterized by &lt;20 cm height, &lt;10 cm visual obstruction reading, with dry to moist soils (no standing water), adjacent to (within 50 m) or intermingled with sagebrush (10 to 25% sage canopy cover), from early June to late July, to benefit sage grouse and snipe broods.</li> <li>• Provide 2,830 to 3,120 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native species (grasses, sedges, forbs, rushes) characterized by 10 to 30 cm visual obstruction reading, 0 to 10 cm duff layer and minimal (&lt;5%) bare ground from mid-April to the end of July to benefit nesting waterfowl (gadwall, shoveler, pintail, green-winged teal) and sage grouse broods.</li> </ul>	<ul style="list-style-type: none"> <li>• Provide 20 to 50 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native plants (rushes, sedges, grasses, forbs) characterized by &lt;20 cm height, &lt;10 cm visual obstruction reading, with dry to moist soils (no standing water), adjacent to (within 50 m) or intermingled with sagebrush (10 to 25% sage canopy cover), from early June to late July, to benefit sage grouse and snipe broods.</li> <li>• Provide 2,830 to 3,120 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native species (grasses, sedges, forbs, rushes) characterized by 10 to 30 cm visual obstruction reading, 0 to 10 cm duff layer and minimal (&lt;5%) bare ground from mid-April to the end of July to benefit nesting waterfowl (gadwall, shoveler, pintail, green-winged teal) and sage grouse broods.</li> </ul>

**MEADOW HABITATS GOAL:** "Provide and manage irrigated, grassland dominated meadows historically developed for hay production, to support sage grouse broods, waterfowl nesting, and meadow dependent migratory birds."

<b>Alternative A (No Action Alternative)</b>	<b>Alternative B</b>	<b>Alternative C</b>	<b>Alternative D (Preferred Alternative)</b>
	<ul style="list-style-type: none"> <li>• Provide 1,100 to 1,400 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native plants (grasses, sedges, forbs, rushes) characterized by &gt;30 cm visual obstruction reading, 10 to 20 cm duff layer and minimal (&lt;5%) bare ground to benefit nesting waterfowl (mallard, gadwall, pintails, scaup), songbirds (savannah sparrow, meadowlark), and foraging shorebirds if flooded (snipe, phalarope, white-faced ibis, curlew, willet, sora).</li> <li>• Short-term variations of habitat objectives may be considered, on a case-by-case basis, by refuge management for important ecosystem projects within North Park.</li> <li>• Establish a private lands program to provide funding and technical assistance to encourage wildlife-compatible land management practices in meadow habitats to accomplish objectives similar to those of the Refuge.</li> <li>• Work with partners to address land health issues throughout Jackson County.</li> </ul>	<ul style="list-style-type: none"> <li>• Provide 1,100 to 1,400 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native plants (grasses, sedges, forbs, rushes) characterized by &gt;30 cm visual obstruction reading, 10 to 20 cm duff layer and minimal (&lt;5%) bare ground to benefit nesting waterfowl (mallard, gadwall, pintails, scaup), songbirds (savannah sparrow, meadowlark), and foraging shorebirds if flooded (snipe, phalarope, white-faced ibis, curlew, willet, sora).</li> </ul>	<ul style="list-style-type: none"> <li>• Provide 1,100 to 1,400 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native plants (grasses, sedges, forbs, rushes) characterized by &gt;30 cm visual obstruction reading, 10 to 20 cm duff layer and minimal (&lt;5%) bare ground to benefit nesting waterfowl (mallard, gadwall, pintails, scaup), songbirds (savannah sparrow, meadowlark), and foraging shorebirds if flooded (snipe, phalarope, white-faced ibis, curlew, willet, sora).</li> <li>• Short-term variations of habitat objectives may be considered, on a case-by-case basis, by refuge management for important ecosystem projects within North Park.</li> <li>• Establish a private lands program to provide funding and technical assistance to encourage wildlife-compatible land management practices in meadow habitats to accomplish objectives similar to those of the Refuge.</li> <li>• Work with partners to address land health issues throughout Jackson County.</li> </ul>

**WETLAND HABITATS GOAL:** "Provide and manage natural and man-made permanent and semipermanent wetlands (in three wetland complexes) to provide habitat for migratory waterfowl, shorebirds, wading birds and associated wetland-dependent wildlife."

<b>Alternative A (No Action Alternative)</b>	<b>Alternative B</b>	<b>Alternative C</b>	<b>Alternative D (Preferred Alternative)</b>
<ul style="list-style-type: none"> <li>• Protect foraging habitat for occasional use by peregrine falcons and bald eagles to ensure that these and other federally-listed species are adequately protected and remain relatively undisturbed on Refuge lands.</li> <li>• Develop and manage approximately 839 acres of foraging, pairing, nesting, and brood-rearing habitat contributing to the production of 11,000 to 12,000 ducks and 500 Canada geese throughout the Refuge annually.</li> <li>• Improve the condition, vigor, and productivity of Refuge wetlands for the benefit of shorebirds, wading birds, and other wetland-dependent species.</li> </ul>	<ul style="list-style-type: none"> <li>• Maintain 10 acres of, and attempt to establish in one other wetland basin, tall (<math>\geq 60</math> cm visual obstruction reading) emergent vegetation in water depths <math>&gt;4</math> cm over a 5-year period to provide nesting habitat for over-water nesting birds (black-crowned night-heron, white-faced ibis, waterfowl, marsh wrens, coots, rails, blackbirds).</li> <li>• Provide 10% of the wetland acres, over a 5-year average, in short (<math>&lt;10</math> cm), sparse (<math>&lt;10</math> cm visual obstruction reading) emergent vegetation in water depths <math>&lt;4</math> cm from April to August to provide foraging habitat for shorebirds and waterfowl, as well as nesting and brood-rearing habitat for shorebirds.</li> <li>• Provide 20% of the wetland acres, over a 5-year average, of emergent vegetation <math>&gt;25</math> cm tall with visual obstruction reading <math>&gt;80\%</math> of vegetation height in water depths 4 to 18 cm to provide escape cover and foraging habitat for dabbling duck broods and molting ducks and foraging habitat for water birds.</li> </ul>	<ul style="list-style-type: none"> <li>• Maintain 10 acres of, and attempt to establish in one other wetland basin, tall (<math>\geq 60</math> cm visual obstruction reading) emergent vegetation in water depths <math>&gt;4</math> cm over a 5-year period to provide nesting habitat for over-water nesting birds (black-crowned night heron, white-faced ibis, waterfowl, marsh wrens, coots, rails, blackbirds).</li> <li>• Provide 10% of the wetland acres, over a 5-year average, in short (<math>&lt;10</math> cm), sparse (<math>&lt;10</math> cm visual obstruction reading), emergent vegetation in water depths <math>&lt;4</math> cm from April to August to provide foraging habitat for shorebirds and waterfowl, as well as nesting and brood-rearing habitat for shorebirds.</li> <li>• Provide 20% of the wetland acres, over a 5-year average, of emergent vegetation <math>&gt;25</math> cm tall with visual obstruction reading <math>&gt;80\%</math> of vegetation height in water depths 4 to 18 cm to provide escape cover and foraging habitat for dabbling duck broods and molting ducks and foraging habitat for water birds.</li> </ul>	<ul style="list-style-type: none"> <li>• Maintain 10 acres of, and attempt to establish in one other wetland basin, tall (<math>\geq 60</math> cm visual obstruction reading) emergent vegetation in water depths <math>&gt;4</math> cm over a 5-year period to provide nesting habitat for over-water nesting birds (black-crowned night-heron, white-faced ibis, waterfowl, marsh wrens, coots, rails, blackbirds).</li> <li>• Provide 10% of the wetland acres, over a 5-year average, in short (<math>&lt;10</math> cm), sparse (<math>&lt;10</math> cm visual obstruction reading) emergent vegetation in water depths <math>&lt;4</math> cm from April to August to provide foraging habitat for shorebirds and waterfowl, as well as nesting and brood-rearing habitat for shorebirds.</li> <li>• Provide 20% of the wetland acres, over a 5-year average, of emergent vegetation <math>&gt;25</math> cm tall with visual obstruction reading <math>&gt;80\%</math> of vegetation height in water depths 4 to 18 cm to provide escape cover and foraging habitat for dabbling duck broods and molting ducks and foraging habitat for water birds.</li> </ul>

**WETLAND HABITATS GOAL:** "Provide and manage natural and man-made permanent and semipermanent wetlands (in three wetland complexes) to provide habitat for migratory waterfowl, shorebirds, wading birds and associated wetland-dependent wildlife."

Alternative A (No Action Alternative)	Alternative B	Alternative C	Alternative D (Preferred Alternative)
	<ul style="list-style-type: none"> <li>• Provide 10 to 20% of the wetland acres within each wetland complex, over a 5-year average, with a 70% coverage of submergent aquatic vegetation species (<i>Potamogeton</i>, <i>Ruppia</i>) in wetlands of &gt;18 cm water depth to provide invertebrates and seed sources for foraging water birds, especially waterfowl broods, and escape cover for diving ducks.</li> <li>• Enhance the existing private land programs to encourage creation and restoration of wetlands in North Park and surrounding areas through funding and technical assistance to accomplish the same objectives as on the Refuge.</li> </ul>	<p>Provide 10 to 20% of the wetland acres within each wetland complex, over a 5-year average, with a 70% coverage of submergent aquatic vegetation species (<i>Potamogeton</i>, <i>Ruppia</i>) in wetlands of &gt;18 cm water depth to provide invertebrates and seed sources for foraging water birds, especially waterfowl broods, and escape cover for diving ducks.</p>	<ul style="list-style-type: none"> <li>• Provide 10 to 20% of the wetland acres within each wetland complex, over a 5-year average, with a 70% coverage of submergent aquatic vegetation species (<i>Potamogeton</i>, <i>Ruppia</i>) in wetlands of &gt;18 cm water depth to provide invertebrates and seed sources for foraging water birds, especially waterfowl broods, and escape cover for diving ducks.</li> <li>• Enhance the existing private land programs to encourage creation and restoration of wetlands in North Park and surrounding areas through funding and technical assistance to accomplish the same objectives as on the Refuge.</li> </ul>

**UPLAND HABITATS GOAL:** "Provide a sagebrush/grassland upland community representative of the historic flora and fauna in a high valley of the southern Rocky Mountains to provide habitat for sage grouse, large mammals and other shrub associated species."

<b>Alternative A (No Action Alternative)</b>	<b>Alternative B</b>	<b>Alternative C</b>	<b>Alternative D (Preferred Alternative)</b>
<ul style="list-style-type: none"> <li>• Protect foraging habitat for occasional use by peregrine falcons and bald eagles to ensure that these, the North Park Phacelia (<i>Phacelia formosula</i>) and other federally-listed species are adequately monitored, protected, and remain relatively undisturbed on Refuge lands.</li> <li>• Improve the condition, vigor, and productivity of approximately 14,000 acres of Refuge sagebrush / grassland uplands for the benefit of sage grouse, waterfowl, pronghorn antelope, song birds, and raptors.</li> </ul>	<ul style="list-style-type: none"> <li>• Provide 2,000 acres, over a 5-year average, of uplands composed of shrubs (&gt;70% sage) &gt;25 cm height and 20 to 30% canopy cover, &gt;20% grass cover, and &gt;10% forbs (native species preferred) to benefit sage grouse, vesper sparrow, brewers sparrow, elk, and pronghorn antelope.</li> <li>• Provide 2,000 acres, over a 5-year average, of uplands composed of shrubs (&gt;70% sage) &gt;40 cm height and &gt;30% canopy cover, &lt;20% grass cover, and &gt;5% forbs (native species preferred) to benefit brewer's sparrow, sage thrasher, and pronghorn antelope.</li> <li>• Manage the remaining 10,000 acres of sagebrush / grassland uplands based on a better understanding of Refuge habitats, wildlife uses, and affected variables using best management practices.</li> <li>• Manage North Park Phacelia (<i>Phacelia formosula</i>) populations currently known to exist on the Refuge to ensure its continued existence.</li> <li>• Establish a private lands program to encourage restoration of degraded upland habitats in North Park through funding and technical assistance to accomplish the same objectives as on the Refuge.</li> </ul>	<ul style="list-style-type: none"> <li>• Provide 2,000 acres, over a 5-year average, of uplands composed of shrubs (&gt;70% sage) &gt;25 cm height and 20 to 30% canopy cover, &gt;20% grass cover, and &gt;10% forbs (native species preferred) to benefit sage grouse, vesper sparrow, brewers sparrow, elk, and pronghorn antelope.</li> <li>• Provide 2,000 acres, over a 5-year average, of uplands composed of shrubs (&gt;70% sage) &gt;40 cm height and &gt;30% canopy cover, &lt;20% grass cover, and &gt;5% forbs (native species preferred) to benefit brewer's sparrow, sage thrasher, and pronghorn antelope.</li> <li>• Manage the remaining 10,000 acres of sagebrush / grassland uplands based on a better understanding of refuge habitats, wildlife uses, and affected variables using best management practices.</li> <li>• Manage North Park Phacelia (<i>Phacelia formosula</i>) populations currently known to exist on the Refuge to ensure its continued existence.</li> </ul>	<ul style="list-style-type: none"> <li>• Provide 2,000 acres, over a 5-year average, of uplands composed of shrubs (&gt;70% sage) &gt;25 cm height and 20 to 30% canopy cover, &gt;20% grass cover, and &gt;10% forbs (native species preferred) to benefit sage grouse, vesper sparrow, brewers sparrow, elk, and pronghorn antelope.</li> <li>• Provide 2,000 acres, over a 5-year average, of uplands composed of shrubs (&gt;70% sage) &gt;40 cm height and &gt;30% canopy cover, &lt;20% grass cover, and &gt;5% forbs (native species preferred) to benefit brewer's sparrow, sage thrasher, and pronghorn antelope.</li> <li>• Manage the remaining 10,000 acres of sagebrush / grassland uplands based on a better understanding of Refuge habitats, wildlife uses, and affected variables using best management practices.</li> <li>• Manage North Park Phacelia (<i>Phacelia formosula</i>) populations currently known to exist on the Refuge to ensure its continued existence.</li> <li>• Establish a private lands program to encourage restoration of degraded upland habitats in North Park through funding and technical assistance to accomplish the same objectives as on the Refuge.</li> </ul>



# Appendix A. Arapaho National Wildlife Refuge Species List

## Birds

Taxonomic list of birds at Arapaho NWR (Order follows the A.O.U. Check-list of North American Birds, 7th ed. 1998) January, 2002.

General: 203 species occurring. 82 species breeding, 13 accidental/vagrant. 2 on the ESA: 0 Federal Endangered, 2 Federal Threatened, 0 Federal Candidate: Threatened.

### Grebes

Pied-billed Grebe	<i>Podilymbus podiceps</i>
Eared Grebe	<i>Podiceps nigricollis</i>
Western Grebe	<i>Aechmophorus occidentalis</i>

### Pelicans

American White Pelican	<i>Pelecanus erythrorhynchos</i>
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### Cormorants

Double-crested Cormorant	<i>Phalacrocorax auritus</i>
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### Bitterns, Herons, and Egrets

American Bittern	<i>Botaurus lentiginosus</i>
Great Blue Heron	<i>Ardea herodias</i>
Snowy Egret	<i>Egretta thula</i>
Cattle Egret	<i>Bubulcus ibis</i>
Green Heron	<i>Butorides virescens</i>
Black-crowned Night-Heron	<i>Nycticorax nycticorax</i>
Yellow-crowned Night-Heron	<i>Nyctanassa violaceus</i>

### Ibises and Spoonbills

White-faced Ibis	<i>Plegadis chihi</i>
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### New World Vultures

Turkey Vulture	<i>Cathartes aura</i>
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### Swans, Geese, and Ducks

Snow Goose	<i>Chen caerulescens</i>
Canada Goose	<i>Branta canadensis</i>
Trumpeter Swan	<i>Cygnus buccinator</i>
Tundra Swan	<i>Cygnus columbianus</i>
Wood Duck	<i>Aix sponsa</i>
Gadwall	<i>Anas strepera</i>
American Wigeon	<i>Anas americana</i>
Mallard	<i>Anas platyrhynchos</i>
Blue-winged Teal	<i>Anas discors</i>
Cinnamon Teal	<i>Anas cyanoptera</i>
Northern Shoveler	<i>Anas clypeata</i>
Northern Pintail	<i>Anas acuta</i>
Green-winged Teal	<i>Anas crecca</i>
Canvasback	<i>Aythya valisineria</i>
Redhead	<i>Aythya americana</i>
Ring-necked Duck	<i>Aythya collaris</i>
Lesser Scaup	<i>Aythya affinis</i>
Bufflehead	<i>Bucephala albeola</i>
Common Goldeneye	<i>Bucephala clangula</i>
Hooded Merganser	<i>Lophodytes cucullatus</i>
Common Merganser	<i>Mergus merganser</i>
Ruddy Duck	<i>Oxyura jamaicensis</i>

### Osprey, Kites, Hawks, and Eagles

Osprey	<i>Pandion haliaetus</i>
Bald Eagle	<i>Haliaeetus leucocephalus</i>
Northern Harrier	<i>Circus cyaneus</i>
Sharp-shinned Hawk	<i>Accipiter striatus</i>
Cooper's Hawk	<i>Accipiter cooperi</i>
Northern Goshawk	<i>Accipiter gentilis</i>
Swainson's Hawk	<i>Buteo swainsoni</i>
Red-tailed Hawk	<i>Buteo jamaicensis</i>
Ferruginous Hawk	<i>Buteo regalis</i>
Rough-legged Hawk	<i>Buteo lagopus</i>
Golden Eagle	<i>Aquila chrysaetos</i>

### Falcons and Caracaras

American Kestrel	<i>Falco sparverius</i>
Merlin	<i>Falco columbarius</i>
Peregrine Falcon	<i>Falco peregrinus</i>
Prairie Falcon	<i>Falco mexicanus</i>

### Gallinaceous Birds

Sage Grouse	<i>Centrocercus urophasianus</i>
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### Rails

Virginia Rail	<i>Rallus limicola</i>
Sora	<i>Porzana carolina</i>
American Coot	<i>Fulica americana</i>

### Cranes

Sandhill Crane	<i>Grus canadensis</i>
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### Plovers

Black-bellied Plover	<i>Pluvialis squatarola</i>
Killdeer	<i>Charadrius vociferus</i>

### Stilts and Avocets

Black-necked Stilt	<i>Himantopus mexicanus</i>
American Avocet	<i>Recurvirostra americana</i>

### Sandpipers and Phalaropes

Greater Yellowlegs	<i>Tringa melanoleuca</i>
Lesser Yellowlegs	<i>Tringa flavipes</i>
Solitary Sandpiper	<i>Tringa solitaria</i>
Willet	<i>Catoptrophorus semipalmatus</i>
Spotted Sandpiper	<i>Actitis macularia</i>
Upland Sandpiper	<i>Bartramia longicauda</i>
Long-billed Curlew	<i>Numenius americanus</i>
Marbled Godwit	<i>Limosa fedoa</i>
Western Sandpiper	<i>Calidris mauri</i>
Least Sandpiper	<i>Calidris minutilla</i>
Baird's Sandpiper	<i>Calidris bairdii</i>
Long-billed Dowitcher	<i>Limnodromus scolopaceus</i>
Common Snipe	<i>Gallinago gallinago</i>
Wilson's Phalarope	<i>Phalaropus tricolor</i>
Red-necked Phalarope	<i>Phalaropus lobatus</i>

### Skuas, Jaegers, Gulls, and Terns

Franklin's Gull	<i>Larus pipixcan</i>
Bonaparte's Gull	<i>Larus philadelphia</i>
Ring-billed Gull	<i>Larus delawarensis</i>
California Gull	<i>Larus californicus</i>
Forster's Tern	<i>Sterna forsteri</i>
Black Tern	<i>Chlidonias niger</i>

### Pigeons and Doves

Mourning Dove	<i>Zenaidura macroura</i>
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Cuckoos and Anis		Northern Rough-winged Swallow	
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>	Bank Swallow	<i>Stelgidopteryx serripennis</i>
<i>Barn Owls</i>		Cliff Swallow	<i>Riparia riparia</i>
Barn Owl	<i>Tyto alba</i>	Barn Swallow	<i>Petrochelidon pyrrhonota</i>
Typical Owls		Titmice and Chickadees	
Great Horned Owl	<i>Bubo virginianus</i>	Black-capped Chickadee	<i>Poecile atricapillus</i>
Burrowing Owl	<i>Athene cunicularia</i>	Mountain Chickadee	<i>Poecile gambeli</i>
Long-eared Owl	<i>Asio otus</i>		
Short-eared Owl	<i>Asio flammeus</i>	Nuthatches	
Northern Saw-whet Owl	<i>Aegolius acadicus</i>	Red-breasted Nuthatch	<i>Sitta canadensis</i>
Nightjars		Wrens	
Common Nighthawk	<i>Chordeiles minor</i>	Rock Wren	<i>Salpinctes obsoletus</i>
Hummingbirds		House Wren	<i>Troglodytes aedon</i>
Calliope Hummingbird	<i>Stellula calliope</i>	Sedge Wren	<i>Cistothorus platensis</i>
Broad-tailed Hummingbird	<i>Selasphorus platycercus</i>	Marsh Wren	<i>Cistothorus palustris</i>
Rufous Hummingbird	<i>Selasphorus rufus</i>	Dippers	
Kingfishers		American Dipper	<i>Cinclus mexicanus</i>
Belted Kingfisher	<i>Ceryle alcyon</i>	Kinglets	
Woodpeckers		Ruby-crowned Kinglet	<i>Regulus calendula</i>
Lewis' Woodpecker	<i>Melanerpes lewis</i>	Thrushes	
Yellow-bellied Sapsucker	<i>Sphyrapicus varius</i>	Eastern Bluebird	<i>Sialia sialis</i>
Red-naped Sapsucker	<i>Sphyrapicus nuchalis</i>	Western Bluebird	<i>Sialia mexicana</i>
Downy Woodpecker	<i>Picoides pubescens</i>	Mountain Bluebird	<i>Sialia currucoides</i>
Hairy Woodpecker	<i>Picoides villosus</i>	Veery	<i>Catharus fuscescens</i>
Northern Flicker	<i>Colaptes auratus</i>	Swainson's Thrush	<i>Catharus ustulatus</i>
Tyrant Flycatchers		Hermit Thrush	<i>Catharus guttatus</i>
Olive-sided Flycatcher	<i>Contopus cooperi</i>	American Robin	<i>Turdus migratorius</i>
Western Wood-Pewee	<i>Contopus sordidulus</i>	Mimic Thrushes	
Willow Flycatcher	<i>Empidonax traillii</i>	Gray Catbird	<i>Dumetella carolinensis</i>
Hammond's Flycatcher	<i>Empidonax hammondi</i>	Northern Mockingbird	<i>Mimus polyglottos</i>
Dusky Flycatcher	<i>Empidonax oberholseri</i>	Sage Thrasher	<i>Oreoscoptes montanus</i>
Cordilleran Flycatcher	<i>Empidonax occidentalis</i>	Brown Thrasher	<i>Toxostoma rufum</i>
Say's Phoebe	<i>Sayornis saya</i>	Starlings	
Western Kingbird	<i>Tyrannus verticalis</i>	European Starling	<i>Sturnus vulgaris</i>
Eastern Kingbird	<i>Tyrannus tyrannus</i>	Wagtails and Pipits	
Shrikes		American (Water) Pipit	<i>Anthus rubescens</i>
Loggerhead Shrike	<i>Lanius ludovicianus</i>	Waxwings	
Northern Shrike	<i>Lanius excubitor</i>	Bohemian Waxwing	<i>Bombycilla garrulus</i>
Vireos		Cedar Waxwing	<i>Bombycilla cedrorum</i>
Warbling Vireo	<i>Vireo gilvus</i>	Wood Warblers	
Crows, Jays, and Magpies		Orange-crowned Warbler	<i>Vermivora celata</i>
Steller's Jay	<i>Cyanocitta stelleri</i>	Nashville Warbler	<i>Vermivora ruficapilla</i>
Pinyon Jay	<i>Gymnorhinus cyanocephalus</i>	Virginia's Warbler	<i>Vermivora virginiae</i>
Clark's Nutcracker	<i>Nucifraga columbiana</i>	Yellow Warbler	<i>Dendroica petechia</i>
Black-billed Magpie	<i>Pica pica</i>	Chestnut-sided Warbler	<i>Dendroica pensylvanica</i>
American Crow	<i>Corvus brachyrhynchos</i>	Magnolia Warbler	<i>Dendroica magnolia</i>
Common Raven	<i>Corvus corax</i>	Yellow-rumped Warbler	<i>Dendroica coronata</i>
Larks		MacGillivray's Warbler	<i>Oporornis tolmiei</i>
Horned Lark	<i>Eremophila alpestris</i>	Common Yellowthroat	<i>Geothlypis trichas</i>
Swallows		Wilson's Warbler	<i>Wilsonia pusilla</i>
Tree Swallow	<i>Tachycineta bicolor</i>	Tanagers	
Violet-green Swallow	<i>Tachycineta thalassina</i>	Western Tanager	<i>Piranga ludoviciana</i>

Sparrows and Towhees  
 Green-tailed Towhee *Pipilo chlorurus*  
 Spotted Towhee *Pipilo maculatus*  
 Eastern Towhee *Pipilo erythrophthalmus*  
 American Tree Sparrow *Spizella arborea*  
 Chipping Sparrow *Spizella passerina*  
 Brewer's Sparrow *Spizella breweri*  
 Vesper Sparrow *Poocetes gramineus*  
 Lark Sparrow *Chondestes grammacus*  
 Sage Sparrow *Amphispiza belli*  
 Lark Bunting *Calamospiza melanocorys*  
 Savannah Sparrow *Passerculus sandwichensis*  
 Fox Sparrow *Passerelia iliaca*  
 Song Sparrow *Melospiza melodia*  
 Lincoln's Sparrow *Melospiza lincolni*  
 Harris' Sparrow *Zonotrichia querula*  
 White-crowned Sparrow *Zonotrichia leucophrys*  
 Dark-eyed Junco *Junco hyemalis*  
 McCown's Longspur *Calcarius mccownii*  
 Lapland Longspur *Calcarius lapponicus*  
 Chestnut-collared Longspur *Calcarius ornatus*  
 Snow Bunting *Plectrophenax nivalis*

Grosbeaks, and Allies  
 Rose-breasted Grosbeak *Pheucticus ludovicianus*  
 Black-headed Grosbeak *Pheucticus melanocephalus*  
 Blue Grosbeak *Guiraca caerulea*  
 Lazuli Bunting *Passerina amoena*  
 Indigo Bunting *Passerina cyanea*  
 Dickcissel *Spiza americana*

Blackbirds and Orioles  
 Bobolink *Dolichonyx oryzivorus*  
 Red-winged Blackbird *Agelaius phoeniceus*  
 Western Meadowlark *Sturnella neglecta*  
 Yellow-headed Blackbird *Xanthocephalus xanthocephalus*  
 Brewer's Blackbird *Euphagus cyanocephalus*  
 Common Grackle *Quiscalus quiscula*  
 Brown-headed Cowbird *Molothrus ater*  
 Bullock's Oriole *Icterus bullockii*

Finches  
 Gray-crowned Rosy-Finch *Leucosticte tephrocotis*  
 Black Rosy-Finch *Leucosticte atrata*  
 Brown-capped Rosy-Finch *Leucosticte australis*  
 House Finch *Carpodacus mexicanus*  
 Pine Siskin *Carduelis pinus*  
 Lesser Goldfinch *Carduelis psaltria*  
 American Goldfinch *Carduelis tristis*  
 Evening Grosbeak *Coccothraustes vespertinus*

Old World Sparrows  
 House Sparrow *Passer domesticus* Introduced

**Mammals** (General: 33 species occurring January, 2002.)

Shrews  
 Masked Shrew *Sorex cinereus*

Hares and Rabbits  
 Nuttall's Cottontail *Sylvilagus nuttallii*  
 White-tailed Jackrabbit *Lepus townsendii*

Squirrels  
 Least Chipmunk *Eutamias minimus*  
 Yellow-bellied Marmot *Marmota flaviventris*  
 Wyoming Ground Squirrel *Spermophilus elegans*  
 Thirteen-lined Ground Squirrel *Spermophilus tridecemlineatus*  
 Golden-mantled Ground Squirrel *Spermophilus lateralis*  
 White-tailed Prairie Dog *Cynomys leucurus*

Beaver  
 Beaver *Castor canadensis*

Mice, Rats and Voles  
 Deer Mouse *Peromyscus maniculatus*  
 Northern Grasshopper Mouse *Onychomys leucogaster*  
 Montane Vole *Microtus montanus*  
 Muskrat *Ondatra zibethicus*

Old World Mice  
 House Mouse *Mus musculus*

Jumping Mice  
 Western Jumping Mouse *Zapus princeps*

Porcupine  
 Porcupine *Erethizon dorsatum*

Dogs, Wolves and Foxes  
 Coyote *Canis latrans*  
 Red Fox *Vulpes vulpes*

Bears  
 Black Bear *Ursus americanus*

Racoons  
 Racoon *Procyon lotor*

Weasels, Skunks, etc.  
 Ermine *Mustela erminea*  
 Long-tailed Weasel *Mustela frenata*  
 Mink *Mustela vison*  
 River Otter *Lutra canadensis*  
 Badger *Taxidea taxus*  
 Striped Skunk *Mephitis mephitis*

Cats  
 Mountain Lion *Puma concolor*  
 Bobcat *Felis rufus*

Deer  
 Rocky Mountain Elk *Cervus elaphus*  
 Mule Deer *Odocoileus hemionus*  
 White-tailed Deer *Odocoileus virginianus*  
 Moose *Alces alces*

Pronghorn  
 Pronghorn *Antilocapra americana*

## Fish

General: 9 species occurring. January, 2002.

### Trout

Rainbow Trout	<i>Salmo gairdneri</i>
Brown Trout	<i>Salmo trutta</i>
Brook Trout	<i>Salvelinus fontinalis</i>

### Dace, Minnows, Chub and Darters

Northern Redbelly Dace	<i>Phoxinus eos</i>
Fathead Minnow	<i>Pimephales promelas</i>
Creek Chub	<i>Semotilus atromaculatus</i>
Johnny Darter	<i>Etheostoma nigrum</i>

### Suckers

Long-nosed Sucker	<i>Catostomus catostomus</i>
White Sucker	<i>Catostomus commersoni</i>

## Amphibians and Reptiles

General: 6 species occurring. January, 2002.

### Amphibians

Barred Tiger Salamander	<i>Ambystoma tigrinum mavortium</i>
Western Toad	<i>Bufo boreas</i>
Wood Frog	<i>Rana sylvatica</i>
Northern Leopard Frog	<i>Rana pipiens</i>
Striped Chorus Frog	<i>Pseudacris nigrita maculatata</i>

### Reptiles

Wandering Garter Snake	<i>Thamnophis elegans vagrans</i>
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## Plants

General: 390 species occurring. 1 on the ESA: 1 federally endangered. January 2002.

### Parsley Family (Apiaceae = Umbelliferae)

Sweet cicely	<i>Osmorhiza longistylis</i>
Douglas water hemlock	<i>Cicuta douglasii</i>
Poison-hemlock	<i>Conium maculatum</i>
Western hemlock	<i>Cicuta maculata angustifolia</i>
Lovage, licorice-root	<i>Ligusticum porteri</i>
Hemlock parsley	<i>Conioselinum scopulorum</i>
Cow parsnip	<i>Heracleum lanatum</i>

### Fern Family (Aspleniaceae)

Alpine ladyfern	<i>Athyrium distentifolium</i>
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### Aster Family (Asteraceae)

Aster	<i>Aster campestris</i>
Golden aster	<i>Chrysopsis horrida</i>
Hairy golden aster	<i>Chrysopsis villosa</i>
Leafy aster	<i>Aster foliaceus</i>
Marsh aster	<i>Aster hesperius</i>
Arrowleaf balsamroot	<i>Balsamorhiza sagittata</i>
Heart-leaf arnica	<i>Arnica cordifolia</i>
Leafy or meadow arnica	<i>Arnica chamissonis</i>
Coulter's daisy	<i>Erigeron coulteri</i>
Daisy	<i>Erigeron elatior</i>
Daisy fleabane	<i>Erigeron ochroleucus scribneri</i>
Spear-leaf fleabane	<i>Erigeron lonchophyllus</i>
Subalpine daisy	<i>Erigeron peregrinus</i>
Common dandelion	<i>Taraxacum officinale</i>
Mountain dandelion	<i>Agoseris glauca glauca</i>
Common pearly-everlasting	<i>Anaphalis margaritacea</i>
Dune goldenrod	<i>Solidago simplex</i>
Canada goldenrod	<i>Solidago canadensis</i>
Missouri goldenrod	<i>Solidago missouriensis</i>
Goldenweed	<i>Haplopappus clematis</i>
Goldenweed	<i>Haplopappus lanceolatus</i>
Arrowleaf groundsel	<i>Senecio triangularis</i>
Groundsel	<i>Senecio mutabilis</i>
Groundsel	<i>Senecio soldanella</i>
Groundsel	<i>Senecio sphaerocephalus</i>
Few-leaved groundsel, alpine meadow butterweed	<i>Senecio cymbalarioides</i>
Thickleaf groundsel, butterweed, ragwort	<i>Senecio crassultus</i>
Water groundsel, alkali marsh butterweed	<i>Senecio hydrophilus</i>
Long-leaved hawkbeard	<i>Crepis acuminata</i>
Dandelion hawkbeard	<i>Crepis runcinata</i>
Gray horsebrush	<i>Tetradymia canescens</i>
Mule's ears	<i>Wyethia amplexicaulis</i>
Nothocalais	<i>Nothocalais nigrescens</i>
Pineapple-weed	<i>Matricaria matricaroides</i>
Field pussytoes	<i>Antennaria neglecta</i>
Nuttall's pussytoes	<i>Antennaria parvifolia</i>
Rosy pussytoes	<i>Antennaria microphylla</i>
Tall pussytoes	<i>Antennaria anaphaloides</i>
Gray rabbitbrush	<i>Chrysothamnus nauseosus albicaulis</i>
Rubber rabbitbrush	<i>Chrysothamnus nauseosus nauseosus</i>
Alkali Sage	<i>Artemisia arbuscula longiloba</i>
Big sage	<i>Artemisia tridentata tridentata</i>
Fringed sage	<i>Artemisia frigida</i>
Low sage	<i>Artemisia arbuscula arbuscula</i>

Mountain big sage	<i>Artemisia tridentata vaseyana</i>	Bearberry honeysuckle	<i>Lonicera involucrata</i>
Mountain silver sage	<i>Artemisia cana viscidula</i>	Snowberry	<i>Symphoricarpos orbiculatus</i>
Plains sage	<i>Artemisia longifolia</i>	Twinflower	<i>Linnaea borealis longiflora</i>
Prairie sage	<i>Artemisia ludoviciana</i>		
Sage	<i>Artemisia tridentata rothrockii</i>	Pink Family (Caryophyllaceae)	
Silver sage	<i>Artemisia cana cana</i>	Catchfly	<i>Lychnis drummondii</i>
Western salsify	<i>Tragopogon dubius</i>	Ballheaded sandwort	<i>Arenaria congesta</i>
Broom snakeweed	<i>Gutierrezia sarothrae</i>	Slender sandwort	<i>Arenaria stricta</i>
Orange sneezeweed	<i>Helenium hoopesii</i>	Longleaved starwort	<i>Stellaria longifolia</i>
False sunflower	<i>Helianthus rigidus</i>	Longstalked starwort	<i>Stellaria longipes</i>
Thistle	<i>Cirsium canescens</i>	Whitlow wort	<i>Paronychia sessiliflora</i>
Thistle	<i>Cirsium drummondii</i>		
Thistle	<i>Cirsium scopulorum</i>	Staff-tree Family (Celastraceae)	
Thistle	<i>Cirsium tioganum</i>	Mountain lover	<i>Pachistima myrsinites</i>
Canada thistle	<i>Cirsium arvense</i>		
Floodman's thistle	<i>Cirsium flodmanii</i>	Goosefoot Family (Chenopodiaceae)	
Star-thistle	<i>Centaurea cyanus</i>	Summer cyperus	<i>Kochia americana</i>
Wavy-leaved thistle	<i>Cirsium undulatum</i>	Slimleaf goosefoot	<i>Chenopodium leptophyllum</i>
Western yarrow	<i>Achillea millefolium</i>	White goosefoot, pigweed	<i>Chenopodium album</i>
		Greasewood	<i>Sarcobatus vermiculatus</i>
Barberry Family (Berberidaceae)		Mat saltbush	<i>Atriplex gardneri</i>
Oregon grape	<i>Mahonia repens</i>	Winterfat	<i>Ceratoides lanata</i>
Birch Family (Betulaceae)		Orpine Family (Crassulaceae)	
Mountain alder	<i>Alnus incana</i>	Rose crown	<i>Sedum rhodanthum</i>
Bog birch	<i>Betula glandulosa</i>	Stonecrop	<i>Sedum lanceolatum</i>
		Stonecrop	<i>Sedum stenopetalum</i>
		Rose crown, stonecrop	<i>Sedum rhodanthum</i>
Borage Family (Boraginaceae)			
Houndstongue	<i>Cynoglossum officinale</i>	Cedar Family (Cupressaceae)	
Bluebells	<i>Mertensia humilis</i>	Common juniper	<i>Juniperus communis depressa</i>
Bluebells	<i>Mertensia lanceolata</i>		
Cilate bluebells	<i>Mertensia ciliata</i>	Sedge Family (Cyperaceae)	
Small bluebells	<i>Mertensia longiflora</i>	Many spiked cottongrass	<i>Eriophorum polystachion</i>
Forget-me-not, stickseed	<i>Hackelia leptophylla</i>	Bulrush	<i>Scirpus pallidus</i>
Minors candle	<i>Cryptantha caespitosa</i>	Bulrush, clubrush	<i>Scirpus microcarpus</i>
Stoneseed	<i>Lithospermum incisum</i>	Common spike rush	<i>Eleocharis palustris</i>
		Small spike rush	<i>Eleocharis parvula</i>
Mustard Family (Brassicaceae = Cruciferae)		Beaked sedge	<i>Carex rostrata</i>
American wintercress	<i>Barbarea orthoceras</i>	Capitate sedge	<i>Carex capitata</i>
Bitter cress	<i>Cardamine breweri</i>	Dunhead sedge	<i>Carex phaeocephala</i>
Large mountain bittercress	<i>Cardamine cordifolia cordifolia</i>	Elk sedge	<i>Carex geyeri</i>
Rock cress	<i>Arabis drummondii</i>	Hayden's sedge	<i>Carex ebenea</i>
Yellowcress	<i>Rorripa obtusa</i>	Narrow-leaved sedge	<i>Carex eleocharis</i>
Smallseed false flax	<i>Camelina microcarpa</i>	Nebraska sedge	<i>Carex nebrascensis</i>
Tansy mustard	<i>Descurainia pinnata</i>	Needleleaf sedge	<i>Carex filifolia</i>
Common peppergrass	<i>Lepidium densiflorum</i>	Parry sedge	<i>Carex parryana</i>
Shepherd's purse	<i>Capsella bursa-pastoris</i>	Sedge	<i>Carex kelloggi</i>
Slender thelypody	<i>Thelypodium sagittatum</i>	Shortbeaked sedge	<i>Carex simulata</i>
Spreading wallflower	<i>Erysimum repandum</i>	Slenderbeaked sedge	<i>Carex athrostachya</i>
		Wooly sedge	<i>Carex lanuginosa</i>
Cactus Family (Cactaceae)			
Pincushion cactus	<i>Coryphantha vivipara</i>	Oleaster Family (Elaeagnaceae)	
Prickly pear cactus, brittle cactus	<i>Opuntia fragilis</i>	Russet buffaloberry	<i>Shepherdia canadensis</i>
Prickly pear cactus	<i>Opuntia polyacantha polyacantha</i>		
		Horsetail Family (Equisetaceae)	
Bluebell Family (Campanulaceae)		Common horsetail	<i>Equisetum arvense</i>
Arctic harebell, bellflower	<i>Campanula uniflora</i>	Horsetail	<i>Equisetum laevigatum</i>
Bellflower, lady's thimble	<i>Campanula rotundifolia</i>	Northern scouring rush	<i>Equisetum variegatum nelsoni</i>
Caper Family (Capparaceae)		Heath Family (Ericaceae)	
Rocky mountain beeplant	<i>Cleome serrulata</i>	Bearberry	<i>Arctostaphylos uva-ursi</i>
		Dwarf billberry	<i>Vaccinium caespitosum</i>
Honeysuckle Family (Caprifoliaceae)		Low billberry	<i>Vaccinium myrtilus</i>
Buckbrush	<i>Symphoricarpos albus</i>	Grouse whortleberry	<i>Vaccinium scoparium</i>
Elderberry	<i>Sambucus racemosa</i>		

Pea Family (Fabaceae = Leguminosae)		Chives	<i>Allium schoenoprasum</i>
Alsike clover	<i>Trifolium hybridum</i>	Cucumber root, clasping-leaved twisted stalk	<i>Streptopus amplexifolius</i>
Long-stalked clover	<i>Trifolium longipes</i>		<i>Zigadenus paniculatus</i>
Sweet clover	<i>Melilotus officinalis</i>	Panicled deathcans	<i>Fritillaria atropurpurea</i>
White, dutch clover	<i>Trifolium repens</i>	Fritillary	<i>Veratrum californicum</i>
Silky crazyweed	<i>Oxytropis sericea sericea</i>	California false-hellebore	<i>Calochortus nuttallii</i>
Plains loco	<i>Oxytropis campestris</i>	Sego lily	<i>Lilium umbellatum</i>
Tall locoweed	<i>Oxytropis lambergii</i>	Red lily	<i>Allium geyeri</i>
Big leaf lupine	<i>Lupinus polyphyllus humicola</i>	Onion	<i>Smilacena stellata</i>
Prairie lupine	<i>Lupinus lepidus utahensis</i>	Starry solomon plume	
Silvery lupine	<i>Lupinus argenteus argenteus</i>		
Milkvetch, locoweed	<i>Astragalus parryi</i>	Mallow Family (Malvaceae)	
Park milkvetch	<i>Astragalus leptaleus</i>	Mallow	<i>Malva crispa</i>
Thistle milkvetch	<i>Astragalus kentrophyta</i>	Checkermallow, false mallow	<i>Sidalcea candida</i>
Silver-leaved milkvetch	<i>Astragalus argophyllus</i>	Scarlet globemallow	<i>Sphaeralcea coccinea</i>
Wooly-pod milkvetch	<i>Astragalus purshii</i>		
Plains orophaca	<i>Astragalus gilyiflorus</i>	Evening Primrose Family (Onagraceae)	
Yellow pea	<i>Thermopsis rhombifolia</i>	Fireweed, blooming sally	<i>Epilobium angustifolium</i>
American vetch	<i>Vicia americana americana</i>	Common willow herb	<i>Epitobium glandulosum tenue</i>
		Willow herb	<i>Epilobium glaberrimum fastigiatum</i>
		Racemed ground smoke	<i>Gayophytum racemosum</i>
Gentian Family (Gentianaceae)			
Gentian	<i>Gentiana forwoodii</i>	Orchid Family (Orchidaceae)	
Gentian	<i>Gentiana parryi</i>	Leafy white orchid	<i>Habenaria dilatata</i>
Pleated or prairie gentian	<i>Gentiana affinis</i>	Giant, western rattlesnake plantain	<i>Goodyera oblongifolia</i>
Moss gentian	<i>Gentiana fremontii</i>		
Northern gentian	<i>Gentianella amarella</i>	Pine Family (Pinaceae)	
Smaller fringed gentian	<i>Gentiana thermalis</i>	Douglas fir	<i>Pseudotsuga menziesii</i>
Swertia	<i>Swertia perennis</i>	Subalpine fir	<i>Abies lasiocarpa</i>
		White fir	<i>Abies concolor</i>
Geranium Family (Geraniaceae)		Limberpine	<i>Pinus flexilis</i>
Richardson's geranium	<i>Geranium richardsonii</i>	Lodgepole pine	<i>Pinus contorta latifolia</i>
		Blue spruce	<i>Picea pungens</i>
Gooseberry Family (Grossulariaceae)		Engleman spruce	<i>Picea engelmannii</i>
Swamp gooseberry	<i>Ribes lacustre</i>		
Whitestem gooseberry	<i>Ribes inerme</i>	Plantain Family (Plantaginaceae)	
		Nippleseed plantain	<i>Plantago major</i>
Waterleaf Family (Hydrophyllaceae)			
North Park Phacelia	<i>Phacelia formosula</i>	Grass Family (Poaceae = Gramineae)	
		Nuttall alkaligrass	<i>Puccinellia airoides</i>
St. Johnswort Family (Hypericaceae)		Foxtail barley	<i>Hordeum jubatum</i>
St. Johnswort	<i>Hypericum perforatum</i>	Meadow barley	<i>Hordeum brachyantherum</i>
		Thurber bentgrass	<i>Agrostis thurburiana</i>
Iris Family (Iridaceae)		Winter bentgrass	<i>Agrostis scabra</i>
Blue-eyed grass	<i>Sisyrinchium idahoense occidentale</i>	Alkali bluegrass	<i>Poa juncifolia</i>
Blue-eyed grass	<i>Sisyrinchium montanum</i>	Big bluegrass	<i>Poa ampla</i>
Rocky mountain iris	<i>Iris missouriensis</i>	Bog bluegrass	<i>Poa leptocoma</i>
		Canada bluegrass	<i>Poa compressa</i>
Rush Family (Juncaceae)		Canby bluegrass	<i>Poa canbyi</i>
Baltic rush	<i>Juncus balticus</i>	Cusick bluegrass	<i>Poa cusickii</i>
Dagger-leaf rush	<i>Juncus ensifolius</i>	Kentucky bluegrass	<i>Poa pratensis</i>
Field woodrush	<i>Luzula campestris</i>	Nevada bluegrass	<i>Poa nevadensis</i>
Long-styled rush	<i>Juncus lonistylis</i>	Sandberg bluegrass	<i>Poa secunda</i>
Smallflowered woodrush	<i>Luzula parviflora</i>	Wheeler bluegrass	<i>Poa nervosa</i>
Tuberous rush	<i>Juncus nodosus</i>	Cheatgrass, downy brome	<i>Bromus tectorum</i>
		Fringed brome	<i>Bromus ciliatus</i>
Arrowgrass Family (Juncaginaceae)		Mountain brome	<i>Bromus marginatus</i>
Seaside arrowgrass	<i>Triglochin maritimum</i>	Nodding brome	<i>Bromus anomalus</i>
Marsh arrowgrass	<i>Triglochin palustre</i>	Smooth brome	<i>Bromus inermis</i>
		Arizona fescue	<i>Festuca arizonica</i>
Mint Family (Lamiaceae)		Idaho fescue	<i>Festuca idahoensis</i>
Field mint	<i>Mentha arvensis</i>	Sheep fescue	<i>Festuca ovina</i>
Common hemp nettle	<i>Galeopsis tetrahit</i>	Thurber fescue	<i>Festuca thurberi</i>
Marsh or willoweed skullcap	<i>Scutellaria galericulata</i>	Fowl grass	<i>Poa palustris</i>
		Meadow foxtail	<i>Alopecurus pratensis</i>

Blue grama	<i>Bouteloua gracilis</i>	Purslane Family (Portulacaceae)	
Hairy grama	<i>Bouteloua hirsuta</i>	Least, dwarf, alpine lewisia	<i>Lewisia pygmaea</i>
Tufted hairgrass	<i>Deschampsia cespitosa cespitosa</i>	Spring beauty	<i>Claytonia lanceolata lanceolata</i>
Junegrass	<i>Koeleria pyramidata</i>		
Mannagrass	<i>Glyceria borealis</i>	Primrose Family (Primulaceae)	
Mat muhly	<i>Muhlenbergia richardsonis</i>	Fairy candleabra, rock jasmine	<i>Androsace septentrionalis</i>
Minute muhly	<i>Muhlenbergia minutissima</i>	Few flowered or dark throat shooting star	<i>Dodecatheon pulchellum</i>
Mountain muhly	<i>Muhlenbergia montana</i>		
Mutton grass	<i>Poa fendleriana</i>		
Needle and thread	<i>Stipa comata</i>	Wintergreen Family (Pyrolaceae)	
Columbia needlegrass	<i>Stipa columbiana</i>	Alpine pyrola	<i>Pyrola asarifolia</i>
Green needlegrass	<i>Stipa viridula</i>		
Letterman's needlegrass	<i>Stipa lettermanii</i>	Buttercup Family (Ranunculaceae)	
Pine needlegrass	<i>Stipa pinetorum</i>	Cliff anemone	<i>Anemone globosa</i>
Parry oatgrass	<i>Danthonia patryi</i>	Baneberry	<i>Actaea rubra</i>
Oniongrass	<i>Melica bulbosa</i>	Buttercup	<i>Ranunculus alismifolius</i>
Purple oniongrass	<i>Melica spectabilis</i>	Macoun's buttercup	<i>Ranunculus macounii</i>
Orchardgrass	<i>Dactylis glomerata</i>	Sagebrush buttercup	<i>Ranunculus glaberrimus ellipticus</i>
Redtop	<i>Agrostis alba</i>	Sharp buttercup	<i>Ranunculus acriformis acriformis</i>
Common reed	<i>Phragmites australis</i>	Columbine	<i>Aquilegia coerulea</i>
Reed canary grass	<i>Phalaris arundinacea</i>	Globeflower	<i>Trollius laxus</i>
Bluejoint reedgrass	<i>Calamagrostis canadensis</i>	Larkspur	<i>Delphinium barbeyi</i>
Narrow spiked reedgrass -		Little larkspur	<i>Delphinium bicolor</i>
	<i>Calamagrostis inexpansa inexpansa</i>	Slim or dwarf larkspur	<i>Delphinium depauperatum</i>
Plains reedgrass	<i>Calamagrostis montanensis</i>	Tall larkspur	<i>Delphinium occidentale</i>
Indian ricegrass	<i>Oryzopsis hymenoides</i>	Marsh marigold	<i>Caltha leptosepala</i>
Blue wild rye	<i>Elymus glaucus</i>	Veiny meadowrue	<i>Thalictrum venulosum</i>
Saltgrass	<i>Distichlis stricta</i>	Monkshood	<i>Aconitum columbianum</i>
Prairie sandreed	<i>Calamovilfa longifolia</i>	Pasqueflower	<i>Anemone patens multifida</i>
Scratchgrass	<i>Muhlenbergia asperifolia</i>		
Sleepy grass	<i>Stipa robusta</i>	Buckthorn Family (Rhamnaceae)	
Sloughgrass	<i>Beckmannia syzigachne</i>	Buckbrush	<i>Ceanothus velutinus</i>
Bottlebrush squirrel tail	<i>Sitanion hystrix</i>		
Timothy	<i>Phleum pratense</i>	Rose Family (Rosaceae)	
Spike trisetum downy oatgrass,	<i>Trisetum spicatum</i>	Largeleaved avens	<i>Geum macrophyllum</i>
Sweetgrass	<i>Hierochloa odorata</i>	Bitterbrush	<i>Purshia tridentata</i>
Baker's wheatgrass	<i>Agropyron bakeri</i>	Blackberry	<i>Rubus idaeus peramoenus</i>
Bearded wheatgrass	<i>Agropyron subsecundum</i>	Chokecherry	<i>Prunus virginiana</i>
Bluebunch wheatgrass	<i>Agropyron spicatum</i>	Biennial cinquefoil	<i>Potentilla biennis</i>
Crested wheatgrass	<i>Agropyron cristatum cristatum</i>	Cinquefoil	<i>Potentilla diversifolia</i>
Elongate wheatgrass	<i>Agropyron elongatum</i>	Cinquefoil	<i>Potentilla gracilis elmeri</i>
Intermediate wheatgrass	<i>Agropyron intermedium</i>	Cinquefoil	<i>Potentilla pucherrima</i>
Slender wheatgrass	<i>Agropyron trachycaulum</i>	Early cinquefoil	<i>Potentilla concinna</i>
Streambank wheatgrass	<i>Agropyron riparium</i>	Prairie cinquefoil	<i>Potentilla pensylvanica</i>
Thickspiked wheatgrass	<i>Agropyron dasystachyum</i>	Shrubby cinquefoil, yellow rose	<i>Potentilla fruticosa</i>
Western wheatgrass	<i>Agropyron smithii</i>	Prairie smoke	<i>Geum triflorum</i>
Brookgrass, water whorlwort	<i>Catabrosa aquatica</i>	Woods rose	<i>Rosa woodsii</i>
		Common silverweed	<i>Potentilla anserina</i>
Phlox Family (Polemoniaceae)		Serviceberry	<i>Amelanchier alnifolia</i>
Narrow-leaf collomia	<i>Collomia linearis</i>	Strawberry	<i>Fragaria virginiana</i>
Scarlet gilia	<i>Gilia agregata</i>		
Hood's phlox	<i>Phlox hoodii</i>	Madder Family (Rubiaceae)	
Long leaf phlox	<i>Phlox longifolia</i>	Northern bedstraw	<i>Galium boreale</i>
Phlox	<i>Phlox multiflora</i>	Small bedstraw	<i>Galium trifidum</i>
Prickly-leaved phlox	<i>Phlox aculeata</i>		
Skunk or sticky polemonium	<i>Polemonium viscosum</i>	Willow Family (Salicaceae)	
		Quaking aspen	<i>Populus tremuloides</i>
Buckwheat Family (Polygonaceae)		Narrowleaf cottonwood	<i>Populus angustifolia</i>
American bistort	<i>Polygonum bistortoides</i>	Booth's willow	<i>Salix boothii</i>
Sulphur buckwheat		Coyote willow	<i>Salix exigua melanopsis</i>
	<i>Eriogonum umbellatum dichrocephalum</i>	Drummond's willow	<i>Salix drummondiana</i>
Wild buckwheat	<i>Eriogonum jamesii flavescens</i>	Greyer's willow	<i>Salix geeyeriana</i>
Curly dock	<i>Rumex crispus</i>	Mountain willow	<i>Salix monticola</i>
Heartweed, spotted ladysthumb	<i>Polygonum persicaria</i>	Planeleaf willow	<i>Salix planifolia planifolia</i>
Douglas' knotweed	<i>Polygonum douglasii</i>	Planeleaf willow	<i>Salix planifolia monica</i>

Scouler's willow	<i>Salix scouleriana</i>
Whiplash willow	<i>Salix lasiandra caudata</i>
Wolf's willow	<i>Salix wolfii</i>

Sandalwood Family (Santalaceae)  
 Bastard toadflax *Comandra umbellata pallida*

Saxifrage Family (Saxifragaceae)  
 Alumroot *Heuchera bracteata*  
 Alumroot *Heuchera hallii*  
 Alumroot *Heuchera parvifolia*  
 Slender fringe-cup, woodlandstar *Lithophragma tenellum*  
 Brook saxifrage *Saxifraga arguta*

Figwort Family (Scrophulariaceae)  
 Beardtongue *Penstemon alpinus*  
 Beardtongue *Penstemon cyathophorus*  
 Beardtongue *Penstemon glaber*  
 Beardtongue *Penstemon saxosorum*  
 American brooklime *Veronica americana*  
 Yellow owl clover *Orthocarpus luteus*  
 Elephant's head *Pedicularis groenlandica*  
 Bracted lousewort *Pedicularis bracteosa*  
 Leafy lousewort *Pedicularis racemosa alba*  
 Lousewort *Pedicularis crenulata*  
 Lousewort *Pedicularis scopulorum*  
 Yellow monkey-flower *Mimulus guttatus*  
 Desert paintbrush *Castilleja chromosa*  
 Indian paintbrush *Castilleja angustifolium chromosa*  
 Indian paintbrush *Castilleja angustifolium puberula*  
 Yellow paintbrush *Castilleja flava*  
 Yellow paintbrush *Castilleja puberula*  
 Slender penstemon *Penstemon gracilis*  
 Small-flowered penstemon *Penstemon procerus*  
 Whipple's penstemon *Penstemon whippleanus*  
 Speedwell *Veronica arvensis*  
 Yellow toadflax *Linaria vulgaris*

Spike Moss Family (Selaginellaceae)  
 Spike moss *Selaginella densa*

Cattail Family (Typhaceae)  
 Common Cattail *Typhya latifolia*

Nettle Family (Urticaceae)  
 Stinging nettle *Urtica dioica*

Valerian Family (Valerianaceae)  
 Valerian *Valeriana occidentalis*

Violet Family (Violaceae)  
 Violet *Viola canadensis*  
 Violet *Viola nuttallii*

## Appendix B. Glossary

- Adaptive Management.** Refers to a process in which policy decisions are implemented within a framework of scientifically driven experiments to test predictions and assumptions inherent in management plan. Analysis of results help managers determine whether current management should continue as is or whether it should be modified to achieve desired conditions.
- Allelopathic.** A plant that is able to suppress the growth of other plants by releasing toxic substances.
- Alternative. 1.** A reasonable way to fix the identified problem or satisfy the stated need (40 CFR 1500.2). **2.** Alternatives are different means of accomplishing Refuge purposes and goals and contributing to the System mission (Draft Service Manual 602 FW 1.5).
- Animal Unit Month.** A measure of the quantity of livestock forage. Equivalent to the amount of forage needed to support a 1,000 pound animal (or 1 cow/calf pair) for 1 month.
- Biological Diversity.** The variety of life and its processes, including the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur (USFWS Manual 052 FW 1. 12B). The System's focus is on indigenous species, biotic communities and ecological processes. Also referred to as Biodiversity.
- Biological Control.** The use of organisms or viruses to control weeds or other pests.
- Canopy.** A layer of foliage; generally the upper-most layer, in a forest stand. Can be used to refer to mid- or understory vegetation in multi-layered stands. Canopy closure is an estimate of the amount of overhead tree cover (also canopy cover).
- Categorical Exclusion (CE, CX, CATEX, CATX).** A category of actions that do not individually or cumulatively have a significant effect on the human environment and have been found to have no such effect in procedures adopted by a Federal agency pursuant to the National Environmental Policy Act (40 CFR 1508.4).
- CDOW SC.** Colorado Division of Wildlife Species of Special Concern.
- CFR** Code of Federal Regulations.
- Noxious Weed.** Those noxious weeds not native to the state that are of limited distribution or are unrecorded in the state and that pose a serious threat to the state.
- Noxious Weed.** Those noxious weeds not native to the state that are of limited distribution or are unrecorded in a region of the state and that pose a serious threat to that region.
- Designate.** These are noxious weeds whose populations in a region or area are such that all seed production can be prevented within a calendar year.
- Compatible Use.** A wildlife-dependent recreational use or any other use of a Refuge that, in the sound professional judgment of the Director, will not materially interfere with or detract from the fulfillment of the Mission of the System or the purposes of the Refuge (Draft Service Manual 603 FW 3.6). A compatibility determination supports the selection of compatible uses and identified stipulations or limits necessary to ensure compatibility.
- Comprehensive Conservation Plan (CCP).** A document that describes the desired future conditions of the Refuge; and provides long-range guidance and management direction for the Refuge manager to accomplish the purposes of the Refuge, contribute to the mission of the System, and to meet other relevant mandates (Draft Service Manual 602 FW 1.5).
- Concern.** See definition of "Issue."
- Cover Type.** The present vegetation of an area.
- Cultural Resources.** The remains of sites, structures, or objects used by people in the past.
- Cultural Resource Inventory.** A professionally conducted study designed to locate and evaluate evidence of cultural resources present within a defined geographic area. Inventories may involve various levels, including background literature search, comprehensive field examination to identify all exposed physical manifestations of cultural resources, or sample inventory to project site distribution and density over a larger area. Evaluation of identified cultural resources to determine eligibility for the National Register follows the criteria found in .36 CFR 60.4 (Service Manual 614 FW 1.7).
- Cultural Resource Overview.** A comprehensive document prepared for a field office that discusses, among other things, its prehistory and cultural history, the nature and extent of known cultural resources, previous research, management objectives, resource management conflicts or issues, and a general statement on how program objectives should be met and conflicts resolved. An overview should reference or incorporate information from a field offices background or literature search described in Section VIII of the Cultural Resource Management Handbook (Service Manual 614 FW 1.7).
- Depredation.** Damage inflicted upon agricultural crops or ornamental plants by wildlife.
- Demography.** The quantitative analysis of population structure and trend.

- Designated Wilderness Area.** An area designated by the United States Congress to be managed as part of the National Wilderness Preservation System (Draft Service Manual 610 FW 1.5).
- Disturbance.** Significant alteration of habitat structure or composition. May be natural (e.g., fire) or human-caused events (e.g. timber harvest).
- Dixie Harrow.** A farming implement pulled behind a tractor that reduces sagebrush density by breaking off sagebrush plants. Typically one pass over sagebrush removes 60 to 70 percent of the live sagebrush plants.
- Early Seral Stage.** An area that is in the primary stages of ecological succession.
- Ecological Succession.** The orderly progression of an area through time from one vegetative community to another in the absence of disturbance. For example, an area may proceed from grass-forb through aspen forest to mixed-conifer forest.
- Ecosystem.** A dynamic and interrelating complex of plant and animal communities and their associated non-living environment.
- Ecosystem Management.** Management of natural resources using system wide concepts to ensure that all plants and animals in ecosystems are maintained at viable levels in native habitats and basic ecosystem processes are perpetuated indefinitely.
- Endangered Species (Federal).** A plant or animal species listed under the Endangered Species Act that is in danger of extinction throughout all or a significant portion of its range.
- Endangered Species (State).** A plant or animal species in danger of becoming extinct or extirpated in Colorado within the near future if factors contributing to its decline continue. Populations of these species are at critically low levels or their habitats have been degraded or depleted to a significant degree.
- Endemic Species.** Plants or animals that occur naturally in a certain region and whose distribution is relatively limited to a particular locality.
- Environmental Assessment (EA).** A concise public document, prepared in compliance with the National Environmental Policy Act, that briefly discusses the purpose and need for an action, alternatives to such action, and provides sufficient evidence and analysis of impacts to determine whether to prepare an environmental impact statement or finding of no significant impact (40 CFR 1508.9).
- Environmental Impact Statement (EIS).** A detailed written statement required by section 102(2)(C) of the National Environmental Policy Act, analyzing the environmental impacts of a proposed action, adverse effects of the project that cannot be avoided, alternative courses of action, short-term uses of the environment versus the maintenance and enhancement of long-term productivity, and any irreversible and irretrievable commitment of resources (40 CFR 1508.1 I).
- Fauna.** All the vertebrate and invertebrate animals of an area.
- Federal Trust Resources.** A trust is something managed by one entity for another who hold the ownership. The FWS hold in trust many natural resources for the people of the United States of America as a result of Federal Acts and treaties. Examples are species listed under the Endangered Species Act, migratory birds protected by international treaties, and native plant or wildlife species found on a National Wildlife Refuge.
- Federal Trust Species.** All species where the Federal government has primary jurisdiction including federally endangered or threatened species, migratory birds, anadromous fish, and certain marine mammals.
- Finding of No Significant Impact (FONSI).** A document prepared in compliance with the National Environmental Policy Act, supported by an environmental assessment, that briefly presents why a Federal action will have no significant effect on the human environment and for which an environmental impact statement, therefore, will not be prepared (40 CFR 1508.13).
- Fire Regime.** A description of the frequency, severity, and extent of fire that typically occurs in an area or vegetative type.
- Flora.** All the plant species of an area.
- Floriferous.** Flower bearing plant.
- Forb.** A broad-leaved, herbaceous plant; for example, a columbine.
- Fragmentation.** The process of reducing the size and connectivity of habitat patches.
- Goal.** Descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose but does not define measurable units (Draft Service Manual 620 FW 1.5).
- Geographic Information System (GIS).** A computer system capable of storing and manipulating spatial data.
- Habitat.** Suite of existing environmental condition required by an organism for survival and reproductions. The place where an organism typically lives.
- Habitat Type.** See Vegetation Type.

**Habitat Restoration.** Management emphasis designed to move ecosystems to desired conditions and processes, and/or to healthy forestlands, rangelands, and aquatic systems.

**Historic Range of Variability (HRV).** The natural fluctuation of components of healthy ecosystems over time. In this EIS, HRV refers to the range of conditions and processes that are Rely to have occurred prior to settlement of the project area by people of European descent (approximately the mid- 1800s), which would have varied within certain limits over time.

Historic range of variability is discussed in this document as a reference point to establish a baseline set of conditions for which sufficient scientific or historical information is available to enable comparison to current condition.

**Indicator Species.** A species of plant or animals that is assumed to be sensitive to habitat changes and represents the needs of a larger group of species. Also referred to as a key species.

**Inholding.** Privately owned land inside the boundary of a national Refuge.

**Integrated Pest Management.** Methods of managing undesirable species, such as weeds, including: education; prevention; physical or mechanical methods of control; biological control; responsible chemical use; and cultural methods.

**Issue.** Any unsettled matter that requires a management decision; e.g., a Service initiative, opportunity, resource management problem, a threat to the resources of the unit, conflict in uses, public concern, or the presence of an undesirable resource condition (Draft Service Manual 602 FW 1.5).

**Inviolate.** Not violated or profaned, pure.

**Management Alternative.** See Alternative.

**Management Concern.** See Issue.

**Management Opportunity.** See Issue.

**Microhabitat.** Habitat features at a fine scale; often identifies a unique set of local habitat features.

**Migration.** The seasonal movement from one area to another and back.

**Mission Statement.** Succinct statement of a unit's purpose and reason for being.

**Mitigation.** Measures designed to counteract environmental impacts or to make impacts less severe.

**Monitoring.** The process of collecting information to track changes of selected parameters over time.

**National Environmental Policy Act of 1969 (NEPA).** Requires all agencies, including the Service, to examine the environmental impacts of their actions, incorporate environmental information, and use public participation in the planning and implementation of all actions. Federal agencies must integrate NEPA with other planning requirements, and prepare appropriate NEPA documents to facilitate better environmental decision making (from 40 CFR 1500).

**National Wildlife Refuge (NWR).** A designated area of land, water, or an interest in land or water within the System.

**National Wildlife Refuge System.** Various categories of areas administered by the Secretary of the Interior for the conservation of fish and wildlife, including species threatened with extinction, all lands, waters, and interests therein administered by the Secretary as wildlife Refuges, areas for the protections and conservation of fish and wildlife that are threatened with extinction, wildlife ranges, games ranges, wildlife management areas, or waterfowl production areas.

**National Wildlife Refuge System Mission.** The mission is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

**Native Species.** Species that normally live and thrive in a particular ecosystem.

**Neotropical Migratory Bird.** A bird species that breeds north of the U.S.-- Mexican border and winters primarily south of this border.

**Notice of Intent (NOI).** In the case of a Federal action, such as analyzed in this documentation, an NOI is a notice that an environmental impact statement will be prepared and considered (40 CFR 1508.22). Published in the Federal Register.

**Noxious Weed.** A plant species designated by Federal or state law as generally possessing one or more of the following characteristics: aggressive or difficult to manage; parasitic; a carrier or host of serious insect or disease; or non-native, new, or not common to the United States, according to the Federal Noxious Weed Act (PL 93-639), a noxious weed is one that causes disease or had adverse effects on man or his environment and therefore is detrimental to the agriculture and commerce of the United States and to the public health.

**Objective.** An objective is a concise target statement of what will be achieved, how much will be achieved, when and where it will be achieved, and who is responsible for the work. Objectives are derived from goals and provide the basis for determining management strategies. Objectives should be attainable and time-specific and should be stated quantitatively to the extent possible. If objectives cannot be stated quantitatively, they may be stated qualitatively (Draft Service Manual 602 FW 1.5).

Physiognomy. External aspect.

Planning Area. A planning area may include lands outside existing planning unit boundaries that are being studied for inclusion in the System and/or partnership planning efforts. It may also include watersheds or ecosystems that affect the planning area.

Planning Team. A planning team prepared the Comprehensive Conservation Plan. Planning teams are interdisciplinary in membership and function. Teams generally consist of a planning team leader; Refuge manager and staff, biologists; staff specialists or other representatives of Service programs, ecosystems or regional offices; and other governmental agencies as appropriate.

Planning Unit. A single Refuge, an ecologically / administratively related complex of Refuges, or distinct unit of a Refuge.

Plant Association. A classification of plant communities based on the similarity in dominants of all layers of vascular species in a climax community.

Plant Community. An assemblage of plant species unique in its composition; occurs in particular locations under particular influences; a reflection or integration of the environmental influences on the site -- such as soils, temperature, elevation, solar radiation, slope, aspect, and rainfall; denotes a general kind of climax plant community, i.e., ponderosa pine or bunchgrass.

Preferred Alternative. This is the alternative determined (by the decision maker] to best achieve the Refuge purpose, vision, and goals; contributes to the Refuge System mission, addresses the significant issues; and is consistent with principles of sound fish and wildlife management.

Prescribed Fire. The skillful application of fire to natural fuels under conditions of weather, fuel moisture, soil moisture, etc., that allow confinement of the fire to a predetermined area and produces the intensity of heat and rate of spread to accomplish planned benefits to one or more objectives of forest management, wildlife management, or hazard reduction.

Public. Individuals, organizations, and groups; officials of Federal, State, and local government agencies; Indian tribes; and foreign nations. It may include anyone outside the core planning team. It includes those who may or may not have indicated an interest in Service issues and those who do or do not realize that Service decisions may affect them.

Public Involvement. A process that offers affected and interested individuals and organizations an opportunity to become informed about, and to express their opinions on Service actions and policies. In the process, these views are studied thoroughly and thoughtful consideration of public views is given in shaping decisions for Refuge management.

Public Involvement Plan. Broad long-term guidance for involving the public in the comprehensive planning process.

Purpose(s) of the Refuge. The purpose of a Refuge is specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorization, or expanding a Refuge, Refuge unit, or Refuge subunit.

Refuge Operating Needs System (RONS). The Refuge Operating Needs System is a national database which contains the unfunded operational needs of each Refuge. Projects included are those required to implement approved plans, and meet goals, objectives, and legal mandates.

Refuge Use. Any activity on a Refuge, except administrative or law enforcement activity carried out by or under the direction of an authorized Service employee.

Record of Decision (ROD). A concise public record of decision prepared by the Federal agency, pursuant to NEPA, that contains a statement of the decision, identification of all alternatives considered, identification of the environmentally preferable alternative, a statement as to whether all practical means to avoid or minimize environmental harm from the alternative selected have been adopted (and if not, why they were not), and a summary of monitoring and enforcement where applicable for any mitigation (40 CFR 1505.2).

Refuge Goal. See Goal.

Refuge Purposes. The purposes specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a Refuge, a Refuge unit, or Refuge subunit (Draft Service Manual 602 FW 1.5).

Refuge Revenue Sharing. A 1978 Act (Public Law 95-469) which authorizes payments to counties in which Service-owned land is located. The amount of the payment is computed based on things such as the appraised value of Service fee land, number of acres of fee land, and net receipts collected by the Service for certain activities permitted on reserve lands (lands withdrawn from the public domain).

Rest. Refers to lands that are free from biological, mechanical or chemical manipulation.

Riparian. Refers to an area or habitat that is transitional from terrestrial to aquatic ecosystems; including streams, lakes wet areas, and adjacent plant communities and their associated soils which have free water at or near the surface; an area whose components are directly or indirectly attributed to the influence of water; of or relating to a river; specifically applied to ecology, "riparian" describes the land immediately adjoining and directly influenced by streams. For example, riparian vegetation includes any and all plant-life growing on the land adjoining a stream and directly influenced by the stream.

- Seral Stage.** Any plant community whose plant composition is changing in a predictable way; characterized by a group of species or plant community that will eventually be replaced by a different group of species or plant community, for example, an aspen community changing to a coniferous forest community.
- Special Status Species.** Plants or animals which have been identified through either Federal law, state law, or agency policy, as requiring special protection of monitoring. Examples include federally listed endangered, threatened, proposed, or candidate species; state listed endangered, threatened, candidate, or monitor species; U.S. Fish and Wildlife Service species of management concern and species identified by the Partners in flight program as being of extreme or moderately high conservation concern.
- Species of Concern.** Those plant and animal species, while not falling under the definition of special status species, that are of management interest by virtue of being Federal trust species such as migratory birds, important game species including white-tailed deer, furbearers such as American marten, important prey species including red-backed vole, or significant keystone species such as beaver.
- Step-down Management Plans.** Step-down management plans provide the details necessary to implement management strategies identified in the comprehensive conservation plan (Draft Service Manual 602 FW 1.5).
- Sound Professional Judgement.** A finding, determination, or decision that is consistent with principles of sound fish and wildlife management and administration, available science and resources, and adherence to the requirements of the Refuge Administration Act and other applicable laws.
- Strategy.** A specific action, tool, or technique or combination of actions, tools, and techniques used to meet unit objectives (Draft Service Manual 602 FW 1.5).
- Thalweg.** A line following the lowest part of a valley whether under water or not; the line of continuous maximum descent from any point on a land surface or one crossing all contour lines at right angles; subsurface water percolating beneath and in the same direction as a surface stream course.
- Threatened Species (Federal).** Species listed under the Endangered Species Act that are likely to become endangered within the foreseeable future throughout all or a significant portion of their range.
- Threatened Species (State).** A plant or animal species likely to become endangered in Colorado within the near future if factors contributing to population decline or habitat degradation or loss continue.
- Tiering.** The coverage of general matters in broader environmental impact statements with subsequent narrower statements of environmental analysis, incorporating by reference, the general discussions and concentrating on specific issues (40 CFR 1508.28).
- Trust Species.** Species for which the U.S. Fish and Wildlife Service has primary responsibility, including, most federally list threatened and endangered species, anadromous fish once they enter inland U.S. waterways, and migratory birds. Also see “Federal Trust Species”.
- Understory.** Any vegetation whose canopy (foliage) is below, or closer to the ground than canopies of other plants.
- Unit Objective.** See Objective.
- U.S. Fish and Wildlife Service Mission.** The mission of the U.S. Fish and Wildlife Service is working with others to conserve, protect, and enhance fish and wildlife and their habitats for the continuing benefit of the American people.
- Vegetation Type, Habitat Type, Forest Cover Type.** A land classification system based upon the concept of distinct plant associations.
- Vision Statement.** A concise statement of the desired future condition of the planning unit, based primarily upon the System mission, specific Refuge purposes, and other relevant mandates (Draft Service Manual 602 FW 1.5).
- Watershed.** The region draining into a river, river system, or body of water.
- Wilderness Study Areas.** Lands and waters identified through inventory as meeting the definition of wilderness and undergoing evaluation for recommendation for inclusion in the Wilderness System. A study area must meet the following criteria: (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man’s work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least 5,000 contiguous roadless acres or is sufficient in size as to make practicable its preservation and use in an unimpaired condition (Draft Service Manual 610 FW 1.5).
- Wilderness.** See Designated Wilderness Area.
- Wildfire.** A free-burning fire requiring a suppression response; all fire other than prescribed fire that occurs on wildlands (Service Manual 621 FW 1.7).
- Wildland Fire.** Every wildland fire is either a wildfire or a prescribed fire (Service Manual 621 FW 1.3).
- Wildlife Corridor.** A landscape feature that facilitates the biologically effective transport of animals between larger patches of habitat dedicated to conservation functions. Such corridors may facilitate several kinds of traffic, including frequent foraging movement, seasonal migration, or the once in a lifetime dispersal of juvenile animals. These are transition habitats and need not contain all the habitat elements required for long-term survival or reproduction of its migrants.

Wildlife-dependent Recreation. A use of a Refuge involving hunting, fishing, wildlife observation and photography, or environmental education and interpretation. The National Wildlife Refuge System Improvement Act of 1997 specifies that these are the six priority general public uses of the System.

## *Appendix C. Key Legislation/Policies*

- Antiquities Act (1906): Authorizes the scientific investigation of antiquities on Federal land and provides penalties for unauthorized removal of objects taken or collected without a permit.
- Migratory Bird Treaty Act (1918): Designates the protection of migratory birds as a Federal responsibility. This Act enables the setting of seasons, and other regulations including the closing of areas, Federal or non-Federal, to the hunting of migratory birds.
- Migratory Bird Conservation Act (1929): Establishes procedures for acquisition by purchase, rental, or gift of areas approved by the Migratory Bird Conservation Commission.
- Migratory Bird Hunting and Conservation Stamp Act (1934): Authorized the opening of part of a Refuge to waterfowl hunting.
- Fish and Wildlife Act (1956): Established a comprehensive national fish and wildlife policy and broadened the authority for acquisition and development of Refuges.
- Fish and Wildlife Coordination Act (1958): Allows the Fish and Wildlife Service to enter into agreements with private landowners for wildlife management purposes.
- Refuge Recreation Act (1962): Allows the use of Refuges for recreation when such uses are compatible with the Refuge's primary purposes and when sufficient funds are available to manage the uses.
- National Wildlife Refuge System Administration Act of 1966 as amended by the National Wildlife Refuge System Improvement Act of 1997, 16 U.S.C. 668dd-668ee. (Refuge Administration Act): Defines the National Wildlife Refuge System and authorizes the Secretary to permit any use of a Refuge provided such use is compatible with the major purposes for which the Refuge was established. The Refuge Improvement Act clearly defines a unifying mission for the Refuge System; establishes the legitimacy and appropriateness of the six priority public uses (hunting, fishing, wildlife observation and photography, or environmental education and interpretation); establishes a formal process for determining compatibility; established the responsibilities of the Secretary of Interior for managing and protecting the System; and requires a Comprehensive Conservation Plan for each Refuge by the year 2012. This Act amended portions of the Refuge Recreation Act and National Wildlife Refuge System Administration Act of 1966.
- National Historic Preservation Act (1966) as amended: Establishes as policy that the Federal Government is to provide leadership in the preservation of the nation's prehistoric and historic resources.
- Architectural Barriers Act (1968): Requires federally owned, leased, or funded buildings and facilities to be accessible to persons with disabilities.
- National Environmental Policy Act (1969): Requires the disclosure of the environmental impacts of any major Federal action significantly affecting the quality of the human environment.
- Endangered Species Act (1973): Requires all Federal agencies to carry out programs for the conservation of endangered and threatened species.
- Rehabilitation Act (1973): Requires programmatic accessibility in addition to physical accessibility for all facilities and programs funded by the Federal government to ensure that anybody can participate in any program.
- Archaeological and Historic Preservation Act (1974): Directs the preservation of historic and archaeological data in Federal construction projects.
- Clean Water Act (1977): Requires consultation with the Corps of Engineers (404 permits) for major wetland modifications.
- Executive Order 11988 (1977): Each Federal agency shall provide leadership and take action to reduce the risk of flood loss and minimize the impact of floods on human safety, and preserve the natural and beneficial values served by the floodplains.
- American Indian Religious Freedom Act (1978): Directs agencies to consult with native traditional religious leaders to determine appropriate policy changes necessary to protect and preserve Native American religious cultural rights and practices.
- Archaeological Resources Protection Act (1979) as amended: Protects materials of archaeological interest from unauthorized removal or destruction and requires Federal managers to develop plans and schedules to locate archaeological resources.
- Emergency Wetlands Resources Act (1986): The purpose of the Act is "To promote the conservation of migratory waterfowl and to offset or prevent the serious loss of wetlands by the acquisition of wetlands and other essential habitat, and for other purposes."
- Federal Noxious Weed Act (1990): Requires the use of integrated management systems to control or contain undesirable plant species; and an interdisciplinary approach with the cooperation of other Federal and State agencies.
- Native American Graves Protection and Repatriation Act (1990): Requires Federal agencies and museums to inventory, determine ownership of, and repatriate cultural items under their control or possession.
- Americans With Disabilities Act (1992): Prohibits discrimination in public accommodations and services.

Executive Order 12996 Management and General Public Use of the National Wildlife Refuge System (1996): Defines the mission, purpose, and priority public uses of the National Wildlife Refuge System. It also presents four principles to guide management of the System.

Executive Order 13007 Indian Sacred Sites (1996): Directs Federal land management agencies to accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners, avoid adversely affecting the physical integrity of such sacred sites, and where appropriate, maintain the confidentiality of sacred sites.

Volunteer and Partnership Enhancement Act of 1998: To amend the Fish and Wildlife Act of 1956 to promote volunteer programs and community partnerships for the benefit of national wildlife refuges, and for other purposes. October 5, 1998

Executive Order 13287 Preserve America (2003): It is the policy of the Federal Government to provide leadership in preserving America's heritage by actively advancing the protection, enhancement, and contemporary use of the historic properties owned by the Federal Government, and by promoting intergovernmental cooperation and partnerships for the preservation and use of historic properties (March 3, 2003).

## Appendix D. RONS Projects

<b>RONS #</b>	<b>Goal or Objective (See MMS table for key to abbrev)</b>	<b>Project Description</b>	<b>Construction Funding</b>	<b>First Year Need (\$1,000)</b>	<b>Recurring Annual Need (\$1,000)</b>	<b>FTE*</b>
03001	PUF1, P1, R1, R2, RI1-7	Conduct a Riparian study		195	10	
97011	PUH1, PUH3, OU1, P1, P2	Implement the CCP and associated step-down plans		128	70	1.0
00002	U1-3, W1-4, RI1-5, M1-4	Improve irrigation and fence maintenance		100	50	0.5
98002	P1-2, R1-2, U4	Conduct a life history study of the endangered North Park Phacelia		38		
97017	PUF1, PUH1, P1, P2, R1-2, W1-4, RI1-7, M1-6	Platte River Water Conservation, and improving Refuge water use efficiency		98		
98001	PUF2, PUH2, P1, P2, R1-2, U1-4, W1- 5, RI1-7, M1-6	Improve Refuge and ecosystem management capabilities		128	70	1.0
03002	P1, R1, U1-4, W1- 4, RI1-5, M1-3	Improve Refuge GIS use and capabilities		128	70	1.0
97002	PUE2, PUF2, PUH2, PUO2, OU2, P2, U4, W5, RI6-7, M5-6	Interagency coordination		22	22	
03003	U1-4, W1-5, RI1-7, M1-6	Improve administrative functions with increased staff and responsibilities as identified in the CCP		70	40	1.0
03004	PUE1-3, PUO1, OU1	Construct a multi-use trail from Walden to the Brocker overlook		150		
03005	C1-2, PUE1-3, PUO1	Install a trail and interpretation from the Brocker overlook to the old Brocker homestead		25		
03006	PUF1, PUH1, P1, P2, R1-2, RI1-5	Survey the Illinois River and develop a channel restoration plan		150		
03007	PUH1, PUH3, OU1	Create 5 parking areas for hunters		60		
03008	PUO1	Construct a moose and/or elk viewing platform		30		
97006	U1-4, W1-5, RI1-5, M1-4	Maintain Refuge riparian areas, wetlands and associated habitat		110	60	1.0
03009	U1-4, W1-5, RI1-5, M1-4	Install a 6 stall garage at the office		125		
03010	U1-4, W1-5, RI1-5, M1-4	Construct a pole barn for Refuge equipment storage		100		
98003	PUE1-3, PUF1-2, PUO1, PUH1, OU1-2, R1-2	Improve Refuge environmental education and interpretation programs		128	70	1.0
01003	W1-5, RI1-7, M1-6	Provide annual funding for Platte River Depletion payments		14	14	
97005	U1-3	Develop wells on Hampton property		81		
97009	PUH1, P1-2, R1-2, U1-2, W1-5, RI1-5, M1-6	Prescribed fire for wildlife habitat management		28		
		<b>TOTAL</b>		<b>1,908</b>	<b>476</b>	<b>6.5</b>

## Appendix E. MMS Projects

<b>MMS #</b>	<b>Goal or Objective (see below for key)</b>	<b>Description</b>	<b>Cost</b>
00003	W1-5, RI1, RI6, M1-3	Replace wornout hydraulic excavator	\$177,000
95011	PUE1-3, PU01, OU1	Regravel auto tour route	\$798,000
93004	W1-4	Replace deteriorated water control structures	\$62,000
01021	P1-2	Replace 1986 Ford 4X4 pickup	\$25,000
99002	U1-3	Replace deteriorated boundary fence	\$79,000
98017	PUE1-3, PU01	Replace visitor center interpretive displays	\$99,000
95007	W1-4, RI1-5, M1-4	Replace deteriorated river headgates	\$84,000
95010	PUE1-3, PU01	Replace public use and education signs	\$40,000
02006	PUE1, PUF1, PUH1, PU01	Rehabilitate Allard backroad and Fishermans parking lot road.	\$1,419,000
00012	PUE1, PUF1, PU01	Replace outhouse and parking area at Fishermans parking lot	\$87,000
96002	U1-3, W1-4, M1-4	Replace interior fence on Case tract	\$45,000
01002	U1-3, W1-4, RI1-5, M1-4	Replace 1997 Polaris 6X6 AllTerrain Vehicle	\$12,000
01016	U1-3, W1-4, RI1-5, M1-4	Replace 1993 Chevy 4X4 pickup	\$35,000
90010	U1-3, W1-4, RI1-5, M1-4	Replace 1980 Case tracked crawler/bulldozer	\$241,000
01006	U1-3, W1-4, RI1-5, M1-4	Replace 1984 International Dump Truck	\$101,000
03001	PUE1-3, PUF1, PUH1, PU01, OU1	Rehabilitate Allard Kiosk and overlook	\$50,000
00007	U1-4, W1-5, RI1-5, M1-4	Replace quarters #4, and two outbuildings with a bunkhouse.	\$250,000
00004	C1-2, PUE1-3	Rehabilitate the historic barn on the Case tract	\$266,000
<b>Total</b>			<b>\$3,870,000</b>

RI = Riparian Habitat  
 W = Wetland Habitat  
 M = Meadow Habitat  
 U = Upland Habitat  
 PUH = Public Use Hunting  
 PUF = Public Use Fishing  
 PUO = Public Use Wildlife Observation/Photography  
 PUE = Environmental Education/Interpretation  
 OU = Other Public Uses  
 C = Cultural Resources  
 R = Research  
 P = Partnerships

## *Appendix F. Compatibility Determinations*

Refuge Name: Arapaho National Wildlife Refuge.  
Established September 26, 1967.

Establishing and Acquisition Authority(ies): Migratory Bird  
Conservation Act and Fish and Wildlife Act of 1956.

Refuge Purpose(s): For use as an inviolate sanctuary, or for  
any other management purpose, for migratory birds.  
For the development, advancement, management,  
conservation, and protection of fish and wildlife  
resources for the benefit of the United States Fish and  
Wildlife Service in performing its activities and  
services. Such acceptance may be subject to the terms  
of any restrictive or affirmative covenant, or condition  
of servitude.

National Wildlife Refuge System Mission: The Mission of  
the National Wildlife Refuge System is “to administer a  
national network of lands and waters for the  
conservation, management, and where appropriate,  
restoration of the fish, wildlife, and plant resources and  
their habitats within the United States for the benefit  
of present and future generations of Americans.”



*This goose, designed by J.N. “Ding” Darling, has become  
the symbol of the National Wildlife Refuge System*

## Description of Proposed Use: Recreational Hunting

Arapaho NWR is open to hunting of mourning dove, snipe, rail, American coot, waterfowl, sage grouse, cottontail and jackrabbit, and pronghorn antelope. Hunting seasons are in accordance with State seasons and regulations established for this area. Visitation for these activities is estimated at 500 hunter use days. Species are hunted according to Federal and State laws.

Arapaho NWR is divided into three management units: A, B, and C. Unit A consists of 4,536 acres and is closed to all hunting. This area contains the auto tour route and also a large wetland complex which provides resting areas for migratory birds. Unit B is 8,260 acres and is open for small game, migratory birds, and pronghorn antelope. The remaining 9,415 acres, Unit C is closed to migratory bird hunting but open to small game and pronghorn antelope hunting.

Hunting pressure of all species is approximately 450 to 550 hunter visits annually. During waterfowl, big game, and small game seasons most pressure is concentrated around the opening weekend, with hunter use dropping significantly during the rest of the seasons.

The CCP proposes to continue with the above uses and add or change the following to improve the hunting experience and better protect Refuge resources:

- Develop a hunting step-down management plan which will address existing species as well as elk and furbearer hunting opportunities depending on Refuge habitat objectives and/or population objectives North Park wide.
- Develop 5 parking areas and 3 permanent gates to minimize resource damage.
- Update hunting signs to reflect changes in new hunting step-down management plan.
- Include hunting opportunities on Pole Mountain in Title 50 Code of Federal Regulations.
- Add limited elk hunting to the list of big game hunting opportunities and submit a modification to Title 50 Code of Federal Regulations.

### Availability of resources:

Currently, sufficient resources are available to continue the existing recreational hunting. Implementing the new improvements for hunting will be addressed by funding requests in the form of MMS and RONS projects (Appendices D and E).

### Anticipated impacts of the use:

No detrimental impact is anticipated with the hunting program. Recreational hunting will remove individual animals from the wildlife populations which may help ensure that carrying capacity (especially for big game species) is not exceeded (possibly impacting Refuge habitat objectives). Closed areas will provide some sanctuary for target and non-target species and minimize conflicts between hunters and other visitors. Travel on non-designated roads may be a problem but development of parking areas and gates should minimize this impact.

### Determination:

Recreational hunting is compatible.

### Stipulations necessary to ensure compatibility:

- ✓ Only non-toxic shot is permitted on the Refuge when hunting with a shotgun. This restriction minimizes the exposure of waterfowl and other wildlife to lead.
- ✓ Hunting must be in accordance with Federal and State regulations.
- ✓ All hunting will be coordinated with the Colorado Division of Wildlife to meet Refuge and State goals and objectives.
- ✓ Sound hunting practices will be promoted for safety of visitor/hunter and minimal wildlife disturbance.
- ✓ Vehicle travel is limited to established roads and parking areas.
- ✓ Hunting programs will be conducted to provide a quality hunting experience as defined in the Refuge Manual.

### Justification:

Hunting is a legitimate wildlife management tool that can be used to manage populations. Small game hunting is biologically sound on the basis of limited hunter interest and because populations of small game species fluctuate moderately regardless of whether they are hunted or protected. Migratory bird hunting uses a small portion of the available resource on the Refuge. Hunting on the Refuge harvests a small percentage of the renewable resources which is in accordance with wildlife management objectives and principles.

Based upon biological impacts anticipated above and in the Environmental Assessment, it is determined that recreational hunting at Arapaho NWR will not materially interfere with or detract from the purposes for which this Refuge was established or the habitat goals and objectives.

One of the secondary goals of the National Wildlife Refuge System is to provide opportunities for public hunting when it is found to be compatible and it is identified as a priority public use in the National Wildlife Refuge System Improvement Act of 1997.

## **Description of Proposed Use: Wildlife Observation/Photography and Environmental Education and Interpretation**

The Refuge strives to provide opportunities that support wildlife-dependent recreation, education, and outreach to the public. Approximately 8,000 visitors come to Arapaho NWR annually for wildlife observation, photography, and interpretation/education. The majority of the use is focused on the auto tour route, interpretive nature trail, and visitor contact stations. The auto tour route is a 6-mile self-guided wildlife tour, while the interpretive nature trail is half-mile walk. There are 3 information kiosks, 2 scenic overlooks, and a visitor center.

Interpretation and environmental education opportunities are provided on demand and include talks, tours, and environmental games for school groups, scouts, and special interest groups.

The Comprehensive Conservation Plan proposes to continue with the above uses and add the following to improve wildlife viewing, interpretation, and access for visitors:

- Develop new interpretive displays for visitor center that reflect Refuge habitat and water management.
- Rebuild the Brocker Overlook including new interpretive signs depicting the history of North Park and the Refuge.
- Construct a moose observation platform.
- Develop new Refuge brochures and signs and update old brochures to reflect current management.
- Work with partners to develop specific environmental education programs concerning habitat management, natural history of North Park, and water issues.
- Rehabilitate the Case Barn and provide interpretation of the site.
- Develop new interpretive material involving land management in North Park.
- Continue participation in natural resource events like 'Day in the Woods' and 'Water Carnival.'
- Complete Interpretive Nature Trail boardwalk.

### **Availability of resources:**

Currently, resources are stretched to continue the existing wildlife-dependent recreation. An outdoor recreation planner is required to meet the Refuge's current demands. The additional items to be added from the Comprehensive Conservation Plan are tied to funding requests in the form of RONS and MMS projects (Appendices D and E).

### **Anticipated impacts of the use:**

Some disturbance of wildlife will occur in areas of the Refuge frequented by visitors. The main areas used are the auto tour route, visitor contact points, and interpretive nature trail. Primary species disturbed by vehicles and hikers are waterfowl, moose, raptors, prairie dogs, and shorebirds.

Construction of a moose observation platform, rebuilding the Brocker Overlook, and development of the Case Barn interpretive site will result in the loss of a small portion of wildlife habitat. It is anticipated that all uses will increase, particularly with new interpretation sites.

With an increase in use, the potential for problems with trash will increase; a slight increase in wildlife disturbance may occur.

### **Determination:**

Wildlife Observation/Photography and Environmental Education and Interpretation are compatible.

### **Stipulations necessary to ensure compatibility:**

- ✓ Vehicles will be restricted to designated Refuge roads.
- ✓ Enforce Refuge regulations.
- ✓ Improve signing and update Refuge information brochures.
- ✓ Monitor use, regulate access, and maintain necessary facilities to prevent habitat degradation.
- ✓ Develop a wildlife observation/photography and environmental education/interpretation step-down plan.

### **Justification:**

Based upon anticipated biological impacts above and in the Environmental Assessment, it is determined that wildlife observation/photography and environmental education / interpretation on Arapaho NWR will not interfere with the Refuge habitat goals and objectives or purposes for which it was established. Limited access and monitoring use can help limit any adverse impacts.

One of the secondary goals of the National Wildlife Refuge System is to provide opportunities for the public to develop an understanding and appreciation for wildlife when it is found compatible. The above uses are identified as priority public uses in the National Wildlife Refuge System Improvement Act of 1997 and will help meet the above secondary goal with only minimal conflicts.

## **Description of Proposed Use: Recreational Fishing**

Arapaho NWR is open to recreational fishing in the Illinois River from August 1 to May 31 each year. Fishing is in accordance with State regulations. Game fish include brown trout and limited numbers of rainbow trout. Visitors participating in this use on the Refuge are estimated at 50 to 100 anglers annually. Two parking and access fishing sites are developed and are available on the Refuge with a variety of non-developed access sites also available.

The Comprehensive Conservation Plan proposes to continue with the above uses and add the following to improve fishing opportunities and access for visitors:

- Work with the Colorado Division of Wildlife to create a fishery step-down management plan.
- Improve fishery habitats on private lands through the Services' Partners for Fish and Wildlife Program.
- Assist the Colorado Division of Wildlife with fishery law enforcement, management, and projects in North Park as requested.
- Monitor river gauges on the upstream and downstream ends of the Refuge to evaluate flows and effects on the Illinois River fishery resources.
- Evaluate angler impacts on Refuge goals and objectives.

Availability of resources: Currently, sufficient resources are available for existing recreational fishing. With the addition of projects from the Comprehensive Conservation Plan, additional resources will be needed. These are addressed as funding requests in the RONS and MMS projects (Appendices D and E).

Anticipated impacts of the use:

Fishing can cause disturbance to wildlife and the habitat but at the current levels of use on the Refuge, disturbance impacts will be minimal. The presence of anglers along the River may deny waterfowl and other water birds use of that portion of the River. However, the majority of the fishing pressure on the Illinois River occurs on the southern half of the Refuge, which makes up approximately 10 percent of the riparian and wetland habitats and is closed during two months of the summer. The poisoning of migratory birds due to ingestion of lead sinkers may also occur, but less than 10 percent of the anglers utilize bait in a given year according to creel census information.

Determination:

Recreational fishing is compatible.

Stipulations necessary to ensure compatibility:

- ✓ The Refuge will be closed to fishing from June 1 through July 31 each year.
- ✓ Fishing must be in accordance with State regulations.
- ✓ Parking and access areas will be maintained to prevent habitat damage.
- ✓ Only the Illinois River will be open to fishing.
- ✓ Monitor existing use to ensure that facilities are adequate and disturbance to wildlife continues to be minimal.
- ✓ Improve and/or replace existing signage.

Justification:

Based on the biological impacts addressed above and in the Environmental Assessment, it is determined that recreational fishing will not materially interfere with the Refuge habitat goals and objectives or purposes for establishment. The fishing closure minimizes disturbance during sensitive nesting seasons for migratory birds.

## **Description of Proposed Use: Use of Grazing as a Management Tool**

The Refuge currently uses livestock grazing as the most common management tool to manipulate the riparian, meadow, and upland habitats. Grazing by livestock has been the preferred management tool because the effect on the habitat is controllable and predictable. Livestock grazing is used in a variety of ways including: high intensity short duration, rest rotation, light annual, and complete rest. In general, the meadows and riparian habitats are not grazed until August 1 to minimize disturbance to nesting birds. The upland habitats are grazed earlier but most grazing does not start before June 1 on the Refuge. Grazing rates range from .52 to .71 AUMs per acre with an average of 8,470 AUMs used annually. Actual rates per field vary significantly depending on the site, with some upland areas being as low as 0.01 AUMs per acre and some meadow fields as high as 2.18 AUMs per acre. The Refuge is divided into over 100 fields by barbed wire and electric fences. Maintenance of the fences is a constant effort with weather, water, animals, and human impacts.

The CCP proposes to continue with the proposed use and add/or change the following to improve habitat management:

- Grazing rates will average .4 to 1.0 AUMs per acre for the riparian and meadow habitats and .05 to .15 AUMs per acre for the upland habitat to meet new Refuge objectives.
- Initiate a vegetation and wildlife monitoring program to assess habitat response to the grazing management program.
- Complete an upland habitat inventory by 2008 to gain a better understanding of the existing habitat for future grazing management.

### **Availability of resources:**

Current resources are stressed in an effort to monitor habitats to understand if objectives are being met. Another wildlife biologist is needed to meet current and future Refuge demands. The additional items to be added from the Comprehensive Conservation Plan are tied to funding requests in the form of RONS and MMS projects (Appendices D and E).

### **Anticipated impacts of the use:**

This use is intended to maintain and enhance the habitat for the benefit of migratory birds and other wildlife. Minimal negative impacts are expected through the use of this tool. Some trampling of areas may occur around watering holes or mineral licks. Overgrazing may occur if problems exist with fences, which would negatively impact the habitat. Grazing will be in a mosaic pattern with some plants grazed harder than others. The presence of livestock may be disturbing to some wildlife species and some of our public users. The benefits of this use as a habitat manipulation tool is felt to outweigh these minimal negative impacts. The endangered North Park Phacelia plant does occur in grazed areas of the Case tract. However, plant monitoring data from the past 6 years indicates a stable or slightly expanding population of plants. Therefore, the Refuge proposes to continue grazing these areas until more information is available on North Park Phacelia life history.

### **Determination:**

Using grazing as a habitat management tool is compatible.

### **Stipulations necessary to ensure compatibility:**

- ✓ Monitor the vegetation and wildlife to assess the effects of grazing.
- ✓ Fences will be monitored and maintained.
- ✓ Annually evaluate AUMs per acre used in relation to habitat conditions.
- ✓ Permittees will be issued a special use permit each year with AUMs to be used specified and all other regulations listed.
- ✓ Continue to monitor North Park Phacelia plant populations to ensure grazing program is not negatively impacting plant survival.

### **Justification:**

In order to maintain and enhance the habitat for migratory birds and other wildlife, some habitat manipulation needs to occur. Grazing by livestock is one option that can be used to achieve these desired habitat changes. Because grazing by livestock is controllable and predictable, it is a useful management tool.

**Description of Proposed Use:  
Plowing of Snow Fences by the  
Colorado State Highway Department**

The Colorado State Highway Department plows snow on the Refuge along Highway 125 to make “snow” fences. The snow fences are constructed by a dozer or front-end loader just on the inside of the Refuge boundary fence along Highway 125. The heavy equipment creates two to four parallel strips, of varying heights of snow, approximately 20 feet apart. Snow fences minimize snow drifting across Highway 125 and increase safety for highway travelers.

**Availability of resources:**

Currently, this use does not utilize any Refuge resources.

**Anticipated impacts of the use:**

Plowing of snow along the Refuge boundary to create snow fences has very little impact on the Refuge habitat. These areas are primarily upland habitat. In general, the equipment blade is not lowered to dig into the soil but just skim the surface. Some brush plants may be eliminated in the process but most grasses and forbs are not effected. This leaves strips of land without brush species. The snow fences do provide more water to these areas, with the melting of the built up snow in the spring, possibly promoting the growth of grasses and forbs.

**Determination:**

Plowing snow to create snow fences along Highway 125 is a compatible use.

**Stipulations necessary to ensure compatibility:**

- ✓ Any fence damage done will be repaired by the State Highway Department.
- ✓ Soil disturbance is kept to a minimum.

**Justification:**

Plowing snow fences is necessary to help prevent snow from drifting on Highway 125, helping the highway department maintain this road in the winter for the safety of the general public.

**Description of Proposed Use:  
Providing a Water Line From a  
Refuge Spring to a BLM Grazing Allotment**

In 1991, the Refuge issued a special use permit to a private landowner to construct and maintain a water line across the Refuge. This water line runs from a spring outlet on the Refuge fish hatchery tract to a BLM grazing allotment. The permit allows for the use of the spring water to fill a water trough for livestock on the BLM allotment for approximately 30 days during the grazing season. It also allows access to maintain the water line on the Refuge. This use has continued to date with the special use permit being renewed every 2 years.

This use corresponds with the goals of the CCP of working with partners to promote sound habitat management.

**Availability of resources:**

Currently, the spring that feeds this water line flows enough water to fulfill livestock watering and Refuge needs.

**Anticipated impacts of the use:**

Impacts of the water line are minimal; if the line were to break, some erosion could occur along the line in the upland habitat if the leak was not observed right away. Potentially, in an extremely dry year, the spring could dry up if the use continued.

**Determination:**

Use of the water line to take water from the fish hatchery spring is compatible.

**Stipulations necessary to ensure compatibility:**

- ✓ A new special use permit will be issued every 2 years.
- ✓ The private landowner is responsible for upkeep of the water line.
- ✓ In extremely dry years, the spring will be evaluated for flow production.

**Justification:**

The Refuge is working with the BLM to promote land health improvements. The grazing allotment this water line feeds is large with little water. The position of the water trough helps to promote the movement of the livestock over the whole allotment and to help eliminate over-grazing of certain areas.

## **Description of Proposed Use: Providing a Right-of-Way for a Water Pipeline and Dissipater**

In 1986, the Refuge issued a right-of-way permit to Walden Reservoir Company to construct a pipeline to divert water from a Michigan River irrigation ditch through the Refuge to the Illinois River. The underground pipeline and dissipater were installed in the spring of 1990. Water flows from the Michigan River irrigation ditch down off the hill through the pipeline to the dissipater at the base of the hill. This water then flows through a Refuge irrigation ditch and pond to the Illinois River, giving the Refuge temporary use of the water. Just north of the Refuge, the water is picked up out of the Illinois River in a ditch that feeds Walden Reservoir. The Walden Reservoir Company has used this right-of-way intermittently over the years. This use is not specifically addressed in the CCP but does promote a partnership which is beneficial to wildlife and the habitat.

### **Availability of resources:**

Currently, sufficient resources are available to continue this use.

### **Anticipated impacts of the use:**

Water flows from the Michigan River irrigation ditch have the potential to be substantial and may impact the smaller Refuge ditch, causing blow-outs or erosion of the ditch bank.

### **Determination:**

Use of the right-of-way pipeline and dissipater is compatible.

### **Stipulations necessary to ensure compatibility:**

- ✓ Refuge continues to have temporary use of the water.

### **Justification:**

In permitting this right-of-way, the Refuge benefits from the temporary use of the water flowing across the area. This water can supplement the existing Refuge irrigation water in the spring, if flowing. The water also helps keep Home Pond water fresh with the constant flow, especially when the flows are in the fall, a time the Refuge usually does not have water in its irrigation ditches. A more regional benefit is that of supplementing Walden Reservoir water. This large reservoir is an irrigation storage reservoir but it provides habitat (nesting, brood-rearing, foraging, and molting) for a large number of waterfowl and water birds. Keeping some water in this large reservoir is very important for these birds.

## **Description of Proposed Use: Construction of Multi-Use Trail on Refuge Boundary**

The CCP proposes the construction and use of a multi-use trail along Highway 14 just inside the Refuge boundary. This area is along the northeast edge of the Refuge. The trail would be a 3-mile, 8-foot wide gravel trail. It would be designed to minimize disturbance to wildlife and the environment. This trail would be a partnership with Jackson County, Town of Walden, and the Colorado Scenic Byways. Use would be limited to non-motorized vehicles, walking, and horses. The trail would be fenced to eliminate potential for further excursions onto the Refuge. This 3-mile trail may be too short for purely biking enthusiasts.

### **Availability of resources:**

Currently, no Refuge resources are available for the construction and use of the multi-use trail. Funding requests for this use are in the RONS projects (Appendix D). Other funding would come from partnerships with interested parties.

### **Anticipated impacts of the use:**

Construction of the trail would cause some short-term disturbance to wildlife in the area. The multi-use trail will result in a small amount of habitat loss. This multi-use trail may cause disturbance to wildlife and increase litter problems. Expected level of use should not interfere with Refuge purposes, goals, and objectives. Monitoring of the activity and its impacts will help maintain the use at an acceptable level.

### **Determination:**

Creation and maintenance of a multi-use trail along Highway 14 is compatible.

### **Stipulations necessary to ensure compatibility:**

- ✓ Area is restricted to non-motorized use only.
- ✓ Area will be signed for compliance of use and Refuge regulations.
- ✓ Monitoring will be done to assess the impact of the use on wildlife and the environment.
- ✓ A fence will be constructed between the trail and Refuge to limit further disturbance.
- ✓ Cultural resource clearance would be confirmed before construction.
- ✓ Trail is located on the Refuge boundary to facilitate wildlife viewing, but minimize disturbance to wildlife on the Refuge.

### **Justification:**

This multi-use trail does not appear to create any special problems and biking is associated with wildlife viewing and photography. The trail will also promote partnerships.

**Description of Proposed Use:  
Shooting Range**

The Refuge currently maintains a shooting range just northeast of the Headquarters. The range is used by Refuge, county, and Colorado Division of Wildlife officers to requalify with firearms several times during the year to maintain their law enforcement status. The estimated use is 25 officers requalifying twice during a year. The range is uniquely configured to accommodate pistol, rifle, and shotgun courses required by Refuge law enforcement policy. The CCP supports the continued use of this range. The area encompasses approximately 2 acres of cleared upland with posts and target fastening boards.

**Availability of resources:**

Currently, sufficient resources are available to continue with this use.

**Anticipated impacts of the use:**

This shooting range results in a small amount of habitat loss in an upland site. Wildlife may be disturbed during firearms requalification but use is limited to several times a year. Litter of brass is a potential problem. Use of Refuge equipment and materials to maintain the shooting range will be an annual need. Lead contamination of the soil immediately behind the eight target fastening boards may be of concern.

**Determination:**

Continued use of shooting range is compatible.

**Stipulations necessary to ensure compatibility:**

- ✓ Users of the site will be required to pick up all brass and any litter.
- ✓ Monitor the area for heavy wildlife use before deciding to requalifying that day to minimize disturbance especially in the winter.
- ✓ The public will not be allowed to use the range as the BLM provides a public range near Walden, Colorado.
- ✓ Lead deposition is currently monitored by the USFWS Safety Office. Because the lead collection berm is small, and the lead is underground and useage is low, we feel the exposure to wildlife is limited.

**Justification:**

The shooting range is needed to facilitate the firearms requalification of Refuge and Colorado Division of Wildlife law enforcement officers.

**Signatures:**

Project Leader	Date

**Concurrence:**

Refuge Supervisor	Date

Regional Chief National Wildlife Refuge System	Date

# Appendix G. Economic Analysis

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## Introduction

The National Wildlife Refuge System Improvement Act of 1997 requires all units of the National Wildlife Refuge System to be managed under a Comprehensive Conservation Plan (CCP). The CCP must describe the desired future conditions of a Refuge and provide long range guidance and management direction to achieve Refuge purposes. Arapaho National Wildlife Refuge (NWR), located in the high mountain basin in north-central Colorado known as North Park, is in the process of developing a range of management goals, objectives, and strategies for the CCP. The CCP for Arapaho NWR must contain an analysis of expected effects associated with current and proposed Refuge management strategies.

Special interest groups and local residents often criticize a change in Refuge management, especially if there is a perceived negative impact to the local economy. Having objective data on income and employment impacts may show that these economic fears are drastically overstated. Quite often, residents do not realize the extent of economic benefits a Refuge provides to a local community, yet at the same time overestimate the impact of negative changes. Spending associated with Refuge recreational activities such as wildlife viewing and hunting can generate considerable tourism activity for the regional economy. Refuge personnel typically spend considerable amounts of money purchasing supplies in the local lumber and hardware stores, repairing equipment and purchasing fuel at the local service stations, as well as reside and spend their salaries in the community.

The purpose of this study was to provide the economic analysis needed for the Arapaho NWR CCP by evaluating the regional economic impacts associated with the Arapaho NWR Draft CCP management strategies. For Refuge CCP planning, an economic impact analysis describes how current (No Action Alternative) and proposed management activities (alternatives) affect the local economy. This type of analysis provides two critical pieces of information: 1) it illustrates a refuge's true value to the local community; and 2) it can help in determining whether local economic effects are or are not a real concern in choosing among management alternatives.

There are four alternatives evaluated in the draft CCP. Alternative A, the No Action alternative, would continue Refuge management at current levels. Alternative B focuses on the role of the Refuge in the North Park "sub-ecosystem." This alternative gives consideration to the idea that Arapaho NWR can provide recreational, educational, and economic opportunities in addition to providing quality habitat for migratory birds and other wildlife. Alternative C represents achieving the goals, vision, and purposes of the Refuge by manipulating Refuge habitats in order to reach the apogee of biological potential, and thus support a well balanced and diverse flora and fauna representative of the North Park region. Alternative D is the proposed action. This alternative encompasses most of the objectives and strategies of Alternative B, with some additions from alternative A and C. Alternative D places great importance in the role that Arapaho NWR has in the North Park "sub-ecosystem," both for the environment and the residents of North Park.

This report first provides a description of the local community and economy near the Refuge. An analysis of current and proposed management strategies that could affect the local economy is then presented. The Refuge management activities of economic concern in this analysis are Refuge personnel staffing and Refuge spending within the local community, livestock grazing activities on the Refuge, and spending in the local community by Refuge visitors.

## Regional Economic Setting

Arapaho NWR is located in central Jackson County, directly south of Walden, the county seat. Jackson County is a high mountain basin in north-central Colorado with a total area of 1,613 square miles (1,036,800 acres). The basin is approximately 30 miles wide and 45 miles long. Since it is the most northern of three such "parks" in Colorado, it is known locally as "North Park."

Walden is an historic mountain town established in the 1800s with a strong ranching heritage. The Walden business community provides most of the essential goods and services; however, county residents must travel to cities such as Laramie, Wyoming (65 miles northeast of Walden) to purchase larger durable goods (e.g., cars and major appliances) and specialty items. For the purposes of an economic impact analysis, a region (and its economy) is typically defined as all counties within a 30 to 60 mile radius of the impact area. Only spending that takes place within this local area is included as stimulating the changes in economic activity. The size of the region influences both the amount of spending captured and the multiplier effects. Based on the relative self-containment in terms of retail trade and distance of Walden, Jackson County was assumed to comprise the economic region for this analysis.

## Population, Employment, and Income

The 2000 Census estimated Jackson County's population at 1,577 persons (US Census Bureau). More than 900 of the county's residents reside in Walden, leaving more than a million acres to be inhabited by less than 700 people (Town of Walden 2001). While the State of Colorado experienced a 30.6 percent population increase from 1990 to 2000, Jackson County's population decreased 1.7 percent over the same time frame. In 2000, Jackson County averaged one person per square mile, the State average was 41.5 persons per square mile.

The 2000 Census reported 6.5 percent of the county population consisting of persons of Hispanic or Latino origin, 92.1 percent of white persons not of Hispanic/Latino origin, 0.3 percent of Black or African American persons, 0.8 percent of American Indian and Alaska Native Persons, and 0.1 percent of Asian persons. Fifty-seven percent of the county population 25 years and older were high school graduates, 11 percent were college graduates (US Census Bureau).

According to the Town of Walden (2001), employment in Jackson County is starting to rebound since the closure of the Lumber Mill in 1994. Ranching, retail trade, government, timbering, mining, support services, and recreation are major employers and major exports include livestock, native mountain hay, timber, oil and carbon dioxide (Town of Walden 2001). Local and State employment is shown in Table 1. In 2000, 60.6 percent of county jobs were in private wage and salary employment (people who work for someone else) as compared to 85.6 percent for the State of Colorado. Self-employment in Jackson County accounted for the remaining 39 percent of county jobs and grew by 92 percent from 1970 to 1997 (Morton 2000).

Table 1. Industry Breakdown of Full-time and Part-time Employment for 2000

Industry	Jackson County		State of Colorado	
	# Jobs	% of County Total	# Jobs	% of State Total
Total farm	245	21.6%	44,406	1.5%
Total nonfarm	889	78.4%	2,916,514	98.5%
Private	687	60.6%	2,534,168	85.6%
Ag. Services, forestry, & fishing	(D)	---	39,364	1.3%
Mining	(D)	---	22,634	0.8%
Construction	108	9.5%	226,475	7.6%
Manufacturing	56	4.9%	217,473	7.3%
Transport/utilities	57	5.0%	162,241	5.5%
Wholesale trade	(D)	---	121,306	4.1%
Retail trade	148	13.1%	493,168	16.7%
Insurance/real estate	(D)	---	304,660	10.3%
Services	192	16.9%	946,847	32.0%
Government	202	17.8%	382,346	12.9%
Total full-time and part-time employment	1,134		2,960,920	

Source: U.S. Dept. of Commerce, Bureau of Economic Analysis, Regional Economic Information System, 2002.

(D) not shown to avoid disclosure of confidential information, but the estimates for these are included in the totals.

As shown in Table 2, county per capita personal income was \$20,612 in 2000, which was \$11,822 lower than the State average (U.S. Dept. of Commerce 2001). Total personal income was \$32.57 million for Jackson County in 2000 (Table 2). County non-farm personal income totaled \$32.71 million, farm related income was -\$146,000 in 2000. According to the Town of Walden (2001), while over two-thirds of the employment is in agriculture, only one-fifth of the county's income is generated by agriculture. Agricultural-related income (includes farming and agricultural services) fell from 35 percent of total county personal income in 1973 to just 8 of total personal income in 1997 (Morton 2000).

Table 2. Personal Income for Jackson County and Colorado, 2000

	Jackson County	State of Colorado
Personal Income	\$32,567,000	\$140,224,394,000
Nonfarm personal income	\$32,713,000	\$139,579,510,000
Farm Income	-\$146,000	\$664,884,000
Per capita personal income	\$20,612	\$32,434

Source: U.S. Dept. of Commerce, Bureau of Economic Analysis, Regional Economic Information System, 2002.

Tourism and construction have started to play larger roles in the county economy (Town of Walden 2001). Most jobs pertaining to the recreation and tourism industry are found in the retail trade (spending on supplies, souvenirs, restaurants, and grocery stores) and service (spending on hotels, gas stations, amusement, and recreation activities) sectors in an economy. In 1999, tourism related jobs (mostly hunting) provided almost 17 percent of county employment and 12 percent of total income (Seidl and Garner 2001). According to Colorado Department of Local Affairs (2001), traditional tourism is transitioning to second home tourism where more affluent visitors and retirees are purchasing seasonal homes in Colorado mountain communities. County land use policies and zoning plans have been revised to encourage recreational and second home development (Town of Walden 2001). In 1999, retirees and tourism combined provided almost 30 percent of county employment and more than 50 percent of total base income (Seidl and Garner 2001).

## Economic Impacts of Current and Proposed Management Activities

Economic impacts are typically measured in terms of number of jobs lost or gained, and the associated result on income. Economic input-output models are commonly used to determine how economic sectors will and will not be affected by demographic, economic, and policy changes. The economic impacts of the management alternatives for Arapaho NWR were estimated using IMPLAN, a regional input-output modeling system developed by the USDA Forest Service (Olson and Lindall, 1996).

IMPLAN is a computerized database and modeling system that provides a regional input-output analysis of economic activity in terms of 10 industrial groups involving as many as 528 sectors (Olson and Lindall, 1996). The year 2000 Jackson County IMPLAN data profile was used in this study. IMPLAN estimates for employment include both full-time and part-time workers which are measured in total jobs. The IMPLAN county level employment data estimates were comparable to the US Department of Commerce, Bureau of Economic Analysis, Regional Economic Information System data at the 1 digit Standard Industrial Code level for the year 2000.

### Refuge Staffing and Budgeting

For the current conditions, (Alternative A) staffing at the Refuge consists of 6 permanent and 4 seasonal employees. The current staff accounted for an annual payroll (including salaries and benefits) of \$392,543 in 2002. In addition to providing salaries and benefits, the Refuge purchased goods and services totaling \$105,207 in 2002, approximately 60 percent of which was spent locally in the Jackson County economy.

Table 3 shows the proposed staff for Alternatives B, C, and D. The staffing needs are the same for all alternatives except Alternative C would not include the Private Lands Refuge Operations Specialist or the Outdoor Recreation Planner.

Table 3. Proposed Staffing Needs for Alternatives B, C<sup>1</sup>, and D

Management Staff	
	Complex Project Leader, GS-13 Supervisory Refuge operations Specialist, GS-12 Refuge Operations Specialist, GS-9/11* Private Lands Refuge Operations Specialist, GS 9/11
Biological Staff	
	Complex Wildlife Biologist, GS-11 Wildlife Biologist, GS-9* Career Seasonal Wildlife Biological Technician, GS-6 Seasonal Biological Technicians, GS-3 to GS-5 (4-5)* GIS Coordinator/Data Manager, GS-9/11
Public Use Staff	Outdoor Recreation Planner, GS-9/11*
Administrative Staff	
	Administrative Officer, GS-9*
	Administrative Assistant, GS-5/6*
Maintenance Staff	
	Equipment Operator, WG-10 Career Seasonal Maintenance Worker, WG-8 (Irrigator) Career Seasonal Maintenance Worker, WG-8
<sup>1</sup> Alternative C would not include the Private Lands Refuge Operations Specialist or the Outdoor Recreation Planner *Shared with other stations in Wyoming under Arapaho's Complex Management	

Additional annual funding needed for the proposed personnel/staffing is anticipated to cost \$430,000 for Alternatives B and D and \$323,000 for Alternative C (Table 4). Additional annual non-salary expenditures are anticipated to cost \$46,000 annually (\$36,000 for habitat projects and \$10,000 for research/studies) for Alternatives B, C, and D. For each alternative, it is assumed that approximately 60 percent of non-salary expenditures will still be spent locally in the Jackson County economy. Table 4 summarizes the anticipated annual expenditures by management alternative.

Table 4. Refuge Staffing and Budgeting Expenditures by Management Alternative

	Annual Expenditures by Alternative			
	A	B	C	D
Salary	\$392,543	\$822,453	\$712,543	\$822,543
Non-salary	\$105,207	\$151,207	\$151,207	\$151,207
Total	\$497,750	\$973,750	\$863,750	\$973,750

Because of the way industries interact in an economy, a change in the activity of one industry affects activity levels in several other industries. For example, an increase in funding could allow the Refuge to start new projects or hire additional staff members. This added revenue will directly flow to the businesses from which the Refuge purchases goods and services and to the new Refuge employees. As additional supplies are purchased or as new staff members spend their salaries within the community, local businesses will purchase extra labor and supplies to meet the increase in demand for additional services. The income and employment resulting from Refuge purchases and Refuge employees' spending of salaries locally represents the *direct* effects of Refuge management activities within Jackson County. In order to increase supplies to local businesses, input suppliers must also increase their purchases of inputs from other industries. The income and employment resulting from these secondary purchases by input suppliers are the *indirect* effects of Refuge management activities within the county. The input supplier's new employees use their incomes to purchase goods and services. The resulting increased economic activity from new employee income is the *induced* effect of visitor spending. The sums of the direct, indirect and induced effects describe the total economic effect of Refuge management activities in Jackson County.

Table 5 shows the economic impacts associated with current and proposed management staffing. IMPLAN estimates for employment include both full-time and part-time workers which are measured in total jobs. The current level (Alternative A) of Refuge personnel directly accounts for 7.5 jobs and \$331,023 in personal income. The associated indirect and induced effects generate an additional 1.8 jobs and \$31,575 in personal income throughout the Jackson County economy for a total economic impact of 9.3 jobs and \$362,598 associated with the current level of Refuge personnel. Due to the increased staffing levels for Alternatives B, C, and D (Table 3), the associated economic effects generate more jobs and income than Alternative A.

Table 5. Local Economic Impacts of Refuge Staffing Expenditures

Jackson County	Alternative			
	A	C	B	D
<b>Salary Impacts</b> <i>(excludes benefits)</i>				
<b>Direct Effects (Federal Government Sector)</b>				
Income (\$/year)	\$331,023	\$693,633	\$600,872	\$693,633
Jobs	7.5	15.8	13.7	15.8
<b>Indirect and Induced Effects (in Jackson County Economy)</b>				
Income (\$/year)	\$31,575	\$66,163	\$57,315	\$66,163
Jobs	1.8	3.7	3.2	3.7
<b>Total Effects</b>				
Income (\$/year)	\$362,598	\$759,796	\$658,187	\$759,796
Jobs	9.3	19.5	16.9	19.5

Table 6 shows the economic impacts associated with current and proposed management non-salary spending in Jackson County. For each alternative, it is assumed that 60 percent of the non-salary expenditures reported in Table 4 are spent locally in the Jackson County economy. The current level (Alternative A) of Refuge non-salary expenditures directly accounts for 1.4 jobs and \$26,955 in personal income. The associated indirect and induced effects generate an additional one-third of a job (0.3) and \$6,328 in personal income throughout the Jackson County economy for a total economic impact of 2 jobs and \$36,241 associated with the current level of Refuge non-salary spending in the local economy. Due to the increased non-salary spending levels for Alternatives B, C, and D (Table 3), the associated economic effects generate more jobs and income than Alternative A.

Table 6. Economic Impacts of Refuge Non-salary Expenditures in Jackson County

Jackson County	Alternative			
	A	B	C	D
<b>Non-salary Impacts</b> <i>(60% of total non-salary expenditures spent locally)</i>				
<b>Direct Effects (Federal Government Sector)</b>				
Income (\$/year)	\$29,913	\$42,992	\$42,992	\$42,992
Jobs	1.7	2.4	2.4	2.4
<b>Indirect and Induced Effects (in Jackson County Economy)</b>				
Income (\$/year)	\$6,328	\$9,095	\$9,095	\$9,095
Jobs	0.3	0.5	0.5	0.5
<b>Total Effects</b>				
Income (\$/year)	\$36,241	\$52,087	\$52,087	\$52,087
Jobs	2.0	2.9	2.9	2.9

Table 7 presents the combined economic impacts associated with refuge staffing and non-salary spending in Jackson County. Refuge management activities currently generate 11.3 jobs and \$398,839 in personal income in Jackson County and account for 1 percent of total employment in Jackson County. Alternatives B, C, and D would generate more jobs and income than Alternative A.

Table 7. Combined Refuge Staffing and Non-salary Expenditures in Jackson County

Jackson County	Alternative			
	A	B	C	D
<b>Total Refuge Staffing and Budgeting Impacts</b> <i>(salary and non-salary)</i>				
<b>Direct Effects</b>				
Income (\$/year)	\$360,936	\$736,625	\$643,864	\$736,625
Jobs	9.2	18.2	16.1	18.2
<b>Indirect and Induced Effects (in Jackson County Economy)</b>				
Income (\$/year)	\$37,903	\$75,258	\$66,410	\$75,258
Jobs	2.1	4.2	3.7	4.2
<b>Total Effects</b>				
Income (\$/year)	\$398,839	\$811,883	\$710,274	\$811,883
Jobs	11.3	22.4	19.8	22.4
<b>% of Total County Employment</b>				
	1.0%	2.0%	1.8%	2.0%

## Livestock Grazing Activities

According to the 1997 Census of Agriculture (U.S. Census Bureau), Jackson County had 126 ranches, totaling 477,063 acres (46 percent of total county acreage). Jackson County's cattle and calf inventory numbered 47,683, with 26,549 cattle and calves sold in 1997 (U.S. Census Bureau). Seventy percent of the operators listed ranching as principal occupation, while 30 percent listed ranching as a secondary occupation. Livestock production accounted for \$12.3 million in sales (88 percent of all ranch product sales) in Jackson County in 1997 (U.S. Census Bureau). For 1997 operations, 75 ranches reported net gains, averaging \$48,999 per ranch while 51 ranches reported net losses, averaging \$19,341 per ranch (U.S. Census Bureau).

According to US Census Bureau, Jackson County had 364,255 acres of total pastureland in 1997. Of the 126 ranches in the county in 1997, 69 ranches (55 percent of all county ranches) held public grazing permits with at least one Federal agency, the Bureau of Land Management accounting for most of these permits followed by the USDA Forest Service (U.S. Census Bureau). Pastures on Arapaho NWR are currently leased for cattle grazing to seven local permittees. From 1991 to 2001, 46 to 74 percent (10,692 to 17,200 acres) of Arapaho NWR lands were grazed annually. Thus Arapaho NWR accounts for 2.9 to 4.7 percent of the total grazing capacity in the county.

In order to estimate the local economic impact associated with grazing on Refuge lands, the current level (Alternative A) of AUMs was set as the base level of production. Estimated base level grazing numbers are based on the 1996 to 2001 annual average AUMs of 8,470. This range was used because 1996 was the first year of grazing on the current Refuge acreage of 23,243 acres, following the purchase of the Stelbar tract. The figures for 2002 were not included as they were considered an anomaly since one of the worst droughts on record significantly decreased use.

Generally the Refuge uplands are grazed in the spring after there has been sufficient new plant growth. The cattle are then removed prior to the end of the growing season, allowing grazed plants to recover. Most of the meadows are not grazed until after August 1, or after the majority of the waterfowl and other migratory birds have completed their nesting activities. Most permittees remove all of their cattle prior to, or during, the month of October as heavy snowstorms accompanied by strong winds may develop in North Park at that time. Refuge personnel estimate that the typical grazing season averages 4.5 months.

To determine economic impacts associated with Refuge grazing, the number of head associated with the allotted AUMs must be estimated for each alternative. The USFWS grazing permit records for Arapaho NWR indicate that of the annual average 8,470 AUMs, on average approximately 75 percent are cow/calf pairs, 22 percent are yearlings, and 3 percent are mature bulls or cows. USFWS monthly forage stocking rates equate cow/calf pairs as 1.25 AUM, yearlings as .75 AUM, and mature bulls and cows as 1 AUM. As shown in Table 8, for the average 4.5 month grazing season, the annual AUMs convert to an average of 1,738 head (each cow/calf pair is counted as one head) per month (1,129 pairs, 552 yearlings, and 56 bulls) grazing on Refuge lands.

Table 8. Estimated Number of Head Associated with Annual Average AUMs

Total AUMs (1996-2001 annual average)	8,470
% AUMs	
Pairs (75% of total)	6,352.50
Yearlings (22% of total)	1,863.40
Bulls/Mature Cows (3% of total)	254.1
Average Monthly Number Head (4.5 months)	
Pairs (1.25 AUM)	1,129
Yearlings (.75 AUM)	552
Bulls/Mature Cows (1 AUM)	56
Total	1,738

For the purposes of this analysis, the gross revenue and net revenue associated with the head grazing on the Refuge will be calculated to show the economic value. Gross revenue is the value or sales price of the head at market. Net revenue is the gross revenue minus permittee operational costs, this is the permittee profit.

The 1998-99 Colorado Livestock Enterprise Budget (Colorado State University Cooperative Extension 2000) was used to determine the gross and net revenue from cow/calf operations. For a beef cow/calf enterprise with an average herd size of 250 head, the Colorado Livestock Enterprise Budget estimates total gross revenue at \$366.67 per pair. Total gross revenue from a yearling/stocker operation is estimated at \$250 per yearling (Koontz).

The 1998-99 Colorado Livestock Enterprise Budget (Colorado State University Cooperative Extension 2000) estimated total direct expenses for a cow/calf operation at \$373.27 per pair for an overall net loss of \$6.60 per pair. Because not all operating expenses incurred by a permittee will change directly with the number of cattle grazed on the Refuge, we used a partial budgeting analysis. The Colorado Livestock Enterprise Budget reports cost in terms of animal expenses (\$196.69 per pair), machine and equipment expense (\$25.94 per pair), labor expense (\$8.60 per pair), land expense (\$47.11 per pair), and finance expense (\$94.92 per pair). This analysis excludes costs associated with the land expense (\$47.11 per pair), a portion of finance interests associated with real estate (\$65.82 per pair) and a portion of the livestock feeding expense to account for Refuge forage (\$50.22 per pair). With this more restrictive accounting, operating expenses for a cow/calf operation are estimated at \$210 per pair for a net profit (excluding Refuge grazing fees) of \$156 per pair. The net profit for a yearling/stocker operation is estimated at \$100 per yearling (Koontz).

While the average monthly number of head is used for the economic analysis, it is important to point out that the 7 permittees do not have the same allotted number of AUMs. During the 2000 grazing season, permittee allotments ranged from 90 AUMs to over 2,600 AUMs. A review of the grazing permit records indicate that typically 4 of the 7 permittees annually graze over 1,300 AUMs spanning most of the grazing season while the other 3 permittees graze less than 250 AUMs for only part of the season. Thus, the economic gains and losses associated with current and proposed changes to grazing on the Refuge will have varying impacts on each permittee.

Refuge grazing rate fees are based on the USDA Statistics Board publication for "Grazing Fee Rates for Cattle by Selected States and Regions" for 2002. The USFWS plans to use the USDA yearly published rates as the base rate of charge, but will increase their yearly fee by \$1.00/AUM (current policy allows for this increase) until the base rate is reached. The USDA base rate and yearly Refuge grazing fees are shown in Table 9. Once the USDA base rate is reached, the rate will then be based on the USDA annual rate reported. For the 2000 grazing season, average private land livestock grazing fees for the Jackson County area averaged \$10/AUM for yearlings and \$13/AUM for cow/calf pairs (Colorado State University Cooperative Extension 2001). The USDA reported year 2000 base rate fee of \$11.80/AUM for Colorado was consistent with the range of private land grazing fees in Jackson County. Therefore, it is assumed that once the USDA base rate is reached in 2005, grazing fees for Arapaho NWR will be equivalent to private land grazing fees.

Table 9. Refuge Grazing Fees

Base Rate for 2003 (USDA reported for 2002)	Grazing Fees Charged		
	2001	2002	2003
\$12.60/AUM	\$9.05/AUM	\$10.05/AUM	\$11.05/AUM

### Alternative A

The current average grazing level of 8,470 AUMs converts to an average of 1,738 head per month (1,129 pairs, 552 yearlings, and 56 bulls) for the average 4.5 month grazing season) on Refuge lands. Using the estimated gross revenue of \$366.67 per pair and \$250 per yearling, annual revenue associated with current grazing levels is \$282,333 for pairs and \$202,445 for yearlings for total annual revenue of \$484,779 associated with permittees that use the Refuge as part of their operation (Table 10). Using the IMPLAN model for Jackson County, the sales associated with the current level of head grazed on the Refuge account for an estimated 3.4 jobs and \$67,780 in labor income in the Range Fed Cattle Industry and a total of 6.9 jobs (0.61 percent of total County employment) and \$131,959 in labor income throughout the Jackson County economy (Table 10). It is important to note that the permittees use the Refuge as part of their overall grazing operation, the economic values presented in this analysis represent the value of the overall operation not just the value of grazing on the Refuge.

Table 10. Economic Impacts Associated with the Current Level of Refuge Grazing

	Alternative A
Gross revenue (sales) associated with Refuge grazing	\$484,779
<i>Direct Effects in Range Fed Cattle Industry</i>	
Personal Income (\$/year)	\$67,780
Employment (Jobs)	3.4
<i>Total Effects in Jackson County</i>	
Personal Income (\$/year)	\$131,959
Employment (Jobs)	6.9
% of Total County Employment	0.61%
Annual Net Permittee Profit (Gross revenue minus operational costs and grazing fees)	\$146,264

While the net sales in the Range Fed Cattle industry shows the countywide income and employment effects, it does not account for permittee operational costs incurred per head or grazing fee charged per AUM. Using the Refuge grazing fee of \$10.05/AUM for 2002, seasonal grazing costs for 8,470 AUMs associated with Refuge grazing total \$85,123.50. Subtracting the operational costs (\$156 per pair and \$100 per yearling) and Refuge grazing fee costs from the net revenue gives an annual net profit of \$146,264 associated with the head grazing on the Refuge. Costs associated with Refuge grazing will continue to decrease annual net profit as Refuge grazing fees increase by \$1/AUM each year until USDA base is reached.

### Alternatives B, C, and D

Alternatives B, C, and D all propose the same range in grazing number reductions from the 1996-2001 average base level. Alternatives B, C, and D anticipate a range of grazing numbers from 3,050 to 7,650 AUMs annually, representing approximately a 10-64 percent reduction from 1996-2001 average. Because there is such a large range in the anticipated decrease of AUMs for each proposed alternative, an exact economic loss per alternative cannot be calculated. Therefore, the economic analysis will present the range of anticipated economic losses for a 10 percent and a 64 percent reduction in grazing.

Table 11 shows the associated number of AUMs and head allowed for a 10 percent and a 64 percent reduction from base level Refuge grazing. For a 10 percent reduction in Refuge grazing, 7,650 AUMs would be allowed on Refuge lands supporting 1,570 head for 4.5 months. For a 64 percent reduction in Refuge grazing, 3,050 AUMs would be allowed on Refuge lands supporting 626 head for 4.5 months.

Table 11. Herd and AUM Reductions Associated with Alternatives B, C, and D

Reduction from Base	10%	64%
Annual AUMs	7,650	3,050
% AUMS		
Pairs (75% of total)	5,738	2,288
Yearlings (22% of total)	1,683	671
Bulls/Mature Cows (3% of total)	230	92
Average Monthly Number Head (4.5 months)		
Pairs (1.25 AUM)	1,020	407
Yearlings (.75 AUM)	499	199
Bulls/Mature Cows (1 AUM)	51	20
Total	1,570	626

Table 12 shows the number of head allowed for a 10 percent and 64 percent reduction in Refuge grazing AUMs. A 10 percent AUM reduction in Refuge grazing translates into a reduction of 168 head (109 pairs, 53 yearlings, and 5 bulls/mature cows) allowed on refuge lands. A 64 percent AUM reduction in Refuge grazing translates into a reduction of 1,112 head (723 pairs, 353 yearlings, and 36 bulls/mature cows) allowed to graze on refuge lands.

Table 12. Number of Head by Alternative

	Alternative		
	A	B, C, & D	
	1996-2001 Annual Average	10% Reduction	64% Reduction
AUMs	8,470	7,650	3,050
Monthly number of head on Refuge			
Pairs	1129	1020	407
Yearlings	552	499	199
Bulls	56	51	20
Total	1738	1570	626
Change in number of head from Alt. A			
Pairs		-109	-723
Yearlings		-53	-353
Bulls		-5	-36
Total		-168	-1112

For reduced Refuge grazing below the levels identified in Alternative A, the key issue is to identify how permittees will respond to being able to graze fewer head on the Refuge. Several options are available including transferring to private land, purchasing additional hay, or reducing the number of animals in their operation. Because it is not known how each permittee will respond, this analysis will encompass the best and worst case scenarios to frame the possible impact range. Therefore, permittees are expected to change their operations in one of two ways:

Option 1) permittees will transfer to private pasture for the 4.5 months of grazing provided by Arapaho NWR under alternative A (best case scenario); or

Option 2) all permittees will cut back local production by the associated reduction in AUMs (worst case scenario).

Which option a permittee chooses will depend on their level of dependence on the Refuge for their overall operation. Although option 2 is unlikely for all permittees, an economic analysis of reducing head production was undertaken since this option represents the worst case scenario associated with cuts to the Refuge grazing program.

### Option 1: Transfer to Private Land

The availability of grazing opportunities on private lands will play a key role in determining whether permittees can make arrangements to transfer over to private pasture. According to Seidl and Gamer (2001), agricultural land in Jackson County is either dedicated rangeland or pastureland or is planted in hay to feed cattle. According to Refuge personnel, it is reasonable to assume there is currently enough private land grazing available to accommodate the anticipated decrease in AUMs for each alternative. However, if local ranching operations change, the assumption that private pasture is available to substitute for AUM losses on Refuge pasture might not hold true in future years.

As previously discussed, the FWS grazing fee will continue to increase by \$1/AUM per year until the USDA base rate is reached. The grazing fee for Arapaho NWR is expected to be equivalent to private land grazing fees by 2005. Because implementation of the CCP will not happen until after 2005, an increase in the cost of grazing fees associated with transferring from Refuge lands to private lands is not expected.

For a 10 percent reduction in Refuge grazing AUMs, permittees would have to transfer 168 head to private land. A total of 1,112 head would have to be transferred to private land for a 64 percent reduction in Refuge grazing AUMs. Transferring from Refuge land to private land could increase or decrease the hauling costs and labor requirements for each permittee. The increase in costs from switching from Refuge land to private land is not expected to significantly impact total operational costs.

### Option 2: Decrease Livestock Production

Under this option it is assumed that permittees would cut back numbers in their operation. As shown in Table 12, a 10 percent AUM reduction in Refuge grazing would cut 168 head (109 pairs, 53 yearlings, and 5 bulls/mature cows), and a 64 percent AUM reduction in Refuge grazing would cut 1,112 head (723 pairs, 353 yearlings, and 36 bulls/mature cows). Using the estimated gross revenue of \$366.67 per pair and \$250 per yearling, for 7,650 AUMs (10 percent reduction from base) associated annual revenue is \$437,846 for permittees that use the Refuge as part of their operations. Total annual revenue associated with 3,050 AUMs (64 percent reduction from base) is \$174,566. Table 13 shows the associated direct and total economic effects associated with the number of AUMs allowed. The economic losses associated with Refuge grazing reductions from the 1996 to 2001 base level (Alternative A) are presented in Table 14.

Table 13. Economic Effects of Refuge Grazing by Alternative

	Alternatives B, C, & D Head Associated with a . . .	
	10% Reduction	64% Reduction
AUMs	7,650	3,050
Gross revenue associated with Refuge grazing	\$437,846	\$174,566
<i>Direct Effects in Range Fed Cattle Industry</i>		
Personal Income (\$/year)	\$61,218	\$24,407
Employment (Jobs)	3.1	1.2
<i>Total Effects in Jackson County</i>		
Personal Income (\$/year)	\$119,184	\$47,518
Employment (Jobs)	6.3	2.5
Annual Net Permittee Profit (Gross revenue minus operational costs and grazing fees)	\$132,104	\$52,669

A cut in permittee production by the indicated number of head for a 10 percent and a 64 percent AUM reduction from the current level (Alternative A), would result in a revenue loss of \$46,933 for a 10 percent reduction, and a loss of \$310,213 for a 64 percent reduction (Table 14). As shown in Table 10, the sales associated with a 10 percent reduction from the current level of head grazed on the Refuge would result in a decrease of less than one job (0.3) and \$6,562 in labor income in the Range Fed Cattle Industry and would have an impact of less than one job (0.6) and a decrease of \$12,775 in labor income throughout the Jackson County economy (IMPLAN estimates for employment include both full time and part time workers which are measured in total jobs). The sales associated with a 64 percent reduction from the current level would result in a decrease of 2.2 jobs and \$43,373 in labor income in the Range Fed Cattle Industry and would decrease countywide employment by 4.4 jobs (-0.39 percent of total County employment) and labor income by \$84,441 (Table 14).

Table 14. Economic Losses Associated with Refuge Grazing Reductions

	Alternatives B, C, & D	
	10% Reduction	64% Reduction
Change in gross revenue	-\$46,933	-\$310,213
<i>Change in Direct Effects in Range Fed Cattle Industry</i>		
Employment (Jobs)	-0.3	-2.2
Personal Income (\$/year)	-\$6,562	-\$43,373
<i>Change in Total Effects in Jackson County</i>		
Employment (Jobs)	-0.6	-4.4
Personal Income (\$/year)	-\$12,775	-\$84,441
% Change in Total County Employment	0%	-0.39%
Annual Net Permittee Profit (Gross revenue minus operational costs and grazing fees)	-\$14,160	-\$93,595

While the gross revenue (sales) in the Range Fed Cattle industry shows the countywide income and employment effects, it does not account for permittee operational costs incurred per head or grazing fee charged per AUM. Using the Refuge grazing fee of \$10.05/AUM for 2002, seasonal grazing costs associated with Refuge grazing would total \$76,882.50 for a 10 percent reduction in AUMs and \$30,652.50 for a 64 percent reduction in AUMs. Subtracting the operational costs (\$156 per pair and \$100 per yearling) and Refuge grazing fee costs from the net revenue, would give an annual net profit of \$132,104 (for a 10 percent AUM reduction) and \$52,669 (for a 64 percent AUM reduction) associated with the head grazing on the Refuge. A 64 percent reduction from the base Refuge grazing level would equate to an annual net profit loss of \$93,595, a 10 percent reduction would equate to a \$14,160 annual profit loss for Refuge grazing permittees. However, since costs associated with Refuge grazing will continue to decrease annual net profit as Refuge grazing fees increase by \$1/AUM each year until USDA base is reached, the losses in profit associated with Refuge grazing reductions will decline over the years. While all proposed alternatives have the same range of AUMs, the methods for determining the annual number of AUMs and flexibility for meeting permittee operational needs will vary significantly under each alternative. This will affect the economic viability of using the Refuge as part of permittee grazing operations. Under Alternative B, it is assumed that some grazing will likely occur every year and the Refuge personnel will work closely with permittees to combine Refuge needs and permittee operational needs together as much as possible as far as timing, areas, and to a certain extent, numbers. Alternative C requires tighter decisions based solely on predicted habitat needs therefore creating a higher likelihood of significant variability in AUMs from year-to-year, and an increased possibility of no grazing under certain circumstances. Alternative D anticipates continuing working with existing permittees, and to adjust use to Refuge goals using attrition and across the board cuts in AUMs if needed. Under Alternative D, if all permittees are interested in continued use in two years, all permits will be decreased annually approximately 5 to 10 percent from 1996-2001 averages until objectives levels are met.

Which option (transfer to private land or cut production) a permittee chooses will depend on their level of dependence on the Refuge for their overall operation and the way the Refuge actually reduces AUMs. For alternative B and D, it is anticipated the permittees will still be able to depend on the Refuge for a portion of their operation. Because Alternative C has a high uncertainty in AUMs from year-to-year, a combination of options 1 and 2 may result. While most of the permittees transfer to private land, it may be that permittees with high dependence on the Refuge as part of their operation would have to cut production.

## Recreation Activities

Besides Arapaho NWR, Jackson County is home to the Mount Zirkel, Never Summer, Rawah, and North Platte River Wilderness Areas; Sand Hills Recreation Area; Routt National Forest; Colorado State Forest; over 180,000 acres managed by the Bureau of Land Management; and numerous State Wildlife Areas, including one of two Gold Medal trout lakes in the state. These lands have many diverse uses including, recreation, wildlife management, livestock grazing, woodland products, and mineral resources. In all, the Federal and State government manage sixty four percent of Jackson County's total land area (Table 15). Arapaho NWR accounts for 2.4 percent of Jackson County's total land area and 4.6 percent of the County land managed by the federal government. The abundance of recreational opportunities on federal and state lands makes Jackson County a popular recreation and tourism destination.

Table 15. Area Land Management

	Jackson County	Colorado Total
Total Land Area (acres)	1,036,497	66,614,080
State Land (acres)	124,765	3,318,346
Federal Land (acres)	541,073	24,615,790
Private Land (acres)	370,659	38,679,945
State & Federal Land (%)	64	42
Private Land (%)	36	58

Source: Seidl and Garner 2001.

Arapaho NWR offers visitors a variety of recreation opportunities including wildlife observation and photography, hunting, fishing, environmental education, and interpretation. For the purposes of this analysis, Arapaho NWR annual visitation was estimated based on the 1997 to 2001 annual average estimate of 7,106 visits. Visitation estimates from the year 2002 were not included as they were considered an abnormality since one of the worst droughts on record significantly decreased waterfowl hunting. The Refuge bases visitation estimates on a traffic counter on the auto tour route, visitors entering the Visitor Center/Office, and general observation. Table 16 summarizes estimated visits based on visitor activities.

Table 16. Estimated Annual Arapaho NWR Visitors

	Total # of Visitors
Total Estimated Visitors	7,106
Non-Consumptive Users	
Interpretation/Observation	6,593
Environmental Education	141
Hunting	
Waterfowl	280
Big Game	15
Small Game	18
Fishing	59

To determine the local economic impacts of visitor spending, only spending by persons living outside the local area is included in the analysis. The rationale for excluding local visitor spending is twofold. First, money flowing into Jackson County from visitors living outside is considered new money injected into the Jackson County economy. Second, if Jackson County residents visit Arapaho NWR more or less due to the management changes, they will correspondingly change their spending of their money elsewhere in Jackson County, resulting in no net change to the local economy. These are standard assumptions made in most regional economic analyses at the local level. Refuge personnel estimate that 5 percent of Refuge visitors (across all activities) are local Jackson County residents and 95 percent are nonlocal visitors.

A tourist usually buys a wide range of goods and services while visiting an area. Major expenditure categories include lodging, food, and supplies. A key step in estimating total visitor spending is the development of visitor spending profiles. Average daily travel related expenditure profiles for various recreation activities derived from the 1996 National Survey of Hunting, Fishing and Wildlife Related Recreation (U.S. Dept. of Interior 1996) by the U.S. Forest Service (Niccolucci and Winter 2002) were used in this analysis. For each type of visitor activity, the Survey reports trip related spending of state residents and nonresidents for several different recreational activities.

Refuge personnel estimate that nonlocal visitors participating in hunting, fishing, and environmental education activities on the Refuge are state residents that live along the front range of Colorado (Fort Collins, Denver, and Colorado Springs). Therefore, state resident spending profiles for big game hunting, small game hunting, migratory bird hunting, and fresh water fishing were used for the Arapaho NWR hunting and fishing related visitor activities. The state resident spending profile for non-consumptive wildlife recreation (observing, feeding, or photographing fish and wildlife) was used for environmental education visitors at Arapaho NWR. Refuge personnel estimate that of the nonlocal interpretation/observation visitors, approximately 40 percent are state residents from the front range area and 60 percent are nonresident visitors. The state resident and nonresident spending profiles for non-consumptive wildlife recreation (observing, feeding, or photographing fish and wildlife) were used for nonlocal interpretation/observation visitors at Arapaho NWR. For each visitor activity, spending is reported in the categories of lodging, food and drink, transportation, and other expenses. Total spending per day for each visitor activity is reported in Table 17.

Table 17. Spending per Day for Each Visitor Activity

	Average Spending per Day
Interpretation/Observation (Nonresidents)	\$100
Interpretation/Observation (State Residents)	\$15
Environmental Education (State Residents)	\$15
Hunting (State Residents)	
Waterfowl	\$21
Big Game	\$39
Small Game	\$42
Fishing (State Residents)	\$28

Visitor spending is typically estimated on an average per day (8 hours) or average per trip basis. In order to properly account for the amount of spending associated with each type of Refuge visitor, it is important to determine the average length of trip. Refuge personnel estimate that visitors participating in environmental education activities typically spend 2 hours or less on the Refuge. It is estimated that approximately half of the nonlocal state resident and nonresident interpretation / observation visitors spend about 4 hours at the Refuge observing wildlife, the other half tour the Refuge in 2 hours or less. Visitors participating in fishing activities and waterfowl hunting usually spend a half day (4 hours) and big and small game hunters spend a day (8 hours) on the Refuge. Because the visitor spending profiles are for an 8 hour visitor day, the number of 8 hour visitor days for each visitor activity must be calculated. The current number of visitor days per activity is shown in Table 18.

Table 18. Annual Number of Nonlocal Visitor Days per Activity and Total Spending in Jackson County for Alternative A

	Nonlocal Visitors*	Estimated time spent at Arapaho NWR	Number of Visitor Days (1 day = 8 hours)	Total Visitor Spending in Jackson County
Total Estimated Visitors	6,751			
Interpretation/Observation Visitors (40% are state residents, 60% nonresidents)	6,263			
State Resident Interpretation/Observation Visitors	2,505	50% spend 4 hours (1,253 visitors)	626	\$9,390
		50% spend 2 hours (1,253 visitors)	313	\$4,695
Nonresident Interpretation/Observation Visitors	3,758	50% spend 4 hours (1,879 visitors)	940	\$94,000
		50% spend 2 hours (1,879 visitors)	470	\$47,000
Environmental Education	134	2 hours	34	\$510
Hunting				
Waterfowl	266	4 hours	133	\$2,793
Big Game	14	8 hours	14	\$546
Small Game	17	8 hours	17	\$714
Fishing	56	4 hours	28	\$784
Total			2,575	\$160,432

\*Note: Nonlocal visitors account for 95 percent of total Refuge visitors

Total visitor spending is determined by multiplying the total spending per day (Table 17) by the number of nonlocal visitor days for each visitor activity. As shown in Table 18, current Refuge visitors spend about \$160,500 annually in the Jackson County economy. Table 19 shows the results of the IMPLAN modeling impacts of visitor spending in Jackson County. The current level of visitor spending directly generates \$29,918 in personal income and 2.1 jobs for local businesses accommodating visitors (hotels, restaurants, supply stores, and gas stations) and generates a total of \$39,308 in personal income and 2.5 jobs (0.2 percent of total county employment) throughout the local economy.

Although the economic impacts associated with current Refuge visitation are somewhat limited in terms of overall tourism activities in the area, Arapaho NWR plays an important part in the overall recreational opportunities and scenic open space that makes North Park a popular tourist destination. Any decrease in visitation associated with a change in Refuge management will not have a significant economic effect. An increase in the amount of time current visitors spend on the Refuge will increase the amount of daily spending that can be attributed to visiting the Refuge. An increase in both the length of stay on the Refuge (and in the local economy) and the number of people visiting the Refuge could have a considerable impact on increasing the role Refuge visitors play in the local economy.

Table 19. Economic Impacts of Visitor Spending Associated with Alternative A

Jackson County	Alternative A
<b>Direct Effects</b>	
Income (\$/year)	\$29,918
Jobs	2.1
<b>Indirect and Induced Effects</b>	
Income (\$/year)	\$9,390
Jobs	0.4
<b>Total Effects</b>	
Income (\$/year)	\$39,308
Jobs	2.5
% Total County Employment	0.2%

## Summary and Conclusions

Table 20 summarizes the direct and total economic impacts for all Refuge management activities by management alternative. Under current Refuge management (Alternative A), economic activity directly related to all Refuge operations would generate an estimated 14.7 jobs and \$458,634 in Jackson County. Including direct, indirect, and induced effects, all Refuge activities would account for 20.7 jobs and \$570,106 in personal income in Jackson County. Current Refuge management activities account for 1.8 percent of total County employment.

Table 20. Summary of all Refuge Management Activities by Alternative.

Jackson County	Alternative A	Alternative B	Alternative C	Alternative D
<b>Total Refuge Staffing and Budgeting Impacts</b>				
Direct Effects				
Income (\$/year)	\$360,936	\$736,625	\$643,864	\$736,625
Jobs	9.2	18.2	16.1	18.2
Total Effects				
Income (\$/year)	\$398,839	\$811,883	\$710,274	\$811,883
Jobs	11.3	22.4	19.8	22.4
<b>Refuge Grazing Activities</b>				
<i>Range from a 64% reduction in AUMs (option 2) to no impact expected (Option 1)</i>				
Direct Effects				
Income (\$/year)	\$67,780	\$24,407 to \$67,780	\$24,407 to \$67,780	\$24,407 to \$67,780
Jobs	3.4	1.2 to 3.4	1.2 to 3.4	1.2 to 3.4
Total Effects				
Income (\$/year)	\$131,959	\$47,518 to \$131,959	\$47,518 to \$131,959	\$47,518 to \$131,959
Jobs	6.9	2.5 to 6.9	2.5 to 6.9	2.5 to 6.9
<b>Recreation Activities</b>				
<i>No change in visitation expected across alternatives</i>				
Direct Effects				
Income (\$/year)	\$29,918	\$29,918	\$29,918	\$29,918
Jobs	2.1	2.1	2.1	2.1
Total Effects				
Income (\$/year)	\$39,308	\$39,308	\$39,308	\$39,308
Jobs	2.5	2.5	2.5	2.5
<b>Aggregate Impacts</b>				
Direct Effects				
Income (\$/year)	\$458,634	\$790,950 to \$834,323	\$698,189 to \$741,562	\$790,950 to \$834,323
Jobs	14.7	21.5 to 23.7	19.4 to 21.6	21.5 to 23.7
Total Effects				
Income (\$/year)	\$570,106	\$898,709 to \$983,150	\$797,100 to \$881,541	\$898,709 to \$983,150
Jobs	20.7	27.4 to 31.8	24.8 to 29.2	27.4 to 31.8
<i>% of Total County Employment</i>	<i>1.8%</i>	<i>2.4% to 2.8%</i>	<i>2.2% to 2.6%</i>	<i>2.4% to 2.8%</i>

For alternatives B, C, and D two options were used to estimate the impacts on a reduction in grazing AUMs by alternative. Table 20 presents the range of anticipated economic impacts for the associated cut in permittee operations by the associated reduction in AUMs (the anticipated reduction is 10 percent to 64 percent, the 64 percent reduction impacts are reported to represent the worst case scenario). The other end of the range represents the best case scenario of no economic impacts associated with transferring to private land (Option 1).

For Refuge recreation activities, at this time no significant change is expected in current visitation levels for Alternatives B, C, and D. Therefore, the economic impacts reported in Table 20 are the same across all alternatives.

Table 21 summarizes the economic effects associated with management changes from Alternative A. All proposed alternatives will increase employment and personal income in Jackson County because of proposed increases in staffing and non-salary expenditures.

Table 21. Economic Effects Associated with Changing from Alternative A

Sector and Type of Effect	Alternative B	Alternative C	Alternative D
<b>Total Refuge Staffing and Budgeting Impacts</b>			
<i>Direct Effects</i>			
Income (\$/year)	+\$375,689	+\$282,928	+\$375,689
Jobs	+9.0	+6.9	+9.0
<i>Total Effects</i>			
Income (\$/year)	+\$413,044	+\$311,435	+\$413,044
Jobs	+11.1	+8.5	+11.1
<b>Grazing Activities</b>			
<i>Direct Effects</i>			
Income (\$/year)	Range from a 64% reduction in AUMs (option 2) to no impact expected (Option 1) \$0 to -\$43,373		
Jobs	0 to -2.2		
<i>Total Effects</i>			
Income (\$/year)	\$0 to -\$84,441		
Jobs	0 to -4.4		
<b>Aggregate Impacts</b>			
<i>Direct Effects</i>			
Income (\$/year)	+\$332,316 to +\$375,689	+\$239,555 to +\$282,928	+\$332,316 to +\$375,689
Jobs	+6.8 to +9.0	+4.7 to +9.6	+6.8 to +9.0
<i>Total Effects</i>			
Income (\$/year)	+\$328,603 to \$413,044	+\$226,994 to +\$311,435	+\$328,603 to \$413,044
Jobs	+6.7 to +11.1	+4.1 to +8.5	+6.7 to +11.1

# Appendix H. Habitat Write-ups

## Riparian Habitat

The riparian habitat (4,374 acres) on Arapaho NWR is composed of the channel, floodplain, and transitional upland fringe along portions of the Illinois River and Spring Creek. Historically, the Refuge staff has considered the floodplain and transitional fringe collectively as irrigated meadow. However, we have chosen to use channel, floodplain, and transitional fringe in this document because these components more appropriately represent the collective functions and processes of riparian habitats, and such a designation allows management potential of the entire area to be more thoroughly evaluated.

Although the channel is well-defined as the portion of the riparian zone with flowing surface water (The Federal Interagency Stream Restoration Working Group 1998), delineation of the floodplain and the transitional upland fringe is more difficult because characteristics used to separate these two components are temporally dynamic. The floodplain is a highly variable area on one or both sides of the stream channel that is inundated by floodwaters at some interval. Two methods describe the floodplain: hydrological and topographical. The hydrological floodplain is the land adjacent to the baseflow channel residing below bankfull elevation that is inundated about 2 years out of 3 (The Federal Interagency Stream Restoration Working Group 1998). In contrast, the topographical floodplain is the land adjacent to the channel (including the hydrologic floodplain) up to an elevation reached by a flood peak of a given frequency (e.g., 100-year floodplain) (The Federal Interagency Stream Restoration Working Group 1998). In some cases, these two metrics can result in the same delineation of the floodplain.

The transitional upland fringe is the zone between the floodplain and the surrounding upland landscape. This zone can incorporate numerous landscape features and vegetation communities (e.g., forests and prairies). However, all transitional upland fringes have one common attribute: they are distinguishable from uplands by their greater connection to the floodplain and stream (The Federal Interagency Stream Restoration Working Group 1998). Objective #4 contains further discussion of Illinois River form and function.

Assumptions that were used during the decision-making process included (1) channel incision has occurred (See Objective #4), (2) the width of the floodplain has been reduced [conservative estimate of 137 m on each side of channel], and (3) width of transitional upland fringe has increased [137 m from channel to base of hillslope]. Obviously, these assumptions form the basis for fundamental decisions that have been made; thus, they pervade the entire decision-making framework. Although acceptable at the current time, such assumptions should be validated in the near future. This is particularly critical when considering management options within riparian systems because hydroperiod is a primary function that determines vegetation composition and productivity (Cooper 1986). In some cases, such as restoration of the

willow community, validation of these assumptions must occur prior to initiating management activities. Otherwise, the probability of success will be reduced greatly, staff time will be wasted, and funding will not be used efficiently. Information necessary to make decisions regarding future management of the riparian system will likely include magnitude and duration of peak and low flows, bankfull discharge, stage vs. discharge relationships, and seasonal groundwater changes. More detail on the information and equipment necessary to validate assumptions occurs later in this section.

### Goal:

Provide a riparian community representative of the historic flora and fauna in a high valley of the southern Rocky Mountains to provide habitat for migratory birds, large mammals, and river-dependent species.

### Explanation:

Wetlands are among the most productive ecosystems (Mitsch and Gosselink 1993). In the western United States, this is particularly true with respect to riparian systems (Johnson et al. 1977). In general, riparian habitats often support a higher diversity of plant species, higher density, and more variable structure than associated uplands (American Fisheries Society 1980). Current information indicates that riparian habitat along the Illinois River supports a diverse assemblage of rushes, sedges, grasses, and numerous species of willows (Refuge files). Although birch (*Betula spp.*) and alder (*Alnus spp.*) are common along the Michigan River, another tributary of the North Platte River in North Park, these species currently are not present along the Illinois River, and they were not mentioned in the historical documents located. Historically, the distribution of vegetation communities was highly variable because dynamic river fluctuations, herbivory, and local climatic changes resulted in a constantly changing plant mosaic.

The ability of riparian systems to support a diverse assemblage of vertebrates is also well-documented (Pashley et al. 2000). In fact, riparian habitats are disproportionately more important for support of wildlife than any other type of ecological habitat (Cooper 1986). For example, floodplain vegetation provides habitats for more species of birds than other vegetation associations in western North America (Stanley and Knopf 2000), and in northern Colorado, 82 percent of breeding bird species use riparian vegetation (Knopf 1985). Collectively, the components (channel, floodplain, transitional upland fringe) comprising this system provide habitat for fishes, large and small mammals, amphibians, reptiles, wetland-dependent birds (waterfowl, shorebirds, wading birds), and a large diversity of passerines including neotropical migrants and grassland birds. Species of primary management interest on the Refuge include migratory birds (neotropical migrants, grassland birds, waterfowl, shorebirds), whereas large mammals and channel dependent vertebrates (river otter, fishes) are a secondary focus.

The potential for the Refuge to manage for historic flora remains high because seedbanks and budbanks are resilient (Fredrickson and Taylor 1982; Leck 1989). Rather, the greatest challenge will be the ability to manage hydroperiods and herbivory in a manner necessary to (1) stimulate establishment and ensure survival of some plant species (e.g., willows), (2) mimic the structural variability required by different vertebrates, and (3) provide vegetation communities in a spatial configuration required by certain area-sensitive vertebrates. The ability to successfully manage for this diverse array of plant communities will ultimately determine the populations of vertebrates that will inhabit the riparian corridor. Although the Refuge staff believes that the majority of fauna that historically occurred within the corridor will be supported by the following objectives, populations of some species will likely be lower than historic levels due to constraints on area available and management potential.

*Objectives:*

1) Restore (50 to 100 acres) of dense (40 to 100 percent) willow in patches >2 ha and 20 m wide in the central third of the Illinois River (from the north end of the island to the confluence with Spring Creek) to connect existing willow patches and maintain 535 acres of dense willow in patches in the lower third of the Illinois River to benefit nesting neotropical migrant songbirds (yellow warbler, willow flycatcher) and resident moose and beaver.

*Rationale:*

Woody vegetation is a common component on the Illinois River floodplain. Although cottonwood (*Populus spp.*) is native to this region and some individual trees currently exist on the Refuge, this species occurs primarily at historic homesites and the staff does not consider reestablishment a priority. Rather, willow (*Salix spp.*) is the primary genera composing the woody component along the river. Based on available information, as many as eight willow species are known to occur on the Refuge, including sandbar willow (*S. exigua*), geyer willow (*S. geyeriana*), Wolf's willow (*S. wolfii*), diamondleaf willow (*S. planifolia*), bebb willow (*S. bebbiana*), mountain willow (*S. monitcola*), whiplash willow (*S. caudata*), and blueberry willow (*S. pseudocordata*) (Refuge records; Canon and Knopf 1984). Additional shrub species that represent minor components include interior rose (*Rosa woodsii*) and golden currant (*Ribes aureum*) (Stanley and Knopf 2000).

Several reasons exist for restoring and maintaining the willow community. First, the National Wildlife Refuge System Improvement Act (NWRISA) of 1997 requires the Refuge System to preserve unique or historic habitats if it is compatible with the purpose of the Refuge (16 U.S.C. 668d). Estimates of riparian habitat loss in the United States range from 70 to 90 percent (Council on Environmental Quality 1978, Swift 1984); thus protection of this habitat type is critical (Cooper 1986). At the current time, the extent and width of the woody component of the riparian community on Arapaho NWR is completely absent along several reaches in the northern 33 percent of the Refuge. Second, riparian plant communities (including willow) play an important role in the maintenance of water quality and aquatic habitat, support distinct vegetation communities, and afford high-quality terrestrial wildlife habitat (Thomas et al. 1979; Windell et al. 1986; Naiman et al. 1993; Stoeck 1994). Finally,

the purpose for Refuge establishment was to provide habitat for migratory species (16 U.S.C. 715d). Among this large assemblage are species (referred to as neotropical migrants) that migrate between South and North America. Neotropical migratory species account for 45 percent of 58 area-sensitive bird species in riparian habitats (Freemark et al. 1995). Further, many members of this species group currently are declining throughout much of their range (DeGraaf and Rappole 1995) and some species (e.g., southwestern willow flycatcher) are listed as threatened or endangered (U.S. Fish & Wildlife Service 1995). Approximately 50 percent of the neotropical migrants reported as declining are dependent on woody vegetation for foraging and nesting (DeGraaf and Rappole 1995). In arid climates such as Colorado, riparian habitats represent obligate or preferred nesting sites and support higher densities and diversities of migrating and nesting birds (Carothers and Johnson 1975; Stevens et al. 1977; Knopf 1985).

The Refuge currently supports some neotropical migrants that nest in woody vegetation. Research conducted on the Refuge indicate that yellow warblers, American robins, song sparrows, savannah sparrows, red-winged blackbirds, brown-headed cowbirds, willow flycatchers, Lincoln's sparrows, and white-crowned sparrows represent >90 percent of the breeding individuals within the local avifauna (Knopf et al. 1988). However, abundance of some species is low and certain species known to occur in North Park have not been observed on the Refuge (Knopf, unpublished data, Refuge files). Although the causes for the lack of occurrence are unknown, a potential reason may be area size and/or isolation of willows. Past research on the requirements of breeding bird communities suggests that area, in combination with isolation of woodland, is one of the most important considerations in maintaining natural diversity of breeding bird populations (Robbins 1979; Whitcomb et al. 1981; Askins et al. 1987; Blake and Karr 1987; Lynch 1987). In general, species richness increases with the area or width of riparian forests (Stauffer and Best 1980; Dobkin and Wilcox 1986; Keller et al. 1993; Freemark et al. 1995). Further, the abundance of migrants typically is higher in the interior of riparian habitats (Szaro and Jakle 1985). However, the types of species and amount of use are often influenced by geographic orientation and the type of adjacent habitats. For example, species abundance can differ depending on slope (Dobkin and Wilcox 1986) and surrounding habitat types (Carothers et al. 1974), and nest density can differ depending on orientation of habitat relative to migration pathways (Gutzwiller and Anderson 1992).

Thus, the Refuge staff has decided to restore additional areas of willow along the central portion of the Illinois River and maintain/improve the willow community along the southern extent of the Refuge. A primary reason for restoring willows along the central portion of the Refuge is that research conducted in many areas of North America has suggested that habitat configuration (size, shape, geographical orientation) influences the relative importance of riparian habitats (Freemark et al. 1995); either by affecting presence or abundance (Askins and Philbrick 1987; Villard et al. 1995) and movements (Sutcliffe and Thomas 1996) of species. In this context, increasing the extent of willow to the north would reduce the distance between

willow communities on the Illinois and Michigan River and potentially provide benefits to a wider range of passerines by providing breeding habitat, travel corridors to larger patches of woody habitat, and migratory stopover habitat (Winker et al. 1992; Haas 1995; Thurmond et al. 1995; Machtans et al. 1996; Kilgo et al. 1998; Hagar 1999).

The parameters used to determine the amount and structural characteristics of willow were based on available information. However, much of this research was conducted in riparian areas outside of Colorado; thus, applicability to riparian habitats on the Refuge may not be direct because a given species, patterns in habitat use can vary from one geographic area to another (Hutto 1992), within and among years (Karr and Freemark 1985), and diurnally (Stacier 1992). However, a lack of perfect or even moderate knowledge cannot be an impediment to conservation action (Pashley et al. 2000).

The exact dimensions (width, length) of the woody riparian community necessary to benefit the most birds has received much discussion (Darveau et al. 1993; Spackman and Hughes 1995). Several studies have indicated that widths >100 m are required to support an unaltered bird assemblage (Keller et al. 1993; Hodges and Krementz 1996; Kilgo et al. 1998; but see Gates and Gysel 1978 for potential of areas to function as ecological traps). For example, riparian widths of 40 to 50 m supported densities <50 percent of that observed in interior balsam fir forests (Whitaker and Montevecchi 1999). However, they did indicate that widths >20 m would provide benefits to a relatively diverse bird assemblage. Similar results have been reported in other regions of the United States. Higher bird densities but fewer species were documented in narrow (16-20 m) versus wide (40-60 m) riparian zones in Georgia (Thurmond et al. 1995), Quebec (Darveau et al. 1995), Rocky Mountains (Kinley and Newhouse 1997), and Oregon (Hagar 1999). Based on this information, the Refuge staff will attempt to establish willows in a minimum of 20 m wide zones along the Illinois River. However, the extent to which this objective can be accomplished is currently unknown because the width of the current floodplain must first be defined.

Length, in addition to width, must also be considered in determining the optimum shape of riparian zones because proximity to edge influences use by many neotropical migratory species (Whitcomb et al. 1981). We searched published information on breeding habitat requirements of neotropical migratory birds occurring in Jackson County, Colorado to estimate the minimum area required. Of the species for which information was located, veery was the species with the largest area requirement (20 ha in Maryland; Robbins et al. 1989). Based on an average width of 20 m, the riparian zone would have to exceed 500 m in length to support breeding veery. Riparian areas with these dimensions would provide potential breeding habitat for other neotropical species, including but not limited to house wren, warbling vireo, orange-crowned warblers, northern waterthrush, yellow-billed cuckoo, yellow warbler, willow flycatcher, hairy woodpecker, downy woodpecker, white-breasted nuthatch, and western wood pewee (Galli et al. 1976, Robbins et al. 1989, Hagar 1999; Table 7). However, based on the estimated area requirement (225 ha) of red-shouldered hawk, these areas will not support breeding raptors (Robbins et al. 1989). Although willow restoration at

this scale may be ideal, the ability to accomplish an objective of this magnitude is unknown because critical information on the functions of the river. Therefore, the Refuge will restore 50 to 100 acres of dense willows, in smaller patch sizes of .5 acres for the 15-year Plan, which will provide habitat for many edge and interior edge neotropical species (Table 6).

In addition to area, structure is also an important component determining the types and abundance of species using wooded riparian habitats (Fleming and Giuliano 1998, Dieni and Anderson 1999). Bird species numbers typically increase with the density and distribution of foliage among vertical strata (Martin 1988). This is not surprising since birds are known to actively select habitat on the basis of such proximate factors as landscape features, terrain, substrate, vegetative structure, or arrangement of vegetation (Wiens 1969). In general, a more heterogeneous habitat allows co-occurrence of more species (May 1986) because species-specific habitat requirements are met (Karr 1982) and because species may be spatially segregated (Martin 1986). In addition, some studies using artificial nests have found an inverse relation between predation rates and vegetation complexity in nesting habitat (Bowman and Harris 1980, Ratti and Reese 1988). Therefore, the Refuge has established guidelines to promote multiple shrub layers by managing for variable heights ranging from 1 to 10 m within the woody riparian zone.

Of all structural components that potentially influence habitat use by woodland passerines, most studies have identified nesting and foraging substrate as the two most important. If these components are classified according to general groups (i.e., foraging = ground, low foliage, high foilage; nesting = cavity, ground, low foliage, high foilage), comparisons indicate that a high percentage of variation in species numbers and species richness among areas are explained by viewing structure at this level of complexity (Martin 1988). For example, the number of species observed often is correlated with increasing foliage diversity (height, density). Although this relationship is often explained as a function of increasing foraging niche space or food abundance (MacArthur and MacArthur 1961; Willson 1974; Martin 1984), information also exists that observed relationships result from correlation with suitable nest sites (Oniki 1985; Martin 1988). Regardless, such a relationship indicates that greater structural diversity will support a greater number of species. Although the upper limits of vertical diversity along the Illinois River is somewhat constrained because the woody component is almost exclusively shrubs (willow), management can be directed toward increasing horizontal diversity and vertical diversity <10 m. However, objectives for habitat management must be relatively broad because riparian systems are dynamic and many habitat management practices (e.g., fire, hydrology) cannot be controlled at the finite levels necessary to affect a minute change in conditions (e.g., 40 to 45 percent canopy closure).

The Refuge established structural requirements of the woody riparian community based on the breeding requirements of birds because (1) breeding requirements are more narrow than migratory requirements, and (2) birds distribute among different layers of vegetation (Anderson and Shugart 1974; Willson 1974; Martin 1984). Some information on the specific habitat requirements of species

occurring in North Park was available, but most information was of a general nature that provided undefined descriptions (e.g., dense/sparse, tall/short). We constructed a table (Table 7) using this type of information for individual bird species for the purpose of identifying broad structural components that would be managed within the woody riparian component. We then used available quantifiable information available for several species to define these broad terms.

Research conducted on Arapaho NWR indicates that yellow warblers select nest sites characterized by the horizontal arrangement of willow, including average distance to nearest willow (0.16 m), average distance to farthest willow (0.4 m), and the average distance to the nearest willow in each of 4 quadrants (0.16 m) (Knopf and Sedgwick 1992). This information suggests yellow warblers require clumps of uniform-sized bushes characterized by moderate canopy closure. In a similar study conducted on willow flycatchers, nest sites were characterized by smaller distances between willow ( $0.8 \pm 0.2$  m [mean  $\pm$  standard error]) and greater willow densities (not interpretable) within an area defined by the nest tree and 4 nearest trees in each quadrant; larger willow patches and smaller gaps ( $0.4 \pm 0.5$  m) in 0.07-ha circular plots around nest sites, and greater willow coverage ( $49.3 \pm 2.3$  percent) and less non-willow coverage ( $50.7 \pm 12.4$  percent) in 0.32-ha circular plots surrounding the nest site (Sedgwick and Knopf 1992).

In the Wind River Range of Wyoming, the abundance of western wood-pewees and warbling vireos was greater in unburned Aspen forests because of greater canopy cover (46.9 percent) and canopy depth (4.6) compared to burned aspen forests (18.3 percent canopy cover; 4.1-m canopy depth) (Dieni and Anderson 1999). In addition, orange-crowned warblers and dusky flycatchers were observed more in areas of unburned sites; presumably because of greater shrub cover (19.6 percent in unburned sites and 8.6 percent in burned sites). However, overall species richness did not differ between unburned and burned sites suggesting these species are tolerant of relatively wide ranges of habitat structure.

A comparison of forest/field edges and forest/shrub edges in Pennsylvania suggest that the abundance of song sparrows, chipping sparrows, common yellowthroats, and brown-headed cowbirds were greater, and rose-breasted grosbeaks were lower, in forest/shrub edges (Fleming and Giuliano 1998). Comparison of structural features indicated that shrub canopy cover (76.3 percent between 0-2 m) and vertical cover (68.8 percent) were greater and sapling height (5.0 m maximum) was lower in forest/shrub edges compared to forest/field edges (57.4 percent shrub cover; 17.4 percent vertical cover, 14.7 m shrub height). In western Oregon, the abundance of orange-crowned warblers, MacGillivray's warblers, white-crowned sparrows, house wrens, northern flickers, and Stellar's jays were greatest in logged sites, whereas Hammond's flycatcher abundance was greatest in unlogged sites (Hagar 1999). Of the habitat variables quantified in this study, the number of live stems, stems  $\geq 50$  cm dbh, and snags  $> 30$  cm dbh were lower ( $P < 0.05$ ) in logged ( $90.1 \pm 18.6$  live stems,  $14.6 \pm 3.4$  stems  $> 50$  cm, and  $11.2 \pm 1.8$  snags) compared to unlogged sites ( $139.3 \pm 15.5$  live stems,  $51.2 \pm 10.7$  stems  $> 50$  cm,  $18.3 \pm 3.2$  snags), suggesting that species abundances are related to structural

characteristics effected by tree density (e.g., canopy closure, canopy depth) and cavity availability.

Achieving the conditions stated in this objective should ensure some suitable habitat for the range of neotropical bird species that occur in North Park, including species that require dense, shrubby habitats and those species that require more open, widely-spaced woody cover. Regardless of area requirements, however, the ability of the Refuge to provide breeding habitat for the complete assemblage of birds potentially occurring on the Refuge will not be possible. For example, many species considered (Table 7) require cavities for nesting, but potential cavity sites are limited on the Refuge because willow is the dominant woody vegetation. Therefore, accomplishing this objective will not provide habitat for the entire assemblage of birds known to occur in this habitat type. However, it may provide potential breeding habitat for several neotropical species that currently do not breed on the Refuge.

Although based on breeding requirements of neotropical birds, numerous other species will also benefit from increasing the willow community on the Refuge. For example, the target dimensions of woody riparian habitat will also provide migratory habitat for numerous passerines, forage and cover for large mammals (e.g., moose, elk, mule deer) (Allen et al. 1987; Snyder 1991), and migratory and breeding habitat for several species of waterfowl (e.g., mallard, gadwall, and teal) (Colorado Breeding Bird Atlas 1998). Further, riparian buffers along small headwater streams (e.g., Illinois River) may be instrumental in maintaining populations of amphibians associated with riparian habitat in closed-canopy forests (Vesely 1997).

#### Strategies:

Numerous strategies have been used to successfully reintroduce willows, including establishment from seed, planting slims or bare-root stock, and excavation and movement of existing willows (Svejcar et al. 1991; Friedman et al. 1995; Houle and Babeux 1998; Pezeshki et al. 1998). The viability and costs of each method varies depending on local environmental conditions and availability of a plant source. Information necessary to decide on the best strategy of restoration includes data on dates of seed fall, area that can be expected to receive seed, area that experiences surface flooding, groundwater fluctuations (including peaks, seasonal fluctuations, etc.) at different elevations within the floodplain and transitional fringe, current vegetation conditions, and water management capabilities (surface and groundwater).

1) In general, germination of willow seed requires bare, moist substrates, that are free of shade (Johnson et al. 1976; Bradley and Smith 1986; Rood and Mahoney 1990; Scott et al. 1993). Appropriate conditions can be created using several combinations of strategies, including fire, herbicides, scraping sod, and water management (Friedman et al. 1995). During the initial establishment phase, however, soil moisture conditions are critical to ensure survival (Pezeshki et al. 1998). Seedlings of most cottonwood and willow species are intolerant of low moisture (McLeod and McPherson 1973; Krasny et al. 1988). Numerous studies have indicated that rainfall alone is insufficient to support seed germination and seedling establishment on alluvial sands on sites that are not susceptible to mechanical damage by flooding and

rain (Moss 1938; Engstrom 1948; Segelquist et al. 1993). Therefore, even if slims and bare-root stock are used, success will be dependent largely on the ability to control groundwater fluctuations, particularly rate, duration, and depth of groundwater decline (Segelquist et al. 1993). Results of some studies indicate that a gradually declining water table promotes root growth to a greater depth than a static water table (Fenner et al. 1984; Segelquist et al. 1993). Thus, minor groundwater fluctuations can be advantageous, but extreme fluctuations will tend to result in mortality. For cottonwood (*P. deltoides*), available information suggests that rates of decline exceeding 2 cm/day (Segelquist et al. 1993) and 4 cm/d (Mahoney and Rood 1991) result in significant mortality. Results of these studies provide useful information for estimating the level of groundwater control necessary. However, if established from seed, willow may be more sensitive to groundwater fluctuations the first month following germination; willow seeds obtain moisture from a smaller volume of sediment (Friedman et al. 1995). Another consideration that must be accounted for is the possibility of mortality following establishment. Although willow seedlings are capable of withstanding floods for two growing seasons (Walters et al. 1980), they also are susceptible to mortality through scouring during subsequent high flows (Everitt 1968; Segelquist et al. 1993; Friedman 1993). Such events are common within the channel and on the floodplain during certain portions of the year. Once established, various other factors (e.g., herbivory, fire) can potentially cause significant mortality. Although strategies (e.g., sleeves, exclosures, fire breaks) exist for reducing the impact of these mortality factors, the best solution(s) will likely vary depending on site conditions and location. Therefore, the Refuge staff will evaluate options and make decisions on a site-by-site basis.

2) Provide 3,630 to 3,845 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native plants (rushes, sedges, grasses, forbs) characterized by 10-30 cm VOR, 0-10 cm duff layer and minimal (<5 percent) bare ground and less than 40 percent (canopy closure) willow to benefit nesting waterfowl (pintail, shoveler, gadwall, green-winged teal) and sage grouse broods.

3) Provide 210 to 700 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native species (grasses, sedges, forbs, and rushes) characterized by >30 cm VOR, 10-20 cm duff layer and minimal (<5 percent) bare ground, and less than 40 percent (canopy closure) willow from mid-April through August to benefit nesting waterfowl (mallard, gadwall, pintail, scaup), songbirds (savannah sparrow, meadowlark), and foraging shorebirds if flooded (snipe, phalarope, white-faced ibis, sora, curlew, willet).

#### *Rationale:*

Herbaceous vegetation is a component of riparian systems nationwide. The dominant herbaceous species within the Illinois River corridor are primarily perennial species classified as obligate or facultative wetland plants that are tolerant of temporary surface flooding and seasonally high groundwater tables. These species, including rushes, sedges, grasses, and forbs are adapted to the short growing season (<40 days), low annual precipitation (<10 inches), and high annual evapotranspiration rates characteristic of North

Park. The species composition has been modified by the introduction of additional grasses, but invasive, nonnative species currently occupy <5 percent of the land base and current floristics do not appear to be reducing the value of the area to wildlife (Refuge files).

The primary species of management concern in the grassland-dominated portion of the riparian zone are nesting waterfowl and grassland-dependent passerines. Both groups represent trust resources for the Refuge. The enabling legislation for the Refuge specifically identifies waterfowl production as a purpose of the Refuge. Grassland birds, although not specifically mentioned, are migratory and currently declining in many areas of North America (Herkert 1995). The most abundant duck species nesting on Arapaho NWR are blue-winged teal, gadwall, scaup, wigeon, mallard, and pintail (Refuge files). Based on Refuge banding records, Monitoring Avian Productivity and Survivorship (MAPS) station data (Refuge files), Partners in Flight (PIF) scores (Pashley et al. 2000), and regional species of concern (Refuge files), grassland birds of management interest are savannah sparrow, western meadowlark, vesper sparrow, bobolink, upland sandpiper, and Wilson's phalarope.

Numerous studies have demonstrated that grassland size is an important factor determining avian use of grasslands for both foraging and nesting (Wiens 1969; Herkert 1991; Madden 1996; Greenwood et al. 1995; Clark 1977; Herkert et al. 1993; Vickery et al. 1994). Therefore, as with the willow community, size and dimension of the area must be considered. Some species typically do not nest in small grassland fragments (Samson 1980; Herkert 1994; Vickery et al. 1994) or near grassland edges (Johnson and Temple 1986; Delisle 1995; Helzer 1996) because nest depredation and parasitism are often higher (Johnson and Temple 1986; Johnson and Temple 1990; Burger et al. 1994). A literature review of species known to nest in this region suggests that most are found on grasslands greater than 5 ha, but nest densities of these species are much higher if the grassland is greater than 30-50 ha (Helzer 1996; Herkert 1994; Johnson and Temple 1990; Martin and Gavin 1995). Currently, the size of grass-dominated habitats is not limiting, but the size of areas conforming to each of the objectives is currently unknown. The Refuge staff will evaluate current conditions based on the parameters in each objective and ensure that blocks of sufficient size are provided in each category.

In addition, species that use floodplain grasslands have varying requirements with regards to foods and structural requirements for nesting and brood-rearing. The Refuge established requirements for vegetation structure based primarily on the breeding requirements of grassland nesting ducks and ground-nesting grassland birds. Most of the information used to establish requirements for these species was from studies in other geographic areas and some of the studies used undefined terms (e.g., dense, tall, thick) rather than numeric values. However, it was the best information available and future monitoring will help determine the extent to which the information is applicable to Arapaho NWR. Table 8 summarizes the information used to identify grassland requirements.

The most important structural characteristics are vegetation height and density, residual cover (duff), and

shrub density. Differences in grass cover required by breeding birds can be separated into two broad groups based on nesting requirements. Species, including mallard, scaup, and gadwall require taller, denser cover to conceal nests (Holm 1984; Livezey 1981; Lokemoen et al. 1984; Austin et al. 1998; LeSchack et al. 1997), whereas other species, such as pintail, teal, western meadowlark, Savannah and vesper sparrows, bobolink, and upland sandpiper prefer shorter, less dense cover (Madden 1996; Skinner et al. 1984; Lanyon 1994; Wheelwright and Rising 1993; Livezey 1981; Austin and Miller 1995; Kantrud and Higgins 1992). The cover requirements for both groups are provided by a combination of new growth and residual vegetation often referred to as duff or litter. Most waterfowl and gallinaceous birds depend on residual vegetation for initial nesting attempts and duff is an extremely important factor in nest site selection by dabbling ducks and ground-nesting grassland birds (Wiens 1969; Clark 1977; Kirsch et al. 1978; Leopold 1933). Ground-nesting grassland birds and dabbling ducks preferring shorter, less dense cover (e.g. pintail, teal) are typically found where duff layers are less than 10 cm (Swanson 1998; Wiens 1969; Madden 1996). In contrast, dabbling ducks nesting in the San Luis Valley of Colorado use denser cover characterized by duff layers that exceed 10 cm (Laubhan and Gammonley, unpublished data).

The effects of these characteristics on avian grassland use are most obvious in grasslands subject to different management practices. For example, a study at Malheur National Wildlife Refuge (Clark 1977) showed that duck nest densities were highest where grazing and mowing were prohibited the previous season, intermediate where partial mowing but no grazing were allowed, and lowest where grazing and mowing were unrestricted the previous season. Higher residual cover on the ungrazed and unmowed units was the single best parameter explaining the higher nest densities (Clark 1977). Other duck nesting studies have shown similar results (Reeves 1954; Salyer 1962; Martz 1967; Oetting and Cassell 1971). Structural changes have more varied consequences for nongame birds. For example, studies in Alberta and Saskatchewan found that some species preferred the structural conditions in ungrazed and unmowed grasslands (Savannah sparrow, Baird's sparrow, Sprague's pipit), other species preferred grazed or mowed grasslands (horned lark, McCown's longspur, chestnut collared longspur), while some species were unaffected by grazing or mowing (western meadowlark, clay-colored sparrow) (Owens and Myres 1973; Maher 1973; Karuziak et al. 1977).

In addition, some species of management interest are dependent on the presence of forbs in grasslands either as a nesting site for females or as song perches for males. Based on the requirements of western meadowlark, Savannah sparrow, vesper sparrow, and bobolink, the literature indicates that a minimum composition of 10 percent forbs is required (Wiens 1969; Skinner et al. 1984; Madden 1996; Dechant et al. 1999). Although currently unknown, the Refuge will determine the forb composition of grassland-dominated habitats through monitoring and use various strategies to either maintain or improve the forb community.

Based on a review of the literature, the species of management interest are tolerant of scattered woody

vegetation. In fact, some nesting dabbling ducks (e.g., mallard, green-winged teal, gadwall) will build nests at the base of shrubs (Austin et al. 1998; Kingery 1998; LeSchack et al. 1997). Ground-nesting grassland birds are somewhat less tolerant of woody vegetation but many are found in grasslands with 10 to 40 percent shrub cover (Madden 1996, Schaid et al. 1983). Although scattered willows are likely to become established within the grasslands, no attempt will be made to reduce willows until canopy closure exceeds 40 percent because many species are tolerant of such conditions.

The Refuge used the above information to establish the two grassland objectives. Management to achieve these objectives will occur in the portion of the floodplain that will not be restored to willows. The relative proportion of habitat in each objective is not equal; however, Objective #3 (10-30 cm vor) is being weighted more heavily. This decision was based largely on the capability to manage the riparian corridor for both habitat types. Past modifications limit the ability of the Refuge to manage some areas for dense cover. For example, the highest elevations that are thought to be only minimally impacted by groundwater, and are known to be difficult to irrigate, are best suited for Objective #3, whereas the areas nearest the river are likely to be easier to obtain conditions stated in Objective #2.

#### *Strategies*

Because extensive areas of grasslands currently exist within the riparian habitat, management will be directed primarily toward maintaining existing areas. This will be accomplished by numerous methods, including but not limited to water management, prescribed fire, grazing management, and haying. These management practices affect vegetation height, density, grass:forb ratio, and duff layer and thus avian use of grasslands (Clark 1977; Munding 1976; Oetting and Cassel 1971; Salyer 1962; Enright 1971; Kaiser 1976; Kirsch and Higgins 1976; Owens 1971; Owens and Myres 1973; Maher 1973; Dambach 1944; Madden 1996). Initially grasslands will be monitored to assess current structural conditions, forb distribution, and nonnative distribution. In areas of low (<10 percent) forb composition, attempts will be made to increase this component by seeding in combination with the above listed activities. Areas that contain >10 percent nonnative species (i.e., <90 percent natives) will be identified and attempts made to reduce the composition of these plants using herbicides, biological control, water level management, or other management practices that have proven useful in other areas.

Given the altered river flow regime, provide a properly functioning river channel characterized by a well defined thalweg, outside river edges that are deeper than inside edges, a river sinuosity of 2.0 to 2.5, pool spacing every 7 to 9 channel widths, active point bar formation, and gradients in riffles that are higher than in pools to benefit willow establishment for neotropical migrants, and indirectly provide suitable habitat for native and nonnative fishes.

Rosgen (1996) developed a stream classification system that provided guidelines for identification of stream channel types. This stream classification system utilizes the following criteria: channel gradient, sinuosity, width/ratio, dominant particle size of bed and bank material, channel entrenchment, channel confinement, landform features and

stream bank stability. Utilizing this stream classification system, the Illinois River on the Refuge is classified as a C-channel. The preferred, and most stable channel, is an E-channel (narrower and deeper). Rosgen (1996) describes an E-channel as low gradient, meandering riffle/pool morphology stream with low width to depth ratio and little deposition occurring. E-channels are considered to be the most stable channel types and will encourage willow development; they provide the best habitat for trout. These are very efficient and stable streams found in broad valley/meadows over alluvial materials and characterized by well vegetated banks. Minimizing disturbance to stream banks will facilitate E-channel development.

A thalweg is the deepest point on a stream channel cross section, and typically the deepest point on the valley floor. Functioning streams exhibit well defined thalwegs that move side to side as a stream meanders. Sinuosity is the ratio of the valley slope to the stream slope. E-channels exhibit sinuosity of >1.2, but 2.0 - 2.5 is preferred. Pool spacing for E-channels is generally every 4 to 7 channel widths. Point bar formation is another characteristic of streams that transport water and sediment efficiently. Stream gradients are defined as the rise/run along the longitudinal profile of the stream. Functioning streams exhibit higher gradients over riffle areas (Rosgen 1996).

#### *Rationale:*

This objective recognizes the altered Illinois River condition. The Refuge will strive to produce a naturally functioning channel, given flow and irrigation shortcomings. Understanding the location and functional processes of the floodplain and transitional fringe are crucial to improving management on the Refuge because these processes determine the potential composition and structure of vegetation and, therefore, the associated wildlife benefits (Pashley et al. 2000). In addition, a greater understanding of these processes will allow the Refuge staff to identify potential management strategies that have a high probability of success. However, delineation of the floodplain and transitional upland fringe along the Illinois River that traverses the Refuge is difficult. First, the hydrology of the river in North Park has been altered greatly; thus, it is not possible to assume that historic indicators (e.g., location of landforms) can be used to define these components. This statement is based on the fact that an extensive irrigation and water storage system has been developed within the riparian system. However, the impacts of these developments are difficult to quantify because the historic gauge station on the Refuge has been removed. Second, even if existing gauges were still in place, many of the original alterations leading to water diversions occurred prior to the establishment of USGS gauge stations. This is supported by conversations with the state water engineer and local ranchers who have stated that water management has not changed appreciably in the last 100 years and 50 years, respectively. The Refuge attempted to confirm these statements by comparing USGS data from 1935-1939 and 1995-1999 that was collected at Rand, Colorado (URL: <http://nwis-colo.cr.usgs.gov> and <http://co.water.usgs.gov/nwis/>). Several diversions (e.g., McFarland Reservoir, landowner ditches) occur between the gauge and the Refuge boundary; thus, the usefulness of this information for purposes of Refuge management is poor. Regardless, the data confirms that the hydrology of the

river, at least at this location, has not changed appreciably during the past 40 years based on comparisons of peak discharge, flow duration curves and seven day minimum flows. In general, the Illinois River at Rand is characterized by (1) peak flows (500-600 cfs) in spring that are of short duration, (2) 90 percent of flows do not exceed five cubic feet per second (cfs), and (3) minimum daily flows are about two cfs. Further, a spatial comparison of the river channel on the Refuge indicates the river has not undergone appreciable lateral migration during this period.

Although it is not possible to mathematically derive the location and extent of the floodplain and transitional fringe because both current and pre-development information is unavailable, the Refuge staff has evaluated the riparian system within the limits of their ability and have concluded the channel is in a state of change even though management has remained relatively static during the past few decades. This conclusion is supported by several subjective assessments. First, an October 2000 evaluation of several river reaches using the Rosgen method (Rosgen 1996) suggests the river is functional-at-risk. Specific factors identified during the evaluation included evidence of channel incision, reduction in fine sediment load, and occasional mass failure of banks (i.e., sloughing). Further, indications of the direction of change can be assessed by placing these observations in the context of the channel equilibrium equation (Lane 1955).

$$Q_s \cdot D_{50} \% Q_w \cdot S, \text{ where}$$

$Q_s$  = sediment discharge,  $D_{50}$  is sediment particle size,  $Q_w$  is streamflow, and  $S$  = stream slope

Channel equilibrium occurs when all four of the above variables are in balance. If one variable changes, one or more of the other variables must increase or decrease proportionally (The Federal Interagency Stream Restoration Working Group 1998). In the case of the Illinois River on the Refuge, channel incision suggests stream slope may be increasing, whereas the small amount of fine sediment suggests that sedimentation size or discharge may have been reduced compared to historical. This latter observation is supported by (1) dominance of large substrates (e.g., cobble) in the river channel, (2) increased sedimentation in palustrine basins that have been developed within the riparian corridor, and (3) lack of significant point-bar formation within the channel. Irrigation practices may remove the peak water flows, alter sediment loads, and change the duration of water events critical to stream function. Collectively, this information suggests that the equilibrium equation is currently unbalanced. During a December 2000 workshop, these factors were considered in relation to a channel evolution diagram that depicts the current stage of disequilibrium and theoretically may help predict future changes in habitat or stream morphology (The Federal Interagency Stream Restoration Working Group 1998). Based on the diagram produced by Simon (1989), the staff classified the channel as either degrading or degrading-and-widening. Characteristics associated with this classification include large scallops and bank retreat, reduction or flattening in bank angles, a flow line that is low relative to the top of the bank, and a prediction that a new floodplain will be developed (Simon 1989).

Despite the fact that the Refuge currently lacks detailed information necessary to quantify current and predict future

channel changes, available information suggests that the elevation of the channel is lower than historic conditions. Because the intensity and frequency of flooding is important in determining community structure and system functions (Odum 1978), this directional change affects not only the channel, but also the floodplain and associated fringe (Baxter 1977; Lillehammer and Saltveit 1984). For example, lower channel elevation, coupled with lower peak flows, reduces the frequency, duration, and extent of overbank flooding. Consequently, the current width of the floodplain, as defined by hydrologic parameters, is narrower than the historic floodplain. Although the current extent of the floodplain has not been quantified, staff observations during the past 15 years indicate that the maximum extent surface water extends onto the floodplain is about 137 m (150 yds). Consequently, the transitional upland fringe has encroached toward the channel during the past four decades.

More information must be obtained on the current hydrology of the riparian zone prior to initiating restoration efforts. Data on bankfull discharge, seasonal and peak flows, and stage vs discharge relationships must be developed. This will require establishing gauge stations to monitor river flows, placement of piezometers (or other equipment) perpendicular to the channel at various locations to monitor groundwater fluctuations, and obtaining elevation data at several points along the channel. In combination, this information will allow areas with highest potential for restoration to be selected, identify the best method of restoration (e.g., seeds, slims), and allow development of the most appropriate water management strategies at different sites within the riparian zone.

Efforts to restore the Illinois River channel will most likely improve the Refuge fishery resource. Fish are primarily found only in the Illinois River and other aquatic sites, including Potter Creek, Spring Creek and Refuge ponds, represent poor fishery habitat. Water depth and winter survival is the limiting factor in most of these systems. Winter-kill is a common problem with many of the lakes on the Refuge and throughout North Park. Fish species found in the other aquatic sites include longnose dace, creek chub, white sucker, long-nosed sucker, fathead minnow, and johnny darter (Kehmeier 2001). The Illinois River is a transition stream, beginning as a trout stream in the headwaters and transitioning to a native species stream by the time it meets the Michigan River. This transition appears to occur as the river crosses the Refuge. The lower flows experienced at the north end of the Refuge may be responsible for the trout giving way to the more tolerate native species. Trout are not native to North Park streams. Sampling in 1998 found that upstream from the Refuge, the fishery is dominated by brook and brown trout at or near carrying capacity of 114 kg/ha of biomass. Sampling near the Allard bridge found a high diversity of habitats, and the highest species count (6 native species and 1 nonnative). Brown trout are reproducing and demonstrate recruitment in the Illinois River. Rainbow trout were not sampled in 1998; however, they may exist because of previous Colorado Division of Wildlife stocking efforts. Sampling downstream of the Ward Ditch #1 found mostly native species mentioned above.

Instream structure is limited to willow root balls, aquatic vegetation (*Elodia*, Potamogeton, and *filamentous algae*)

and small woody debris. Beaver dams, common on the upstream end of the system, help the system become more dynamic and provide excellent angling opportunities. Continued stream bank protection is critical to sustaining the fishery resource. Degraded stream banks exhibit shallow water spread over a wide stream channel. Deep water pools are critical to sustain healthy fish populations. Fishery habitat efforts must focus restoring natural structure and function to the Illinois river and will result in better fishery habitat. A Fishery Management Step-Down Management Plan will be prepared by 2005.

#### General Consideration of Areas Specified:

The area of each habitat component (defined by objectives) will vary over time depending on annual and seasonal conditions (e.g., river flow, precipitation, etc.). In addition, it is likely that some areas originally meeting the conditions of one objective will develop conditions that meet another objective. For example, grasslands with less cover (Objective# 3) may develop more cover (Objective #2). Such changes (succession) are natural and have many benefits (e.g., nutrient cycling, soil stabilization) other than providing wildlife habitat. Therefore, the Refuge has established broad tolerances in the area (ha) of each habitat that will be provided. This is based on the concept that disturbance-driven spatial and temporal variability is a vital attribute of nearly all ecological systems (Landres et al. 1999). Further, managing within the constraints of site variability and history is easier, requires fewer external subsidies, and is more cost effective than attempting to achieve management goals that are outside the bounds of the system (Allen and Hoekstra 1992). Conditions that collectively fall within the established ranges will be sufficient to provide some habitat for species of interest in most, if not all, years.

Table 7. General Breeding Habitat Requirements of Selected Woodland Birds in North Park, Colorado							
Species	Breed <sup>a</sup>		Nest <sup>e</sup>		Forage <sup>f</sup>		General habitat characteristics <sup>g</sup>
	Type	Minimum patch (ha)	Type	Ht (m)	Type	Ht (m)	
American redstart	I	118.0	F	4-12	A,F	3-6	open, moist, deciduous woods w/ good undergrowth of shrubs/young trees
Blackbird, Red-winged	E	24.0	F	<3	F	<3	
Bluebird, Mountain	E		C				prefer forest edges and open habitats;
Chickadee			C		F	>3 - >15	aspen/cottonwood preferred
Black-capped Mountain	IE	4.7					
Common Yellowthroat	IE	2.3	F	<3;<0.5	F,G	<3;<5.5	prefer cattail or low streamside thickets; require open water
Cowbird, Brown-headed	E	2.3					
Cuckoo, Yellow-billed	IE	2.3	F	<3; 0.5-6			old growth w/ dense understory
Dove, Mourning	E	2.3					
Flicker, Northern	IE	1.8	C		G		
Flycatcher							
Dusky			F	<3			dense shrubby understory
Hammond's				3-31	F	6-12	mature conifer with little ground cover; limited understory; some occur in shrubs
Olive-sided	E <sup>b</sup>		F	4.5-21	A		conifers w/ snags and clearings; early post-fire communities; nearby water
Willow	E			1.2	F	0.6-18 <sup>a</sup>	2-3 layers of shrubs preferred; presence of water; dense shrub patches with openings for nesting; nest in areas with trees 3-15 m w/ or w/o distinct overstory and very dense <2 m; forage in areas <10 m wide; shrub patches with canopy cover 40-100% and foliage density 50-70% in nesting shrub layer. <sup>h</sup>
Grosbeak, Rose-breasted	IE	24.0					
Horned lark			G		G		shortgrass w/ considerable bare ground and grasses <3 cm; widely spaced shrubs <25 cm tall
Jay, Stellar's			F	>3	F	>3	
Kingfisher, Belted			G		W		requires clear, slow-moving water; nest w/ 800 m of water; perching/nest sites limiting
Nuthatch							
White-breasted	I	4.7	C		B		prefer conifers/aspen over riparian
Red-breasted	I <sup>b</sup>		C		B		
Robin, American	E	1.8	F	>3	G		
Solitaire, Townsends			G		F,G	<3	forage in open areas of understory
Sparrow							
Field	E	28.0					
Fox			G		G		dense/shrubby understory associated with water
Lincoln's <sup>b</sup>	E		G		G		boggy areas w/ willows/sedges/aspen; wet ground for foraging; nest in dense sedges; associated w/ warblers (Yellow, Wilson's), sparrows (Song, Fox, White-crowned), and Dusky Flycatcher
Savannah		>10 <sup>e</sup>					avoid areas with extensive tree cover; prefer intermediate vegetation height and density, sparse or low (<3 m) shrubs; forb:grass (25:75)
White-crowned	E <sup>b</sup>		G		G		requires grasslands, bare ground for foraging, and dense shrubs for nesting; associated w/ Wilson's Warbler and sparrows (Fox, Lincoln's)

Table 7. General Breeding Habitat Requirements of Selected Woodland Birds in North Park, Colorado							
Species	Breed <sup>a</sup>		Nest <sup>e</sup>		Forage <sup>f</sup>		General habitat characteristics <sup>k</sup>
	Type	Minimum patch (ha)	Type	Ht (m)	Type	Ht (m)	
Swallow, violet-green			C		A		
Thrush							
Hermit			F	1-3	F,G	<2	prefer conifer/hardwood; leaf litter for foraging; drier than Swainson's thrush
Swainson's			F	1-1.5	A		similar to veery but less dense understory and larger willows growing in larger patches; associated with sparrows (Fox, Song, Lincoln's White-crowned), warblers (Yellow, Wilson's), and flycatchers (Dusky, Willow)
Towhee, Green-tailed			F,G	<3	G		dry brushy areas w/ open spaces between shrubs
Veery <sup>b</sup>	I	28.0	G	G; <1.5			thick/dense understory
Vireo, Warbling		7.0 <sup>d</sup>	F	>3	F	>3-16	widely spaced trees w/ little undergrowth and open canopy
Warbler							
MacGillivray's			F	<3	F	<3	large shrubs; similar to orange-crowned warblers
Orange-crowned			F,G		F	>3; ALL	dense willows; associated with Virginia's and MacGillivray's warblers
Virginia's			G				dense understory;
Wilson's							dense willows
Yellow	E	0.05-0.45 <sup>j</sup>	F	0-15 <sup>h</sup>	A,F	0-16 <sup>i</sup>	require tall singing posts and open space; breeding primarily in willows 1-2 m; shrub densities 60-80% optimal; avoid widely spaced shrubs and forests w/closed canopies; <sup>i</sup>
Yellow-rumped			F	1.2-15	F,G		prefer conifer/aspens;
Waterthrush, Northern							thick/dense willows
Woodpecker							
Downy	IE	16.2	C	1.2-12			small/young trees w/ low canopy
Hairy	I	1.8	C	1.5-18	B		mature forests w/ dense canopy; snags
Wood Pewee, Western			F	2-24		6-23	nests in shrubs (low density); requires trees with exposed branches;
Wren, House	E	2.3	C		F	<3	prefer aspen/cottonwood

<sup>a</sup> From Blake and Karr (1987). Patches sampled ranged from 1.8-600 ha. Habitat classification (I = interior; IE = interior and edge; I = interior) based on literature (Kendeigh 1982, Bohlen 1978, Whitcomb et al. 1981) and authors experience in Illinois.

<sup>b</sup> From Whitaker and Montevecchi (1999).

<sup>c</sup> Robbins et al. (1989) report 20 ha as minimum.

<sup>d</sup> Maximum territory size according to Colorado Breeding Bird Atlas (1998).

<sup>e</sup> From Colorado Breeding Bird Atlas (1998) and Martin (1988); C = cavity, F = foliage, G = ground.

<sup>f</sup> From Colorado Breeding Bird Atlas (1998) and Martin (1988); A = air, B = bark, F = foliage, G = ground, W = water.

<sup>g</sup> From Illinois (Herkert et al. 1993).

<sup>h</sup> From Sogge et al. (1997).

<sup>i</sup> From Morse (1966), Hutto (1981), Schroeder (1982), Knopf and Sedgwick (1992), Steverson and Anderson (1994), Briskie (1995), Dunn and Garrett (1997), Lowther et al. (1999).

<sup>j</sup> Territory size, which is not equivalent to minimum patch size. From Fryendall (1967) and Lowther et al. (1999).

<sup>k</sup> From Colorado Breeding Bird Atlas (1998) unless otherwise noted.

Table 8. General Breeding Habitat Requirements of Selected Grassland Birds in North Park, Colorado

Species	Nest Type	Territory (ha)	Patch (ha)	Grass (%)	Forbs (%)	Shrubs (%)	Duff (cm)	VOR (cm)	General habitat characteristics
western meadow-lark	G	2-13 <sup>b</sup>	>5 <sup>c</sup> ; mod. sensitive <sup>c</sup> depredation less on >130 <sup>aa</sup>	32-52 <sup>m</sup> high <sup>b</sup>	35 <sup>a</sup> high <sup>b</sup> 24-41 <sup>m</sup>	10-22 <sup>m</sup> little or no <sup>b</sup>	0-3 <sup>a</sup> low-mod. <sup>b</sup> 2.9-5.3 <sup>m</sup>	1.2-2.0 <sup>m</sup>	nest in dense vegetation with thick litter cover <sup>a,t</sup>
Savannah sparrow	G	.05-1.25 <sup>i</sup>	sensitive <sup>d</sup> may occur <5 <sup>g</sup> >10 in Ill. <sup>c</sup> >40 for 50% occurrence <sup>i</sup>	0-20 <sup>a</sup> 21-42 <sup>m</sup>	2-7 <sup>a</sup> 27 <sup>a</sup> little <sup>d</sup> 25:75 forbs: grass <sup>i</sup> 16-30 <sup>m</sup>	very sparse <sup>e</sup> shrubless <sup>f</sup> 15-40 <sup>m</sup>	0-4 territory <sup>a</sup> 1-6 nest <sup>a</sup> well-developed <sup>d</sup> 2.5-5.7 <sup>m</sup>	1.4-2.4 <sup>m</sup>	open country with short vegetation, moist grassy meadow <sup>a,u</sup>
vesper sparrow				0-7 <sup>n</sup>	30 <sup>a</sup> 0-10 <sup>a</sup>		0-3 <sup>a</sup>		sparsely or patchily distributed shrubs with good grass cover <sup>n</sup>
bobolink	G	.45-2.0 <sup>f</sup>	>50 for 50% occurrence <sup>i</sup> much higher densities >30 than <10 <sup>f</sup>	32-48 <sup>m</sup>	28 <sup>a</sup> 18-31 <sup>m</sup>	12-30 <sup>m</sup>	0-4 territory <sup>a</sup> 1-6 nest <sup>a</sup> 1.1-5.3 <sup>m</sup>		grassy meadows with nearby forbs and high litter cover <sup>f</sup>
mallard	G			48-50 and 43-49 cm tall <sup>p</sup>				14.7 <sup>o</sup> >20 <sup>q</sup>	
scaup	G							16 <sup>o</sup>	tall vegetation cover in native prairie, meadow, or sparse shrub <sup>w</sup>
blue-winged teal	G			22-24 and 37-39 cm tall <sup>p</sup>				15.1 <sup>o</sup>	dense, tall cover <sup>f</sup>
pintail	G			sparse				11.7 <sup>o</sup>	open sites with low vegetation, residual cover of short grasses <sup>x</sup>
gadwall	G			48-60 cm tall <sup>p</sup> 25 and >30 cm tall <sup>p</sup>				17.3 <sup>o</sup> >20 <sup>q</sup>	dense grasses, forbs, or shrubs <sup>y</sup>
common snipe	G	2-12 <sup>e</sup>		low, sparse <sup>k</sup>					low grass/sedge or fairly dense low woody growth with open terrain nearby <sup>a</sup>
upland sandpiper	G			0-15 and <30 cm tall <sup>n</sup>	0-8 <sup>a</sup>				thick, mid-height grasslands <sup>s</sup>
Wilson's phalarope	G			sparse to mod. dense <sup>j</sup>				<20 <sup>j</sup>	moist sedge/rush meadows with low vegetation and adjacent open water <sup>r</sup>

<sup>a</sup> Wiens (1969)

<sup>b</sup> Dechant et al. (1999)

<sup>c</sup> Helzer (1996)

<sup>d</sup> Swanson (1998)

<sup>e</sup> Wheelwright and Rising (1993)

<sup>f</sup> Arnold and Higgins (1986)

<sup>g</sup> Potter (1972)

<sup>h</sup> Herkert (1991)

<sup>i</sup> Herkert et al. (1993)

<sup>j</sup> Kantrud and Higgins (1992)

<sup>k</sup> Arnold (1994)

<sup>l</sup> Herkert (1994)

<sup>m</sup> Madden (1996)

<sup>n</sup> Skinner et al. (1984)

<sup>o</sup> Holm (1984)

<sup>p</sup> Livezey (1981)

<sup>q</sup> Lokemoen et al. (1984)

<sup>r</sup> Martin and Gavin (1995)

<sup>s</sup> Colorado Breeding Bird Atlas (1998)

<sup>t</sup> Lanyon (1994)

<sup>u</sup> Schaid et al. (1983)

<sup>v</sup> Mueller (1999)

<sup>w</sup> Austin et al. (1998)

<sup>x</sup> Austin and Miller (1995)

<sup>y</sup> LeSchack et al. (1997)

<sup>z</sup> Williamson (1960)

<sup>aa</sup> Johnson and Temple (1990)

## Wetland

To facilitate discussion and future management planning, the Refuge staff defined wetland habitat as all natural and created ponds and lakes up to the high water mark, excluding the surrounding meadows and riparian corridor. This habitat, henceforth referred to as basins or wetlands, composes 824 acres based on National Wetland Inventory (NWI) land coverage for the Refuge. Three wetland complexes were identified for management purposes, mainly based on location: Case, Illinois River, and Soap Creek. Meadow habitat is defined as the grasslands/old hay meadows on all areas of the Refuge except those along the riparian corridor (which are considered part of the riparian habitat) and consist of 2,683 acres.

Of the wetlands on the Refuge, about 10 percent are natural freshwater basins and about 90 percent are created freshwater basins. Meadows characteristically occur adjacent to wetland basins in lowland sites and in the more upland areas that are irrigated. The Illinois River, Spring Creek, Soap Creek, and Potter Creek flow through the Refuge and are the major source of water to basins and meadows through natural subsurface and surface flows and via a complex ditch irrigation system. Origination of the ditches occurs both on- and off-Refuge with the Illinois River as the major water source. Other surface and groundwater resources also affect the timing, duration, frequency, and depth of flooding among sites.

### Goals

#### Wetland Goal

Provide and manage natural and man-made permanent and semipermanent wetlands (in three wetland complexes) to provide habitat for migratory waterfowl, shorebirds, wading birds, and associated wetland-dependent wildlife.

#### Meadow Goal

Provide and manage irrigated, grass-dominated meadows historically developed for hay production, to support sage grouse broods, waterfowl nesting, and meadow-dependent migratory birds.

#### Justification

Water resources are limited in the west and a variety of wetland types (e.g., permanently flooded wetlands, seasonally flooded meadow) are needed to provide the required life resources of migratory birds and other wildlife. Wetland systems are characterized by their flooding patterns (e.g., timing, frequency, duration, depth) (Mitsch and Gosselink 1993) that directly and indirectly determine plant productivity and wildlife use. Wetland complexes (proximate wetlands with different hydrologic regimes) often favor the availability of resources for wetland-dependent wildlife in dry and wet years.

Wetland and meadow on Arapaho NWR have been altered by various artificial disturbances. Because North Park is a cold mountain desert, we assume that historically, aside from the river, most of the water sources likely were temporal and/or seasonal. Early (circa 1900) settlers of Colorado created grassland meadows and dry-land crops in river bottomlands and adjacent sagebrush habitat where soils were suitable and irrigation was possible (Rogers 1964). With the intent of maximizing cattle production, previous landowners presumably used seeps, springs,

natural contours, and areas with high water tables to create much of the meadows and perhaps a few of the artificial basins. These areas were used as watering holes, productive range sites, and irrigated hay meadows. Reports indicate that irrigated hay meadows were common in Jackson County before Refuge establishment (Rogers 1964). Historical records show that at least five selected wells on the Refuge were drilled around 1956 by private landowners mostly for domestic and stock use (Voegeli 1965). Three major reservoirs (Case 1,2, and 3), germ and the fish hatchery ponds were created prior to Refuge establishment. However, the majority of semipermanent/permanent basins were created by the Refuge. Largely due to past ranching practices and the construction of various water control structures (including ditches), the extent of sagebrush habitat has declined and the structure and composition of many of the sagebrush and wetland systems have changed. Because the historic conditions of these sites are largely unknown, a complete and accurate description of the structural and functional modifications that have occurred is not possible. Nonetheless, the complex of roads and ditches on the Refuge has invariably altered historic hydrologic regimes by impounding more water for longer periods in some areas and less water for shorter periods in other areas.

Differences among wetlands and meadows on Arapaho NWR vary largely due to: (1) Refuge infrastructure (e.g., roads and ditches that affect water flow, control structures); (2) management (e.g., flooding, burning, grazing, no action); (3) position in the landscape (e.g., degree of slope in and around basin or meadow, size of depression, aspect/solar exposure, horizontal and vertical proximity to the river and water table, juxtaposition of habitat types); and (4) soil characteristics (water-holding capacity, organic/mineral content). Collectively, these characteristics of basins and meadows affect water quality and the availability of moisture and nutrients that influence plant composition and productivity (Mitsch and Gosselink 1993). Different types, abundances, and distributions of plants creates varied habitat conditions that, in turn, support a diversity of wildlife.

Plants in and around wetlands characteristically are distributed in zones largely based on differences in soil and moisture (Castelli et al. 2000). Plants in wetland habitat on Arapaho NWR include species that are adapted to semipermanent/permanent flooding regimes (standing water), a short growing season (33 days), high daily and annual temperature fluctuations (25-40°F, -49-96°F, respectively), and cold mean annual temperatures (36.5°F) (climate data from various sources in Kuhn et al. 1983). Species in wetland habitat are dominated by perennials, including submergents (e.g., sago pondweed, wigeongrass), tall emergents (e.g., cattail and bulrush), and short emergents (a mix of grasses, rushes, sedges, and forbs). The short emergent sites occurring within the high water mark likely are a result of fluctuating water levels among dry and wet years and, therefore, are limited in size and relatively short-lived when high water levels persist. These short emergent areas within wetland habitat are a continuum into meadow habitat (e.g., Windell et al. 1986). Thus, while the boundary defining the margins of wetland and meadow sites remains the same (i.e., defined by the high water mark), the habitat conditions within each habitat type may vary within seasons and among years. Nonetheless, periodic

disturbances (e.g., flooding/drying) are necessary to continually provide diverse habitat conditions and to maintain system productivity.

The ability for the Refuge to provide (1) wetland habitat for migratory waterfowl, shorebirds, wading birds, and associated wildlife and (2) meadow habitat for sage grouse broods, waterfowl nesting, and meadow-dependent migratory birds has been achieved in past and recent years (refuge files). Regardless, adaptive management practices will be implemented to improve the quality and quantity of those resources and to increase management efficiency (cost vs. benefit). In this process, changes on- and off-Refuge that potentially influence management are considered. The relative importance of a particular habitat or wildlife species often changes or new information (e.g., species-habitat relationships or management strategies) influences management approach. For example, sage grouse has become a species of concern in North Park, and we are evaluating how we can best support the species throughout the annual cycle (nesting, brooding, and wintering).

## Wetland and Meadow Objectives

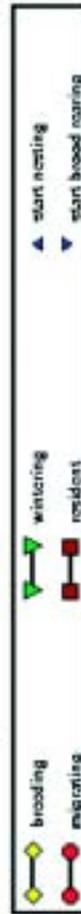
### Rationale

Because the habitat characteristics (e.g., vegetation composition and structure) on Arapaho NWR are not currently quantified, we used the known habitat requirements of a select group of wildlife species to facilitate the process of writing habitat-based objectives. Required resources of the selected species effectively represent the range of potential habitat conditions that naturally may have occurred in wetland and meadow habitat on Arapaho NWR. As stated in the goal, wetland habitat on the Refuge will be managed for migratory waterfowl, shorebirds, wading birds, and associated wetland-dependent wildlife. Thus, particular attention was paid to wetland-dependent species and species of Refuge concern and consideration was given to multiple bird conservation plans/lists (e.g., State and Federal threatened and endangered species, Partners in Flight, Bird Conservation Regions). Further, species habitat requirements typically vary among life cycle events (e.g., migrating, nesting, brood-rearing) and, therefore, the chronologies of these species events were identified with respect to Refuge use periods to maximize resource availability (See Chronology Charts starting on next page). Because the life requisites of plants and wildlife vary temporally and among species, different types of conditions (e.g., height, density, composition, water depth) must be provided within each of the habitat types (i.e., upland, riparian, wetland, meadow) at particular times in the year (e.g., nesting, migration). Each objective describes a range of habitat conditions that is within the management capabilities of the Refuge. Collectively, these objectives support a high diversity of wildlife species.

Habitat Use Chronology  
Arapaho National Wildlife Refuge

Chronology Chart #1

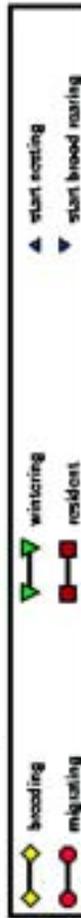
Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
American avocet							▲	◆				
				●	●	●	●	●	●	●	●	●
American coot				▲	◆							
				●	●	●	●	●	●	●	●	●
American wigeon				▲	◆							
				●	●	●	●	●	●	●	●	●
antelope												◆
black-crowned night heron							▲	◆				
black-necked stilt						▲	◆					
black tern						▲	◆					
bufflehead				●	●	●	●	●	●	●	●	●
Canada goose				▲	◆							



Habitat Use Chronology  
Arapaho National Wildlife Refuge

Chronology Chart #2

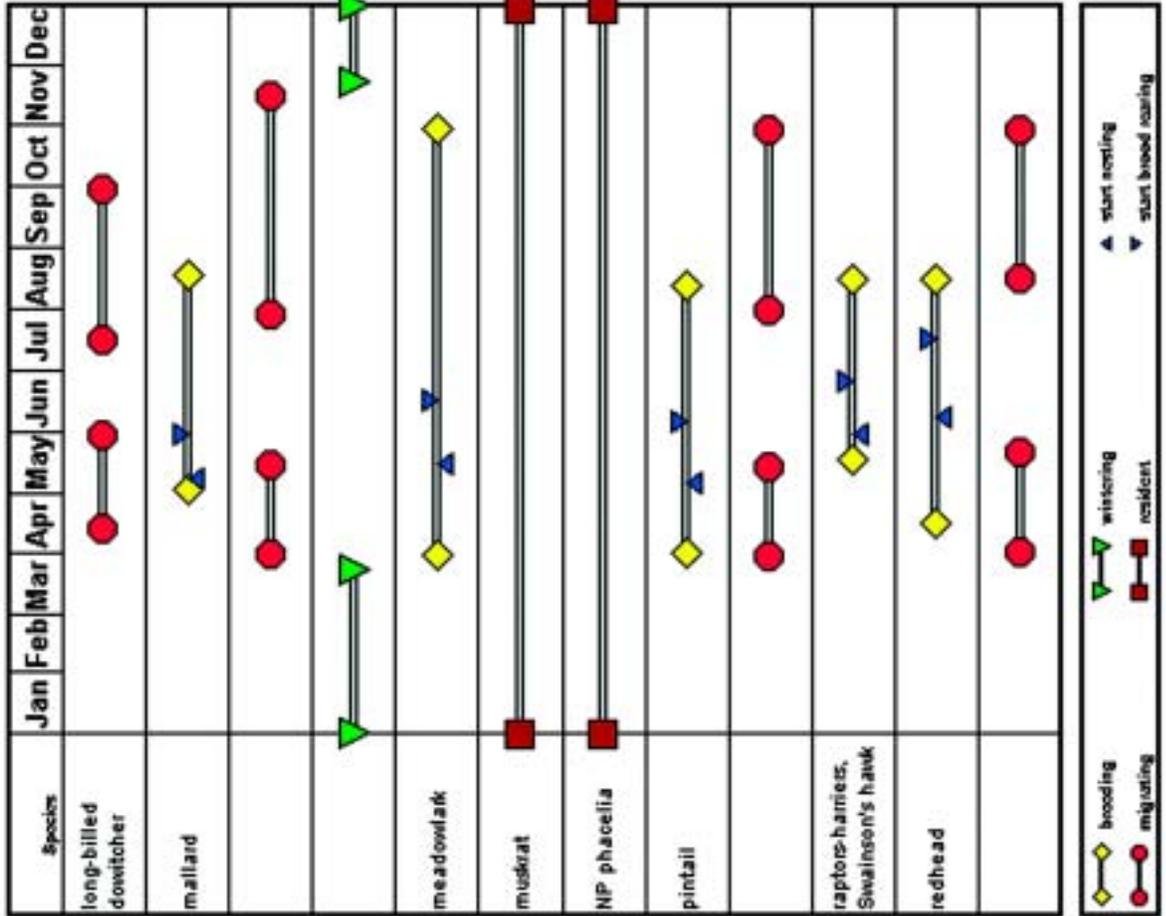
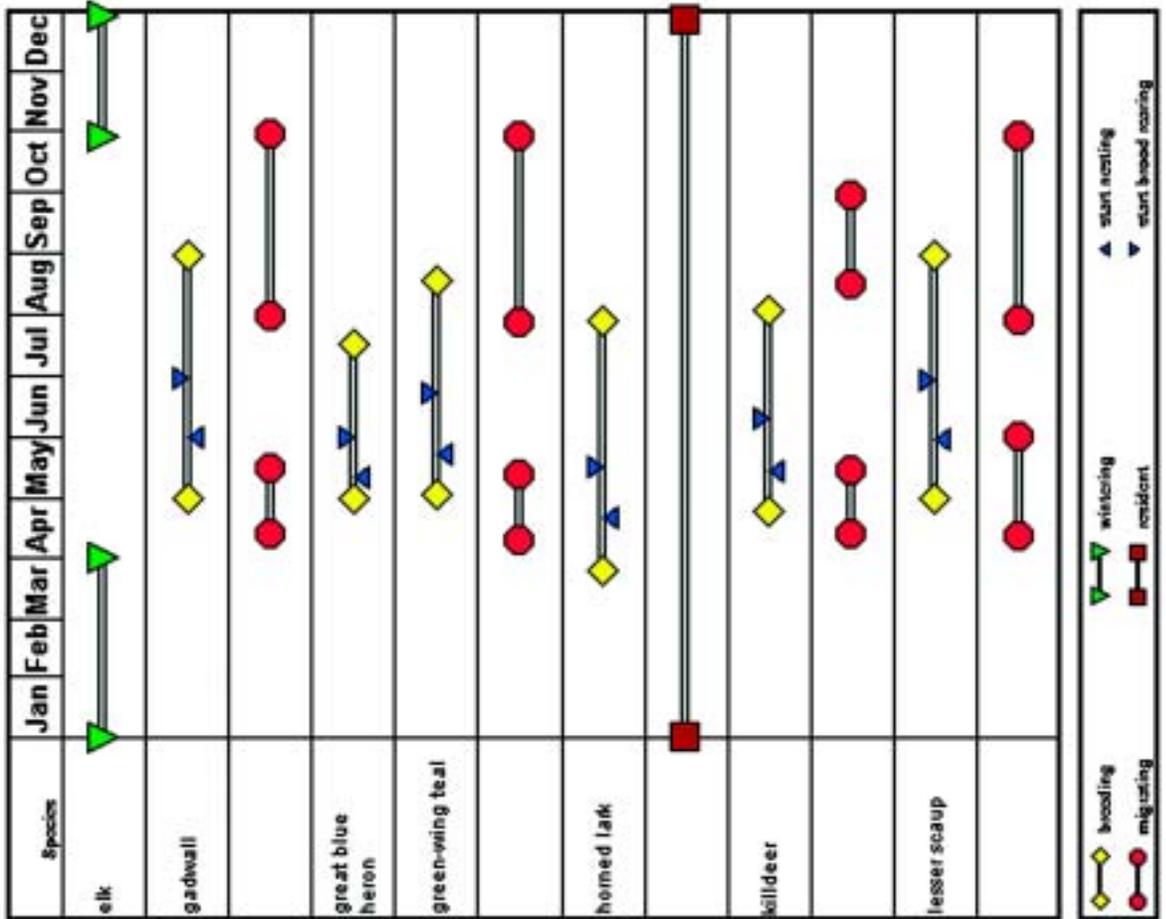
Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
canvasback							▲	◆				
				●	●	●	●	●	●	●	●	●
cinnamon teal							▲	◆				
				●	●	●	●	●	●	●	●	●
common merganser							▲	◆				
				●	●	●	●	●	●	●	●	●
common snipe							▲	◆				
				●	●	●	●	●	●	●	●	●
coyotes												■
eared grebe							▲	◆				
				●	●	●	●	●	●	●	●	●



Habitat Use Chronology  
Arapaho National Wildlife Refuge

Habitat Use Chronology  
Arapaho National Wildlife Refuge

Chronology Chart #4



Habitat Use Chronology  
Arapaho National Wildlife Refuge

Chronology Chart #5

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
red-winged blackbird												
ring-necked duck												
ruddy duck												
sage grouse												
??winterting												
sage thrasher												
Savannah sparrow												
short-eared owl												
soot												

brooding  
 migrating  
 wintering  
 resident  
 start nesting  
 start brood rearing

Habitat Use Chronology  
Arapaho National Wildlife Refuge

Chronology Chart #6

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
sparrow-fox, Lincoln's, Savannah												
spotted sandpiper												
Swainson's thrush												
tiger salamander												
Vesper sparrow												
Virginia rail												
western chorus frog												
white-faced ibis												

brooding  
 migrating  
 wintering  
 resident  
 start nesting  
 start brood rearing

**Habitat Use Chronology**  
**Arapaho National Wildlife Refuge**

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
white pelican												
willet												
willow flycatcher												
wintering												
Wilson's phalarope												
wood duck												
yellow-headed blackbird												
yellowlegs												
yellow warbler												

 brooding    
  wintering    
  nesting    
  start nesting  
 migrating    
  no/lost    
  start brood nesting

## Wetlands

The Refuge will try to manipulate wetlands to fulfill the habitat needs of the diverse wetland-dependent wildlife. Much of the information on wetland species-habitat relationships results from studies conducted outside the intermountain region. While the existing information describes potentially important relationships, we must consider the source of information (e.g., what, where, when, why, and how data collected) when actual and theoretical outcomes do not coincide.

Wetland habitat selection by water birds is largely dependent on species and scale (Brown and Dinsmore 1986; Gibbs et al. 1991; Orians and Wittenberger 1991). Studies have demonstrated that wetland use by breeding birds that are wide-ranging (e.g., black tern, northern pintail) is greatly influenced by landscape level features (e.g., landscape heterogeneity, wetland isolation/density, surrounding habitat types and conditions), while use by other birds (e.g., Virginia rail, pied-billed grebe) largely is affected by habitat characteristics within the area of the nest wetland (e.g., local vegetation conditions; Brown and Dinsmore 1986; Naugle et al. 1999; Naugle et al. 2001). Farmer and Parent (1997) indicated that the foraging efficiency of migrating shorebirds increases when the distance between small wetlands decreases, forming a complex.

At the wetland scale, habitat characteristics that variably affect wetland use by water birds largely include wetland size and type, distance to shore, amount and distribution of shoreline vegetation, distance to nearest open water, distance to nearest vegetated edge, surface water area, and the interspersed cover and open water areas. Weller and Spatcher (1965) recorded differences in the abundance and distribution of many bird species in relation to changes in habitat condition of the marsh and at nest sites. While bird species numbers and diversity were highest when the cover:water ratio reached 50:50 (hemi-marsh), the interspersed cover and open water areas seemed even more important. For example, grebes and waterfowl preferred areas with waterways through the emergent vegetation that connected various pools. Studies also show that hemi-marsh conditions do not satisfy the requirements of all species and preferences of cover:water interspersed for a given species may vary temporally (Weller and Spatcher 1965; Murkin et al. 1997). In another study, habitat preferences of the horned, eared, and pied-billed grebes largely differed according to basin size and the amount and distribution of shoreline vegetation. Horned grebes selected smaller ponds than eared and pied-billed grebes, whereas pied-billed grebes used ponds with relatively more shoreline vegetation relative to the other grebe species. In part, these differences were attributed to behavioral characteristics. Typically, horned and pied-billed grebes nested in isolation and needed visual separation, while eared grebes nested colonially and needed more space for nesting. The importance of distance parameters in habitat selection is less clear likely due to how it differentially relates to bird behavior (e.g., solitary vs. colonial nesters, secretive vs. social species, territoriality) and other habitat variables (e.g., wetland size (Boe 1993), proximity to other habitat types).

The significance of microhabitat characteristics in determining bird use within a wetland, such as structure (plant height and density), plant composition, litter, and area, was discussed in the riparian habitat section. Those same concepts similarly apply to other habitat types, including wetland habitat. In addition, water depth at nesting and foraging sites are distinctive features of wetland habitat that greatly affect bird use. Relationships between water depth and water bird use are discussed under the objectives below.

## Objective

Maintain 10 acres of, and attempt to establish in one other wetland basin, tall (>60 cm VOR) emergent vegetation in water depths >4 cm over a 5-year period to provide nesting habitat for over-water nesting birds (black-crowned night-heron, white-faced ibis, waterfowl, marsh wrens, coots, and blackbirds).

## Value

The most conspicuous attribute of this habitat condition is the tall, dense vegetation that provides the necessary nesting cover for large-bodied wading birds (e.g., black-crowned night-heron, white-faced ibis) and more secretive waterbirds (e.g., rails). No other habitat objective shares this feature. The vegetation density largely is a function of the litter or duff layer (the amount of new and residual plant growth), commonly used by water birds as nesting substrate. As well, flooded emergent litter is important for macroinvertebrate production in the spring (Nelson et al. 1990), prior to the emergence of submergent vegetation (Nelson and Kadlec 1984). Invertebrate matter is a primary source of protein for many wetland and terrestrial birds (Fredrickson and Reid 1986). Waterfowl especially rely on invertebrate matter as a component of their diet during the breeding (Bartonek and Hickey 1969; Krapu and Reinecke 1992; Baldassarre and Bolen 1994) and brood-rearing seasons (Sudgen 1973; Cox et al. 1998).

## Achievability

The current coverage of tall emergent vegetation (primarily cattail [*Typha spp.*]) on Arapaho NWR is extremely limited. Our attempt to maintain the estimated 10 acres that currently exists is largely experimental as we learn more about our ability to manage for the desired habitat condition described in the objective. We believe it is possible because it exists in similar high elevation parks in Colorado, specifically South Park and the San Luis Valley. Our present concern is that some of our wetland basins have margin slopes that do not favor plant germination. In addition, some of our basins possibly have enough sedimentation accumulation and turbidity to adversely effect germination of some plant species. Most of the sedimentation comes through the ditches that enter the ponds. Wang et al. (1994) found that sediment loads of 0.2-0.4 cm decreased cattail seed germination by 60-90 percent. Further, coarse-textured sediments had more adverse effects on seedling density compared to fine-textured sediments (Dittmar and Neely 1999). If sedimentation has occurred, the source (e.g., bank erosion, inflow from adjacent uplands or ditches), extent (e.g., current sediment load, seed burial, turbidity), and rate of sedimentation (e.g., retention/re-suspension of potential of bottom materials, past and current rates of inflow, wind action, shoreline slope) should be examined. This information in addition to

our ability to manage water levels may indicate which sites have the highest management potential for cattail establishment.

#### Strategies

To encourage germination and establishment of cattail, experimental wetland basins that show the highest potential for cattail establishment would need to be selected.

Selection criteria may include water control capabilities, rates of evaporation (e.g., how fast <1 inch of water becomes a mudflat and how soon mudflat dries out completely), amount and distribution of existing cattail in each basin, and shoreline conditions (slope). Our ability to expose mudflats when temperatures are optimal for cattail germination (25-35° C) would have to be evaluated for relatively dry, average, and wet years. For established cattail stands, effective management requires periodic disturbance. Disturbance characteristics (e.g., flooding depth, frequency, duration) and timing in relation to the annual cycle of cattail growth will largely determine cattail response (Beule 1979; Apfelbaum 1985; Sojda and Solberg 1993).

An understanding of the environmental conditions that favor and discourage cattail germination and growth likely will improve our ability to manage for the desired habitat condition described in the objective. Cattail reproduces by seed and vegetatively via rhizomes. Germination of cattail occurs in shallow water depths (e.g., ≤0.5 inch of water, Sojda and Solberg 1993) and on mudflats (van der Valk and Davis 1978; Sojda and Solberg 1993) under a wide range of temperatures (Sojda and Solberg 1993). Results of greenhouse experiments indicated that cattail germination required flooding (Bedish 1967). Cattail germination seemed best in water 1 inch deep when light and temperatures were optimal (Bedish 1967; Weller 1975). Under field conditions, most studies show germination of cattail occurs after mudflats have been exposed (Beule 1979). Subsequent shallow flooding may promote seedling establishment (discussed below). Fully saturated or flooded soils produce anaerobic conditions near the soil surface (e.g., <2 cm, Mortimer 1971 in Bonnewell et al. 1983). Cattail seed germination was reported highest on the soil surface, but occurred <1 cm below the surface of sandy soil (Galinato and van der Valk 1986). Studies show reduced O<sub>2</sub> concentrations promote cattail germination (Hutchinson 1975 in Bonnewell et al. 1983). Bonnewell et al. (1983) found that germination of submerged cattail seeds was maximized in O<sub>2</sub> concentrations of 2.3-4.3 mg/L. In the same study, seeds flooded for <24 hours had higher germination than those flooded for 7 days. Seed germination of cattail was significantly reduced by 1000 mg/L of NaCl (Galinato and van der Valk 1986). A salinity of 10 ppt was responsible for the decreasing cattail cover that was flooded for most of a growing season (Sojda and Solberg 1993). Thus, especially in arid environments, it is important to pay close attention to increasing soil and/or water salinities as water levels decrease. Though results vary, optimum soil-surface temperatures for cattail germination generally range 25-35 degrees C (Bonnewell et al. 1983; Sojda and Solberg 1993). Bonnewell et al. (1983) found no germination occurred at 10 degrees C and was very low at 15 degrees C. Long light exposure is another cattail germination requirement and an environmental characteristic of open mudflats (Bonnewell et al. 1983). Following germination, cattail establishment may occur fastest in 1 inch water depth, though it is able to grow well

in saturated soils and in water 6 inches deep (Bedish 1967). Once mature plants are established, cattail may tolerate a range of water depths (generally ≤20 inches). However, extended periods of deep (>26 inches) flooding have stressed cattail plants and may terminate growth (Apfelbaum 1985; Sojda and Solberg 1993). In Wisconsin, cattail endured water depths of 3 ft (91 cm) for <2 full growing seasons before a die-back was observed (Beule 1979).

In the process of managing to favor cattail germination, other benefits are gained depending on the timing of a drawdown or flooding event. For example, food resources may be made available as a result of a drawdown during spring or fall migration. A drawdown may also stimulate Submerged aquatic vegetation beds.

#### Objective

Provide 10 percent of the wetland acres over a 5-year average in short (<10 cm), sparse (<10 cm VOR) emergent vegetation in water depths <4 cm from April to August to provide foraging habitat for shorebirds and waterfowl, as well as nesting and brood-rearing habitat for shorebirds.

Shallowly flooded, short, sparse emergent vegetation are typical foraging sites for many waterbird species (Fredrickson and Reid 1986; Helmers 1992; Laubhan and Gammonley 2000). This habitat condition is notably important for various shorebird and waterfowl species that occur on Arapaho NWR during spring and fall migration and throughout the breeding season (April to August). Further, while similar habitat exists off-Refuge in North Park, we feel the number of sites that satisfy all the conditions (e.g., <4 cm water depth) described in this objective is limited. In part, this habitat condition may be limited because of differences in land management objectives of on- and off-Refuge sites. Relatively open stands of vegetation allow shorebirds to utilize visual and/or tactile strategies to acquire food resources that occur in sites with dry/moist ground and/or in flooded sites with water depths of <10 cm (Helmers 1992). While morphological attributes (tarsus and culmen length; Baker 1979), foraging preferences, and nesting behavior (semi-colonial, solitary) differ among shorebird guilds (Helmers 1992), habitat conditions (water depth <4 cm) described in this objective primarily allow relatively small bodied shorebirds of the Interior Region (e.g., plover, curlew, turnstone, small and medium sandpipers, yellowlegs) to exploit the necessary invertebrate resources typically found in newly flooded areas. The medium to large bodied shorebirds (godwit, avocet, stilts, phalarope) also may use these areas for foraging and nesting, but more characteristically forage for invertebrates resources in water depths >4 cm and <20 cm (Helmers 1992).

#### Objective

Provide 20 percent of the wetland acres over a 5-year average of emergent vegetation >25 cm tall with visual obstruction reading >80 percent of vegetation height in water depths 4-18 cm to provide escape cover and foraging habitat for dabbling duck broods and molting ducks, and foraging habitat for water birds.

Unlike the habitat conditions described in the other wetland objectives, these conditions provide both shallow water and moderately dense cover that is especially important for

water birds with relatively low mobility (e.g., molting ducks, broods). The relatively shallow water increases the availability of food resources and the moderate cover permits movement and concurrently decreases the risk of predation. Brood-rearing habitat is a limited resource in North Park in dry years partly because of the arid climate and agricultural activities that demand water resources earlier in the growing season. While agricultural activities have created reservoirs for irrigation that provide some brood habitat, they do not always satisfy all the conditions described in the objective and may differ from habitat provided on-Refuge in terms of quality.

#### Value

The availability of different habitat conditions may benefit a greater diversity of wildlife species and/or support species for longer periods in their annual life cycle.

#### Achievability

The above two habitat objectives are created when water levels in wetland basins are artificially and/or naturally drawn down (e.g., to encourage germination and growth of emergent vegetation or to stimulate submerged aquatic vegetation growth). At present the Refuge tries to provide some shoreline habitat for spring migrating shorebirds resulting from drawdowns. In fall, water levels naturally drop in many of the ponds and spring flooding also creates much shallow water. The Refuge is unique in North Park in managing for shorebirds. Slow, staged drawdowns can work well, but cannot refill basins in most years. Nevertheless, those habitat conditions likely are similar to historic dynamics of many of the natural basins. Drawdown will also help Submergent aquatic vegetation beds.

#### Strategies

Strategies used to achieve habitat described in Objective 2 involve both drawdowns and back flooding of different areas to create the habitat described. For Objective 3, drawdowns will provide the desired conditions in subsequent years.

#### Objective

Provide 10 to 20 percent of the wetland acres, within each wetland complex, over a 5-year average with 70 percent coverage of submergent species (*Potamogeton*, *Ruppia*) in wetlands of >18 cm water depth provide invertebrates and seed sources for foraging water birds, especially waterfowl broods, and escape cover for diving ducks.

#### Value

Submergent vegetation provides complex structure for macroinvertebrate production when it becomes established in early summer (Krull 1970, Voigts 1976, Nelson and Kadlec 1984). Sago pondweed and wigeongrass are two major submergent plant types that occur on Arapaho NWR. Both submergents are reputable productive waterfowl food resources (drupelets, tubers, stems/leaves, and invertebrates; Kantrud 1990, 1991). Waterfowl broods rely heavily on the availability of both invertebrate and plant foods (Sudgen 1973). In addition, these submergents are used by many wetland-associated wildlife species (Kantrud 1990, 1991) for nesting, foraging, and escape habitat.

#### Achievability

Some submergent vegetation already exists on the Refuge, but its occurrence has not been a result of actively managing

for its production. These habitat conditions have regional importance due to the limited availability of quality open water habitat (e.g., extent of submergent vegetation with water depth >18 cm proximate to nesting habitat) in North Park during the brood-rearing season. By managing for these habitat conditions within each complex, we will maximize the availability and accessibility of resources that these habitat conditions provide.

#### Strategies

A monitoring plan will be developed to show when significant changes from *Potamogetons* and wigeongrass to other submergent types occur on Arapaho NWR, signifying the need for a drawdown. In order to favor wigeongrass production, Hietzman (1978 in Kantrud 1991) recommended drawdowns to consolidate and oxidize sediments when silt deposition and decomposing vegetation on the substrate was deeper than about 4 cm. Otherwise, wigeongrass might become poorly rooted and susceptible to damage by wave action. Partial early spring and fall drawdowns and complete summer drawdowns with reflooding in the fall have also been used to stimulate wigeongrass growth (Kantrud 1991). Wigeongrass shoot survival may increase if produced earlier in the growing season and if able to reproduce. Also, floating fragments may eventually grow roots, sink, and attach to the bottom substrate. Water level manipulations have also been used to encourage sago production, but success has varied. Where sediments are high in organic material, complete drawdowns may be used to release nutrients that may stimulate sago production when the wetland is reflooded. Partial drawdowns (e.g., to 0.3 m water depth by August in the aspen parkland region of Canada) have increased Sago and other pondweed production as well (Kantrud 1991).

Accomplishing this objective requires management that encourages the production of macrophytes, specifically sago pondweed (*Potamogeton pectinatus* L.; *sago*) and wigeongrass (*Ruppia maritima* L.). Unless otherwise cited, all information on the germination and growth requirements of sago and wigeongrass was derived from Kantrud (1990, 1991), respectively.

Sago has a circumpolar distribution and has exhibited both annual and perennial life cycles due to its ability to adapt to a wide range of environmental conditions. Sago absorbs nutrients from the water column and, therefore, may be rooted (>0.5 m in sandy soils and <0.5 m in finer textured soils) in sediments with low oxygen levels. Sago vegetative growth begins when water temperatures are 10 degrees C (late March - late June), but may not reach the water surface for weeks (May - mid-July). Low light conditions increase the rate of growth. Sago may reproduce from fruit (drupelets), but more often reproduces vegetatively via root or stem structures termed winter buds, tubers, or turions. The number of turions often far exceeds that of drupelets and some sago plants only use this form of reproduction, especially in permanently flooded wetlands. Germination and turion growth is maximized when temperatures are 15-26 degrees C. Minimum temperatures reported for turion germination in the field are 5.5 degrees C and temperatures of >30 degrees C may inhibit germination. Germination of drupelets and development of overwintering turions may occur as early as late March. New drupelets form about 3 weeks after flowering. Drupelets exposed for >1 year on dry

substrate and then moistened may germinate in >4 days. Turions develop at the tips of branches that grow from rhizomes (beneath the surface of the substrate) and at the tips of leafy shoots (above the surface of the substrate). It is unclear whether turions are produced throughout the growing season or after peak plant biomass. Peak turion development occurs in late summer or early fall. Turions may remain viable from one to several years, longer when conditions are flooded compared to exposed. It has been reported that when sediment moisture was <23 percent for 2 weeks, most overwintering turions did not germinate due to desiccation. Vegetation senescence sometime between late August - October.

Several environmental factors regulate sago growth. As with most macrophytes, production and depth distribution of sago is largely determined by water transparency or turbidity. Turbidity is an environmental condition resulting from complex interactions involving characteristics (e.g., texture, slope, aspect) of the bottom substrate, wave action (prevailing wind speed and direction in relation to basin size) or water movement (e.g., bottom-feeding fish activity), and water chemistry. A secchi transparency of >60 cm seems to favor sago growth and low production has been reported where secchi depths were <30 cm. Field studies indicate that sago growth does not occur in waters with pH <6.3 and >10.7. A study that sampled 116 sites where sago occurred in central North America found a mean pH of 8.5. Optimum biomass occurs at 2-15 g/L TDS and lower values within this range favor reproductive material (propagules). Sago often occurs in waters high in CO<sub>3</sub> or HCO<sub>3</sub> ion (>18 mg/L). Sago may be out-competed by *Ruppia* in SO<sub>4</sub>-dominated waters with salinities >26 g/L and by other macrophytes in HCO<sub>3</sub>-dominated waters with salinities <0.7 g/L (Stewart and Kantrud 1972 in Kantrud 1990). Relative to sago, wigeongrass is a more salt tolerant macrophyte and *Utricularia vulgaris* is less salt tolerant. As water levels fluctuate and environmental conditions (e.g., water chemistry) are modified, changes in composition of submergent plant species will occur naturally.

Like sago, wigeongrass is adapted to a wide range of environmental conditions. It also exhibits annual life cycle traits in extreme environmental conditions (e.g., drought, high salinities) and perennial traits in more stable environments where productivity usually is highest. Almost all below ground biomass is within 10 cm below the surface of the bottom substrate and close to 90 percent is within 5 cm. Rhizomes occur within a few mm and most drupelets within 5 cm of the surface of the bottom substrate. The shallow root system makes turbulent waters a limiting factor. Wigeongrass is able to grow in well-oxygenated and reduced sediments if able to obtain enough oxygen from photosynthesis. Numerous flowers are produced about 5-6 weeks after wigeongrass begins growth. Drupelets and rhizomes on overwintering plants develop about 2 weeks after the start of flowering. Annual wigeongrass requires water temperatures of 10-33° C to complete its life cycle. Temperatures for drupelet germination and seedling development occur at 10-20° C and 15-25° C, respectively. Peak growth typically occurs sometime in July or August in temperate regions. In north temperate wetlands, temperatures of >30° C may adversely affect wigeongrass growth. Measurements of water transparency have indicated the importance of light as a growth requirement of

wigeongrass. In Canada, wigeongrass dominated in waters with a Secchi disk reading of 3.0 m (Gallup 1978 in Kantrud 1991) and, in another study, biomass decreased with Secchi disk reading <1 m (Bailey and Titman 1984 in Kantrud 1991). However, other environmental factors may have contributed to the reported increases and decreases in wigeongrass growth.

Below ground biomass has been reported most productive in well-oxygenated, coarse-textured sediments. Optimum growth of wigeongrass in the laboratory and the field occurred in 0.4 m and 0.6 m water depths, respectively. The most productive growth of wigeongrass in finer substrates (clay and silt) occurred in water depths of >0.61 m compared to up to 4.0 m in sandy substrates. Germination of drupelets will occur in shallow water depths (5-10 cm), but plants produced may have low drupelet production. Germination of drupelets is reduced or may not occur if buried >10 cm, exposed on moist soil, in sediments with >1-2 percent soluble salts, or in waters with NaCl concentrations of 15 g/L. However, drupelets are highly drought-resistant, may recover from high salinities when inundated in freshwater for about 2 weeks, and may remain viable for <3 years. Water chemistry (e.g., salinity, alkalinity) parameters for wigeongrass occurrence seem to vary greatly among study locations (e.g., regions, lab vs. field) and among plant life stage (e.g., germination, growth, reproduction). Generally, it tolerates higher salinities than other submersed macrophytes and does not do well in fresh, soft, or acidic water. In the prairie pothole region, Stewart and Kantrud (1972 in Kantrud 1991) reported the greatest abundance of wigeongrass occurring in waters with salinities 0.35 to >100 g/L. While other studies in prairie wetlands found wigeongrass commonly occurring in waters with salinities ranging from 15 to >45 g/L (Millar 1976 in Kantrud 1991) and abundantly fruiting where salinities were 36 g/L (Metcalf 1931 in Kantrud 1991). Wigeongrass generally occurs in natural waters with alkalinities of about pH 6.0-10.0.

Other key factors to consider in macrophyte production is the amount of algae and phytoplankton growth. Extensive algae cover may limit light, temperature, and oxygen (from photosynthesis) necessary for macrophyte growth. Phytoplankton achieves high growth rates when nutrient availability is high (e.g., from water inflows) and, like epiphytic algae, may affect photosynthesis of wigeongrass.

## **Meadow**

The Refuge will maintain and enhance existing meadow habitats to provide grass-forb communities, composed primarily of native plants, to benefit migratory birds and other wildlife species.

### **Rationale**

The meadow objectives are written similarly to riparian objectives 2 and 3 and the rationale for those riparian objectives applies to these meadow objectives. Therefore, in this section, we will only note how the meadow and riparian habitat areas differ and how those differences may influence wildlife use. Major differences include the proximity to different habitat types (e.g., the river in the lowland), the riparian habitat is subject to flooding from the river channel, and plant composition (e.g., willow in riparian zone and not in upland irrigated meadows).

(1) Provide 20 to 50 acres over a 5-year average of grass-forb (75:25) plant community composed primarily of native plants (rushes, sedges, grasses, forbs) characterized by <20 cm height, <10 cm VOR, with dry to moist soils (no standing water), adjacent to (within 50 m) or intermingled with sagebrush (10-25 percent sage canopy cover), from early June to July, to benefit sage grouse and snipe broods.

#### Value

North Park has developed a Sage Grouse Working Plan for the declining sage grouse population in the Jackson County. We suspect that the current amount of interspersed grasses and forbs in the sagebrush may not support a sufficient abundance of arthropods and invertebrates for foraging sage grouse broods. Meadows have the moisture and nutrients that encourage plant growth. The decomposing plant matter promotes invertebrate production. We believe that if we provide some meadow habitat devoid of surface water during the brood-rearing season, these food resources would be accessible to sage grouse broods. Meadow areas that are proximate to the sagebrush may increase sage grouse survival because they would not have to travel as far for different resource requirements.

#### Achievability

Management of these habitat conditions in the meadow is somewhat experimental to see if we are able to create sage grouse brood habitat (some in riparian zone too).

#### Objective

Provide 630 to 790 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native plants (grasses, sedges, forbs, and rushes) characterized by >30 cm VOR, 10-20 cm duff layer and minimal (<5 percent) bare ground to benefit nesting waterfowl (mallard, gadwall, pintails, scaup), songbirds (savannah sparrow, meadowlark), and foraging shorebirds if flooded (snipe, phalarope, white-faced ibis, curlew, willet, and sora).

#### Achievability

We currently are able to keep maybe 40 percent of the meadows flooded through end of July in most years. Only about 20-30 percent of the meadows defined as dense in the riparian objectives can be kept flooded to 2-3 inches through July most years (largely due to channel alterations). Therefore, we must try to enhance the irrigation systems to providing more of this type of habitat in upland meadow areas.

#### Objective

Provide 1,650 to 1,850 acres, over a 5-year average, of a grass:forb (75:25) plant community composed primarily of native species (grasses, sedges, forbs, and rushes) characterized by 10-30 cm VOR, 0-10 duff layer and minimal (<5 percent) bare ground from mid-April to the end of July to benefit nesting waterfowl (gadwall, shoveler, pintail and green-winged teal) and sage grouse broods.

No substantial differences exist in the meadow and riparian habitats in regards to this objective.

## Upland Habitat

### *Refuge Habitat Description*

The upland habitat consists of 14,285 acres of a shrub-steppe plant community dominated by sagebrush, drought tolerant perennial bunchgrasses and forbs. Uplands are the dominate Refuge habitat type and includes all lands not accounted for in the wetland, meadow and riparian descriptions. Many upland habitats exhibit a mosaic pattern around meadows sites on the Refuge. These sites are generally managed in conjunction with associated meadows, including using the same grazing regime. The focus of past Refuge management efforts have been to create quality wetland habitats, therefore general upland plant community information is limited.

### *History*

Historically, the shrub-steppe community encompassed 9.4 million acres in the intermountain west. Early explorer accounts of sagebrush densities are varied and conflicting. Vale (1975) reviewed 29 historic explorer documents and concluded that presettlement (prior to 1843) conditions included a range type dominated by sagebrush, and that grasses became more scarce as you traveled west. Alternately, Stewart (1941) concluded that historical documents emphasized an abundance of grass under pristine conditions. Historical records are too incomplete to tell us what comprised the pristine vegetation of the Artemisia ecosystem (Young et al. 1984). Geologist F.V. Hayden entered North Park in 1868 and described the site as “an excellent grazing region” and reported seeing “myriads of antelope” that were “quietly feeding.” Naturalist George Bird Grinnell entered the Park in 1879 near the Pinkham ranch and writes “the country at this point had been burned over, and was black and extremely desolate in appearance; I learned from the owner of the ranch that the burn had been made to clear off the sagebrush which takes up so much room that might be occupied by grass” (in Hampton 1971). The historic plant composition of the North Park basin may never be determined; however, it is likely relatively similar to today’s conditions. The shrub-steppe community is dominated by sagebrush, and a small percentage of grasses and forbs. Relative abundance of the plant components has been altered by range management practices (fire, grazing, mowing, and chemicals) over the last 125 years.

### *Vegetation types*

#### *Dominant Sage:*

The intermountain west contains 11 sagebrush species and 13 sagebrush sub-species. Big sagebrush (*Artemisia tridentata*) and its five subspecies is the most common and widely distributed (McArthur 1992). The three most common big sagebrush species are basin big sagebrush (*A. tridentata tridentata*) also potentially the largest and most floriferous; mountain big sagebrush (*A. tridentata vaseyana*); and Wyoming big sagebrush (*A. tridentata wyomingensis*) the smallest and least floriferous (McArthur and Welch 1982). Most sagebrush species distribution is controlled by moisture-elevation gradients, seasonal moisture and soil properties (McArthur 1992). Generally, *A. tridentata tridentata* occupies deep soils, with minimal profile development in low to moderate precipitation and moderate elevations. *A. tridentata wyomingensis* prefers to occupy moderate depth, low-to-moderate precipitation and lower elevations. *A. tridentata vaseyana* dominates areas where moisture improves and high elevations. Big sagebrush traits

include good digestibility, high winter crude protein and provide high winter phosphorus and carotene (Welch 1983; Welch and McArthur 1990). Herbaceous growth in sagebrush occurs only when the appropriate warm temperatures and available soil moisture occurs in the late spring and early summer (West 1996). Summer precipitation is usually not sufficient to allow plant growth; fall moisture patterns are too sparse to allow plant regrowth. The three primary sage species located on the Refuge include basin big sagebrush, mountain big sagebrush and Wyoming big sagebrush; however, small stands of silver sagebrush (*A. cana*), alkali sagebrush (*A. longiloba*), fringed sage (*A. frigida*), black sage (*A. Nova*), and others may exist. The Refuge lacks basic plant inventory and distribution data to fully assess and manage upland habitats. Therefore, the Refuge proposes to complete an uplands plant survey prior to the year 2008 that will facilitate future management.

Young (et al. 1976) describes the introduction and concentrations of large herbivores in the late 1800s on *Artimisian* grasslands as having dramatic results. The result was that for most *Artimisian* grasslands, native perennial grasses were greatly reduced (Young 1994). In the intermountain west, the dominate understory grasses and grasslike species of the sagebrush communities is usually perennial bunchgrass. The major perennial grass and grasslike species include: Bluebunch Wheatgrass (*Agropyron spicatum*), Thurber's needlegrass (*Stipa thurberiana*), Needle-and-thread (*Stipa comata*), California brome (*Bromus carinatus*), *Elymus cinereus*, Sandberg bluegrass (*Poa secunda*), and elk sedge (*Carex geyeri*) (Young et al. 1984). Common forbs include silverleaf lupine, sulfur flower, hooded phlox and Douglas phlox.

#### *Soils and Range Sites*

**Dry Mountain loam Range site:** This site comprises 25.7 acres of the Refuge. The most extensive range type in North Park, it consists of moderate-deep to deep well drained soils. The potential plant community includes 15 percent stream bank wheatgrass, 10 percent sheep fescue, 10 percent muttongrass, 8 percent pine needlegrass, 5 percent Letterman needlegrass, 3 percent Sandberg bluegrass, and 5 percent junegrass, bluebunch wheatgrass. Big sagebrush makes up 15 percent of the community. The forb community consists of lupine, pussytoes, aster, fleabane, yarrow, bluebells, buckwheat, phlox, fringed sage, snakeweed and other forbs. Total annual production of all vegetation is 600 pounds per acre (USDA-NRCS). Heavy grazing by herbivores causes more undesirable grasses such as bluebunch wheatgrass, sheep fescue, pine needlegrass, and other plants such as big sagebrush and less palatable forbs to increase.

#### *Valley Bench Site*

This site comprises 3,065.9 acres of the Refuge. This site is extensive, typically found on uplands and benches, and can be deep to shallow, well drained sites. The potential plant community consists of 20 percent streambank wheatgrass, 15 percent mutton grass, 10 percent junegrass, 9 percent Indian ricegrass, 5 percent pine needlegrass, and 5 percent other grasses. Big sagebrush makes up 15 percent of this community, Douglas rabbitbrush makes up 3 percent. Forbs consist of 5 percent phlox, 3 percent pussytoes, and 5 percent lupine, gray horsebrush and other forbs. Heavy grazing by herbivores causes pine needlegrass, junegrass

and muttongrass to decrease and big sagebrush, Douglas rabbitbrush and forbs to increase. Total annual production ranges from 400 to 900 pounds per acre.

#### *Mountain Meadow Range Site*

This site comprises 1,416.5 acres of the Refuge. It is a highly productive site along natural streams consisting of deep, poorly drained soils. The site is characterized by 20 percent thurber fescue, 12 percent tufted hairgrass, 10 percent slender wheatgrass and 5 percent sedges, Baltic rush may also be found. Forbs are abundant and include 3 percent iris, 3 percent herbaceous cinquefoil, 2 percent yarrow, 15 percent wild celery, cow parsnip, clovers, American bistort, aster, arnica, groundsels, waterhemlock, false-hellebore, monkshood, marsh marigold, sedum, fireweed, shooting star, primrose, green gentian, elephant-head and others. The community also contains 5 percent silver sage, 10 percent willow, and 5 percent other shrubs. This site can produce 2,000 to 4,000 pounds of forage per acre.

#### *Salt Flats Range Site*

This site comprises 3,290.7 acres of the Refuge. This site consists of deep, well drained soils that are effected by sodium salts. The potential plant community is 25 percent western wheatgrass, 20 percent saltgrass, 5 percent Indian ricegrass, 5 percent alkali bluegrass, 5 percent alkali grass, and 5 percent other grasses. Forbs are not abundant on this site and make up 10 percent of the plant composition. The site is also 10 percent greasewood, 5 percent winterfat, 5 percent mat saltbrush, and 5 percent other shrubs. Excessive grazing causes Indian rice grass, winterfat, and alkali bluegrass decrease and western wheatgrass, alkali grass, saltgrass and greasewood increase. The site produces 500 to 900 pounds per acre depending on annual precipitation.

#### *Alkaline Slopes Range Site*

This site comprises 2,078.1 acres of the Refuge. This site contains well drained soils that are 20 to 40 inches deep over shale. The potential plant community is 15 percent wheatgrass, 10 percent saltgrass, 10 percent Indian rice grass, 10 percent squirreltail, 5 percent pine needlegrass, 5 percent bluegrasses and 10 percent other grasses. Phlox, buckwheat and other forbs makeup 5 percent of the community. The community is also 15 percent big sagebrush, 10 percent greasewood, and 5 percent winterfat, masaltbrush, fringed sage and other shrubs. Excessive grazing causes Indian rice grass, bluebunch wheatgrass and pine needlegrass to decrease, and rhizomatous wheatgrasses, Sandberg bluegrass, big sagebrush and greasewood to increase. Total annual production for these sites is 300 to 700 pounds per acre depending on moisture.

### *Spatial Considerations*

Dominance of grasses or sagebrush in upland systems may be attributed to differences in management (Cooper 1953; Savory and Butterfield 1999). Overgrazing can cause a loss and vigor and density of native grasses which permit *Artemisia tridentata* to dominate a site (Wright and Wright 1948). Evidence is also clear that proper management of grazing can permit grasses to reduce sagebrush to a subordinate role in the community (Cooper 1953).

Big sagebrush is the most widespread and common shrub of the Western United States (Rice 1974). Numerous studies have presented evidence that *Artemisia Sp.* have allelopathic effects against neighboring species. The success and distribution of *A. tridentata* may partly depend on its production of allelopathic substances which inhibit the germination and growth of potential competitors (Weaver and Klarich 1977). Groves and Anderson (1980) demonstrated inhibition of crested wheatgrass and giant wildrye germination using crushed *A. tridentata* leaves.

### *Structural Considerations*

Annual precipitation levels clearly cause changes in habitat physiognomy in sagebrush steppe plant communities. Structural changes are not just associated with changes in shrub species, but instead are strongly correlated with forb and litter coverage, coverage diversity and total vegetation cover. Bird species showed no abundance changes of either individual species or local or regional assemblages due to changes in habitat physiognomy. Perhaps local changes in sage cover are not significant enough to change avian use. (Rotenberry and Wiens 1980). Rotenberry and Wiens (1991) also conclude that bird populations in shrub steppe vary largely independent of each other. Structural components of the uplands can also be changed with treatment. Several studies have investigated how treatment of sagebrush may effect structure (Cooper 1953; Savory and Butterfield 1999). Clearly management can change plant community structure toward desired conditions.

### Primary Factors Influencing Distribution and Structural Conditions

#### Soils

We utilized Jackson County, Colorado soil type maps as depicted by U.S. Department of Agriculture, and generated number of acres of each soil type within the Refuge. Five soils that list sagebrush being "common" included Boettcher-Bundyman association, Bosler sandy loam, Dobrow loam, Morset loam, and Spicerton sandy loam for a total of 9,877.04 Refuge acres. Generally, these soils are considered moderate to deep and typically are used for grazing or pasture. These soils are found on slopes less than 15 percent, and generally have slow to moderate permeability.

#### Physical Characteristics

Soil depth, soil texture, aspect, and soluble salts and slope all determine vegetation densities in the shrub-steppe. Following precipitation, water flows downslope and establishes a moisture gradient with respect to slope position. The slope crests are the most xeric and the slope base being the most mesic. Slope effects vegetation density, generally at the base of the knolls is more dense, with the midslope vegetation being moderately dense and the vegetation of the knoll crest being the least dense

(Brotherson 1999). Sturges (1977) found mountain big sagebrush, for example, growing at midslope and bottom slope sites and suggested that these sites were more mesic and, therefore, were better suited for mountain big sagebrush. In general, soil depth increases downslope, as does the number of plant species. Total cover of both annuals and forbs decreased downslope, while shrubs cover was most important at the slope base (Brotherson 1999).

#### Salinities

*Artemisia* species generally will not tolerate soil salinities higher than 18 mmhos/cm<sup>2</sup> (Gates et al. 1956). Generally, as soil salinity increases, sagebrush becomes less dominant, and greasewood species become more abundant.

#### Soil Textures

Soil textures form the slope crest, show lower clay content, and higher sands and exposed rock. As water moves downslope, it takes the smaller textured particles and dissolved nutrients along with it. Soil organic matter, pH, bare ground, litter cover, total dissolved salts and concentrations of sodium and potassium all increase downslope (Brotherson 1999).

#### Aspect

The direction that a slope hillside faces influences soil temperature, air temperature, soil moisture, solar radiation and, therefore, plant community characteristics. Overall, south and west facing slopes are warmer than north and east facing slopes. Air temperature on south facing slopes averages 0.9 Celsius warmer than north facing slopes. The morning sun finds moist soils and plants, and a large part of the solar radiation received is lost to evaporation. However, afternoon sun shines on relatively dry soils and plants; therefore, the received energy is applied to increasing soil temperature. Soil moisture is 1.7 percent to 2.2 percent higher on north facing slopes (Ayyad and Dix 1964) than south facing. Soil temperature on the upper and middle positions of a hillside are warmer than lower sights. South facing hillsides have 5 to 6 degree difference in soil temperature between upper and lower sites.

#### Climate

Climate conditions of North Park are characterized by low relative humidity, abundant sunshine, large daily and seasonal temperature variations, and increasing precipitation with elevations (Fletcher 1981). North Park's remoteness from moisture sources and high elevation result in low humidity and a semi-arid climate (Kuhn et al. 1983). Mean annual precipitation ranges from about 10 to 16 inches in the basins, and up to 40 inches in the surrounding mountains. The basin receives the majority of precipitation during the summer months (May – September). Snowfall is the most significant precipitation and accumulates in the mountains in depths of 5 – 10 feet. Melting snowpack provides 65 to 85 percent of annual stream flow. Summer precipitation is generally produced by convective thunderstorms, but because moisture is lacking, the rainfall from these storms is generally less than one inch (Kuhn et al. 1983).

Daily temperature variations at Walden (8,120 feet elevation) are reported to be 25 Fahrenheit during winter and 40 Fahrenheit during midsummer and fall. Recorded temperature extremes are 96 and minus 49 with a mean

annual temperature of 36.5. Walden averages 43 frost-free days per year due primarily to high elevation. Winter winds are frequent and typically from the west or southwest. The May – September average evaporation potential estimated for North Park is about 35 inches (McKee et al. 1981).

#### Disturbance: Fire / Grazing

Big sagebrush communities had fire cycles that varied between 60 and 110 years before European settlement (Whisenant 1990). Grasses and forbs have an advantage over sagebrush when sites are burned. Most *Artemisia* species do not resprout after fire, but have to reestablish from seed. The introduction of cheat grass (*bromus tectorum*) led to more frequent fires, and combined with unrestricted grazing, native vegetation becomes easily replaced with exotic annual plants (West 1996). Much of the sagebrush steppe has been burned at least once in the last three decades and is now dominated by introduced annuals like cheat grass and medusahead. This replacement is undesirable in all aspects (West 1996)

Grazing in sagebrush steppe systems tends to increase sagebrush density, decrease sagebrush cover, reduce litter accumulation, decrease soil moisture, reduce grass and forb abundance, and increase the potential for nonnative invasion. Large grazers and grasses have co-evolved. Without moderate grazing and/or fire, plant litter builds thatch that withholds nutrients and physically limits vegetative regrowth and seedling establishment (McNaughton et al. 1982). Some grazing and burning are necessary to allow optimal light penetration and nutrient cycling. Maximum grassland plant community diversity is usually attained under moderate grazing (West 1993). The dense stands of excess sagebrush prevent the herbaceous species from recovering. Such brush-choked stands are usually chosen by both livestock and wildlife managers for manipulation to diversify vegetation structure (West 1996). A reduction in sagebrush also enhances water yields (Sturges 1977).

Goodrich (et al. 1999) estimated ground cover at sagebrush steppe sites protected from livestock averaged 55 percent. Sites grazed annually in the spring averaged 30 percent ground cover. The greatest difference in ground cover was the amount of litter or plant residue deposited on the ground. Litter cover was about two times greater in areas protected from livestock grazing. High ground cover can be maintained under moderate intensity, rest or deferred rotation grazing. Holechek and others (1998) concluded: . . . various studies of gazing impacts on rangeland soils and watershed status are highly consistent in showing that vegetation residue is the primary factor determining degree of soil erosion and water infiltration into the soil. As residue is depleted by heavy grazing, soil erosion increases, water infiltration decreases and water overland flow increases . . .

Where ground cover is less than 50 percent over more than 10 percent of a grazing unit, a need for change in management is strongly indicated. Exclusion of either or both wild ungulates and moderate intensity cattle grazing has not resulted in overall higher resource values than where both were present (Goodrich et al. 1999).

Close grazing reduces soil moisture, decreases infiltration, the energy of falling raindrops is not dispersed by

vegetation, and the soil surface is compacted and sealed by raindrop splash. In Ashley National Forest, eastern Utah, a comparison of summer-long grazing and three rest-rotation systems that revealed no difference in residual cover (Johnson 1987).

Timing of grazing or fire treatments and rest significantly effects outcome. A study in Browns Park, Colorado and Daggett County, Utah found crown cover for Wyoming big sagebrush after 30 years of ungulate exclusion was 22 percent, 11 percent after 9 years of exclusion, and 17 percent after 13 years. Absence of cattle grazing, coupled with high levels of wild ungulate use reduced Wyoming big sagebrush cover to less than 5 percent (Goodrich et al. 1999). Twenty-two percent crown cover appears to be the maximum crown cover Wyoming big sagebrush will support. At this level, the frequency of needle-and-thread grass was significantly less, and production and vigor appears to be reduced.

#### Refuge Objectives:

Development of Refuge objectives involved selecting sage-obligate species, identifying species habitat requirements, detailing period of Refuge use, and finally developing measurable habitat based objectives that specify desirable range conditions. Unfortunately, little is known about Refuge upland habitats. The Refuge's first priority is to conduct vegetative assessments of upland habitats and incorporate the information into map databases. Past management efforts have focused on developing suitable waterfowl nesting and brood-rearing sites in meadow habitats. Much of the upland plant community information that had been acquired was lost to an office fire in April of 1997. Therefore, uplands management is conservative, identifying only 4,000 acres with specific and measurable objectives. The remaining upland acreage will be utilized for sagebrush research. Specific and measurable objectives will be determined on the remaining acreage after the vegetative assessments are completed, and research on desirable range conditions is conducted.

#### Species Selection:

The Intermountain West Regional Shorebird Conservation Plan recognizes that throughout the Great Basin, uplands associated with wetlands and riparian areas provide critical nesting areas for shorebirds, especially long-billed curlew (*Numenius americanus*) and willet (*Catoptrophorus semipalmatus*). The Partners in Flight (Colorado State Plan) identifies northern sage grouse (*Centrocercus urophasianus*), Brewer's sparrow (*Spizella breweri*), sage sparrow (*Amphispiza belli*), vesper sparrow (*Pooecetes gramineus*), and sage thrasher (*Oreoscoptes montanus*) as species of concern (priority >20). Arapaho NWR is uniquely situated to support several goals and objectives identified in these plans. Working with the Colorado Division of Wildlife, and with existing data on uplands use by songbirds and shorebirds, the Refuge developed the following objectives. Northern sage grouse are a species of concern for the State of Colorado. Elk and pronghorn antelope are common on upland habitats and were considered during objectives development.

#### Upland Objective #1:

1. Provide 2,000 acres over a 5-year average of uplands composed of shrubs (>70 percent sage) >25 cm height and 20 – 30 percent canopy cover, >20 percent grass cover, and >10

percent forbs (native species preferred) to benefit sage grouse, vesper sparrow, elk, and antelope.

#### Habitat requirements of species: Sage Grouse

Sage grouse are closely associated with sagebrush ecosystems of western North America. Sage grouse are well adapted to a variety of sagebrush heights including tall sage, low sagebrush, forb-rich mosaics, riparian meadows, steppes with native grasses and forbs, and scrub willow. (Schroeder et al, 1999). Nests are placed in thick cover, generally dominated by big sagebrush. Vegetative diverse habitats (horizontally and vertically) provide the best habitats. Broods are found in rich mosaics of habitat including sagebrush, riparian meadows, greasewood bottoms. The common feature of brood areas is they are rich in forbs and insects. Females with broods prefer 19-31 percent sagebrush cover with 9-19 percent cover of forbs (Drut et al 1994). Broods respond to dry conditions by concentrating in areas with succulent vegetation. Nesting predation is lowest in dense (41 percent) canopy cover with heavy grass (19 percent) canopy cover (Gregg et al. 1994) and at least 17 percent sagebrush cover. Winter range includes sagebrush with 6-43 percent canopy cover but prefer at least 15 percent canopy cover (Johnson and Braun 1999). Diet consists of leaves, buds, stems, flowers, insect and grit. Grouse tend to feed on the ground in open habitats during morning and mid-afternoon (Hupp and Braun 1989). Hupp and Braun (1989) noted that sage grouse feeding activity was influenced by snow depth and mountain big sagebrush exposure above the snow. Feeding activity of sage grouse occurred in drainages and on slopes with south or west aspects. Additionally, big sagebrush plants in drainages tend to be taller, and northeast slopes and flat sagebrush sites were shorter in height. Sagebrush is essential for sage grouse and dominates the diet during late autumn, winter and early spring (Girard 1937).

#### Habitat requirements of species: Vesper sparrow

Vesper sparrows are distributed from the Northwest Territories across to Alberta south to central California, Nebraska, Illinois, Virginia and Maine (Breeding Bird Survey data). Vesper sparrows prefer dry, open areas with short, sparse and patchy vegetation including sagebrush plant communities (Roberts 1932). Vesper sparrows prefer upland habitats and are most abundant in shrub steppe environments (Kantrud 1981). In Wyoming, the availability of sagebrush for nest cover and song perches was important. Vesper sparrows occurred in areas dominated by sagebrush, and were absent from areas with only grass or cactus (Fautin 1975). Abundance of vesper sparrows is also positively correlated with forb cover. Perches may be any structure or vegetation higher than nest height, such as sagebrush (Berger 1968). Average vesper sparrow territory size in Montana was 1.65 ha (Reed 1986). Vesper sparrows are a fairly common host to brown-headed cowbird nest predation, and will frequently raise cowbird young (Friedmann 1963). Vesper sparrows arrive on the breeding grounds March to late May, and depart in mid-August to late November (Johnsgard 1980). In Wyoming, vesper sparrows were among the most common breeding species in the grass/sagebrush areas. Generally, a lack of sagebrush (perch sites) accounts for low density of vesper sparrows. Nesting occurs on the ground beneath relatively short (14 to 34.3 cm in height) big sagebrush using grass to conceal the nests. Western wheatgrass, bluebunch wheatgrass, green

needlegrass, and junegrass were commonly used food items (Best 1972). Vesper sparrows are also known to occur near white-tailed prairie dog colonies (Clark et al. 1982).

#### Habitat Requirements of Species: Elk

Herbivory (elk, moose, cattle) impacts to riparian, upland and meadow habitats are not known. Willow regeneration along the Illinois river is slow, and small willow shoots are frequently grazed to 2-5 cm in height. Elk damage to riparian areas is well documented in the scientific literature (Zeigenfuss et al. 2002). Currently, approximately 150 elk utilize the Refuge during the spring, summer and fall. During winter months (November - March), elk numbers vary considerably but average 1,000 to 1,400. Elk distribution is varied; however, most use occurs in the willow riparian community along the Illinois River and on the Case Flats. Elk numbers and elk damage are not necessarily a linear relationship. Snow depth, temperature, duration of feeding, and a host of other factors may determine wintering elk impacts. Elk wintering on the Refuge may minimize game damage on adjacent private lands.

Wintering elk (*Cervus elaphus*) diets include approximately 63-100 percent (average is 84 percent) grasses, 9 percent shrubs, and 8 percent forbs (Kufeld 1973). Spring grass use in eight Montana elk food habitat studies averaged 87 percent grass. During summer months, forbs became more important, averaging 64 percent, 30 percent grasses, and 6 percent shrubs. Forbs can grow to 100 percent of the summer diet. Fall elk diets revert primarily back to grasses (73 percent). (Geer 1959; Geer 1960; Kirsch 1963; Mackie 1970; Morris and Schwartz 1957). Nutritionally, forbs were highly valuable for Montana elk, especially *Agoseris glauca* and *Geranium viscosimum*. *Lupinus spp.* and *Aster spp.* were also highly valuable forbs. Grasses and grass like plants included *agropyron spicatum*, *carex spp.*, *carex geyeri*, *Festuca idahioensis*, *Festuca scabrella*, and *Poa sp.* Highly valuable shrub species (based on a large number of references) were *Amelanchier alnifolia*, *Ceanothus sanguineus*, *Ceanothus velutinus*, *Populus tremuloides*, *Prunus virginiana*, *Pushia tridentata*, *Quercus gambellii* and *Salix spp.* (Kufeld, 1972)

#### Habitat Requirements of Species: Pronghorn Antelope:

Sixty-eight percent of antelope (*Antilocapra americana*) in North America occur in grassland habitats (Yoakum 1978) and 56 percent occur on wheatgrass (*agropyron*) dominated prairies (Sundstrom et al. 1973). Pronghorn antelope use is widely distributed across the Refuge. During all seasons, 25 to 250 antelope utilize the Refuge and are generally concentrated in upland habitats. Winter habitat use in south-central Wyoming indicates that high pronghorn densities occurred in habitat complexes containing an average of 0.5 big sagebrush plants/sq m that were >29 cm tall (Ryder and Irwin 1987). Use of sagebrush dominated habitats was 45 percent. Wintering antelope tended to use northwest ridges and benches and those containing black greasewood mixed with big sagebrush in stands averaging 0.4 plants/sq.m in draws and lowland flats. Antelope responded to deep snow (>25 cm) by moving to windswept terrain or draw bottoms where taller sagebrush is available. In Montana, silver sagebrush is the dominate food item in antelope diets. Presence of silver sage is a characteristic of

optimum antelope habitats. (Wood 1989). Fall and winter diets consist primarily of sagebrush. Antelope normally avoid areas with broken topography and vegetation >76 cm tall (Sundstrom et al. 1973).

#### Uplands Objective #2:

2. Provide 2,000 acres over a 5-year average of uplands composed of shrubs (>70 percent sage) >40 cm height and >30 percent canopy cover, <20 percent grass cover, and >5 percent forbs (native species preferred) to benefit brewer's sparrow, sage thrasher, and antelope.

**Habitat Requirements of Species: Brewer's Sparrow:** Brewer's sparrow forage primarily on arthropods in sagebrush shrubs with an average canopy height <1.5 m (Rotenberry et al. 1999); little foraging occurs in nearby rabbitbush (Rotenberry and Wiens 1998) or on open ground between shrubs (Wiens et al 1987). Compared to surrounding shrubs, these sparrows forage in larger and more vigorous shrubs (Rotenberry et al. 1999) In a study across the breeding range, vigor (percent live stems) of a shrub patch was the best vegetative descriptor of Brewer's sparrow habitat (Knopf et al. 1990).

Compared to surrounding habitat, Brewer's sparrow nests tend to be located in significantly taller, denser shrubs (primarily big sagebrush) with reduced bare ground and herbaceous cover (Peterson and Best 1985). In Idaho, nest shrubs averaged 69 cm (range 42-104 cm) versus an average of 43 cm for surrounding shrubs. Brewer's sparrows prefer shrubs that are entirely or mostly alive (Rotenberry and Wiens 1989).

**Habitat Requirements of Species: Sage Thrasher:** Sage thrasher are considered a sage obligate species but noted in black greasewood habitats (Braun et al. 1976). Sage thrasher numbers are positively correlated with the amount of sagebrush cover, positively correlated with sagebrush height (30-60 cm), and negatively correlated with grass cover (Rotenberry and Wiens 1980). Foraging characteristics indicated a strong preference for ground insects such as ants (*Formicidae*) and ground beetles (*Carabidae*) (Stephens 1985). Sage thrashers are opportunistic feeders and may take grasshoppers (*acridomorpha*), crickets, ants, various true bugs and may take larger seeds (Knowlton and Harmston 1943).

Individual nesting sites indicate a preference for taller shrubs with wider crowns. When adequate canopy coverage exists, sage thrasher abundance is positively correlated with a perennial grass understory. Canopy coverage in 175 nest sites in Idaho ranged from 11 to 44 percent (Rich 1980).

#### Uplands Objective #3:

Establish research plots to evaluate herbivory impacts to sage height and grass/forb abundance to benefit nesting and wintering sage grouse, songbirds (vesper sparrow, sage thrasher, Brewer's sparrow) and antelope.

The lack of knowledge on upland habitats (plant species, distribution, condition, height, density) prevent the development of habitats specific goals and objectives. The remaining 10,225 acres of upland habitats will be surveyed by 2008. The staff will focus on evaluating impacts of current

management and herbivory on upland habitats, and will develop habitat based goals and objectives by 2017.

#### Strategies:

Conduct plant composition surveys of Refuge uplands by 2008. The Refuge staff will develop research plots (exclosures) to evaluate herbivory impacts to sage height and grass/forb abundance to benefit nesting and wintering sage grouse, songbirds (vesper sparrow, sage thrasher, Brewer's sparrow) and antelope. Working with partners, the Refuge will develop management strategies for all 14,000 acres of sagebrush uplands.

Investigate methods to increase sagebrush abundance or quality. Attempt to modify forb component using Dixie harrow, fire, fertilizers, seeding and/or herbicides as tools. Native grasses and forbs are preferred; however, limited nonnative species would be considered to enhance the Refuges ability to achieve objectives. The Service policy is to promote natives; additionally, natives tend to sustain ecological integrity of the system (wildlife, plants, system function). The disadvantage is higher costs, lower success rates, and viability of the stand. Nonnatives are less expensive, generally show higher success rates, are readily available, and many have high wildlife value. The downside to nonnatives include risk of spread, poor ecological integrity, compete with native species, and other unknown consequences. Revegetation and sagebrush enhancement preference will be given to soil types that typically support quality sagebrush stands.

#### Uplands Objective #4:

Monitor North Park *phacelia* populations currently known to exist on the Refuge. Initiate research to understand the plants life history and develop a management plan to ensure its continued existence.

North Park *phacelia* is an endangered plant that exists in at least three general areas of Jackson County. One area occurs on the Case tract of the Refuge and includes two primary plant strongholds. Since 1997, Refuge staff have monitored plant numbers on these two sites. Enumeration of rosettes have averaged 741 (range 221 to 1,692) and flowering plants average 1,783 (range 104 to 5,391). The plants inhabit wind swept, gravel dominated hillsides with little or no competing vegetation. Currently, the plant is not excluded from grazing, and no specific plant management is occurring. The plant does not appear to be increasing or decreasing in abundance on the Refuge. Therefore, the Refuge proposes to investigate the life history, life requirements and management options of North Park *phacelia*. Additionally, the ongoing monitoring of rosettes and flowering plants will continue annually. A step-down management plan will be created by 2010 that details future management actions. Strategies will include a research component that emphasizes full recovery of the plant species.

## Appendix. Literature Cited

- Allen, A. W., P. A. Jordan, J. W. Terrell. 1987. Habitat suitability index models: moose, Lake Superior region. U.S. Fish and Wildlife Service, Biological Report 82 (10.155).
- Allen, T. F. H., and T. W. Hoekstra. 1992. Toward a unified ecology. Columbia University Press, New York, New York.
- American Fisheries Society, Western Division. 1980. Position paper on management and protection of western riparian stream ecosystems. American Fisheries Society, Bethesda, Maryland.
- Anderson, S. H., and H. H. Shugart, Jr. 1974. Habitat selection of breeding birds in an east Tennessee deciduous forest. *Ecology* 55:828-837.
- Apfelbaum, S. I. 1985. Cattail (*Typha* spp.) management. *Natural Areas Journal* 5(3):9-17.
- Arnold, K. A. 1994. Common Snipe. Pages 117-125 in T. C. Tacha and C. E. Braun, editors. Migratory shore and upland game bird management in North America. Allen Press, Lawrence, Kansas.
- Arnold, T. W., and K. F. Higgins. 1986. Effects of shrub coverages on birds of North Dakota mixed-grass prairies. *Canadian Field Naturalist* 100: 10-14.
- Askins, R. A., and M. J. Philbrick. 1987 Effects of changes in regional forest abundance on the decline and recovery of a forest bird community. *Wilson bulletin* 99:7-21.
- Askins, R. A., M J. Philbrick, and D. S. Sugeno. 1987. Relationship between the regional abundance of forest and the composition of forest bird communities. *Biological Conservation* 39:129-152.
- Austin, J. E., and M. R. Miller. 1995. Northern pintail (*Anas acuta*). In A. Poole, and F. Gill, editors. The Birds of North America, Number 163. The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.
- Austin, J. E., C. M. Custer, and A. D. Lofton. 1998. Lesser scaup (*Aythya affinis*). In A. Poole, and F. Gill, editors. The Birds of North America, Number 338. The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.
- Ayyad, M.A.G. and R.L. Dix. 1964. An analysis of a vegetation-micro-environmental complex on prairie slopes in Saskatchewan. *Ecological Monographs*, Volume 34, No. 4 pp 421-442.
- Bailey, R. 1995. Description of the Ecoregions of the United States. USDA Forest Service. Misc. Publication # 1391.
- Baker, M. C. 1979. Morphological correlates of habitat selection in a community of shorebirds (Charadriiformes). *Oikos* 33:121-126.
- Baldassarre, G. A. and E. G. Bolen. 1994. Feeding ecology. In *Waterfowl Ecology and Management*, pp. 165-197. John Wiley & Sons, Inc., New York.
- Bartonek, J. C. and J. J. Hickey. 1969. Food habits of canvasbacks, redheads, and lesser scaup in Manitoba. *Condor* 71(3):280-290.
- Baxter, R. M. 1977 Environmental effects of dams and impoundments. *Annual Review of Ecology and Systematics* 8:255-283.
- Bedish, J. W. 1967. Cattail moisture requirements and their significance to marsh management. *American Midland Naturalist* 78(2):288-300.
- Berger, A. J. 1968. Eastern Vesper Sparrow. Pages 868 - 882 in O. L. Austin, Jr., editor. Life histories of North American cardinals, grosbeaks, buntings, towhees, finches, sparrows, and allies. Dover Publications, Inc., New York, New York.
- Best, L. B. 1972. First-year effects of sagebrush control on two sparrows. *Journal of Wildlife Management*: 36: 534 - 544.
- Beule, J. D. 1979. Control and management of cattails in southeastern Wisconsin wetlands. Department of Natural Resources Technical Bulletin No. 112, Madison, Wisconsin.
- Blake, J. G., and J. R. Karr. 1984. Bird communities and forest size. *Biological Conservation* 30:173-187.
- Blake, J.G. and Karr, J.R. 1987. Breeding birds of isolated woodlots: area and habitat relationships. *Ecology* 68: 1724-1734.
- Boe, J. S. 1993. Colony sites selection by eared grebes in Minnesota. *Colonial Waterbirds* 16(1):28-38.
- Bohlen, H. D. 1978. An annotated check-list of the birds of Illinois. Illinois State Museum Popular Science Series 9:1-155.
- Bonnewell, V., W. L. Koukkari, and D. C. Pratt. 1983. Light, oxygen, and temperature requirements for *Typha latifolia* seed germination. *Canadian Journal of Botany* 61:1330-1336.
- Bowman, G. B., and L. D. Harris. 1980. Effect of spatial heterogeneity on ground-nest depredation. *Journal of Wildlife Management* 44:806-813.
- Bradley, C. E., and D. G. Smith. 1986. Plains cottonwood recruitment and survival on a prairie meandering river floodplain, Milk River, southern Alberta and northern Montana. *Canadian Journal of Botany* 64:1433-1442.

- Braun, C. E. 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 bull.* 88:165-171.
- Briskie, J. V. 1995. Nesting biology of the Yellow Warbler at the northern limit of its range. *Journal of Field Ornithology* 66: 531-543.
- Brotherson, J. D. 1999. Measured and inferred moisture gradient relationships across ecotone boundaries in shrub-dominated foothill communities. In: McArthur, E. Durant; 1998 August 12-14: Ephraim, UT. Proc. RMRS-P-11. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.
- Brown, M. and J. J. Dinsmore. 1986. Implications of marsh size and isolation for marsh bird management. *Journal of Wildlife Management* 50(3):392-397.
- Burger, L. D., L. W. Burger Jr., and J. Faaborg. 1994. Effects of prairie fragmentation on predation on artificial nests. *Journal of Wildlife Management* 58: 249-254.
- Cannon, R. W., and F. L. Knopf. 1984. Species composition of a willow community relative to seasonal grazing histories in Colorado. *Southwestern Naturalist* 29: 234-237.
- Carothers, S. W., and R. R. Johnson. 1975. Water management practices and their effects on non-game birds in range habitats. Proceedings of the Symposium on Management of Forest and Range Habitats for Non-Game Birds. U.S. Department of Agriculture, Forest Service General Technical Report WO-1.
- Carothers, W. W., R. R. Johnson, and S. W. Aitchison. 1974. Population structure and social organization of southwestern riparian birds. *American Zoologist* 14:97-108.
- Cassells, E.S. 1997. *The Archaeology of Colorado*, Revised Edition. Johnson Books, Boulder.
- Castelli, R. M., J. C. Chambers, and R. J. Tausch. 2000. Soil-plant relations along a soil-water gradient in Great Basin riparian meadows. *Wetlands* 20(2):251-266.
- Clark, J. P. 1977. Effects of experimental management schemes on production and nesting ecology of ducks at Malheru national Wildlife Refuge. Masters thesis, Oregon State University.
- Clark, T. W., T. W. Campbell III, D. G. Socha, and D. E. Cassey. 1982. Prairie dog colony attributes and associated vertebrate species. *Great Basin Naturalist* 42: 572-582.
- Colorado Breeding Bird Atlas. 1998. H. E. Kingery, editor. Published by Colorado Bird Atlas Partnership and Colorado Division of Wildlife.
- Colorado Department of Local Affairs. 2001. 1999 Estimates of State & County Tourism Jobs. [www.dola.state.co.us/demog/cbef/tourism99.pdf](http://www.dola.state.co.us/demog/cbef/tourism99.pdf)
- Colorado State University Extension. 2000. The 1998-99 Colorado Livestock Enterprise Budget.
- Cooper, D. J. 1986. Community structure and classification of Rocky Mountain wetland ecosystems. Pages 66-147 in J. T. Windell, B. E. Willard, D. J. Cooper, S. Q. Foster, C. F. Knud-Hansen, L. P. Rink, and G. N. Kiladis, eds. An ecological characterization of Rocky Mountain montane and subalpine wetlands. U.S. Fish and Wildlife Service, Biological Report 86.
- Cooper, H. W. 1953. Amounts of big sagebrush in plant communities near tensleep, Wyoming, as affected by grazing treatment. Soil Conservation Service, Lincoln Nebraska. pp 186 - 189.
- Costello, D.F., 1944. Important species of the major forage types in Colorado and Wyoming. *Ecological Monographs*, Volume 14, Issue 1. 107-134.
- Council on Environmental Quality. 1978. Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act, 40 CFR 1500-1508, Council on Environmental Quality, November 28, 1978.
- Cox, R. R., Jr., M. A. Hanson, C. C. Roy, N. H. Euliss, Jr., D. H. Johnson, and M. G. Butler. 1998. Mallard duckling growth and survival in relation to aquatic invertebrates. *Journal of Wildlife Management* 62(1):124-133.
- Dambach, C. A. 1944. A ten-year ecological study of adjoining grazed and ungrazed woodlands in northwestern Ohio. *Ecological Monograph* 14: 256-270.
- Darveau, M., L. Belanger, J. Huot, and J. C. Ruel. 1993. Mid-term effects of windfall on bird use of riparian forest strips. *Proceedings of the International Union of Game Biologists* 21:104-109.
- Darveau, M., P. Beauchessne, L. Belanger, J. Huot, and P. Larue. 1995. Riparian forest strips as habitat for breeding birds in boreal forest. *Journal of Wildlife Management* 59:67-78.
- Dechant, J. A., M. L. Sondreal, D. H. Johnson, L. D. Igl, C. M. Goldade, A. L. Zimmerman, and B. R. Euliss. 1999. Effects of management practices on grassland birds: Western Meadowlark. Northern Prairie Wildlife Research Center, Jamestown, North Dakota.
- DeGraaf, R. M., and J. H. Rappole. 1995. Neotropical migratory birds. Comstock Publishing Assoc., Ithaca, NY.
- Delisle, J. 1995. Avian use of fields enrolled in the conservation reserve program in southeast Nebraska. Masters thesis, University of Nebraska, Lincoln, Nebraska.

- Dieni, J. S., and S. H. Anderson. 1999. Effects of recent burning on breeding bird community structure in aspen forests. *Journal of Field Ornithology* 70:491-503.
- Dittmar, L. A. and R. K. Neely. 1999. Wetland seed bank response to sedimentation varying in loading rate and texture. *Wetlands* 19(2):341-351.
- Dobkin, D. S., and B. A. Wilcox. 1986. Analysis of natural forest fragments: riparian birds in the Toiyabe Mountains, Nevada. Pages 293-299 *in* J. Verner, M. L. Morison, and C. J. Ralph, editors. *Wildlife 2000: modeling habitat relationships of terrestrial vertebrates*. University of Wisconsin Press, Madison, Wisconsin.
- Drut, M.S., J. A. Crawford, and M.A. Gregg. 1994. Brood habitat use by Sage Grouse in Oregon. *Great Basin Naturalist* 54:170-176.
- Dunn, J. L., and K. L. Garrett. 1997. A field guide to warblers of North America. Houghton Mifflin Company, Boston, Massachusetts.
- Engstrom, A. 1948. Growing cottonwood from seed. *Journal of Forestry* 46:130-132.
- Enright, C. A. 1971. An analysis of mallard nesting habitat on the Monte Vista National Wildlife Refuge. Masters thesis, Colorado State University, Fort Collins, Colorado.
- Everitt, B. L. 1968. Use of the cottonwood in an investigation of the recent history of a flood plain. *American Journal of Science* 266:417-439.
- Farmer, A. H. and A. H. Parent. 1997. Effects of the landscape on shorebirds movements at spring migration stopovers. *Condor* 99:698-707.
- Fautin, R. W. 1975. The terrestrial vertebrate fauna of the Atlantic Richfields Company's Black Thunder Coal lease property in Campbell County Wyoming. Pages 635-650 in Fort Union Coal Field Symposium.
- Fenner, P., W. W. Brady, and D. R. Patton. 1984. Observations on seeds and seedlings of Fremont cottonwood. *Journal of Desert Plants* 6:55-58.
- Fleming, K. K., and W. M. Giuliano. 1998. Effect of border-edge cuts on birds at woodlot edges in southwestern Pennsylvania. *Journal of Wildlife Management* 62:1430-1437.
- Fletcher, Louis A. 1981. Soil survey of the Jackson County area, Colorado. USDA, Soil Conservation Service, 159 pp.
- Fredrickson, L. H. and F. A. Reid. 1986. Wetland and riparian habitats: a nongame management overview. Pages 58-96 *in* J. B. Hale, L. B. Best, and R. L. Clawson, editors, *Management of nongame wildlife in the Midwest: a developing art*. Proceedings of the 47<sup>th</sup> Midwest Fish and Wildlife Conference.
- Fredrickson, L. H., and T. S. Taylor. 1982. Management of seasonally flooded impoundments for wildlife. U.S. Fish and Wildlife Service, Resource Publication 148, Washington, D.C.
- Freemark, K. E., J. B. Dunning, S. J. Hejl, and J. R. Probst. 1995. A landscape ecology perspective for research, conservation, and management. Pages 381-427 *in* T. E. Martin and D. M. Finch, editors. *Ecology and management of neotropical migratory birds: a synthesis and review of critical issues*. Oxford University Press, New York, New York.
- Friedmann, H. 1963. Host relations of the parasitic cowbirds. U.S. National Museum Bulletin 233: 1-176.
- Friedman, J. M. 1993. Vegetation establishment and channel narrowing along a Great-Plains stream following a catastrophic flood. PhD dissertation, University of Colorado, Boulder, Colorado.
- Friedman, J. M., M. L. Scott, and W. M. Lewis, Jr. 1995. Restoration of riparian forest using irrigation, artificial disturbance, and natural seedfall. *Environmental Management* 19:547-557.
- Fryendall, M. J. 1967. Feeding ecology and territorial behavior of the Yellow Warbler. Ph.D. Dissertation, Utah State University, Logan, Utah.
- Fullfilling The Promise. 1999
- Galinato, M. I. and A. G. van der Valk. 1986. Seed germination traits of annuals and emergents recruited during drawdowns in the Delta Marsh, Manitoba, Canada. *Aquatic Botany* 26:89-102.
- Galli, A. E., C. F. Lusk, and R. T. T. Forman. 1976. Avian distribution patterns in forest islands of different sizes in central New Jersey. *Auk* 93:356-364.
- Gates, D.H., L. A. Stoddart, and C.W. Cook. 1956. Soil as a factor influencing plant distribution on salt deserts of Utah. *Ecology Monograph* 26: 155 -175
- Gates, J. E., and L. W. Gysel. 1978. Avian nest dispersion and fledging success in field-forest ecotones. *Ecology* 59:871-883.
- Geer, Kenneth R. 1959. Analysis of 68 samples from the 1956 Gallatin Canyon elk "Hunter Kill." In *Wildlife investigations - State: Wildlife investigations laboratory*. Montana Dep. Of Fish and Game. Fed. Aid Compl. Rep. Project W-83-R-2. All jobs. P. 8.
- Geer, Kenneth R. 1960. Analysis of twenty-one elk *rumens* collected from the 1956 hunter kill and Boyd Rance, Missoula county. In *Wildlife investigations - State: Wildlife investigations laboratory*. Montana Dep. Of Fish and Game. Fed. Aid Compl. Rep. Project W-83-R-3. All jobs. P. 14.

- Gibbs, J. P., J. R. Longcore, D. G. McAuley, and J. K. Ringelman. 1991. Use of wetland habitats by selected nongame water birds in Maine. U.S. Fish and Wildlife Service, Fish and Wildlife Research 9. 57 pp.
- Gilmore, K.P., M. Tate, M.L. Chenault, B. Clark, T. McBride, and M. Wood. 1999. Colorado prehistory: a context for the Platte River Basin. Colorado Council of Professional Archeologists, Denver.
- Girard, G. L. 1937. Life history, habitats and food of the Sage Grouse, *Centrocercus urophasianus* Bonaparte. Univ. Wyoming, Laramie, Publ. 3.
- Goodrich, S., D. Nelson and N. Gale, 1999. In: McArthur, E. Durant; 1998 August 12-14: Ephraim, UT. Proc. RMRS-P-11. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.
- Greenwood, R. J., and A. B. Sargeant., D. H. Johnson, L. M. Cowardin, and T. L. Shaffer. 1995. Factors associated with duck nest success in the prairie pothole region of Canada. Wildlife Monograph 128. 57pp.
- Gregg, M.A., J.A. Crawford, M. S. Drut, and A.K. DeLong. 1994. Vegetational cover and predation of sage grouse nests in Oregon. Journal of Wildlife Management 58:162-166.
- Groves, C. R. and J. E. Anderson. 1980. Allelopathic effects of *Artemisia tridentata* leaves on germination and growth of two grass species. American Midland naturalist, Volume 106, Issue 1 (Jul.,1981), 73-79.
- Guthrie, Mark R., Powys Gass, Renee Johnson, and Joseph J. Lischka. 1984. Colorado Mountains Prehistoric Context. Colorado Historical Society, Denver.
- Gutzwiller, K. J., and S. H. Anderson. 1992. Interception of moving organisms: influences of patch shape, size, and orientation on community structure. Landscape Ecology 6:293-303.
- Haas, C. A. 1995. Dispersal and use of corridors by birds in wooded patches on an agricultural landscape. Conservation Biology 9:845-854.
- Hagar, J. C. 1999. Influence of riparian buffer width on bird assemblages in western Oregon. Journal of Wildlife Management 63:484-496.
- Hampton, H.D. 1971. With Grinnell in North Park (in) The Colorado Magazine, volume XLVIII number 4, pp 274 - 298
- Helmers, D. L. 1992. Shorebird management manual. Western Hemisphere Shorebirds Reserve Network, Manomet, MA. 58 pp.
- Helzer, C. J. 1996. The effects of wet meadow fragmentation on grassland birds. Masters thesis. University of Nebraska, Lincoln, Nebraska.
- Herkert, J. R. 1991. An ecological study of the breeding birds of grassland habitats within Illinois. Ph.D. Dissertation, University of Illinois at Urbana-Champaign, Urbana, Illinois.
- Herkert, J. R. 1994. The effects of habitat fragmentation on Midwestern grassland bird communities. Ecological Applications 4: 461-471.
- Herkert, J. R., R. E. Szafoni, V. M. Kleen, and J. E. Schwegman. 1993. Habitat establishment, enhancement and management for forest and grassland birds in Illinois. Natural Heritage Technical Publication Number 1. Illinois Department of Conservation, Springfield, Illinois.
- Herkert, J. R. 1995. An analysis of midwestern breeding bird population trends: 1966-1993. American Midland Naturalist 134:41-50.
- Hodges, M. F., and D. G. Kremetz. 1996. Neotropical migratory breeding bird communities in riparian forests of different widths along the Altamaha River, Georgia. Wilson Bulletin 108:496-506.
- Holechek, J. L.; Gomes, H. G.; Molinar, F.; Galt, D. 1998. Grazing intensity: Critique and approach. Rangelands 20: 15-18.
- Holm, J. W. 1984. Nest success and cover relationships of upland-nesting ducks in northcentral Montana. Masters Thesis, University of Montana, Helena, Montana.
- Houle, G., and P. Babeux. 1998. The effects of collection date, IBA, plant gender, nutrient availability, and rooting volume on adventitious root and lateral shoot formation by *Salix planifolia* stem cutting from the Ungava Bay area (Quebec, Canada). Canadian Journal of Botany 76:1687-1692.
- Hupp J.W. and C.E. Braun. 1989. Topographic distribution of sage grouse foraging in winter. J. Wildl. Manage. 53(3): pp823-829.
- Hutto, R. L. 1981. Seasonal variation in the foraging behavior of some migratory western wood warblers. Auk 98: 765-777.
- Hutto, R. L. 1992. Habitat distributions of migratory landbird species in western Mexico Pages 211-239 in J. M. Hagan, III and D. W. Johnston, editors. Ecology and conservation of neotropical migrant landbirds. Smithsonian Institution Press, Washington, D.C.
- Johnsgard, P. A. 1980. A preliminary list of the birds of Nebraska and adjacent Plains states. University of Nebraska, Lincoln, Nebraska. 156 pages.
- Johnson, K.L. 1987. Sagebrush types as ecological indicator to integrated pest management (IPM) in the sagebrush ecosystem of western north America. In. Integrated Pest Management on Rangeland-State of the Art in the Sagebrush Ecosystem. US Dept. of Agriculture, Agricultural Research Service, ARS-50, pp 1-10.

- Johnson, R. G., and S. A. Temple. 1986. Assessing habitat quality for birds nesting in fragmented tallgrass prairies. Pages 245-249 in J. Verner, M. L. Morrison, and C. J. Ralph, editors. Modeling habitat relationships of terrestrial vertebrates. University of Wisconsin Press, Madison, Wisconsin, Wisconsin.
- Johnson, R. G., and S. A. Temple. 1990. Nest predation and brood parasitism of tallgrass prairie birds. *Journal of Wildlife Management* 54: 106-111.
- Johnson, R. R., L. T. Haight, and J. M. Simpson. 1977. Endangered species vs. endangered habitats: a concept. Pages 68-79 in R. R. Johnson and D. A. Jones, editors. Importance, Preservation and Management of Riparian Habitat: A Symposium. U.S. Department of Agriculture, Forest Service General Technical Report RM-43.
- Johnson, W. C., R. L. Burgess, and W. R. Keammerer. 1976. Forest overstory vegetation and environment on the Missouri River floodplain in North Dakota. *Ecological Monographs* 46:59-84.
- Johnson, K. H., and C. E. Braun. 1999. Viability and conservation of an exploited sage grouse population. *Conservation Biology* 13:77-84.
- Kaiser, P. H. 1976. Habitat preferences of upland nesting waterfowl in southeastern South Dakota. Masters thesis, University of Missouri, Columbia, Missouri.
- Kantrud, H. A. 1981. Grazing intensity effects on the breeding avifauna of North Dakota native grasslands. *Canadian Field-Naturalist* 95:404-417.
- Kantrud, H. A. 1990. Sago pondweed (*Potamogeton pectinatus* L.): A literature review. U.S. Fish and Wildlife Service, Resource Publication 176. 89 pp.
- Kantrud, H. A. 1991. Wigeongrass (*Ruppia maritima* L.): A literature review. U.S. Fish and Wildlife Service, Fish and Wildlife Research 10. 58 pp.
- 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.
- Karr, J. R. 1982. Avian extinction on Barro Colorado Island, Panama: a reassessment. *American Naturalist* 119:220-239.
- Karr, J. R., and K. E. Freemark. 1985. Disturbance and vertebrates: An integrative perspective. Pages 153-167 in S. T. A. Pickett and P. S. White, editors. The ecology of natural disturbance and patch dynamics. Academic Press Inc., San Diego.
- Karuziak, D., H. Vriend, J. G. Stelfox, and J. R. McGillis. 1977. Effects of livestock grazing on mixed prairie range and wildlife within PRFA, Suffield Military Reserve. Canadian Wildlife Service, Edmonton, Alberta, Canada.
- Kehmeier, K. 2001. Fishery and Habitat Analysis of the Illinois River and Its Tributaries for the Arapaho National Wildlife Refuge, Colorado Division of Wildlife publication. 15 pp.
- Keller, C. M. E., C. S. Robbins, and J. S. Hatfield. 1993. Avian communities in riparian forests of different widths in Maryland and Delaware. *Wetlands* 13:137-144.
- Kendeigh, S. C. 1982. Bird populations in east-central Illinois: fluctuations, variations, and development over a half-century. *Illinois Biological Monographs* Number 52.
- Kilgo, J. C., R. A. Sargent, B. R. Chapman, and K. V. Miller. 1998. Effect of stand width and adjacent habitat on breeding bird communities in bottomland hardwoods. *Journal of Wildlife Management* 62:72-83.
- Kingery, H., editor. 1998. Colorado Breeding Bird Atlas. Colorado Bird Atlas Partnership.
- Kinley, T. A., and N. J. Newhouse. 1997. Relationship of riparian reserve zone width to bird density and diversity in southeastern British Columbia. *Northwest Science* 71:75-86.
- Kirsch, John B. 1963. Range use, relationships to logging, and food habits of the elk in the Little Belt Mountains, Montana. Montana M.S. Thesis. Montana State Univ., Bozeman. 44pp.
- Kirsch, L. M., and K. F. Higgins. 1976. Upland sandpiper nesting and management in North Dakota. *Wildlife Society Bulletin* 4: 16-20.
- Kirsch, L. M., H. F. Duebbert, and A. D. Kruse. 1978. Grazing and haying effects on habitats of upland nesting birds. *Transactions of the North American Wildlife and Natural Resources Conference* 43:486-497.
- Knopf, F. L. 1985. Significance of riparian vegetation to breeding birds across an altitudinal cline. Pages 105-111 in R. R. Johnson, C. D. Ziebell, D. R. Patton, P. F. Foliott, and R. H. Hamre, technical coordinators. Riparian ecosystems and their management: reconciling conflicting uses. U.S. Department of Agriculture, Forest Service General Technical Report RM-120, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.
- Knopf, F. L., and J. A. Sedgwick. 1992. An experimental study of nest-site selection by yellow warblers. *Condor* 94:734-742.
- Knopf, F. L., J. A. Sedgwick, and D. B. Inkley. 1990. Regional correspondence among shrubsteppe bird habitats. *Condor* 92: 45-53.
- Knopf, F. L., J. A. Sedgwick, and R. W. Cannon. 1988. guild structure of a riparian avifauna relative to seasonal cattle grazing. *Journal of Wildlife Management* 52:280-290.
- Knowlton, G. F., and F. C. Harmston. 1943. Grasshoppers and crickets eaten by Utah birds. *Auk* 60:589-591.

- Koontz, S. 2003. Agricultural Economist. Colorado State University. Personal Communication. April 2003.
- Krapu, G. L. and K. J. Reinecke. 1992. Foraging ecology and nutrition. *In Ecology and Management of Breeding Waterfowl*, B. D. J. Batt, A. D. Afton, M. G. Anderson, C. D. Ankney, D. H. Johnson, J. A. Kadlec, and G. L. Krapu, editors, pp. 1-29. University of Minnesota Press, Minneapolis.
- Krasny, M. E., K. A. Vogt, and J. C. Zasada. 1988. Establishment of four Salicaceae species on river bars in interior Alaska. *Holarctic Ecology* 11:210-219.
- Krull, J.N. 1970. Aquatic plant-macroinvertebrate associations and waterfowl. *Journal of Wildlife Management* 34(4):707-718
- Kufeld, R. C. 1973. Foods Eaten by the Rocky Mountain Elk. *Journal of Range Management* 26 (2), pp 106-113.
- Kuhn, G., P.B. Daddow, and G.S. Craig, Jr. 1983. Hydrology of area 54. USGS Water Resources Investigation / open-file report 83 – 146. 95pp.
- Landres, P. B., P Morgan, and F. J. Swanson. 1999. Overview of the use of natural variability concepts in managing ecological systems. *Ecological Applications* 9:1179-1188.
- Lane, E. W. 1955. The importance of fluvial morphology in hydraulic engineering. *Proceedings of the American Society of Civil Engineers* 81:1-17.
- Lanyon, W. E. 1994. Western meadowlark (*Sturnella neglecta*). *In A. Poole, and F. Gill, editors. The Birds of North America*, Number 104. The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.
- Larson, Mary Lou and Rhonda Letts. 2003. Cultural resource overview of the Laramie basin and Pathfinder Reservoir, Wyoming and North Park, Colorado. George C. Frinson Institute of Anthropology and Archaeology, University of Wyoming.
- Leck, M. A. 1989. Wetland seed banks. Pages 283-305 *in* M. A. Leck, V. T. Parker, and R. L. Simpson, editors. *Ecology of soil seed banks*. Academic Press, San Diego, CA.
- Leopold, A. 1933. *Game management*. Charles Scribner's Sons, New York.
- LeSchack, C. R., S. K. McKnight, and G. R. Hepp. 1997. Gadwall (*Anas strepera*). *In A. Poole, and F. Gill, editors. The Birds of North America*, Number 283. The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.
- Lillehammer, A., and S. J. Saltveit, editors. 1984. *Regulated rivers*. Universitetsforlaget, Oslo, Norway.
- Lischka, Joseph J., Mark E. Miller, R. Branson Reynolds, Dennis Dahms, Kathy Joyner Mcguire, and David Mcguire. 1983. . An Archaeological inventory in North Park, Jackson County, Colorado, Bureau of Land Management report, Denver Colorado, 359 pp.
- Livezey, B. C. 1981. Duck nesting in retired croplands at Horicon National Wildlife Refuge, Wisconsin. *Journal of Wildlife Management* 45: 27-37.
- Lokemoen, J. T., H. F. Duebbert, and D. E. Sharp. 1984. Nest spacing, habitat selection, and behavior of waterfowl on Miller Lake Island, North Dakota. *Journal of Wildlife Management* 48:309-321.
- Lowther, P. E., C. Celada, N. K. Klein, C. C. Rimmer, and D. A. Spector. 1999. Yellow Warbler (*Dendroica petechia*). *In A. Poole, and F. Gill, editors. The Birds of North America*, Number 454. The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.
- Lynch, J. F. 1987. Responses of breeding bird communities to forest fragmentation. Pages 123-140 *in* D. A. Saunders, G. W. Arnold, A. A. Burbidge, and A. J. M. Hopkins, editors. *Nature conservation: the role of remnants of native vegetation*. Surrey Beatty and Sons, Sydney, Australia.
- MacArthur, R. H., and J. W. MacArthur. 1961. On bird species diversity. *Ecology* 42:594-598.
- Machtans, C. S., M.A. Villard, and S. J. Hannon. 1996. Use of riparian buffer strips as movement corridors by forest birds. *Conservation Biology* 10:1366-1379.
- Mackie, Richard J. 1970. Range ecology and relations of mule deer , elk and cattle on the Missouri River Breaks, Montana. *Wild. Mongr. No. 20*. 79 p.
- Madden, E. M. 1996. Passerine communities and bird-habitat relationships on prescribe-burned, mixes-grass prairie in North Dakota. Masters thesis, Montana State University, Bozeman, Montana.
- Maher, W. J. 1973. *Birds: 1. Population dynamics*. Canadian Comm. for the IBP. Saskatoon, Saskatchewan. 56 pp.
- Mahoney, J. M., and S. B. Rood. 1991. A device for studying the influence of declining water table on poplar growth and survival. *Tree Physiology* 8:305-314.
- Martin, S. G., and T. A. Gavin. 1995. Bobolink (*Dolichonyx oryzivorus*). *In A. Poole, and F. Gill, editors. The Birds of North America*, Number 176. The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.
- Martin, T. E. 1984. Impact of livestock grazing on birds of a Colombian cloud forest. *Tropical Ecology* 25:158-171.
- Martin, T. E. 1986. Competition in breeding birds: on the importance of considering processes at the level of the individual. *Current Ornithology* 4:181-210.

- Martin, T. E. 1988. Habitat and area effects on forest bird assemblages: is nest predation an influence? *Ecology* 69:74-84.
- Martz, G. F. 1967. Effects of nesting cover removal on breeding puddle ducks. *Journal of Wildlife Management* 31: 236-247.
- McArthur, E. D.; Welch, B.L. 1982. Growth rate differences among big sagebrush (*Artemisia tridentata*) accessions and subspecies. *Journal of Range Management*. 35: 396-401.
- McArthur, E.D. 1992. Ecology, distribution, and values of sagebrush within the intermountain region. In: Paper presented at symposium on ecology, management and restoration of intermountain annual rangelands, Boise, ID, May 18-21, 1992
- McKee et al. 1981(in) Kuhn, G., P.B. Daddow, and G.S. Craig, Jr. 1983. Hydrology of area 54. USGS Water Resources Investigation/open-file report 83 – 146. 95pp.
- McLeod, K. W., and J. K. McPherson. 1973. Factors limiting the distribution of *Salix nigra*. *Bulletin of the Torrey Botanical Club* 100:102-110.
- McNaughton S.J., M.B. Coughenour, and L.L. Wallace. 1982. Integrative processes in grassland ecosystems. In *Grasses and Grasslands: Systematics and Ecology*, eds. J. R. Estes, R. J. Tynl, and J. N. Brunken, pp 167-194. University of Oklahoma Press, Norman, Okla.
- Minnesota IMPLAN Group, Inc., 2002. Year 2000 IMPLAN Data File for Jackson County, Colorado  
www.implan.com
- Mitsch, W. J., and J. G. Gosselink. 1993. *Wetlands*. Second edition. Van Nostrand Reinhold, New York, New York.
- Morris, M. S., and J. E. Schwartz. 1957. Mule deer and elk food habitats on the National bison Range. *J. Wildl. Manage.* 21:189 - 193.
- Morse, D. H. 1966. The context of songs in the yellow warbler. *Wilson Bull.* 78: 444-455.
- Moss, E. H. 1938. Longevity of seed and establishment of seedlings in species of *Populus*. *Botanical Gazette* 99:529-542.
- Morton 2000. *Economic Profiles for Colorado Counties: Jackson County*. The Wilderness Society.  
www.wilderness.org
- Mueller, H. 1999. Common snipe (*Gallinago gallinago*). In A. Poole, and F. Gill, editors. *The Birds of North America*, Number 417. The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.
- Mundinger, J. G. 1976. Waterfowl response to rest-rotation grazing. *Journal of Wildlife Management* 40: 60-68.
- Murkin, H. R., E. J. Murkin, and J. P. Ball. 1997. Avian habitat selection and prairie wetland dynamics: a 10 year experiment. *Ecological Applications* 7:1144-1159.
- Naiman, R. J., H. Decamps, and M. Pollock. 1993. The role of riparian corridors in maintaining regional biodiversity. *Ecological Applications* 3:209-212.
- Naugle, D. E., K. F. Higgins, S. M. Nusser, and W. Carter Johnson. 1999. Scale-dependent habitat use in three species of prairie wetland birds. *Landscape Ecology* 14:267-276.
- Naugle, D. E., R. R. Johnson, M. E. Estey, and K. F. Higgins. 2001. A landscape approach to conserving wetland bird habitat in the prairie pothole region of eastern South Dakota. *Wetlands* 21(1):1-17.
- Nelson, J. W. and J. A. Kadlec. 1984. A conceptual approach to relation habitat structure and macroinvertebrate production in freshwater wetlands. *Transactions of the North American and Natural Resources Conference* 49: 262-270.
- Nelson, J. W., J. A. Kadlec, and H. R. Murkin. 1990. Responses by macroinvertebrates to cattail litter quality and timing of litter submergence in a northern prairie marsh. *Wetlands* 10(1):47-60.
- Nicolucci, M. and S. Winter. 2002. Trip-related expenditures for hunting, fishing, and non-consumptive wildlife recreation activities. U.S. Forest Service, Fort Collins, CO.
- Odum, E. P. 1978. Ecological importance of the riparian zone. Pages 2-4 in R. R. Johnson and J. F. McCormick, technical coordinators. *Strategies for protection and management of floodplain wetlands and other riparian ecosystems*. United States Department of Agriculture, Forest Service General Technical Report WO-12, Washington, D.C.
- Oetting, R. B., and J. F. Cassel. 1971. Waterfowl nesting on interstate highway right-of-way in North Dakota. *Journal of Wildlife Management* 35: 774-781.
- Olson, D. and S. Lindall. 1996. *IMPLAN Professional Software, Analysis, and Data Guide*. Minnesota IMPLAN Group, Inc.
- Oniki, Y. 1985. Why robin eggs are blue and birds build nests: statistical tests for Amazonian birds. Pages 536-545 in P. A. Buckley, M. S. Foster, E. S. Morton, R. S. Ridgely, and F. G. Buckley, editors. *Neotropical ornithology*. *Ornithological Monographs* Number 36. Washington, D.C.
- Orians, G. H. and J. F. Wittenburger. 1991. Spatial and temporal scales in habitat selection. *American Naturalist* 137:S27-S49.
- Owens, R. A. 1971. The effects of several agricultural regimes upon populations of native passerine birds of an Alberta fescue grassland. Masters thesis, University of Calgary, Calgary, Alberta, Canada.

- Owens, R. A., and M. T. Myres. 1973. Effects of agriculture upon populations of native passerine birds of an Alberta fescue grassland. *Canadian Journal of Zoology* 51: 697-713.
- Pashley, D. N., C. J. Beardmore, J. A. Fitzgerald, R. P. Ford, W. C. Hunter, M. S. Morrison, and K. V. Rosenberg. 2000. *Partners In Flight: Conservation of the land birds of the United States*. American Bird Conservancy, The Plains, Virginia.
- Petersen, K. L., and L. B. Best. 1985. Brewer's Sparrow nest-site characteristics in a sagebrush community. *J. Field Ornithol.* 56:23-27.
- Pezeshki, S. R., P. H. Anderson, and F. D. Shields, Jr. 1998. Effects of soil moisture regimes on growth and survival of black willow (*Salix nigra*) posts (cuttings). *Wetlands* 18:460-470.
- Potter, P. E. 1972. Territorial behavior in Savannah sparrows in southeastern Michigan. *Wilson Bulletin* 84: 48-59.
- Ratti, J. T., and K. P. Reese. 1988. Preliminary test of the ecological trap hypothesis. *Journal of Wildlife Management* 52:484-491.
- Reed, J. M. 1986. Vegetation structure and Vesper Sparrow territory location. *Wilson Bulletin* 98: 144 - 147/
- Reeves, H. M. 1954. Muskrat and waterfowl production and harvest in Dingle Swamp, Bear Lake County, Idaho. Masters thesis. Utah State Agricultural College, Logan, Utah.
- Rice, E. L. 1974. *Allelopathy*. Academic Press, New York. 353 p.
- Rich, T. D. 1980. Nest placement in Sage Thrashers, Sage sparrows and Brewer's Sparrows. *Wilson Bull.* 92:362-368.
- Robbins, C. S. 1979. Effect of forest fragmentation on bird population. U.S. Department of Agriculture, Forest Service General Technical Report NC-51:198-212. North Central Forest Experiment Station, St. Paul, Minnesota.
- Robbins, C. S., D. K. Dawson, and B. A. Dowell. 1989. Habitat area requirements of breeding forest birds of the middle atlantic states. *Wildlife Monographs* 103.
- Roberts, T. S. 1932. *The birds of Minnesota, Volume 2*. University of Minnesota Press, Minneapolis, Minnesota, 821 pages.
- Rogers, G. E. 1964. Sage grouse investigations in Colorado. Colorado Game, Fish and Parks Department, Technical Publication Number 16. 132 pp.
- Rood, S. B., and J. M. Mahoney. 1990. Collapse of riparian poplar forests downstream from dams in western prairies: probable causes and prospects for mitigation. *Environmental Management* 14:451-464.
- Rosgen, D. L. 1996. *Applied river morphology*. Wildland Hydrology, Pagosa Springs, Colorado.
- Rotenberry, J.T. and J.A. Wiens. 1980. Temporal variation in habitat structure and shrub steppe bird dynamics. *Oecologia (berl.)* 47, pp 1-9.
- Rotenberry, J.T. and J.A. Wiens. 1980. Habitat structure, patchiness, and avian communities in North American steppe vegetation: A multivariate analysis. *Ecology* 61:1228-1250.
- Rotenberry, J. T., 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, eds). The Birds of North America, Inc., Philadelphia, PA.
- Rotenberry, J.T., and J. A. Wiens. 1989. Reproductive biology of shrubsteppe passerine birds: Geographical and temporal variation in clutch size, brood size, and fledging success. *Condor* 91: 1-14.
- Rotenberry, J. T., and J. A. Wiens. 1998. Foraging patch selection by shrubsteppe sparrows. *Ecology* 79:1160-1173.
- Rotenberry, J. T. and J. A. Wiens. 1991. Weather and reproductive variation in shrubsteppe sparrows: a hierarchical analysis. *Ecology* 72:1325-1335.
- Ryder, RT. J. and Irwin L. L. 1987. Winter habitat relationships of pronghorns in south central Wyoming. *J. Wildl. Manage.* 51(1):79-85.
- Salyer, J. W. 1962. Effects of drought and land use on prairie nesting ducks. *Transactions of the North American Wildlife and Natural Resources Conference* 27:69-79.
- Samson, F. B. 1980. Island biogeography and the conservation of prairie birds. Pages 293-299 in C. L. Kucera, editor. *Proceedings of the 7<sup>th</sup> North American Prairie Conference*, Southwest Missouri State University, Springfield, Missouri.
- Savory, A., and J. Butterfield. 1999 *Holistic Management*, Island press: Washington D.C. 616 pp.
- Schaid, T. A., D. W. Uresk, W. L. Tucker, and R. L. Linder. 1983. Effects of surface mining on the Vesper Sparrow in the northern Great Plains. *Journal of Range Management* 36:500-503.
- Schroeder, M. A., J. R. Young, and C. E. Braun. 1999. Sage Grouse (*Centrocercus urophasianus*). In *The Birds of North America*, No 425 (a. Poole and F. gill, eds.) *The Birds of North America Inc.*, Philadelphia, PA.
- Schroeder, R. L. 1982. Habitat suitability index models: yellow warbler. U.S. Department of Interior, Fish and Wildlife Service. FWS/OBS-82/10.27.

- Scott, M. L., M. A. Wondzell, and G. T. Auble. 1993. Hydrograph characteristics relevant to the establishment and growth of western riparian vegetation. Pages 237-246 in H. J. Morel-Seytoux, editor. Proceedings of the thirteenth annual American Geophysical Union Hydrology Days. Hydrology Days Publications, Atherton, California.
- Sedgwick, J. A., and F. L. Knopf. 1992. Describing willow flycatcher habitats: scale perspectives and gender differences. *Condor* 94:720-733.
- Seidl, A. and E. Garner. 2001. Agricultural Land Use and Economic Trends in Four North Central Colorado Mountain Counties: Routt, Jackson, Grand, and Summit. Department of Agricultural and Resource Economics Extension Publication. Colorado State University.
- Simon, A. 1989. A model of channel response in distributed alluvial channels. *Earth Surface Processes and Landforms* 14:11-26.
- Skinner, R. M., T. S. Baskett, and M. D. Blenden. 1984. Bird habitat on Missouri prairies. Terrestrial Series #14, Missouri Department of Conservation, Jefferson City, Missouri.
- Snyder, S. A. 1991. *Alces alces*. In W. C. Fischer, compiler. The Fire Effects Information System (data base). U.S. Department of Agriculture, Forest Service Intermountain Research Station, Intermountain Fire Sciences Laboratory, Missoula, Montana.
- Sogge, M. K., R. M. Marshall, S. J. Sferra, and T. J. Tibbets. 1997. A southwestern willow flycatcher natural history summary and survey protocol. U.S. Department of the Interior, National Park Service, Colorado Plateau Research Station, Technical Report NPS/NAUCPRS/NRTR-97/12, Flagstaff, Arizona.
- Sojda, R. S. and K. L. Solberg. 1993. Management and control of cattails. Fish and Wildlife Service, Waterfowl Management Handbook, Leaflet 13. 8 pp.
- Spackman, S. C., and J. W. Hughes. 1995. Assessment of minimum stream corridor width for biological conservation: species richness and distribution along mid-order streams in Vermont, USA. *Biological Conservation* 71:325-332.
- Stacier, C. A. 1992. Social behavior of the northern parula, Cape May warbler, and prairie warbler wintering in second-growth forest in southwestern Puerto Rico. Pages 308-320 in J. M. Hagan III and D. W. Johnston, editors. Ecology and conservation of neotropical migrant landbirds. Smithsonian Institution Press, Washington, D.C.
- Stanley, T. R., and F. L. Knopf. 2000. Avian responses to late-season grazing in a shrub-willow floodplain. Submitted to *Conservation Biology*.
- Stauffer, D. F., and L. B. Best. 1980. Habitat selection by birds of riparian communities: evaluating effects of habitat alterations. *Journal of Wildlife Management* 44:1-15.
- Stephens, D. A. 1985. Foraging ecology of shrubsteppe birds in central Washington. Master's thesis, Central Washington Univ., Ellensburg.
- Stevens, L., B. T. Brown, J. M. Simpson, and R. R. Johnson. 1977. The importance of riparian habitat to migrating birds. Pages 156-164 in R. R. Johnson and D. A. Jones, editors. Importance, preservation and management of riparian habitat: a symposium. U.S. Department of Agriculture, Forest Service General Technical Report RM-43.
- Stevenson, H. M., and B. H. Anderson. 1994. The birdlife of Florida. University Press of Florida, Gainesville, Florida.
- Stewart, G. 1941. Historic records bearing on agriculture and grazing ecology of Utah. *J. For.* 39:313- 375
- Stocek, R. 1994. The importance of riparian zones as wildlife habitat. Pages 33-35 in J. Singleton, B. Higgs, J. Campbell, A. Eddy, and T. Murray, editors. Proceedings of the symposium on riparian zone management. Canadian Forest Service Research and Development Report 9.
- Sturges, D. L. 1977. Snow accumulation and melt in sprayed and undisturbed big sagebrush vegetation. USDA Forest Service, Rocky Mtn. Forest and Range Expt. Sta. Research Note RM-348.
- Stynes, D. 1998. Guidelines for Measuring Visitor Spending. Department of Park Recreation and Tourism Resources, Michigan State University.
- Sudgen, L. G. 1973. Feeding ecology of pintail, gadwall, American widgeon and lesser scaup ducklings in southern Alberta. *Can. Wildl. Serv. Rep. Ser. No. 24*. Ottawa, 43 pp.
- Sundstrom, C., W. G. Hepworth, and K.L. Diem. 1973. Abundance, distribution and food habits of the pronghorn. Wyoming Game and Fish Depart. Bull., 12:1-61.
- Sutcliffe, O., and C. D. Thomas. 1996. Open corridors appear to facilitate dispersal by Ringlet Butterflies (*Aphantopus hyperantus*) between woodland clearings. *Conservation Biology* 10:1359-1365.
- Svejcar, T. J., G. M. Riegel, S. D. Conroy, and J. D. Trent. 1991. Establishment and growth potential of riparian shrubs in the northern Sierra Nevada. Symposium on Ecology and Management of Riparian Shrub Communities, Sun Valley, Idaho.
- Swanson, D. A. 1998. Effects of management practices on grassland birds: Savannah Sparrow. Northern Prairie Wildlife Research Center, Jamestown, ND.

- Swift, B.L. 1984. Status of riparian ecosystems in the United States. *Water Resources Bulletin* 20:233-238.
- Szaro, R. C., and M. D. Jakle. 1985. Avian use of a desert riparian island and its adjacent scrub habitat. *Condor* 87:511-519.
- The Federal Interagency Stream Restoration Working Group. 1998. Overview of stream corridors. Pages 1-32 in L. Hill and J. Simpson, editors. *Stream corridor restoration: principles, processes, and practices*. Publisher unknown.
- Thomas, J. W., C. Maser, and J. E. Rodiek. 1979. Riparian zones. Pages 40-47 in J. W. Thomas, editor. *Wildlife habitats in managed forests: the Blue Mountains of Oregon and Washington*. U.S. Forest Service Agricultural Handbook 553.
- Thurmond, D. P., K. V. Miller, and T. G. Harris. 1995. Effect of streamside management zone width on avifauna communities. *Southern Journal of Applied Forestry* 19:166-169.
- Town of Walden. 2001. Economic Development Summary. [www.northpark.org/town/econdemographicmain.htm](http://www.northpark.org/town/econdemographicmain.htm)
- U.S. Census Bureau. 2002. [www.census.gov](http://www.census.gov)
- U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Information System 2002. [www.bea.gov](http://www.bea.gov)
- U.S. Department of Interior. 1996. National Survey of Fishing, Hunting and Wildlife-Associated Recreation, National Report. U.S. Department of Interior, Fish and Wildlife Service. Washington, D.C.
- U.S. Fish & Wildlife Service. 1995. Final rule determining endangered status for the Southwestern Willow Flycatcher. *Federal Register* 60: 10694-10715 (February 27, 1995).
- U.S. Fish & Wildlife Service. 1999. Fulfilling the promise. *The National Wildlife Refuge System*. Pp94
- Vale, T.R. 1975. Pre-settlement vegetation in sagebrush-grass area of the intermountain west. *Journal of Range Management* 28(1), January 1975 pp 32-36.
- Vesely, D. G. 1997. Terrestrial amphibian abundance and species richness in headwater riparian buffer strips. Oregon Coast Range. Thesis, Oregon State University, Corvallis, Oregon.
- Vickery, P. D., M. L. Hunter Jr., and S. M. Melvin. 1994. Effects of habitat area on the distribution of grassland birds in Maine. *Conservation Biology* 8: 1087-1097.
- Villard, M. A., G. Merriam, and B. A. Maurer. 1995. Dynamics in subdivided populations of neotropical migrant landbirds in a temperate fragmented forest. *Ecology* 76:27-40.
- Voegeli, P. T., Sr. 1965. Groundwater resources of North Park and Middle Park, Colorado-A reconnaissance. U. S. Geological Survey Water-Supply Paper 1809-G. 54 pp.
- Voigts, D. K. 1976. Aquatic invertebrate abundance in relation to changing marsh vegetation. *American Midland Naturalist* 95(2):313-322.
- Walters, M. A., R. O. Teskey, and T. M. Hinckley. 1980. Impact of water level changes on woody riparian and wetland communities. Volume 8. Pacific Northwest and Rocky Mountain Regions. U.S. Fish and Wildlife Service FWS/OBS-78/94.
- Wang, S., T. W. Jurik, and A. G. van der Valk. 1994. Effects of sediment load on various stages in the life and death of cattail (*Typha x Glauca*). *Wetlands* 14(3):166-173.
- Weaver, T. and D. Klarich. 1977. Allelopathic effects of volatile substances from *Artemisia tridentata* Nutt. *Am. Midl. Nat.*, 97:508-512.
- Welch, B.L. 1983. Big sagebrush: nutrition, selection, and controversy. In: Johnson, K.L., ed. *Proceedings of the first Utah shrub ecology workshop: 1981 September 9-10; Ephraim, UT. Logan, UT: Utah State University, College of Natural Resources: 21-33.*
- Welch, B.L. and McArthur, E.D. 1990. Big sagebrush-its taxonomy, origin, distribution and utility. In: Fisser H.G., ed. *Proceedings of the fourteenth Wyoming shrub ecology workshop; 1985 May 29-30; Rock Springs, WY. Laramie, WY: University of Wyoming, Department of Range Management: 3-19*
- Weller, M. W. 1975. Studies of cattail in relation to management for marsh wildlife. *Iowa State Journal of Research* 49(4):383-412.
- Weller, M. W. and C. E. Spatcher. 1965. Role of habitat in the distribution and abundance of marsh birds. Iowa Agricultural and Home Economics Experiment Station. Iowa State University of Science and Technology, Ames, Iowa. Special Report 43.
- West, N.E. 1993. Western Intermountain sagebrush steppe. In *Temperate Deserts and Semi-deserts*. Vol. 5, *Ecosystems of the World*, ed. N.E. West, pp 351-374. Elsevier, Amsterdam.
- West, N.E. 1996. Strategies for maintenance and repair of biotic community diversity on rangelands. (In) *Biodiversity in managed landscapes – Theory and Practice*. (Ed.) Szaro, R.C. and D.W. Johnston, Oxford University Press, New York. pp326-346
- Wheelwright, N. T., and J. D. Rising. 1993. Savannah Sparrow (*Passerculus sandwichensis*). In A. Poole, and F. Gill, editors. *The Birds of North America*, Number 45. The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.

- Whisenant, S. G. 1990. Changing fire frequencies on Idaho's Snake River Plains: ecological and management implications. In: McArthur, E.D.; Romney, E. M.; Smith, S. D. : Tueller, P.T., comps. Proceedings- symposium on cheat grass invasion, shrub die-off, and other aspects of shrub biology and management: 1989 April 5-7; Las Vegas, NV. Gen Tech. Rep. INT-276. Ogden, UT; U.S. Department of agriculture, Forest Service, Intermountain Research Station pp 4-10.
- Whitaker, D. M., W. A. Montevecchi. 1999. Breeding bird assemblages inhabiting riparian buffer strips in Newfoundland, Canada. *Journal of Wildlife Management* 63:167-179.
- Whitcomb, R. F., C. S. Robbins, J. F. Lynch, B. L. Whitcomb, M. K. Klimkiewicz, and D. Bystrak. 1981. Pages 125-205 in R. L. Burgess and D. M. Sharpe, editors. *Forest island dynamics in man-dominated landscapes: effects of forest fragmentation on avifauna of the eastern deciduous forest*. Springer-Verlag, New York.
- Wiens, J. A. 1969. An approach to the study of ecological relationships among grassland birds. *Ornithological Monographs* No. 8. American Ornithologists' Union, Ithaca, New York.
- Wiens, J.A., and J. T. Rotenberry, and B. Van Horne. 1987. Habitat occupancy patterns of shrubsteppe birds: the effects of spatial scale. *Oikos* 48:132-147.
- Williamson, K. 1960. Snipe at St. Kilda. *Bird Notes* 29: 5-8.
- Willson, M. F. 1974. Avian community organization and habitat structure. *Ecology* 55:1017-1029.
- Windell, J. T., B. E. Willard, and S. Q. Foster. 1986. Introduction to Rocky Mountain wetlands. Pages 1-41 in J. T. Windell, B. E. Willard, D. J. Cooper, S. Q. Foster, C. F. Knud-Hansen, L. P. Rink, and G. N. Kiladis, eds. *An ecological characterization of Rocky Mountain montane and subalpine wetlands*. U.S. Fish and Wildlife Service, Biological Report 86.
- Windell, J. T., B. E. Willard, D. J. Cooper, S. Q. Foster, C. F. Knud-Hansen, L. P. Rink, and G. N. Kiladis. 1986. An ecological characterization of Rocky Mountain and subalpine wetlands. U. S. Fish and Wildlife Service Biological Report 86(11). 298 pp.
- Winker, K., D. W. Warner, and A. R. Weisbrod. 1992. Migration of woodland birds at a fragmented inland stopover site. *Wilson Bulletin* 104:580-598.
- Wood, A. K. 1989. Comparative distribution and habitat use by antelope and mule deer. *J. Mamm.* 70(2):335-340.
- Wright J. C., and E. A. Wright. 1948. Grassland types of south central Montana. *Ecology* 29: 449- 460.
- Yoakum, J. D. 1978. Pronghorn. Pp. 102-121, in *Big game of North America* (J. L. Schmidt and D. L. Gilbert, eds). The Stackpole Co., Harrisburg, Pennsylvania, 494 pp.
- Young, J. R. 1994. The influence of sexual selection on phenotypic and genetic divergence among Sage Grouse populations. Ph.D. diss., Purdue Univ., West Lafayette, IN.
- Young, J.A., R.A. Evans, and P.T. Tueller. 1976. Great Basin plant communities – pristine and grazed. Pp. 187-217. (IN) *Holocene environmental change in Great Basin*. Robert Elston (Ed.) Nevada Arch. Survey. Res. Pap. No. 6. Reno, NV.
- Young, J.A., R.A. Evans, and R.E. Eckert, Jr 1984. Successional patterns and productivity potentials of the sagebrush and salt desert ecosystems.
- Zeigenfuss, L. C., Singer, F. J., Williams, S. A. and T. L. Johnson. 2002 Influences of herbivory and water on willow in elk winter range. *Journal of Wildlife Management* 66(3):788-795.

**Additional References Not Cited in Text:**

- Alyea (no date): National Oceanic and Atmospheric Administration, (in) Kuhn, G., P.B. Daddow, and G.S. Craig, Jr. 1983. Hydrology of area 54. USGS Water Resources Investigation/open-file report 83 – 146. 95pp.
- Boe, J. S. 1992. Wetland selection by eared grebes, *Podiceps nigricollis*, in Minnesota. *Canadian Field-Naturalist* 106:480-488.
- Burger, J. 1985. Habitat selection in temperate marsh-nesting birds. Pages 253-281 in Cody, editor. *Habitat Selection in Birds*, Physiol. Ecol. Ser.
- Crowder, K. 2001. North Park Greater Sage-Grouse Conservation Plan. Jackson County Administrator, Jackson County, Colorado. 51 pp.
- Duley, F. L. and C. E. Domingo. 1949. Effect of grass on intake of water. *Nebraska Agr. Exp. Sta. Res. Bull.* 159:1-15.
- Faaborg, J. 1976. Habitat selection and territorial behavior of the small grebes of North Dakota. *Wilson Bulletin* 88(3):390-399.
- Hail, William J., Jr. 1968. Geology of southwestern North Park and vicinity, Colorado. United States Geological Survey bulletin 1188, Washington
- Harris, J.H., S.D. Sanders, and M.A. Flett. 1988. The status and distribution of the Willow Flycatcher in the Sierra Nevada: Results of the survey. California Department of Fish and Game, Wildlife Management Division, Administrative Report 88-1.
- James, R. D. 1976. Foraging behavior and habitat selection of three species of vireos in southern Ontario *Wilson Bulletin* 88:62-75.
- Johns, B. W. 1993. The influence of grove size on bird species richness in aspen parklands. *Wilson Bulletin* 105(2): 256-264.
- Kanud, H. A. 1981, Grazing intensity effects on the breeding avifauna of North Dakota native grasslands. *Canadian Field-Naturalist* 95: 404-417.
- Karr, J. R., and K. E. Freemark. 1985. Disturbance and vertebrates: an integrative perspective. Pages 153-168 in S. T. A. Pickett and P. S. White, editors. *The ecology of natural disturbance and patch dynamics*. Academic Press, New York, New York.
- Kushlan, J. A. 1978. Feeding ecology of wading birds. In *Wading Birds*, A. Sprunt, IV, J. C. Ogden, and S. Winckler, editors, pp. 249-297. Research Report No. 7, National Audubon Society, New York.
- Laubhan, M. K. and J. H. Gammonley. 2000. Density and foraging habitat selection of waterbirds breeding in the San Luis Valley of Colorado. *Journal of Wildlife Management* 64(3):808-819.
- May, R. M. 1986. The search for patterns in the balance of nature: advances and retreats. *Ecology* 67:1115-1126.
- Patterson, R. L. 1952. The sage grouse in Wyoming. Wyoming Game and Fish Comm., and Sage books, Inc., Denver, Colorado. 341 pp.
- Rotella, J. J. and J. T. Ratti 1992. Mallard brood survival and wetland habitat conditions in southwestern Manitoba. *Journal of Wildlife Management* 56(3):499-507.
- Rotella, J. J. and J. T. Ratti. 1992. Mallard brood movements and wetland selection in southwestern Manitoba. *Journal of Wildlife Management* 56(3):508-515.
- Segelquist, C. A., M. L. Scott, and G. T. Auble. 1993. Establishment of *Populus deltoides* under simulated alluvial groundwater declines. *American Midland Naturalist* 130:274-285.
- van der Valk, A. G. and C. B. Davis. 1978. The role of seed banks in the vegetation dynamics of prairie glacial marshes. *Ecology* 59(2):322-335.
- Whitmore, R. C. 1975. Habitat ordination of passerine birds of the Virgin River Valley, southwestern Utah *Wilson Bulletin* 87:65-74.
- Wiens, J.A., and J. T. Rotenberry. 1981. Habitat associations and community structure of birds in shrub steppe environments. *Ecological Monographs*, Volume 51, Issue 1 (mar., 1981)
- Wiens, J.A., and J. T. Rotenberry. 1985. Response of breeding passerine birds to rangeland alteration in a North American shrub steppe locality.

# Appendix J. Mailing List

## Federal Officials

- U.S. Senator Ben Nighthorse Campbell, Washington, D.C.  
Keith Johnson, Fort Collins, CO
- U.S. Senator Wayne Allard, Washington, D.C.  
Kristine A. Pollard, Englewood, CO
- U.S. Representative Scott McInnis, Washington, D.C.  
William Endriss, Glenwood Springs, CO

## Federal Agencies

- US BLM, Chuck Cesar, Linda Gross, Kremmling, CO
- NRCS - Jackson County, Walden, CO
- US EPA, Denver, CO
- US Forest Service, Chuck Oliver, Walden, CO
- US FWS, Albuquerque, NM; Alamosa/Monte Vista NWR, CO; Anchorage, AK; Arlington, VA; Arrowwood NWR, ND; Atlanta, GA; Denver, CO; Browns Park NWR, CO; Fort Snelling, MN; Hadley, MA; Juneau, AK; Air Quality Branch, CO; Ecological Services Field Office, CO; Fish Springs NWR, UT; Lost Trail NWR, MT; Medicine Lake NWR, MT; Portland, OR; Sacramento, CA; Sand Lake NWR, SD; Sherwood, OR; Seedskaadee NWR, WY; Shepherdstown, WV
- USGS, Biological Resources Division, Fort Collins (David Hamilton, Murray Lauhban, Rick Schroeder)

## State Officials/Tribes

- Governor Bill Owens
- Representative Al White
- Senator Jack Taylor
- Southern Ute Indian Tribe
- Arapaho Business Committee
- Pawnee Tribe

## State Agencies

- Colorado Division of Natural Resources
- Colorado Division of Wildlife  
Brad Petch, Meeker, CO; Josh Dille, Walden, CO; Jim Gammonley, Fort Collins, CO; Liza Graham, Steamboat Springs, CO; Jim Hicks, Steamboat Springs, CO; Rick Kahn, Fort Collins, CO; Steve Porter, Fort Collins, CO; J. Wenum, Walden, CO; Kirk Snyder, Walden, CO; Sue Werner, Steamboat Springs, CO
- Colorado Natural Heritage Program, Fort Collins, CO
- Colorado State Forest, Jackson County, Walden, CO
- Colorado State Historic Preservation Office, Denver, CO
- Colorado State Parks and Recreation, Walden, CO
- Colorado Water Commissioner, Walden, CO
- IL Department of Natural Resources, Springfield, IL

## City/County/Local Governments

- Jackson County Administrator; Commissioners; Extension Office; Sheriff's Office; Weed Coordinator; Soil Conservation District
- Mayor Kyle Fliniau

## Organizations

- Colorado Cooperative Fish & Wildlife, Fort Collins, CO
- Colorado Ducks Unlimited
- North Park Cattlewomen's Association
- North Park Chamber of Commerce, Walden, CO
- North Park Fair Board Association
- North Park Stockgrowers Association, Cowdrey, CO
- North Park Water Conservancy District, Walden, CO
- North Park Habitat Partnership Program, Walden, CO
- National Audubon Society, Washington, D.C.
- Natl. Wildlife Ref. Assoc., Brent Giezentanner, CO Springs, CO
- Owl Mountain Partnership, Walden, CO
- Sage Grouse Working Group, Walden, CO
- TWS, Central Mountain & Plains Section, Fort Collins, CO
- Wildlife Management Institute, Washington, D.C.
- KRA Corp., F&W Reference Section, Bethesda, MD
- Defenders of Wildlife, Washington, D.C.
- The Wilderness Society, Washington, D.C.
- Animal Protection Institute, Sacramento, CA
- The Nature Conservancy, Boulder, CO
- National Trappers Association, New Martinsville, WV
- Fund for Animals, Silver Spring, MD

## Newspapers, Radio, TV

- Jackson County Star, Walden, CO
- Steamboat Pilot, Steamboat Springs, CO
- The Coloradoan, Fort Collins, CO

## Schools/Universities and Libraries

- Colorado State University, Fort Collins & Walden, CO
- Jackson County Library, Walden, CO
- Mesa State College
- Northwestern Univ., Prof. Friesema, Evanston, IL
- North Park School District
- University of Wyoming

## Individuals

- |                       |                              |
|-----------------------|------------------------------|
| Heman Adams           | Jerry Kaltenhanuer           |
| Dale Agger            | J-B Ranch                    |
| Mike Allnut           | John and Kay Kemp            |
| Philip Anderson       | Norbert & Elizabeth Ketola   |
| Jackie Boss           | Nick Komar                   |
| Bill Broderick        | Carey Lewis                  |
| Les Burde             | Dick Martley                 |
| Tom and Anne Butler   | Dave McClone                 |
| Phil and Kris Cafaro  | Cynthia Melcher/Ken Geisen   |
| Louie and Barb Czencz | Bill Miller                  |
| John Decker           | Michele Miller               |
| Brian DeVries         | Eugene Patten                |
| Blaine Evans          | Jeff Phillips                |
| Sarah Flick           | Jeune Reinhold               |
| Iveta Glover          | Kate Rite                    |
| Deb Hankins           | Bob Sinclair                 |
| David Hanni           | Jeff Stark                   |
| Rick Harness          | Carl Trick II                |
| James Hines           | Mike and Barb Turnbull       |
| Marcus Honnecke       | Geo Uyeno                    |
| Garrety Hudkins       | Wilford Ranch                |
| Dale Hudspeth         | Laurie Zuckerman/Tom Mathies |