4 Management Direction

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Refuge wetland complex.

The Service selected the management direction described in this chapter after determining that it does the following:

- best achieves the refuge's purposes, vision, and goals, and helps fulfill the Refuge System mission
- maintains and, where appropriate, restores the ecological integrity of the refuge and the Refuge System, and addresses the significant issues and mandates
- is consistent with principles of sound fish and wildlife management

This chapter also discusses objectives and strategies that will be implemented to help refuge staff achieve the CCP goals.

4.1 MANAGEMENT FOCUS

- There will be improved management of wetland habitats for trumpeter swans and other waterfowl and wetland birds. Management will focus on maintaining high wetland productivity through infrequent drawdowns of modified and created wetlands to benefit breeding and migrating waterfowl.
- There will be improved management of riparian habitats to benefit migratory birds and Arctic grayling. There will be restoration of some modified wetlands (including Culver and McDonald ponds) back to riparian corridors.
- Management actions (such as prescriptive grazing and prescribed fire) will only occur on the refuge to achieve specific habitat and wildlife objectives, and will include increased and improved oversight, monitoring, and research conducted to assess if management objectives are being met.
- Visitor service programs will be improved to provide a quality visitor experience while promoting an increased awareness and understanding of refuge resources and management programs, which will result in garnering support for the Refuge System and the conservation of Red Rock Lakes National Wildlife Refuge and the Centennial Valley.
- In addition to the current staff of five and the existing facilities, the following will be needed to fully implement this plan:
  - one permanent full-time GS-9 wildlife biologist and at least three temporary biological science technicians
  - one permanent full-time GS-7 range technician
  - one permanent WG-6 seasonal maintenance worker
  - one temporary visitor services specialist
  - one temporary office assistant

- one of the seven permanent staff will be required to carry law enforcement credentials
- Due to expanded refuge programs all grade levels for current staff will be evaluated
- up to four new residences for current and added staff
- three additional concrete pads to accommodate recreational vehicles needed to recruit seasonal volunteers

4.2 GOALS, OBJECTIVES, STRATEGIES, AND RATIONALE

This section discusses goals, objectives, and strategies that serve as the steps needed to achieve the CCP goals.

A *goal* is a descriptive, broad statement of desired future conditions that conveys a purpose but does not define measurable units.

An *objective* is a concise statement that indicates what is to be achieved, the extent of the achievement, who is responsible, and when and where the objective should be achieved.

The *rationale* for each objective provides context, such as background information, assumptions, and technical details.

The *strategies* describe the actions needed to achieve the objectives.

Lake, Pond, and Marsh Habitat Goal

Provide habitat for breeding and staging migratory birds, native fishes, and resident wildlife that maintains the biological diversity and integrity of montane wetland systems.

Target Species for Lake, Pond, and Marsh Habitat

To direct management actions for the greatest benefit of trust species in refuge lake, pond, and marsh habitat, we reviewed several federal, state, and nongovernmental lists to determine birds of conservation concern that use these habitats during breeding and migration. Five migratory bird species were selected as target species: trumpeter swan, lesser scaup, American wigeon, Franklin's gull, and Wilson's phalarope. Managing lake, pond, and marsh habitats for these species will (1) ensure diverse and productive habitats for target species and other native wildlife, (2) support Service conservation priorities and mandates, and (3) support national and regional interagency conservation plans such as the "Pacific Flyway Management Plan for the Rocky Mountain Population of Trumpeter Swans." The target species were selected based on:

- All five species use the refuge for some portion of their breeding cycle.
- Trumpeter swan, lesser scaup, American wigeon, and Wilson's phalarope are Service focal species (USFWS 2005).
- Wilson's phalarope is a bird species of conservation concern (USFWS 2002b).
- Trumpeter swan and Franklin's gull are state-listed sensitive species in Montana (MTNHP and MFWP 2006).
- Trumpeter swan, Franklin's gull, and Wilson's phalarope are listed as priority level III or higher by Montana Partners in Flight (Casey 2000).

Trumpeter Swan Objective

Trumpeter Swan Objective 1: Following objectives put forth by the "Pacific Flyway Management Plan for the Rocky Mountain Population of Trumpeter Swans" (Subcommittee on Rocky Mountain Trumpeter Swans 2008), the refuge will work to ensure there are nineteen nesting pairs and 140 adults and subadult trumpeter swans during the breeding season, on average, in the Centennial Valley by 2013.

Strategies

- Continue seasonal closures of important breeding habitats to minimize disturbance to trumpeter swans and other waterbirds during nesting and brood rearing periods.
- Continue year-round closures of natural lakes to fishing and hunting for the benefit of staging and migrating trumpeter swans and other waterbirds (Swan and Upper Red Rock lakes).
- Continue to manage wetlands using infrequent drawdowns to improve productivity of these habitats for breeding, staging, and migrating trumpeter swans.
- Continue to coordinate the annual fall survey of the tri-state component of the Rocky Mountain population of trumpeter swans.
- Continue to conduct annual nest and brood surveys of the refuge and surrounding Centennial Valley to monitor trumpeter swan production.
- Continue to work with cooperators to address factors affecting key demographic rates of tri-state trumpeter swans, such as adult survival.

Rationale

Trumpeter swans were once abundant across most of North America, but were reduced to a population of less than 120 known individuals by 1936 (Banko 1960). From this population low point, through diligence and hard work by many, trumpeter swans have recovered remarkably. In 2005, there were nearly 35,000 known trumpeter swans in North America, with breeding populations in fifteen states across the native range of the species. The

Rocky Mountain population of trumpeter swans, which includes swans that nest and winter in the Centennial Valley, reached a record high of 5,228 birds in 2005. This population winters in the tri-state area of southwestern Montana, southeastern Idaho, and northwestern Wyoming. The population nests in two general areas. The largely nonmigratory tri-state subpopulation nests primarily in the Centennial Valley of southwestern Montana, Yellowstone National Park, and southeastern Idaho. A migratory population segment, the interior Canada subpopulation, nests in Alberta, British Columbia, Yukon, Northwest Territories, and Saskatchewan.

Red Rock Lakes National Wildlife Refuge played a pivotal role in the contiguous restoration of trumpeter swans, and the Centennial Valley continues to be one of the most productive swan habitats in the tri-state area of Montana, Idaho, and Wyoming. From the inception of the refuge in 1935 to the winter of 1992–93, winter feeding of trumpeter swans occurred on the refuge, with the initial goals of increasing swan production in the surrounding area and improving the refuge's ability to protect the small population from illegal harvest. Winter feeding was one of a suite of actions taken to restore trumpeter swans that included translocation, captive rearing, and intensive field studies to provide a better understanding of swan ecology.

Trumpeter swan management on the refuge is currently focused on providing productive and undisturbed wetland habitats during critical breeding, staging, and migrating periods. This includes a recent change in water level management of Lower Red Rock Lake and River Marsh, which supports more nesting swans than any other habitat on the refuge. Beginning in 1988, after the construction of the existing WCS at the outflow of Lower Lake, water management called for a Lower Lake water level of 6609.0 mean sea level (msl) during early spring. This level results in most residual emergent wetland vegetation being flooded to a level that makes it unavailable to overwater nesting waterfowl. These high water levels were commonly maintained into June and in some years much longer, essentially shifting the ecology of Lower Lake from a highly productive wetland to a less productive shallow lake. Other potential negative effects of high spring water levels on waterfowl during the prebreeding and breeding periods include reduced availability of foodstuffs, including aquatic invertebrates (Murkin and Kadlec 1986) and roots and tubers. High water levels may also delay the onset of submerged aquatic vegetation (SAV) growth by limiting light penetration and causing lower water temperatures, negatively affecting foraging waterfowl. Trumpeter swans may be particularly sensitive to elevated water levels in the early spring. Tubers are an important carbohydrate-rich food source for trumpeter swans, especially during late winter and early spring (Anderson and Low 1976, Paullin 1973, Squires and Anderson 1995). Although little is known of the nutrient dynamics of breeding trumpeter swans, many temperate breeding waterfowl are dependent upon stored endogenous fat reserves obtained during early spring for clutch formation (Alisauskas and Ankney 1992). Reduced availability of tubers could prevent prebreeding swans from attaining adequate endogenous reserves.

While it is obvious that a population must successfully reproduce to sustain itself, reproductive success, per se, may not be the most significant factor affecting population growth. Reproduction is considered 'costly' to individuals due to the increased mortality risks associated with breeding and caring for young. This results in a trade-off between reproductive effort and adult survival, and suggests that individuals must balance the immediate cost of reproducing in a given year and the probability of future reproductive success. For short-lived bird species this typically results in most, or all, individuals breeding each year regardless of conditions—their chance of surviving to breed again is low, so they have little choice but to breed in an effort to maximize their lifetime reproductive success. They have to put all their proverbial "eggs in one basket." However, in long-lived bird species, individuals are likely to survive for multiple breeding seasons; therefore, they can optimize their lifetime reproductive success by not breeding at all, or abandoning their brood, during poor years, surviving to breed in years where the likelihood of fledging young is greater. For trumpeter swans, which can live greater than 20 years in the wild, maximum fitness can be achieved by foregoing breeding in a poor year, waiting until better conditions are available to attempt nesting and rearing of young. This can result in seemingly extreme variation in annual production in long-lived species in variable environments, like trumpeter swans in the Centennial Valley. It is also believed that this is why population growth is most sensitive to changes in adult survival of long-lived species (Gaillard et al.

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Trumpeter swans.

2000, Ricklefs 1977, Schmutz et al. 1997). Given this understanding of how long-lived species have evolved a life-history strategy that maximizes adult survival, it is imperative that trumpeter swan management considers factors affecting key demographic rates like juvenile and adult survival in addition to annual reproductive success.

Natural Lakes Objective

Natural Lakes Objective 1: Maintain Upper Red Rock and Swan lakes in a SAV-dominated stable state (>35% and 60% SAV canopy cover, respectively) throughout the life of the CCP, for the benefit of migratory birds and native fishes.

Strategies

- Review existing water quality data to provide an understanding of the natural variation to be expected in Upper Red Rock and Swan lakes.
- Develop a monitoring protocol with an emphasis on factors that could alter phosphorous and nitrogen levels, as well as turbidity (for example, upland management in the surrounding watershed).

Rationale

Shallow lakes often exist in one of two stable states. The first, and current state of Upper Red Rock and Swan lakes, is a relatively clear water, SAV-dominated condition. The second state is characterized by turbid water and algal domination. These two states seem to fall along a continuum of abiotic and biotic factors such as total phosphorous concentrations (Bayley and Prather 2003) and the presence of zooplankton grazers (Jeppesen et al. 1998), respectively. Several of these factors can be altered by human actions higher in the watershed.

The refuge's natural lakes provide foraging and brood-rearing habitat for a diverse group of waterfowl and waterbirds. Maintaining these lakes in a SAV-dominated condition increases the value of the lakes to foraging birds. Greater plant biomass directly benefits predominantly herbivorous species such as trumpeter swan (Mitchell 1994, Squires and Anderson 1995), as well as increases the abundance and diversity of invertebrates (Krull 1970, Voigts 1976, Zimmer et al. 2000) for breeding ducks (Baldassarre and Bolen 2006) and largely carnivorous species such as eared grebe (Cullen et al. 1999), Franklin's gull (Burger and Gochfeld 1994), and Wilson's phalarope (Colwell and Jehl 1994).

Upper Red Rock Lake also supports one of the last endemic populations of adfluvial Arctic grayling in the contiguous United States (Kaya 1992, Unthank 1989). This population migrates into Red Rock Creek during the spring to spawn and lives the remainder of the year in Upper Red Rock Lake (Gangloff 1996, Nelson 1954). There is limited evidence that a small component of the population migrates into Odell Creek during the spring to spawn (Gangloff 1996, Nelson 1954), although a recent Service survey indicated most Arctic grayling that spawn in Odell Creek spend the entire year in the creek. Aquatic invertebrates are a significant food source for lake-dwelling Arctic grayling (Kruse 1959, Leonard 1939); therefore, this unique population of Arctic grayling will also benefit from maintaining Upper Red Rock Lake in its current SAV-dominated condition.

Water-quality monitoring will be conducted to ensure the management of adjacent habitats would not adversely affect the lakes. Grazing and fire are known to increase the nutrient cycling of nitrogen and phosphorous (Burke et al. 2005, Hauer and Spencer 1998, McEachern et al. 2000). Management of upland habitats adjacent to Upper Red Rock or Swan lakes could result in elevated levels of these nutrients. Elevated levels of phosphorous and nitrogen can lead to increases in algae and turbidity in shallow lakes, which may ultimately lead to significant losses of SAV communities (Egertson et al. 2004).

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Created wetland, North Tuck Slough.

Managed Wetlands Objectives

Managed Wetlands Objective 1: Manage Shambow, Shorebird, Shoveler, Sparrow, and Tepee Creek ponds and Sparrow Slough with alternate, infrequent drawdowns to provide approximately 132 acres of semipermanent palustrine emergent habitat with 30%–50% flooded emergent canopy cover for the benefit of breeding target species and other migratory birds over the life of the CCP.

Managed Wetlands Objective 2: Over the life of the CCP, divert water to North Tuck Slough from Red Rock Creek only in years when snow-water equivalent is above the 30-year average by the last day of snow-pack accumulation, as measured by the SNOTEL site (SNOpack TELemetry), U.S. Department of Agriculture Natural Resources Conservation Service. This will provide 103 acres of semipermanent palustrine emergent habitat with 30%–50% flooded emergent canopy cover for breeding migratory bird habitat, while protecting riparian corridors on Red Rock Creek.

Strategies

- Conduct a drawdown every 7 years (on average), in an alternating cycle, on managed wetlands, throughout the life of the CCP.
- Begin monitoring emergent wetland vegetation to ensure the objective is being met, within the first year of implementation of the CCP.
- Fill North Tuck's Slough, via the Hansen diversion, as prescribed.
- Throughout the life of the CCP, monitor Red Rock Creek for Arctic grayling fry upstream of the Hansen diversion weekly when diverting water to North Tuck's Slough. The diversion will be closed when Arctic grayling fry are observed (see Arctic Grayling Objective 1).

Rationale

Periodic drawdowns will be undertaken to increase productivity of these managed wetlands. Maintaining relatively static and high water levels, as has been done with the wetlands in recent history, lowers wetland productivity. Static water levels create anaerobic conditions within wetlands, thereby limiting decomposition and nutrient cycling (Brinson et al. 1981). The natural drought cycle of prairie glacial wetlands allows for infrequent aeration of the bottom substrate and decomposition of accumulated detritus (Mitsch and Gosselink 1986). Less is known about the effects of drought on montane wetlands, but key physical processes (such as decomposition of detritus and release of soluble nutrients) should function in much the same fashion. Therefore, drawdowns in managed wetlands are frequently recommended in order to mimic the natural drought cycle and stimulate the decomposition of accumulated detritus and nutrient cycling (Payne 1992).

Persistent deep water in wetlands also alters plant communities. Many species of wetland plants do not germinate in deep water and cannot survive if continuously flooded (Bishop et al. 1979, Harris and Marshall 1963, Kadlec 1962, Weller 1999). As a result, there are greater open-water areas, which reduces populations of aquatic invertebrates and lowers bird diversity (Weller and Spatcher 1965, Weller 1981). Although this open-water marsh stage is selected by various bird species such as American coot, lesser scaup, ruddy duck (Murkin et al. 1997), and grebes (Cullen et al. 1999, Muller and Storer 1999, Storer and Nuechterlein 1992), it represents a phase of the natural cycle marshes undergo, not a climax community. Drought conditions "reset the clock" for an open-water-stage marsh by lowering water levels, which results in exposed mud flats that stimulate plant germination. When reflooding occurs, dense stands of inundated emergent vegetation persist for a brief period before being flooded out. The period of open water, interspersed with emergent vegetation in roughly equal amounts, is known as the hemi-marsh. Maximum bird numbers and the greatest diversity of dabbling duck species are associated with the hemi-marsh stage (Kaminski and Prince 1981, Murkin et al. 1997, Weller and Spatcher 1965). The continued flooding during the hemi-marsh stage results in the return of the marsh to the open-water stage.

Managed Wetlands Objective 3: Remove impoundments on Elk Springs Creek and the upper reach of Picnic Creek that create MacDonald and Culver ponds, respectively, within 15 years of CCP approval, to restore approximately 1.7 miles of riparian habitat for spawning Arctic grayling, migratory birds, and native ungulates (see Arctic Grayling Objective 1).

Managed Wetlands Objective 4: Throughout the life of the CCP, maintain Widgeon Pond at full pool to maintain the trumpeter swan nesting territory and provide lacustrine habitat for Arctic grayling during nonbreeding periods of their life-cycle.

Managed Wetlands Objective 5: Restore a spawning population of Arctic grayling in Elk Springs and Picnic creeks within 15 years of the plan's approval (see Arctic Grayling Objective 1).

Strategies

- Conduct drawdowns on Culver and MacDonald ponds during the first 5 years of the plan and monitor trumpeter swan response.
- Until restoration is complete, maintain the current infrastructure on Culver and MacDonald ponds to allow water-level manipulations to (1) establish stream channels, (2) restore native riparian vegetation, and (3) provide the option of flooding out nonnative invasive plants such as Canada thistle.

- Use stream sections below each of the proposed restorations as representative sites (such as width to depth ratio, sinuosity, and riparian vegetation species composition and canopy cover) to determine when restoration has been successfully completed.
- Define Arctic grayling spawning habitat based on cobble size, steam stretch classification (riffle, pool, run), and water temperature and velocity to ensure suitable spawning habitat is provided in each restored stretch.
- Update the WCS at Widgeon Pond to a design that will prevent emigration or immigration of fish.
- Replace the culvert on Culver Road to make fish movement to the headwaters of Elk Springs Creek easier.
- Remove nonnative fish from Picnic Creek and Widgeon Pond, throughout the life of the CCP.
- Use remote-site incubators (Kaeding and Boltz 2004) in Elk Springs and Picnic creeks to reestablish Arctic grayling populations.
- Restore Pintail Ditch. This will also preclude diversion of water to the West Pintail Ditch wetlands. Move the recently installed fish screen on Pintail Ditch to the Hansen Diversion, which is used to fill North Tuck Slough from water diverted from Red Rock Creek.

Rationale

Arctic grayling in Montana represent a glacial relict population from the Wisconsinan Ice Age (Redenbach and Taylor 1999). Two endemic Arctic grayling populations are known to persist in Montana: a fluvial (river-dwelling) form in the Big Hole River and an adfluvial (lake-dwelling and stream spawning) form in Upper Red Rock Lake, and two lakes in the Big Hole river drainage. These populations represent the last endemic populations of adfluvial Arctic grayling in the contiguous United States, although populations have been established in greater than thirty lakes throughout western Montana (MFWP 1996). Adfluvial Arctic grayling spend the nonbreeding season in lake habitats, while using lake tributaries for spring spawning activities.

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Moose depend on refuge riparian areas for winter survival.

Early accounts by homesteaders show that Arctic grayling were common throughout the lakes and streams of the upper Centennial Valley (Unthank 1989). The population began to decline in the 1930s (Vincent 1962), likely due to a combination of factors such as introduction of nonnative fish (such as brook trout), water diversion, Lima and Clark Canyon dams that block fish from historic habitat, and heavy grazing of riparian corridors (Unthank 1989). Upper Red Rock Lake Arctic grayling currently only spawn in Red Rock and Odell creeks, although historically they spawned in other Upper Lake tributaries.

Restoring Elk Springs Creek and the upper reach of Picnic Creek will provide approximately 1.7 miles of stream habitat that was traditional spawning habitat for Arctic grayling. To create a lake and creek complex to meet the life-history needs of adfluvial Arctic grayling, Widgeon Pond, an impoundment downstream of Culver Pond on Picnic Creek, will be maintained. The Picnic Creek and Widgeon Pond complex will be managed specifically for Arctic grayling, which will include the removal of nonnative fish. This complex will provide a local Arctic grayling population for other reestablishment projects in the valley. Widgeon Pond is also large and deep enough that it could possibly support a Westslope cutthroat population as part of the pond's fishery.

Additionally, refuge willow habitats support one of the highest density winter moose populations in Montana (Warren and O'Reilly 2005). The population has been steadily increasing by about 2% annually for the period 1966–2008 (USFWS 2008a). There is evidence that the population is demonstrating density-dependent habitat limitation (Ferguson et al. 2000). The increase in winter moose population has been concurrent with a significant decline in productivity, as measured by the ratio of calves to adults in annual surveys (Warren and O'Reilly 2005). Intense browsing of willow (Keigley and Frisina 2001, O'Reilly 2006) and aspen (Richard Keigley, research ecologist, USGS, personal interview, 2008) by ungulates has been observed within the refuge. This evidence suggests that the moose population may be limited by winter habitat. Restoring Elk Springs Creek and the upper reach of Picnic Creek will increase the available winter habitat for moose on the refuge by approximately 40 acres.

The proposed removal of MacDonald and Culver ponds will eliminate 10–20 acres (varies depending upon ice cover) of winter waterfowl habitat. These ponds were historically used to feed wintering trumpeter swans. Winter feeding at the refuge occurred from 1935 to 1992, and was an important

component of early trumpeter swan conservation efforts. The feeding program was terminated as part of a program to expand the winter range of the increasing population of trumpeter swans (USFWS 1992). According to "Midwinter Waterfowl Survey" results (USFWS 2008), the average number of wintering trumpeter swans on the two ponds during the 5 years before termination of winter feeding (1988–1992) was 348.1 ± 13.4 (mean ± SE), with peak numbers over 800 individuals. The ponds now provide winter habitat for 40.5 ± 7.8 swans, 117.0 ± 10.6 ducks, and 2.1 ± 1.0 geese, based on 10-year averages (USFWS 2008b). Restoring Elk Springs Creek and the upper reach of Picnic Creek will eliminate waterfowl winter habitat but will further efforts to expand the winter range of trumpeter swans.

Lower Red Rock Lake and River Marsh Objective

Lower Red Rock Lake and River Marsh Objective 1: Increase the percent coverage of pondweeds and Canadian waterweed, collectively, to >40% in Lower Red Rock Lake and River Marsh within 10 years of CCP approval.

Strategies

- Follow the "Adaptive Resource Management Plan for Lower Red Rock Lake, Red Rock Lakes National Wildlife Refuge, Montana" (USFWS 2004), throughout the life of the plan.
- Maintain the WCS for the life of this CCP, unless it is determined that removal is warranted due to negative effects on the hydrological system.
- Conduct periodic (every 4–7 years) drawdowns during the summer and fall of Lower Red Rock Lake to increase productivity of the system for the benefit of nesting target species and other waterbirds.
- In years when no drawdowns occur, maintain Lower Red Rock Lake water levels during the fall, within the constraints imposed by climatic variability and the existing WCS, at 6607.5 feet above msl for the benefit of staging and migrating waterfowl.
- Conduct ecological experiments to improve the understanding and management of the WCS and surrounding hydrological system, throughout the life of the CCP.
- Continue to monitor waterbird response to variation in habitat and climate, including trumpeter swan production and lesser scaup survival and recruitment.
- Continue to monitor SAV, climate, and water levels annually, throughout the life of the CCP.
- Unless necessary to conduct ecological studies, the WCS will be left open during the spring and early summer for the benefit of nesting trumpeter swans and other waterfowl.

Rationale

Historical survey data and the relative forage quality of SAV were the criteria used to determine the desired species composition of Lower Red Rock Lake and River Marsh. The SAV community is currently dominated by shortspike watermilfoil (USFWS 2008c). Historical records show this species was always present but that other species were also well represented. A 1922 field report (Sperry 1922) stated shortspike watermilfoil was abundant in Lower Red Rock Lake, as well as several pondweed species, star duckweed, and quillwort. Also recorded in the report were one large bed of Canadian waterweed and several large beds of arumleaf arrowhead. Importantly, these observations were made before any form of WCS was placed on Lower Red Rock Lake.

A wooden WCS was built on the western outflow of Lower Red Rock Lake in 1930 by the state of Montana. This structure was in place for over 20 years before the first refuge survey of the SAV community in 1955–56 (Beed 1957). The greatest percent species composition measured during that initial survey was Canadian waterweed at 39%, followed by pondweeds (18%), and algae (12%). Shortspike watermilfoil was scarce in Lower Red Rock Lake (<2%). The wooden structure was replaced in 1957 with a concrete WCS with a sill height elevation of 6,607 feet above mean sea level. This new structure was built without headgates, preventing the refuge from being able to manipulate water levels.

The SAV community of Lower Red Rock Lake changed little during the 15 years after the construction of the 1957 WCS. Paullin (1973) found that shortspike watermilfoil comprised 2%–17% of the aquatic vegetation during 1956 to 1971, while pondweeds comprised 18%–42% over that same period. However, the proportion of Canadian waterweed and arumleaf arrowhead decreased during this period, the former from 60% to <1% and the latter from 8% to 1.3%. Paullin (1973) attributed the decline of Canadian waterweed to overgrazing by trumpeter swans and macro-nutrient depletion. The decline of arumleaf arrowhead is likely related to the termination of seeding by the refuge. Arumleaf arrowhead was seeded in the lakes by staff for several years after refuge establishment.

The sampling plan established by Paullin (1973) was continued on an annual basis until 1985. By this time, the species composition of vegetation comprised of shortspike watermilfoil increased to 34%, while that of pondweeds remained within its historical range, also at 34%. The 1957 WCS was replaced in 1987 with a WCS that facilitated water level manipulations via six adjustable headgates

with a sill height of 6,604 feet above mean sea level. Unfortunately, SAV surveys of Lower Red Rock Lake were not conducted between 1986 and 2001. When SAV surveys were conducted in 2002, shortspike watermilfoil had increased to 57% species composition, while pondweeds declined to 12%. The Service believes that this result can be partially explained by recent Lower Red Rock Lake water levels. The 7 years preceding this most recent survey were marked by high water levels (>6,607 feet above mean sea level) maintained in Lower Red Rock Lake throughout the summer. Relatively high static water levels during the growing season would likely favor shortspike watermilfoil, a species more common in lacustrine habitats. Additionally, consistently high water levels may negatively affect pondweeds, which are known to produce especially heavy seed crops under drought conditions (Muenscher 1936, Sharp 1951). Sago pondweed, an especially favored waterfowl food (Kadlec and Smith 1989, Kantrud 1990), ostensibly lacks competitive ability in increased water levels (Harris and Marshall 1963).

Maintenance of high water levels in the spring may also directly affect breeding waterfowl. Potential negative effects of high spring water levels include reduced availability of foodstuffs, including macroinvertebrates (Murkin and Kadlec 1986) and roots and tubers, to waterfowl during the prebreeding and breeding periods. High water levels may also delay the onset of SAV growth by limiting light penetration and causing lower water temperatures, also negatively affecting foraging waterfowl. Trumpeter swans may be particularly sensitive to elevated water levels in the early spring. Tubers are an important carbohydrate-rich food source for trumpeter swans, especially during late winter and early spring (Anderson and Low 1976, Paullin 1973, Squires and Anderson 1995). Although little is known of the nutrient dynamics of breeding trumpeter swans, many temperate breeding waterfowl are dependent upon endogenous reserves obtained during early spring for clutch formation (Alisauskas and Ankney 1992). Reduced availability of tubers could prevent prebreeding swans from attaining adequate endogenous reserves. For the above stated reasons, the WCS will be open during the spring and early summer to allow, within the constraints of the existing WCS, a naturally fluctuating hydrological cycle.

In the summer and fall, periodic lowering (drawdowns) of water levels on Lower Red Rock Lake will be undertaken to increase productivity of the wetland complex. Maintaining relatively static and high water levels, as has been done with the Lower Lake in recent history, lowers wetland productivity. Static water levels create anaerobic conditions within wetlands, limiting decomposition and nutrient cycling (Brinson et al. 1981). Persistent, deep water in wetlands also alters plant communities. Many species of wetland plants do not germinate in deep water and can not survive if continuously flooded (Bishop et al. 1979, Harris and Marshall 1963, Kadlec 1962, Weller 1999). As a result there are greater open-water areas, reducing aquatic invertebrates and lowering avian diversity (Weller 1981, Weller and Spatcher 1965). Therefore, periodic lowering of water levels in managed wetlands is frequently recommended to mimic the natural drought cycle, stimulating the decomposition of accumulated detritus, nutrient cycling, and germination of wetland plants (Payne 1992).

Lower Red Rock Lake fall and winter water levels will be maintained at or near historic levels most years. Maintaining fall lake levels at or near 6607.5 msl will increase the amount of flooded habitat available for migrating birds. Increased water levels at this period will also provide greater winter habitat for muskrats (Bishop et al. 1979, Errington 1961), an endemic wetland species of interest due to their role in creating open areas within emergent vegetation (Weller and Fredrickson 1973) and providing nesting platforms for trumpeter swans (Banko 1960). Lastly, higher water levels in the early fall will ensure that fish utilizing the Lower Lake during the summer will be provided with routes to suitable winter habitat.

In addition to meeting specific seasonal habitat needs of wildlife, higher water levels in the fall also meet certain management objectives. The existing memorandum of understanding with downstream water users states “that whenever possible, storage in Lower Red Rock Lake will only occur during the period of October through June.” Moreover, higher water levels during these periods will benefit refuge visitors. Canoeing on the Lower Lake is permitted from September 1 to freeze-up, and waterfowl hunting begins near the end of September and is only allowed on Lower Lake within the refuge.

Recent trends in local climate (increasing temperatures and decreasing precipitation) have raised concern for the future of refuge water resources. If these trends continue, the current WCS may provide important management capabilities to protect wetland habitats. For this reason, the Service will maintain the current structure; however, if studies determine that the current WCS negatively

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Waterfowl hunter on Lower Red Rock Lake.

affects the hydrology of the system, the structure may be removed.

Riparian Habitat Goal

Maintain the processes necessary to sustain the biological diversity and integrity of native riparian vegetation for migratory breeding birds, native fishes, and wintering ungulates.

Arctic Grayling Objectives

Arctic Grayling Objective 1: Following similar restoration goals put forth by the "Montana Fluvial Arctic Grayling Restoration Plan" (MFWP 1995), the refuge will work to ensure at least three refuge streams contain adfluvial Arctic grayling spawning populations by 2013. The refuge will also work with the state of Montana to reestablish additional Arctic grayling spawning populations in other Centennial Valley creeks throughout the life of the plan.

Strategies

- Continue the systematic monitoring of the remaining grayling spawning population located in Red Rock Creek to assure its status and survival.
- Initiate site specific plans that will maintain or reestablish viable self-sustaining grayling spawning populations in the three major stream systems on the refuge; Red Rock, Odell, and Elk Springs creeks.
- Create an adfluvial grayling brood stock within Widgeon Pond (see Managed Wetland Objective 5).
- Design and implement a monitoring program that will measure abundance and population demographics of spawning Arctic grayling to determine the success of grayling recovery throughout the refuge.
- Continue to manage the health of riparian habitats and natural stream corridors to maintain stream connectivity for migrating adult grayling, and to benefit annual production.
- Where appropriate, remove nonnative fishes from refuge lakes and streams to minimize competition with native fishes, throughout the life of the CCP.
- Continue to work with cooperators to address factors affecting key population demographics of adfluvial Arctic grayling, such as adult and young-of-the-year survival.
- Work with the state and neighboring landowners to address impacts to off-refuge Arctic grayling habitat upstream of the refuge.

Rationale

Arctic grayling once existed throughout the Upper Missouri River drainage, with two distinct life-history forms known to occur in Montana. Fluvial (river dwelling) Arctic grayling were once widespread in this drainage but currently persist only in the Big Hole River. One of the only known populations of endemic adfluvial (lake dwelling, but use streams to spawn in) grayling in the contiguous United States reside in the Centennial Valley of southwestern Montana. Historic records indicate that these fish spawned in the tributary streams of Upper and Lower Red Rock lakes (Nelson 1954, USFWS 1978), tributaries to the main stem Red Rock River below Lower Red Rock Lake (Nelson 1954), and in streams entering nearby Elk Lake (Lund 1974). More recent surveys determined that adfluvial grayling spawning use is currently limited to Red Rock and Odell creeks (Mogen 1996, Kaeding and Boltz 1999, Kaeding and Boltz 2004), primarily on the refuge.

Concern for the survival of the adfluvial Arctic grayling population led to the development of a management plan, in cooperation with MFWP, to reestablish self-sustaining grayling spawning populations in refuge tributaries other than Red Rock Creek. A component of this plan is the establishment of an Arctic grayling brood stock in one or more refuge ponds. This brood stock would provide an egg source for restoring grayling to other Centennial Valley streams. Restoring other self-sustaining adfluvial grayling spawning populations on the refuge and in other Centennial Valley streams would reduce the risk of a natural disaster eliminating this life-history form, which is currently limited to three small populations.

Maintaining healthy riparian habitats with free-flowing stream systems not only improves the quality of life for the land-based wildlife dependent on such habitats, but these conditions also provide access to reaches of streams where lake dwelling grayling prefer to spawn. Naturally functioning stream corridors transport sediment properly and prevent bank erosion, thereby continually cleaning the stream gravels and improving spawning conditions for grayling. This results in greater numbers of grayling fry produced each year, ultimately adding to the size and health of the refuge grayling population.

Most streams of the Upper Centennial Valley, and the refuge in particular, contain suitable habitat for spawning grayling. Therefore, factors affecting the quality and quantity of non-breeding habitat may be responsible for the absence of spawning populations in streams. For example, limited overwintering habitat, high summer water temperatures, and competition with nonnative fishes in the Red Rock lakes are frequently raised as causes of grayling mortality. If these factors, independently or synergistically, are reducing survival of adult grayling, declines in the number of spawning grayling would be expected.

Artic Grayling Objective 2: Provide relatively shallow (<16 inches) gravel and pebble (0.1–2.4 inches)

dominated, moderate flow (0.9–3.0 feet per second) habitat for spawning Arctic grayling (Sempeski and Gaudin 1995) on Odell and Red Rock creeks within the refuge, over the life of the CCP.

Strategies

- Determine current spawning grounds within Odell and Red Rock creeks within the refuge, and identify any immediate threats to these areas within 2 years of CCP approval.
- Restore irrigation ditches that influence the hydrology of streams currently used for spawning by Arctic grayling, while retaining ditches needed for grassland restoration efforts.
- Throughout the life of the CCP, work with adjacent landowners to reduce effects of cattle grazing on upstream sections of Red Rock Creek to protect and improve Arctic grayling spawning habitat. Encourage establishment of seasonal grazing and fencing systems. Encourage landowners to avoid trailing cattle through streams during peak spawning, and during fry movement and dispersal.
- Use visual assessments to examine the hydrologic function and riparian habitat quality of refuge streams in terms of the level of bank erosion, vegetation cover, and sedimentation, throughout the life of the CCP.
- Work with adjacent landowners to reevaluate the current condition of spawning habitat contained in streams (particularly Red Rock and Odell) upstream of the refuge boundary.

Rationale

The refuge provides habitat for one of the last known endemic populations of adfluvial Arctic grayling in the contiguous United States. Historically, this species spawned in numerous tributaries of Lower and Upper Red Rock lakes. Currently, spawning occurs only in Odell and Red Rock creeks. Threats to Arctic grayling include water quality (sedimentation and nutrients), as well as water quantity. High overbank flows can strand spawning Arctic grayling on streambanks, whereas low flows can result in increased sedimentation and water temperatures (Nelson 1954). Competition with and predation by introduced fish species, especially brook and rainbow trout, has also impacted Arctic grayling populations. Water diversions used for irrigation purposes through the 1970s resulted in direct mortality of adult spawning Artic grayling and fry as they returned to the lakes. Finally, livestock grazing, both historic and current, has had a detrimental effect on Arctic grayling spawning habitat by removing vegetation and increasing sediment and nutrient loads, as well as trampling of Arctic grayling eggs and fry in the stream gravels.

Shiras Moose Objective

Shiras Moose Objective 1: Maintain at least 2,000 acres of willow-dominated riparian habitat at moderate to low browse levels for greater than eighty wintering Shiras moose throughout the life of this plan. Eighty moose is within 20% of the 1990–2009 average of moose observed wintering on the refuge.

Strategies

- Continue to exclude cattle used for prescriptive grazing from willow-dominated riparian areas.
- Continue to monitor browse levels in willow-dominated riparian habitats.
- Continue to cooperate with MFWP to conduct annual aerial surveys of wintering moose and setting of harvest regulations.
- Investigate seasonal use of willow-dominated riparian habitats by native ungulates.
- Explore seasonal movements of moose that winter on or near the refuge to determine connectivity with surrounding areas.

Rationale

Floodplain riparian habitat provides relatively stable and important wintering habitat for moose in the Rocky Mountains (Dorn 1970, Houston 1968, Poole and Stuart-Smith 2004, Stevens 1970). The Centennial Valley in southwest Montana contains the largest wetland complex in the Greater Yellowstone Ecosystem, and the associated riparian habitat supports one of the largest and highest-density wintering Shiras moose populations in the central Rocky Mountains. Most of this habitat is encompassed by Red Rock Lakes National Wildlife Refuge, situated in the eastern extent of the valley. This habitat is also believed to support the majority of the moose population within MFWP's Hunting District 334 (HD334) during the winter. The importance of the refuge as winter habitat for moose may be underscored due to assumed losses of riparian habitat in nearby areas since European settlement (Lesica and Cooper 1997).

The importance of the refuge as wintering habitat for Centennial Valley Shiras moose is difficult to quantify. Early attempts to better understand habitat use and seasonal movements of moose in the valley suggested that some of the moose that wintered on the refuge summered in the nearby Gravelly and Centennial mountain ranges (Dorn 1969). Additionally, movements of moose summering on the refuge to wintering areas in Idaho have been documented (Dorn 1969, Ritchie 1978, Schladweiler 1974). Assuming a resident population on the refuge, there are three patterns of refuge habitat utilization by moose: (1) year-round residents, (2) summer migrants, and (3) winter migrants. Although a complete understanding of seasonal movements is

lacking for the Centennial Valley moose population, peak numbers on the refuge occur during December and January (see figure 15).

Efforts to enumerate wintering Shiras moose utilizing refuge habitats have been highly variable. Survey efforts began in 1944 and peaked during the 1980s, during which time the refuge conducted monthly survey flights. Budget constraints and shifting priorities resulted in the termination of regular refuge aerial moose surveys by 1991. MFWP began conducting annual aerial surveys in 1968, but these were also limited by budget constraints and lack of personnel. Moreover, these surveys produced biased, uncorrected minimum estimates of Shiras moose numbers, assuming equal detectability among surveys. This is problematic in that variation among survey estimates includes both potential differences in detection rate and true fluctuations in animal abundance. Ultimately, this reduces the precision of abundance estimates and introduces greater uncertainty into management decisions.

Interest in the relative condition of winter Shiras moose habitat on the refuge evolved concurrently with interest in enumerating wintering moose abundance. MFWP conducted standardized browse surveys (Cole Browse Surveys) from 1965–71 to quantify utilization of key browse plants in HD334 moose winter habitats (all four established survey transects were located on the refuge). Similarly, a willow browse transect was established by the refuge in 1982 to quantify utilization of willow by wintering moose. Although the Cole browse and willow transects differ in gross methodology and placement, they both estimate willow utilization, form class, and age class similarly within the habitat of interest. Currently, the refuge and MFWP conduct regular willow browse evaluations to assist in determining present browse levels and setting of harvest rates.

Riparian Habitat Objectives

Riparian Habitat Objective 1: Maintain at least 500 acres of moderate to dense (>40% canopy cover) willow riparian habitat to benefit breeding migratory songbirds, spawning Arctic grayling, and native ungulates, throughout the life of the CCP.

Strategies

– Continue collecting data on willow canopy cover and shrub volume along Red Rock and Odell creeks as needed to determine and monitor management actions, throughout the life of the CCP.

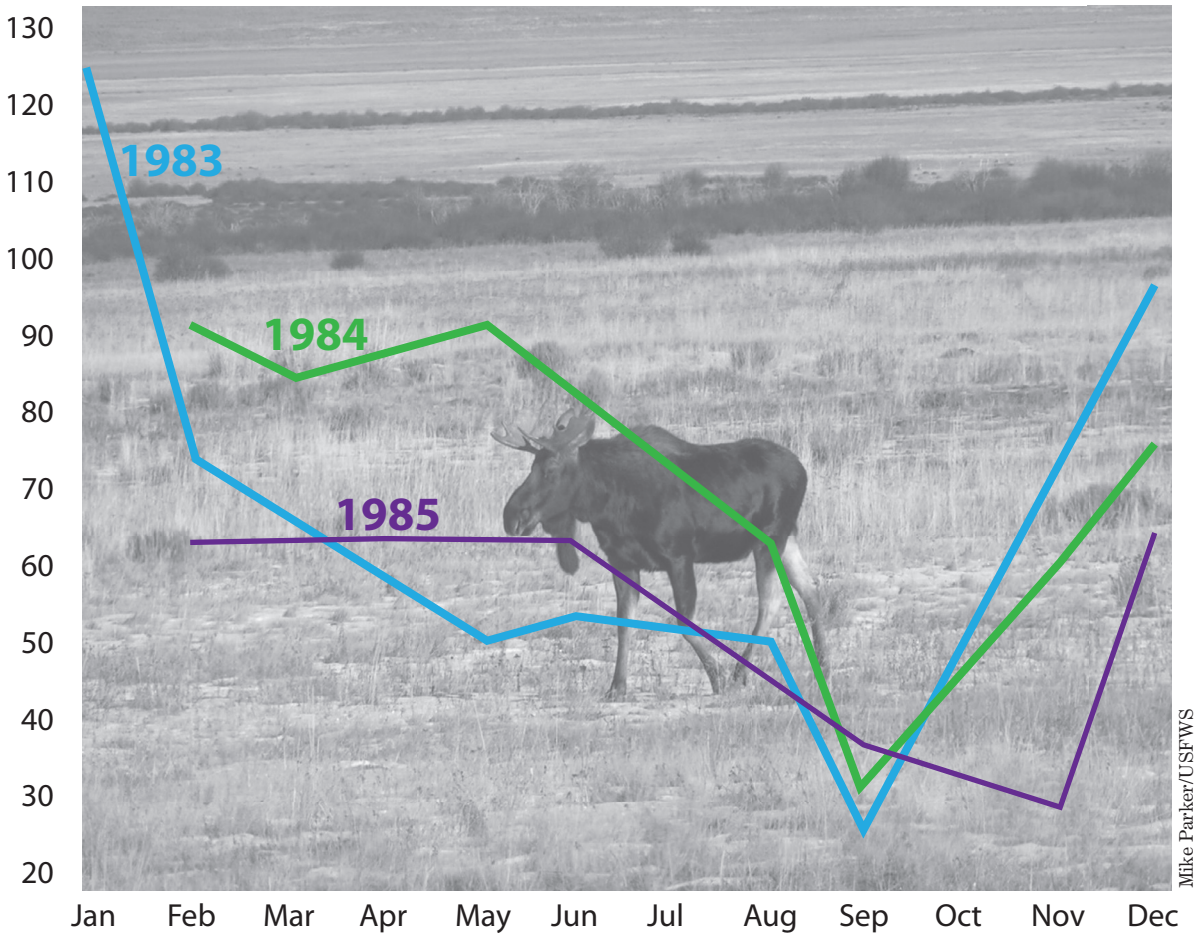

Figure 15. Intra-annual moose abundance on Red Rock Lakes NWR, 1983–1985.

- Maintain existing riparian fences and use temporary fencing, as needed, to protect riparian habitats from cattle, throughout the life of the CCP.
- Restore creeks on the refuge that currently are contained, in part, within old irrigation ditches.
- Continue to cooperate with The Nature Conservancy to conduct annual monitoring and treatment of nonnative invasive plant species, throughout the life of the CCP.

Rationale

Riparian habitat refers to "plant communities contiguous to and affected by surface and subsurface hydrologic features of perennial or intermittent lotic and lentic water bodies (rivers, streams, lakes, or drainage ways). Riparian corridors have one or both of the following characteristics: (1) distinctively different vegetative species than adjacent areas, or (2) species similar to adjacent areas but exhibiting more vigorous or robust growth forms. Riparian corridors are usually transitional between wetlands and uplands" (USFWS 1997).

Riparian habitats on the refuge are comprised of both woody and herbaceous vegetation. Woody vegetation includes Bebb, Booth's, sageleaf, Drummond's, narrowleaf, Geyer, Pacific, false mountain, and Wolf's willows with scattered bog birch and shrubby cinquefoil, whereas the herbaceous community consists of various grasses, sedges, and forbs. Most of the woody species have the ability to resprout following disturbance. A large willow fen covers nearly 1,400 acres on the southeastern edge of Upper Red Rock Lake. Large stands of shrubby cinquefoil, totaling over 2,000 acres, occur throughout the refuge, with the largest stands occurring on the eastern portion. Red Rock and Odell creeks are the two largest streams on the refuge, with each supporting approximately 210 and 130 acres of willow-dominated riparian habitat, respectively. Additionally, each creek has several small tributaries with associated riparian habitat.

Hydrology is the primary determinant of riparian vegetation composition and structure (Beschta 2003, Cary 2005, Cooper et al. 2006). The most important hydrological parameters include the time, duration, magnitude, and frequency of both surface and groundwater flows. Flow magnitude is important to consider in relation to creating suitable conditions (scouring and overbank flooding) for germination. Duration and frequency of near-surface flows are critical to ensuring survival of newly established vegetation.

Hydrology also indirectly affects the periodicity, severity, and intensity of fire, which can exert tremendous influence on both the germination conditions and the structure of existing vegetation (Dwire and Kauffman 2003, Pettit and Naiman 2007). Fires in riparian habitats are typically less intense and occur at a lower frequency than the surrounding uplands due to higher moisture content and higher relative humidity (Dwire and Kauffman 2003, Pettit and Naiman 2007). Typically, fires enter riparian habitats from the surrounding uplands, creating patches of burned and unburned habitat, and the degree to which the riparian habitat burns is related to the intensity of the fire and the width of the riparian corridor. The effect of fire on riparian habitats depends upon several characteristics, including local topography, stream size, vegetation structure and composition, and topographic aspect. Fire can also influence stream sedimentation and nutrient levels (Pettit and Naiman 2007).

The current condition of riparian habitats on the refuge is variable, depending upon which stream is considered. Woody and herbaceous vegetation exists within most stream corridors, but visual observations suggest that new germination may be lacking in some areas. A potential cause for this disruption includes water diversions that have altered the hydrologic system. In addition, nonnative invasive plant species, especially Canada thistle and common tansy, have been introduced to many stream corridors. Many riparian habitats on the refuge have been fenced out to exclude cattle, although cattle are still able to access some streams.

Plant communities associated with riparian habitats on the refuge have multiple natural resource values important in the Intermountain West region and the Centennial Valley. These communities provide breeding and stopover habitat for migratory land birds, browse and forage for native ungulates, and travel corridors for various large mammals. In addition, riparian vegetation also provides many indirect values, including regulation of stream temperatures, and nutrient inputs to streams (particularly headwater areas) that form the basis of the food chain for invertebrates, fish, reptiles, and amphibians.

Dozens of migratory land birds that occur on the refuge depend on riparian habitats for breeding or migration. Breeding bird surveys were conducted over two breeding seasons (2006–2007) in refuge willow riparian habitats. Over 70% of all bird species heard or seen were comprised of five species: yellow warbler, common yellowthroat, song sparrow, Lincoln's sparrow, and white-crowned sparrow. These species represent a range of nesting and foraging requirements (see table 5), demonstrating the habitat diversity currently provided by refuge riparian habitats.

Data from vegetation measurements conducted along both Odell and Red Rock creeks, as well as the willow fen, show that along the creeks, tall-statured willow species predominate (primarily Booth's, Geyer, and Drummond's willow). The willow fen is comprised of a mosaic of low-statured (Wolf's willow) and tall-statured willow species (primarily Booth's,

Bebb, and Geyer's willow). It is located south and east of Upper Red Rock Lake. Canopy cover of willow averaged between 30% and 50%. In a survey conducted by field staff in 2006, it was found that the willow habitat along the creeks tended to have higher volume and structural heterogeneity than the willow fen (O'Reilly 2006).

Riparian Habitat Objective 2: Maintain low to moderate browse levels, as indicated by a positive live/dead browse index, within willow habitats for the maintenance of willow volume, canopy cover, and structural heterogeneity, throughout the life of the CCP.

Strategies

- Cooperate with the MFWP to assess the level of browse within willow riparian habitats on the refuge at least every 3 years, throughout the life of the CCP.
- If browse surveys show that browse levels are above a threshold that would sustain or improve current willow habitats, cooperate with the MFWP to develop and implement an adaptive harvest plan for native ungulates, throughout the life of the CCP.

USFWS

Willows are an important plant on the refuge for moose, songbirds, and beaver, who store them for winter food.

Rationale

Herbivory can significantly influence the vegetative structure and composition of riparian habitats. Riparian habitat on the refuge is critical in maintaining native ungulate populations, particularly moose. The refuge supports one of the highest densities of wintering moose in the central Rocky Mountains. In southwest Montana, willow provides over three-fourths of summer and winter forage for moose (Dorn 1970). Dorn (1970) found Booth's willow to be the preferred browse species for moose in all seasons, as well as the most common species on the refuge. Other work has shown that Geyer willow is preferred most, followed by Booth's willow, with Bebb willow being the least preferred (Cary 2005, Hansen et al. 1995). Booth's willow was the most common species observed in the fen during Dorn's study; however, the majority of tall willow in the fen habitat is currently Bebb willow. This may show that at some point over the last three decades, a shift in willow species composition occurred in response to browse intensity.

The current level of willow browsing by moose was estimated during two growing seasons (2006–2007) by comparing the height of live stems to the height of stems killed by browsing (LD index) (Keigley et al. 2002). The LD index is an efficient method of

Table 5. Nesting and foraging requirements for the five most commonly detected bird species in willow riparian habitat at Red Rock Lakes National Wildlife Refuge, Montana.

Species	*Nesting Habitat* [a,b]	*Nesting Substrate* [c]	*Foraging Substrate* [c]
Yellow warbler	intermediate	shrub	shrub
Common yellowthroat	mesic, short willow, dense cover	ground	ground/low vegetation
Song sparrow	mesic, short willow, dense cover	ground	ground/water
White-crowned sparrow	xeric, tall willow	ground	ground/shrub
Lincoln's sparrow	mesic, short willow, dense cover	ground	ground

[a] *Finch 1989*

[b] *Douglas et al. 1992*

[c] *Lowther et al. 1999, Guzy and Ritchison 1999, Arcese et al. 2002, Chilton et al. 1995, Ammon 1995*

assessing the level of browse pressure in the willow community and predicting related willow community trends. If live stems are taller than stems killed by browsing, this indicates light to moderate browse pressure. The estimated LD index across habitats and years was positive, indicating light to moderate browsing was occurring in willow-dominated riparian habitats on the refuge.

Wet Meadow, Grassland, and Shrub-steppe Habitat Goal

Provide structurally-complex native meadow, grassland, and shrub-steppe habitats, within a watershed context, for upland-nesting migratory birds, sagebrush-dependent species, rare plant species, and other resident wildlife.

Target Species for Wet Meadow Habitat

Wet meadow habitats provide nesting, foraging, and brood-rearing habitat for several species of shorebirds, raptors, game birds, and passerines. To identify target species for wet meadow habitat management, several federal, state, and nongovernmental lists were reviewed to determine birds of conservation concern that breed on the refuge. Five species were selected as target species that reflect the suitable nesting and foraging requirements for wet meadow habitat on the refuge: northern pintail, long-billed curlew, sandhill cranes, short-eared owl, and greater sage-grouse (see table 6). These species were selected for a number of reasons:

- All five species use the refuge for some portion of their breeding cycle.
- Northern pintail, long-billed curlew, sandhill crane, and short-eared owl are service focal species (USFWS 2005).
- Long-billed curlew and short-eared owl are bird species of conservation concern (USFWS 2002b).
- Long-billed curlew is of concern under the "U.S. Shorebird Conservation Plan" (USFWS 2001).
- Long-billed curlew is a state-listed sensitive species in Montana (MTNHP and MFWP 2006).
- Long-billed curlew, short-eared owl, and greater sage-grouse are listed as priority level III or higher by Montana Partners in Flight (Casey 2000).

Mike Parker/USFWS

Long-billed curlew.

Wet Meadow Objective

Wet Meadow Objective 1: Continue to provide nesting, foraging, and brood-rearing habitat for northern pintail, long-billed curlew, short-eared owl, sandhill crane, and greater sage-grouse by ensuring large, contiguous areas (5,000 acres or more) of wet meadow habitat dominated (70% or more of total canopy cover) by native graminoids (sedges, rushes, grasses) with a mosaic of relatively short (<1 foot in height) to moderately tall (1–2 feet in height) vegetation; moderate to high (30% to 70%) litter cover, and moderate (30% to 60%) canopy cover of forbs annually from mid-April to early August, throughout the life of the CCP.

Strategies

- Carry out a vegetation monitoring program to assess if target species habitat requirements are being met within 5 years of CCP approval.
- Determine long-billed curlew occupancy in wet meadow and grassland habitats on the refuge within 5 years of CCP approval.
- Determine sandhill crane occupancy in wet meadow and grassland habitats on the refuge within 5 years of CCP approval.
- Carry out a study of short-eared owls, examining their distribution, in relationship to the annual variation in small mammal abundance during the life of the CCP.
- Carry out a study to determine the influence of cattle grazing on the abundance and distribution of small mammals, the primary prey of short-eared owls, within 2 years of CCP approval.
- Use prescribed cattle grazing or prescribed fire, or both, in an adaptive management context to maintain vegetation characteristics, particularly in areas invaded by smooth brome and Kentucky bluegrass, throughout the life of the CCP.
- Prescriptive grazing and prescribed fire will only be used to achieve habitat and wildlife objectives, with increased and improved oversight, monitoring, and research conducted to assess if management objectives are being met.
- Work with partners to conduct a range survey of the refuge to assess current range health and stocking rates.
- Do not permit lethal control of carnivores (such as wolf, grizzly bear, and mountain lion) on the refuge to protect cattle used in the prescribed grazing program without permission from the refuge manager, a special use permit, and consultation with other partners who have successfully used nonlethal methods for controlling wolves preying on cattle.

Rationale

Although over 7,000 acres of the refuge are wet meadow, the most contiguous area occurs north of Upper Red Rock Lake (5,000 acres or more). Several of the target bird species have large territories (Dugger and Dugger 2002, Rowland 2004, Tacha et al. 1992, Wiggins et al. 2006), thus large contiguous areas of suitable habitat are critical. Vegetative and structural characteristics (such as a mosaic of vegetation heights and residual cover) inherent to wet meadow habitats likely provide suitable nesting, foraging, and brood-rearing habitat for these species. Data on distribution and breeding success for these species on the refuge are necessary to determine what, if any, management changes are needed.

A comprehensive literature review was conducted for these species to determine their specific habitat requirements, and management objectives for this habitat were developed based on these requirements. Requirements such as vegetation height, canopy cover, and litter or residual cover were used to create objectives for this habitat (see table 6).

Northern pintails are one of the earliest breeding North American ducks, preferentially selecting shallow ephemeral wetlands over more permanent wetlands for breeding territories (Stewart and Kantrud 1973). Ephemeral wetlands support abundant chironomids (midges) immediately after ice melt, providing a particularly important food resource for breeding female pintails (Fredrickson and Heitmeyer 1991). Females typically select nest sites further from wetlands and with sparser vegetation than other upland-nesting ducks (Austin and Miller 1995). Refuge wet meadow habitats provide both seasonally flooded shallow wetlands and extensive areas of short, dense vegetation for nesting pintails.

Long-billed curlews typically select nests in vegetation with high vertical density in the 10- to 20-inch range (Pampush and Anthony 1993) and over 12 inches in height (Dugger and Dugger 2002). Foraging territories may be within or outside of nesting territories, as long-billed curlews are opportunistic foragers, feeding primarily on terrestrial insects such as grasshoppers (Dugger and Dugger 2002).

Sandhill cranes nesting in wet meadow habitats typically select vegetation that is between 4 and 12 inches in height early in the nesting season (late April–early May). Late in the nesting season (early June) vegetation around nests can be highly variable (between 4 and 24 inches in height), depending on

Table 6. Habitat requirements for target wet meadow bird species.

Species	*Vegetation Height (inches)*	*Vegetation Cover*	*Litter and/or Residual Cover*	*Area Requirements*	*Nesting*	*Foraging*
Northern pintail	< 12	Nest sites have low visual obstruction readings.	Dependent upon residual cover for nest concealment.	Nesting success positively related to larger, more contiguous, grassland area	X	
Short-eared owl	12–24	Nest sites have high visual obstruction readings. Has higher nest survival in ungrazed habitats. Avoids areas with bare ground.	2–8 years of residual cover buildup	> 250 acres	X	X
Long-billed curlew	< 12	Nest sites have low vertical profile and vegetation density.	Requires moderate residual cover for nesting	35 acres per territory with buffer of 984–1,640 feet	X	X
Sandhill crane	< 4–24	Needs adequate cover for concealment of large nest platforms.	Requires moderate residual cover for nesting	42 acres per territory		X
Greater sage-grouse	Variable	> 15% sagebrush canopy cover	Dense residual cover may hinder movements by young birds	Highly variable; summer range 130–12,000 acres for female with brood		X

Note: < = less than; > = greater than

moisture and vegetative composition. Early season water depths around nests in wet meadows average about 1.5 inches (Austin et al. 2007). Sandhill cranes are opportunistic foragers (Mullins and Bizeau 1978, Tacha et al. 1992).

Short-eared owls select nesting habitat with moderately tall vegetation, dense residual cover, and high visual obstruction readings (Dechant et al. 2003, Fondell and Ball 2004, Herkert et al. 1999, Kantrud and Higgins 1992, Wiggins et al. 2006). Major food items are small mammals, voles in particular (Wiggins et al. 2006). Voles require residual cover for the creation of extensive runways (Foresman 2001). Several studies have noted that short-eared owl annual breeding numbers are closely tied to vole numbers (Wiggins et al. 2006).

Greater sage-grouse use wet meadows contained within a mosaic of upland sagebrush that provide abundant insects and succulent forbs as brood-rearing habitat (Schroeder et al. 1999). Wet meadows may be particularly important for broods in dry years (Rowland 2004).

Target Species for Grassland and Shrub-steppe Habitat

To identify target species for grassland and shrub-steppe habitat management several federal, state, and nongovernmental lists were viewed to determine birds of conservation concern that breed in the grassland and shrub-steppe habitats on the refuge. Four bird species were selected as target species that reflect the suitable nesting and foraging shrub-steppe and grassland habitats on the refuge (see table 7): Brewer's sparrow, greater sage-grouse, Swainson's hawk, and Ferruginous hawk. These species were selected for a number of reasons:

- All four species use the refuge for some portion of their breeding cycle.
- Brewer's sparrow, Swainson's hawk, and ferruginous hawk are bird species of conservation concern (USFWS 2002b).
- All four species are state-listed sensitive species in Montana (MTNHP and MFWP 2006).
- All four species are listed as priority level III or higher by Montana Partners in Flight (Casey 2000).
- Two other state sensitive species have breeding records on the refuge, but populations are irruptive (lark bunting), or the refuge is on the edge of their range (grasshopper sparrow).
- Ground squirrels are the primary prey of both ferruginous hawks and Swainson's hawks during their breeding season (Restani 1991). Thus, their foraging habitats are dictated by the habitat requirements of their prey.

Shrub-steppe and Grasslands Objectives

Shrub-steppe and Grasslands Objective 1: Throughout the life of the CCP, in shrub-steppe habitats, maintain at least 10% canopy cover of sagebrush with moderate (30%–70%) to high (>70%) canopy cover of native bunchgrasses for sagebrush-dependent species, including Brewer's sparrow and greater sage-grouse. Managing for these habitat attributes will also provide nesting, roosting, and foraging habitat for ferruginous hawk and Swainson's hawk.

Shrub-steppe and Grasslands Objective 2: In grassland habitats, maintain moderate (30%–70%) to high (>70%) canopy cover of native bunchgrasses and moderate forb cover (30%–70%) for brood-rearing habitat for greater sage-grouse, throughout the life of this CCP.

Strategies

- Begin vegetation monitoring of shrub-steppe and grassland habitats to ensure adequate coverage of sagebrush, native bunchgrasses, and forb to support the four target species, Brewer's sparrow, greater sage-grouse, ferruginous hawk, and Swanson's hawk.
- Conduct a comprehensive survey for nesting greater sage-grouse on the refuge within 7 years of CCP approval.
- Prescriptive cattle grazing will continue to be used as a management tool in order to meet specific wildlife and habitat objectives and reduce invasive plants, enhance native species, and reduce hazardous fuels.
- Carry out a study to determine the influence of cattle grazing on the abundance and distribution of small mammals (the primary prey of ferruginous hawk and Swainson's hawk), within 2 years of CCP approval.
- Evaluate interior fences to determine their condition and effectiveness in managing the prescriptive cattle grazing program.
- Do not permit lethal control of carnivores (such as wolf, grizzly bear, and mountain lion) on the refuge to protect cattle used in the prescribed grazing program without permission from the refuge manager, a special use permit, and consultation with other partners who have successfully used nonlethal methods for controlling wolves preying on cattle.
- The refuge will support, and participate in a MFWP led landscape-scale restoration of bison as free-ranging wildlife in southwest Montana if the state decides to pursue this initiative. The Service will not support proposals to restore bison as a captive, fenced herd.

Rationale

Idaho fescue, the dominant bunchgrass species on the refuge, can withstand light to moderate grazing, particularly if grazing occurs after flowering (Mueggler and Stewart 1980). Flowering occurs on the refuge around mid-July and coincides with the arrival of cattle. Idaho fescue is relatively intolerant to both heavy grazing and repeated overgrazing, which can lead to eventual replacement by invasive grasses such as cheatgrass (Mueggler and Stewart 1980, Zouhar 2000). Perennial needlegrass species, particularly needle and thread grass, and western and Richardson's needlegrass, make up an important component of these habitats as well. The effect of cattle grazing on needlegrasses is variable, depending upon timing of grazing. For example, needle and thread grass greens up early in the spring and is most sensitive to grazing during flowering; however, the sharp awns developed by mid- to late summer typically result in reduced use of this grass by livestock (Zlatnik 1999).

Detailed fire histories for most shrub communities are lacking (Baker 2006). Threetip sagebrush has the ability to resprout after fire, but this resprouting capacity varies regionally and can also depend upon fire severity (Bunting et al. 1987, Lesica et al. 2005). Cover of threetip sagebrush can decrease in the early years postfire (Lesica et al. 2005). Native bunchgrasses associated with these habitats have variable responses to fire, and fire-related mortality depends upon fire severity. Fire kills the culms, but individual plants can survive if fire does not damage the root crown (Zouhar 2000). Canopy cover of Idaho fescue can return to pre-fire levels; however, livestock grazing immediately following fire can result in high (over 50%) plant mortality (Bunting et al. 1998). Perennial needlegrass species are extremely susceptible to damage by fire (Esser 1992,

Table 7. Habitat requirements for target shrub-steppe and grassland, and Centennial Sandhills bird species.

Species	*Habitat*	*Shrub Height (inches)*	*Shrub Cover*	*Herbaceous Height (inches)*	*Herbaceous Cover*	*Area Requirements (acres)*	*Response to Grazing*	*Nesting/ Brood-rearing*	*Foraging*
Brewer's sparrow	basin big sagebrush shrub-steppe	> 20	> 10%	n/a	> 25%		+/-	+	
Greater sage-grouse	basin big sagebrush shrub-steppe	> 16	≥ 15%	> 7	15%–25%	Highly variable; summer range 130–12,000 acres for female with brood	-	+	
Swainson's hawk	shrub-steppe grass-lands	n/a	n/a	primary prey (ground squirrels and voles) depend upon abundant herbaceous vegetation	home range 1,500–6,800 acres	+/-		+	+
Ferruginous hawk	shrub-steppe grass-lands	n/a	n/a	primary prey (ground squirrels) depen-dent upon abundant herbaceous vegetation	home range 840–2,200 acres	+/-		+	+

Note: > = greater than; ≥ = greater than or equal to; +/- = plus or minus; n/a = not applicable.

Wright and Klemmedson 1965), although they can recover if the fire is not severe enough to damage the crown (Esser 1992).

Shrub-steppe and Grasslands Objective 3: Within 10 years of CCP approval, 200 acres of smooth brome will be restored with native grass species needed to provide nesting and foraging habitat for migratory birds.

Strategies

- Determine focus areas for restoration efforts.
- Conduct experiments using a combination of prescribed fire in the spring or early fall, prescriptive cattle grazing, and mechanical and chemical treatments to determine the best method for smooth brome control and restoration of native grasses.
- Examine potential revegetation options based on the surrounding native plant communities.

Rationale

Historically, smooth brome was planted for livestock forage, and haying occurred annually on over 200 acres of refuge lands until the mid-1970s. Pure stands of smooth brome now cover approximately 1,100 acres on the refuge. Smooth brome also occurs along refuge roads, as isolated patches in wet meadows, and now dominates the understory in over 300 acres of various willow- and sagebrush-dominated habitats within the eastern and southern portions of the refuge. Smooth brome is an aggressive invader, outcompeting desirable native vegetation because of its sod-forming root system and prolific seed production. Current management includes occasional prescribed fire and cattle grazing. Smooth brome is highly tolerant to grazing (Howard 1996). Periodic spring or early fall fires can increase smooth brome productivity by removing litter; however, repeated annual spring burns can reduce tiller elongation and biomass (Willson and Stubbendieck 1997). Repeated heavy grazing during tiller elongation in spring was an effective method to reduce aboveground biomass and cover in cool-season grasslands (Stacy et al. 2005). Mowing may be ineffective if it fails to remove all of the emerging buds (Willson and Stubbendieck 1996). Treatment options also depend upon the amount of remnant native grasses and forbs available to compete with smooth brome (Willson and Stubbendieck 2000).

Target Species for Centennial Sandhills Habitat

Two bird species, Brewer's sparrow and greater sage-grouse, were selected as target species for the Centennial Sandhills habitat that reflect the suitable nesting and foraging tall sagebrush habitat on the refuge (see table 7). These species were selected for a number of reasons:

- Both species use the refuge for some portion of their nesting cycle.
- Both species are bird species of conservation concern (USFWS 2002b).
- Both species are state-listed sensitive species in Montana (MTNHP and MFWP 2006).
- Both species are listed as priority level II or higher by Montana Partners in Flight (Casey 2000).

Centennial Sandhills Objectives

Centennial Sandhills Objective 1: Maintain at least 2,500 acres of basin big sagebrush habitat with at least 10% canopy cover of sagebrush with moderate cover (30%–70%) of native bunchgrasses and forbs and moderate amounts of bare ground (30%–70%) for sagebrush-dependent species, including sage thrasher, Brewer's sparrow, greater sage-grouse, pygmy rabbit, and Preble's shrew.

Strategies

- Continue vegetation monitoring in the Centennial Sandhills to ensure adequate coverage of basin big sagebrush and native bunchgrasses.
- Continue land bird monitoring in the Centennial Sandhills to determine Brewer's sparrow densities.
- Conduct a nesting study of Brewer's sparrow to determine the demography of the population in the sandhills within 10 years of CCP approval.
- Conduct a comprehensive survey for nesting greater sage-grouse in basin big sagebrush habitats on the refuge within 7 years of CCP approval.
- Avoid prescribed fire in large areas of basin big sagebrush habitats to prevent loss of sagebrush cover.

Dave Menke/USFWS

The sage thrasher breeds in areas of dense sagebrush.

Rationale

The Centennial Sandhills are a unique habitat located in the northeastern portion of the Centennial Valley. Vegetation in the sandhills is dominated by sagebrush and native bunchgrass species. On the refuge portion of the sandhills, the dominant sagebrush species is basin big sagebrush. This tall sagebrush has an extremely limited distribution in Montana, occurring in localized stands in southwestern Montana (Morris et al. 1976). Basin big sagebrush is typically confined to areas with relatively deep, well-drained soils (Tirmenstein 1999). The average sagebrush height in the refuge portion of the sandhills is between 16 and 20 inches, although several areas have shrubs that reach heights of well over 5 feet. The sandhills are characterized by moderate to high levels of bare ground (40%–70%), and moderate to high canopy cover of native bunchgrasses (50%–90%), predominantly needle and thread, and Idaho fescue. Canopy cover of basin big sagebrush in the sandhills is low, averaging 10%. Currently, cheatgrass and pale madwort are the major invasive plant species occurring in the sandhills, although coverage is <1%.

Basin big sagebrush is killed by fire and may take at least 20 to 30 years to recover to pre-fire conditions (Lesica et al. 2005). Frequent fires will eliminate basin big sagebrush habitat (Tirmenstein 1999). Recovery of sagebrush communities is slow, in part because of the lack of availability of mature seeds, as seeds do not travel far from mature plants (Baker 2006, Welch and Criddle 2003). A fire burned nearly 2,500 acres of refuge sandhills in October 1974. It is possible that the low sagebrush canopy cover values on the refuge are a result of this fire, as previous cover was described as a "dense stand of old-age sagebrush" (USFWS 1974–1975). Canopy cover in basin big sagebrush stands that have not burned in the past 35 years averaged 20% with a height averaging about 4 feet (Lesica et al. 2005).

Brewer's sparrow and greater sage-grouse, the target species for the Centennial Sandhills, are positively associated with sagebrush cover. Neither of these species will nest in sagebrush habitats with <10% sagebrush canopy cover (Connelly et al. 2000, Walker 2004).

Brewer's sparrow typically nests in sagebrush shrubs over 20 inches in height (Rotenberry et al. 1999). In general, this species is not area sensitive because it will breed in small isolated sagebrush patches (Knick and Rotenberry 1995, Vander Haegen et al. 2000); however, nests can have lower productivity in these smaller fragments (Vander Haegen et al. 2000, 2002).

Active sage grouse leks on lands adjacent to the refuge are <0.5 mile from basin big sagebrush habitats on the refuge, and broods were observed on the refuge during the summer of 2006. Sage grouse females typically nest within 3 miles of lekking grounds (Wallestad and Pyrah 1974), thus it seems probable that greater sage-grouse are nesting in this habitat on the refuge.

Two small mammal species of conservation concern, pygmy rabbit and Preble's shrew, also occur in this habitat. Pygmy rabbits are primarily Great Basin species, but their range extends into southwestern Montana. The summer diet of pygmy rabbits is primarily grasses (over 50%) and forbs (over 30%), whereas sagebrush foliage (over 90%) is the dominant forage in winter (Thines et al. 2004). Pygmy rabbits avoid grazed habitats in eastern Washington (Thines et al. 2004) and cattle can trample burrows (Rauscher 1997). Preble's shrew occupies arid shrub-steppe habitats with sandy soils. Nothing is known about the diet of Preble's shrew, although other shrews eat primarily insects and worms (Foresman 2001).

Centennial Sandhills Objective 2: Work with cooperators over the next 15 years to develop a management plan for the Centennial Sandhills that will guide the management of this habitat, in a landscape context, as a mosaic of early and late-seral stages to maintain four rare early seral-associated plant species (Fendler cat's-eye, sand wildrye, painted milkvetch, and pale evening primrose), as well as late-seral habitats.

Strategies

- Cooperate with BLM, The Nature Conservancy, and other partners to continue rare plant surveys in the Centennial Sandhills.
- Cooperate with BLM and The Nature Conservancy to determine the effectiveness of prescribed fire and cattle grazing to create or maintain early seral habitats in suitable portions of the Centennial Sandhills within 5 years of CCP approval.

Rationale

The Centennial Sandhills are well-vegetated sand dunes characterized by a mosaic of seral stages. The most topographically variable and active (migrating) sand dunes are in the western portion of the sandhills on lands owned by BLM and The Nature Conservancy. As dunes lose sand via depositional loss, the density of vegetation increases such that the dunes become stabilized and movement stops (Chadwick and Dalke 1965). Dunes in the eastern portion of the sandhills are stabilized and blowouts (windblown areas of bare sand) are rare. Two rare plant species, painted milkvetch and sand wildrye, are restricted to these blowouts and have not been documented on the refuge, whereas pale evening primrose and Fendler cat's-eye occur in blowouts and areas of relatively recent deposited sands on the upper slopes of the dunes (Lesica and Cooper 1999). Pale evening primrose is rare in both the western and eastern sandhills, but Fendler cat's-eye is very common, particularly in the eastern sandhills. Late

seral habitats are dominated by basin big sagebrush on the refuge and threetip sagebrush on the western sandhills. Both of these communities are unique in Montana (Cooper et al. 1999).

Aspen Forest, Mixed Coniferous Forest, and Woodland Habitat Goal

Create and maintain aspen stands of various age classes within a mosaic of coniferous forest and shrubland for cavity-nesting birds, and other migratory and resident wildlife.

Aspen Forest and Woodland Objective

Aspen Forest and Woodland Objective 1: Determine the historical and current extent of aspen, current levels of aspen regeneration, and current browse levels by elk and moose within aspen stands on the refuge and surrounding lands in the Centennial Valley within 5 years of CCP approval.

Strategies

- Develop a monitoring plan in conjunction with cooperators to monitor levels of aspen browse in the Centennial Valley.
- If aspen monitoring indicates continued intense browsing, work with partners to develop an adaptive management plan that incorporates native ungulate harvest and large-scale disturbances to benefit aspen.
- Supplement aspen stand delineation via aerial photo interpretation with intensive ground-sampling based on existing data regarding aspen distribution in the Centennial Valley.

Rationale

Large-scale declines of aspen across the American West have been widely distributed, likely caused by a combination of factors, including global climate change, high-levels of ungulate herbivory, and conifer encroachment due to fire suppression (Bartos and Campbell 1998). The Centennial Mountains have seen declines of aspen as great as 80% (Gallant et al. 2003, Korb 2005, Korb et al. 2008). Browsing by native ungulates, especially elk and moose, can significantly reduce aspen regeneration and the ability of stems to grow above browse height (Berger et al. 2001, Romme et al. 1995). The collection of data using the LD index on the current level of aspen regeneration (number of stems/acre) and browsing (Keigley et al. 2002) in the Centennial Valley was started by The Nature Conservancy in the summer of 2006. Preliminary results show that regeneration at current browse levels will be very limited. Additionally, some historic aspen stands have been lost, as evidenced by areas of downed aspen or aspen snags and lack of young aspen stems. The degree to which this loss has occurred throughout the Centennial Valley is unknown.

The Centennial Valley is part of the MFWP Gravelly Elk Management Unit, Hunting District 327. Elk populations in this management unit have more than doubled since 1985 (MFWP 2004). Wintering moose populations on the refuge have also increased four-fold from 1966–2008, with approximately 100 moose currently wintering on or near the refuge (USFWS 2008a). The inability of aspen stems to grow above browse height, coupled with the increase in elk and moose numbers, suggests that intense browsing may be limiting regeneration of aspen in the Centennial Valley.

Aspen provides the only deciduous tree habitat in montane regions of the Rocky Mountains. This habitat has higher biodiversity and productivity than the surrounding upland habitats (Hansen et al. 2000) and is extremely valuable to breeding birds (Dobkin et al. 1995, Finch and Reynolds 1987, Martin et al. 2004). Aspen within a mosaic of coniferous forest is used for nesting disproportionately to its availability (Martin et al. 2004). In particular, primary cavity excavators (such as woodpeckers) create nesting and roosting cavities for a complex community of species. As aspen age, they invariably become infected with fungal heartrot (Hinds 1985). This susceptibility to heartrot creates ideal conditions for cavity excavation (Aitken et al. 2002, Hart and Hart 2001). Several primary cavity-nesting species and secondary cavity-nesting species (nonexcavators) breed in aspen habitats on the refuge, including northern flicker, red-naped sapsucker, house wren, American kestrel, and tree swallow. Other bird species that nest in aspen habitat are ruffed grouse, dusky flycatcher, cordilleran flycatcher, western wood-pewee, warbling vireo, and broad-tailed hummingbird.

Several birds that breed in aspen habitats are listed as species of conservation concern by the Service (red-naped sapsucker; 2002), by the state of Montana (broad-tailed hummingbird; 2006), or by Montana Partners in Flight (red-naped sapsucker, warbling vireo, ruffed grouse, cordilleran flycatcher, and dusky flycatcher; 2000). All of these species require large trees with a dense canopy (Dobkin et al. 1995, Gardali and Ballard 2000, Lowther 2000, Rusch et al. 2000, Sedgwick 1993).

Mixed Coniferous Forest and Woodland Objective

Mixed Coniferous Forest and Woodland Objective 1: Provide wildland–urban interface (WUI) protection and prevention measures around Lakeview based on strategies developed in an interagency fire management plan.

Strategy

– Work with BLM and Forest Service to develop a fire management plan that will use prescribed fire and mechanical treatments to thin conifer stands and reduce hazardous fuels, minimizing the threat to life and property.

Rationale

Wildland fire management must be coordinated across administrative boundaries to reach management goals. It must balance fire suppression methods to protect property and other resources with the use of fire to maintain and promote healthy ecosystems. The development of a fire management plan for the WUI surrounding the town of Lakeview will serve to protect homes and other structures and also allow land management agencies to adopt wildland fire use principles that will support minimal suppression of wildland fire in these habitats.

A 13,600-acre lightning-ignited fire occurred in mixed coniferous forests in the western Centennial Mountains in 2003, burning nearly 1,000 acres of the refuge. Aside from this fire, wildland fires have been essentially absent from coniferous forests in the Centennial Valley for nearly 150 years (Korb 2005). This absence of fire, in combination with mountain pine beetle and spruce budworm outbreaks, and a complex interaction between climatic patterns and fuels, has created suitable conditions for wildland fire to occur in this habitat. Continued maintenance of coniferous forests through natural disturbance will provide habitat for a diverse assemblage of breeding birds.

Several bird species of conservation concern breed in coniferous forests on the refuge. These include Williamson's sapsucker (Casey 2000, MTNHP and MFWP 2006, USFWS 2002b); olive-sided flycatcher, three-toed woodpecker, great gray owl, northern goshawk, brown creeper (Casey 2000, MTNHP and MFWP 2006); and Calliope's hummingbird, Townsend's solitaire, red crossbill, Cassin's finch, and Clark's nutcracker (Casey 2000). Several bird species are also closely associated with burned coniferous forests, including black-backed woodpecker (Casey 2000, MTNHP and MFWP 2006), three-toed woodpecker, and olive-sided flycatcher, which is often more abundant in burned forests than unburned forests (Altman and Sallabanks 2000). The overall guidance for use of prescribed fire and management of wildland fire is in the description of the fire management program in appendix H.

Visitor Services and Cultural Resources Goal

Provide quality wildlife-dependent recreation, environmental education, interpretation, and outreach opportunities that nurture an appreciation and understanding of the unique natural and cultural resources of the Centennial Valley, for visitors and local community members of all abilities, while maintaining the primitive and remote experience unique to the refuge.

Hunting Objective

Hunting Objective 1: Continue to provide and expand hunting opportunities for elk, white-tailed and mule deer, moose, pronghorn, ducks, geese, and coots within modified refuge hunting area boundaries. Seventy-five percent of hunters will report a safe, quality hunting experience that enriches their personal lives while supporting preservation of the unique qualities and natural resources of the refuge and Centennial Valley for future generations.

Strategies

– Hunting boundaries will be modified and expanded to eliminate boundary confusion, address law enforcement issues, address impacts to habitat due to increasing populations and unnatural concentrations of large ungulates (particularly in closed areas), and provide additional opportunities (see figure 14).

– Big game hunting for elk, pronghorn, and mule and white-tailed deer will continue to be permitted on current and expanded portions of the refuge (see figure 14).

– Open the area west of South Valley Road near Saier Corrals to create a contiguous moose hunting area, eliminating hunting boundary confusion. Close the area south of South Valley Road (Red Rock Pass Road) to eliminate a road hunting issue.

– To maintain a quality and ethical hunt and to reduce the potential for crippling elk in the area north of South Valley Road, south of Red Rock Creek, west of Upper Red Rock Lake to the west boundary, except for the closed portion east of Lakeview to Odell Creek, the refuge may pose restrictions such as limiting the number of hunters, shortening the season, or changing the method of harvest.

Mike Parker/USFWS

Great gray owl.

- The refuge will continue the practice of opening moose hunting later than the state moose hunting season. In collaboration with MFWP, this hunting season may be modified (lengthened or shortened further) in the future to meet habitat and population objectives.
- To address illegal road hunting, no big game hunting will be permitted within 50 yards of the centerline of any county or refuge road.
- Develop the hunting chapter within the Visitor Services Plan.
- Hunting for duck, goose, and coot will continue to be permitted on and adjacent to Lower Red Rock Lake under state and federal regulations and seasons (see figure 14).
- Provide one accessible hunting blind for hunters with disabilities (also used for wildlife observation and photography) downriver from Lower Lake.
- Open areas closed to hunting for other public uses according to refuge regulations, in order to promote other wildlife-dependent activities during hunting seasons. The area around residences and maintenance facilities will remain closed to all public uses.
- The public will continue to be provided access down Idlewild Road, primarily used for waterfowl hunting. The refuge will post a sign recommending that only 4-wheel drive or high clearance vehicles utilize the road. The road may be closed at any time due to weather and road conditions.
- Create a hunting regulation brochure that meets Service graphic standards.
- Conduct random hunting surveys to determine the quality of visitors' hunting experiences.

Rationale

Hunting is considered by many to be a legitimate, traditional recreational use of renewable natural resources. The National Wildlife Refuge System Act of 1966, other laws, and the Fish and Wildlife Service's policy permit hunting on a national wildlife refuge when it is compatible with the purposes for which the refuge was established. National wildlife refuges exist primarily to safeguard wildlife populations through habitat preservation.

The word "refuge" includes the idea of providing a haven of safety for wildlife, and as such, hunting might seem an inconsistent use of the National Wildlife Refuge System. However, habitat that normally supports healthy wildlife populations produces harvestable surpluses that are a renewable resource. As practiced on refuges, hunting does not pose a threat to the wildlife populations, and in some instances, are necessary for sound wildlife management.

The refuge is part of a larger ecosystem known as the Greater Yellowstone Ecosystem. Most wildlife species migrate on and off the refuge. Working with MFWP is vital in balancing wildlife populations needed to provide a quality experience for visitors while ensuring habitats are protected from overpopulated and unnaturally concentrated wildlife. In the past, elk regularly concentrated on the refuge's closed areas during the fall hunting season. This unnatural concentration of elk not only impacted refuge habitats (see Aspen and Woodland Objective Rationale), but contributed to the continued overpopulation of elk in this valley, impacting other Centennial Valley habitats. Surveys also indicate a consistent increase in moose populations and increases in browse use, supporting the state's continued limited harvest (currently eleven permits annually) within this hunting unit and the refuge.

The open landscape of the Centennial Valley allows for excellent scouting for big game animals from the road. This sometimes leads hunters to harvest animals illegally by shooting from the road. By adopting a 50 yard closure state regulation (currently used for the state's bison hunt program outside of Yellowstone), the refuge hopes to address this issue.

Currently, the refuge hunt area boundaries and regulations are confusing. By carrying out the strategies, confusing hunting boundaries will be eliminated, additional quality hunting opportunities will be provided, and hunters will be better informed of the location of boundaries and regulations.

Expanding big game hunting areas will serve various purposes. It will eliminate confusion associated with existing hunting boundaries by creating more clearly, easily defined boundaries. It will support the state's elk population objective in the elk management unit that encompasses the refuge. Current population levels exceed state objectives and the refuge's closed area has caused unnatural concentrations of elk during the hunting season. The refuge works with MFWP to meet their elk management objectives; elk are a state-managed species. Elk populations are not imperiled and are more than sufficient in numbers to allow for additional harvest. The expanded portion of the refuge that will now be open to big game hunting is within Red Rock Lakes Wilderness and other roadless areas. Since it is roadless, it will be challenging to hunt and retrieve animals. Nevertheless, we anticipate this disturbance will better disperse elk, while allowing for additional opportunities for a quality hunting experience. The Service does recognize the need to carefully plan and execute these hunts initially, making sure law enforcement is present to ensure they are conducted ethically and safely. The Service may also need to utilize other methods, such as limiting the number of hunters, to achieve this goal. Eventually, the elk will move into other areas more naturally, distributing themselves throughout the valley. Finally, these reduced elk numbers should assist the

refuge and surrounding land management agencies in addressing the lack of regeneration of aspen and other tree species heavily browsed by overabundant elk.

Fishing Objective

Fishing Objective 1: Continue to provide quality fishing opportunities to visitors in a remote, wild setting, with minimal disturbance to migratory birds. These encounters will enrich visitors' personal lives while garnering support for preserving the unique qualities and natural resources of the refuge and Centennial Valley for future generations.

Strategies

- Continue to allow fishing on Odell, Red Rock, and Elk Springs creeks under state river and streams regulations.
- Open all refuge streams to fishing in compliance with refuge, and the state's river and stream regulations.
- Widgeon Pond, and until they are restored, MacDonald and Culver ponds will be open under state river and stream regulations to fishing from the bank unless closure is necessary to protect nesting swans or Arctic grayling restoration efforts.
- Update fishing regulations in the general brochure.
- Produce a fishing regulation "tear sheet" or produce a combination hunting/fishing regulation "tear sheet."
- Improve or replace existing signage.
- Encourage all visitors to keep nonnative fish in accordance with state regulations.
- Open Red Rock Creek west of the Lower Lake WCS to fishing.
- Work with refuge partners to determine population numbers of native and nonnative fish species and potential impacts from fishing.
- Conduct random fishing surveys to determine the quality of visitors' fishing experiences.
- Prevent the spread of aquatic nuisance species by increasing angler awareness through signage, educational brochures, and other techniques.

Rationale

Fishing is one of the priority public uses for the Refuge System and a popular activity on Red Rock Lakes National Wildlife Refuge. Fishing can also play an important role in control of nonnative fish populations for the benefit of Arctic grayling and Westslope cutthroat trout. Fishing is not permitted on the lakes for various reasons, the most important of which is to provide refuge for breeding, staging, and migrating trumpeter swans and other migratory birds. Opening all creeks to fishing will provide additional opportunities for visitors.

Wildlife Observation and Photography Objective

Wildlife Observation and Photography Objective 1: Provide visitors of all abilities with more opportunities to view and photograph wildlife in a wilderness setting. These encounters will enrich visitors' personal lives while garnering support for conserving the unique qualities and natural resources of the refuge and Centennial Valley for future generations.

Strategies

- Maintain wildlife observation and photography opportunities during hunting seasons by using geographic separation. The eastern ponds section (north of Red Rock Creek, east of Elk Lake Road) will be closed to hunting, but open to foot traffic by the public year-round, and to vehicles for a portion of the year.
- Work with Beaverhead County to provide accessible pulloffs for the safe viewing of wildlife and photography. Each site will be interpreted through an interpretive sign or auto-tour brochure.
- Establish an auto tour route for wildlife observation on existing refuge roads open to the public (see figure 14). An auto tour route will require replacing Red Rock Creek Bridge. The auto tour route will be interpreted through a brochure and minimal signage.
- Produce a fish and wildlife checklist that meets Service graphic standards.
- To eliminate confusing regulations, open all refuge roads to vehicles from May 15 to December 2. All roads may be closed at anytime due to weather conditions. An exception is Widgeon Pond Road, it may be closed to minimize disturbance to nesting swans.
- Add a wildlife observation and photography question to the interpretation questionnaire to measure results and quality of enhanced programs.
- Shambow Pond will remain closed to all public access and use.
- Build an accessible blind downriver from Lower Lake (see figure 14) for wildlife observation and photography, and hunting.
- Allow nonmotorized boating on Red Rock Creek and Upper Red Rock Lake from July 1 to freeze-up. Lower Red Rock Lake and River Marsh connecting the two lakes are open September 1 to freeze-up.

Rationale

The refuge is located in one of the most undeveloped and beautiful valleys in Montana, the Centennial Valley. This picturesque setting, combined with rich habitats, make wildlife observation and photography the most popular wildlife-dependent recreational activity at the refuge. There are a few developed trails and some roads from which visitors can view and photograph habitats and wildlife; however, most have not been adequately marked or identified on a map, so they are not obvious to the less adventurous visitor. There are areas where these opportunities could be expanded, but it is also critical that the wilderness characteristics that bring visitors to the refuge be maintained. Shambow Pond will continue to be closed to protect nesting trumpeter swans.

Interpretation Objective

Interpretation Objective 1: Ensure that 75% of refuge visitors will understand they are on a national wildlife refuge where wildlife comes first. These visitors will also understand the purposes and significance of Red Rocks Lakes National Wildlife Refuge and the value of conserving the natural resources of the Centennial Valley.

Strategies

- Recruit a GS-6 temporary visitor services specialist (same as the Outreach objective).
- Develop a common theme for all refuge interpretation that supports and promotes the refuge's purposes, protection of the Centennial Valley, and the unique qualities of being part of the Refuge System.
- Ensure that all current and future brochures and other refuge literature meet Service graphic standards.
- Design and install a comprehensive interpretive package (such as signage, displays, hands-on exercises, and literature) for the visitor contact area.
- Install a new kiosk at the refuge's west entrance on the road to Lower Red Rock Lake. Replace three degraded kiosks at Upper Lake campground, Elk Lake Road, and the east entrance. Design and install two updated interpretive panels at Shambow Pond near the pulloff and the sandhills. Design and install updated panels at the four existing kiosks, and at the one new kiosk.
- Staff the visitor contact area on weekends during months of high visitor use.
- Retain a primitive visitor experience while ensuring that the auto tour route is adequately interpreted with a brochure and low profile interpretive panels.
- Improve signs to ensure all visitors are oriented and understand refuge-specific regulations.
- Improve Sparrow Pond Trail so it is an accessible trail.
- Partner with the BLM and Forest Service to develop interpretive panels at Monida Hill and Red Rock Pass that highlight the value of the refuge and Centennial Valley as a critical wildlife corridor between the Bitterroot and Greater Yellowstone ecosystems.
- Measure results using a visitor questionnaire.

Rationale

The refuge offers excellent opportunities to interpret wildlife resources, the Refuge System, and the large intact landscapes found in the Centennial Valley and southwest Montana. By providing the opportunities listed above, visitors to the refuge should be well informed of refuge resources and its role within this large, undeveloped landscape. Any interpretive facilities will complement the wilderness, rustic qualities of the refuge while better orienting and educating visitors.

Environmental Education Objective

Environmental Education Objective 1: Work with partners to provide annual on-site environmental educational programs for up to five organized groups and 300 visitors and students of all abilities to foster an environmental ethic, and an understanding and appreciation of the issues and programs of the refuge and the value of the natural resources of the Centennial Valley.

Strategies

- Recruit a GS-6 temporary visitor services specialist (same as Interpretation Objective).
- Work with partners to develop environmental educational programs that support and promote the refuge's purposes, protection of the Centennial Valley, and the unique qualities of being part of the Refuge System.
- As part of each program, measure results through verbal and written questions.
- Expand the refuge's website to include educational tools, such as classroom projects and online exercises that educate students about the Refuge System and the values and importance of refuge and Centennial Valley resources. Results will be measured by an online questionnaire, and website usage will be monitored.

Rationale

The refuge is a popular destination to learn about and observe wildlife, hosting approximately 12,000 visitors annually, primarily during the summer and fall months. Providing environmental education will help visitors and students gain a better understanding of the refuge, its wildlife, and its role in the larger Greater Yellowstone Ecosystem. The

refuge has opportunities to provide environmental education to groups, students, and overnight visitors; nevertheless, the refuge is remote and county roads are minimally maintained; particularly fall through spring. This objective is modest, recognizing these limitations, while capturing those opportunities to educate students and visitors who do make the journey to this refuge within the spectacular Centennial Valley.

Outreach Objective

Outreach Objective 1: Reach out to local, state, and federal representatives; local communities; landowners; nongovernmental organizations; and current and potential partners to promote an understanding of refuge purposes and management objectives and to garner support for management actions and the conservation easement program.

Strategies

- Promote participation by local landowners in conservation easement programs by providing information on the programs' benefits to the conservation of the valley and in promoting and preserving their way of life.
- Conduct annual visits and provide a briefing paper to local, county, state, and federal governments that highlights current refuge programs and challenges.
- Continue to work with nongovernmental organizations on projects of mutual interest, where appropriate, ensuring that projects support and enhance the refuge's purposes and the mission of the Refuge System.
- Measure the results of the outreach program by determining the level of support and understanding for refuge resources; current and proposed management programs; and the goals of the Refuge System.

Rationale

The refuge has many challenges and opportunities related to its remote location and wilderness characteristics. Because of the wild, undeveloped landscape of the Centennial Valley, the refuge has the opportunity to work with many partners to protect a large landscape and to provide travel corridors and near-pristine habitat for far-ranging wildlife such as wolves, grizzly bears, wolverine, elk, pronghorn, and waterfowl and other migratory birds. Outreach opportunities will encourage visitors, local communities, landowners, and governments to gain a better understanding the values of the Centennial Valley, the refuge, its resources, management issues, and the Refuge System.

Campgrounds Objective

Campgrounds Objective 1: Continue to provide two primitive campgrounds with a total of approximately seventeen campsites at Upper and Lower lakes to accommodate wildlife-dependent recreation in this remote wilderness setting.

Strategies

- Rehabilitate campground facilities, such as fire rings and access roads.
- Create an accessible campsite at River Marsh campground and improve the current accessible site at Upper Lake.
- Replace the restrooms at the campgrounds to make them accessible.
- Establish a recreational fee program by 2010 to provide added resources for maintaining the campgrounds.

Rationale

It is a policy of the U.S. Fish and Wildlife Service that, "We may allow other activities on refuges, such as camping, to facilitate compatible wildlife-dependent recreation" (605 FW 1, 1.2B). Due to the remote location of this refuge, the great majority of visitors using these campgrounds participate in wildlife-dependent activities on and adjacent to the refuge. The campgrounds allow visitors to stay multiple days to thoroughly experience the refuge, whether they are bird watching, hunting, fishing, hiking, or just experiencing wilderness solitude. Only one other location in the Centennial Valley provides a pit toilet. This is located just north of the refuge at Elk Lake—about 17 miles from headquarters. Elk Lake's primitive campsites are also well used by visitors who are fishing and hunting on other public lands. The refuge's campgrounds also provide a critical watering and stopping point for visitors hiking or biking the Contiguous and Great Divide trails, which both traverse the refuge.

Mike Parker/USFWS

This remote refuge has four houses for refuge staff.

Cultural Resources Objective

Cultural Resources Objective 1: Identify, value, and preserve the cultural resources and history of the refuge to connect the refuge staff, visitors, and the community to the area's past, while ensuring that 100% of known cultural resources are protected from federal and visitor activities.

Strategies

- Continue to conduct site-specific surveys for lands and facilities that may be disturbed by refuge management activities.
- Continue to maintain historic properties currently in use.
- Through partnerships, begin preparing a comprehensive, refuge-wide survey to determine the presence of cultural resources on the refuge.
- Design and print a brochure to interpret select cultural resources and historic structures.
- Address cultural resources in the auto tour interpretive brochure.

Rationale

The refuge has many known historical structures, many of which are still in use, including the refuge office, two residences, and a storage building. The Centennial Valley also has a rich history of Native and Euro-American presence. Federal laws and policies mandate the identification and protection of cultural resources on federal lands. Specifically, Section 106 of the National Historic Preservation Act requires all federal agencies to consider impacts on cultural resources before any federal action. Ideally, a comprehensive refuge-wide inventory will help ensure the protection of these resources. However, these inventories take time and are very costly, which is why most refuges have not completed surveys. Nevertheless, the law requires all federal activities that have the potential to impact cultural resources be evaluated. Throughout the life of this 15-year plan, the refuge will work with other partners, including the regional archaeologist and staff, to begin documenting cultural sites on the refuge. Until this survey is completed, the refuge staff will continue to work with the regional archaeologist to evaluate projects with the potential to have impacts, on a case-by-case basis.

Refuge Operations Goal

Prioritize for wildlife first and emphasize the protection of trust resources in the utilization of staff, funding, and volunteer programs.

Staff Objective

Staff Objective 1: Add the needed staff within 5 years of CCP approval; this includes temporary employees and volunteers necessary to fully carry out the CCP.

Strategies

- Recruit a WG-6 permanent seasonal maintenance worker to help with the large maintenance backlog in support of all refuge programs.
- Recruit one full-time permanent GS-5/7/9 wildlife biologist and at least three temporary biological science technicians.
- Recruit one full-time permanent GS-7 range technician.
- Use additional management capability money to recruit temporary employees, develop and implement the visitor services program, and enhance habitat management and monitoring.
- Annually recruit a temporary visitor services specialist.
- Annually recruit a temporary office assistant.
- Given the added staff and complexity of the expanded refuge programs, evaluate grade levels of current refuge staff.
- Require one staff member to maintain collateral duty law enforcement credentials to provide for the safety of visitors, staff, facilities, and wildlife.

Rationale

Additional staff, including permanent, temporary, permanent seasonal, and volunteer employees, will be necessary in order to carry out the objectives and strategies identified in the CCP. The funding for permanent employees is included in the refuge's base budget, and they return each year, either full-time or seasonal. Temporary employees are funded using annual project money for various refuge programs such as biology, administration, and maintenance. Most employees work for less than six months, but may be employed anytime of the year. Since these temporary positions are based on annual funding, there is no commitment to renew them each year. There have been many needs identified in the CCP such as suggested improvements to the existing maintenance, habitat management and monitoring, law enforcement, and visitor services programs. Many of these changes are dependent on the availability of additional staff to design and execute these new programs. These additional positions will be critical to achieving the vision and goals presented in the CCP. There has been little change to the number of permanent staff and no added housing since the 1950s. Nevertheless, visitor numbers have increased since the refuge was established. Facilities, many historical, are in disrepair, issues have changed and become more challenging, and there

are new opportunities and technologies available to better understand and manage refuge resources. Accommodating visitors and managing the refuge properly takes more than money, it takes people with the expertise to develop and carry out programs. These added challenges and increased staff size, combined with the large area of responsibility, should also warrant evaluating the grade levels of current staff positions.

Facilities Objective

Facilities Objective 1: Maintain, create, or rehabilitate facilities to provide staff and visitors of all abilities with a safe and quality experience while preserving and complementing the remote wilderness character of the refuge.

Strategies

- Construct up to four new residences.
- Build three trailer pads for housing volunteers to support refuge programs.
- Improve parking at headquarters, Odell Creek and Sparrow Pond trailheads, and the entrance to Lower Lake Road.
- Replace all vault toilets with "clean-smelling" technology vault toilets, making them universally accessible to meet requirements of the Architectural Barriers Act Accessibility Standard for Federal Facilities. Develop accessible parking and access routes to all accessible facilities.
- Provide a universally accessible boat launch (hardened surfaces) at Lower Lake for persons with disabilities.
- Provide an accessible trail to Sparrow Pond.
- Replace Red Rock Creek Bridge on Culver Road (currently open to the public) with a new bridge, to allow for development of an auto tour route, and replace Sparrow Pond Trail Bridge used for foot traffic and by heavy equipment to maintain water control structures.
- Provide accessible pulloffs along the auto-tour route for the safe viewing of wildlife and photography.
- Investigate the feasibility of rehabilitating the historic fire tower, in keeping with regulations, and opening it to public access.
- Replace three kiosks and add one new kiosk.
- Replace and update all interpretive panels and signage to ensure visitors are oriented, informed, and feel welcome.
- Improve road, campsites, and parking at Upper Lake campground.
- Rehabilitate existing refuge residences (Q94 foundation repair, Q94 and 110 garage replacement, Q1 foundation and interior rehabilitation, Q90 health safety/attic, and windows in most residences) and restore or stabilize other historic structures (headquarters log barn, Shambow Creek barn, and fire tower).
- Repair and rehabilitate the shop building to be more in keeping with the historic site.

Mike Parker/USFWS

Red Rock Lakes National Wildlife Refuge, Montana.

Table 8. Current and proposed staff, Red Rock Lakes National Wildlife Refuge, Montana.

Program	*Current Positions*	*Proposed changes/added positions*
Management	Refuge manager, GS-13	
	Assistant manager, GS-11	Evaluate this management position for upgrade to the next grade level.
Biological	Wildlife biologist, GS-11	Evaluate the current biologist position for an upgrade to a GS-12. GS-5/7/9 full-time permanent wildlife biologist. GS-7 full-time permanent range technician. At least three temporary biological science technicians.
Administrative	Administrative support assistant, GS-7	Temporary administrative assistant (generalist).
Maintenance	Maintenance worker, WG-8	Additional temporary WG-6 maintenance worker.
Visitor Services	None	GS-6 temporary visitor services specialist

– Replace existing boundary fencing and construct new boundary fencing for newly acquired lands.
– The public will continue to be provided access down Idlewild Road. The refuge will post a sign recommending that only 4-wheel drive or high clearance vehicles utilize the road. The road may be closed at any time due to weather and road conditions.

Rationale

One of the greatest limitations to expanding the refuge's biological and visitor services programs is the lack of staff and facilities. The refuge is located in one of the most remote valleys in Montana where there is often no available housing; thus, the Service needs to provide housing for all staff. Currently, all refuge houses are occupied by existing staff. Adding any new positions will require additional housing.

Existing staff and visitor facilities (such as buildings, signs, kiosks, roads, fences, trails, parking, and campgrounds) are also in need of major repair or replacement in order to provide for a safe, productive working environment and to promote the refuge and its resources in an effective, safe, and professional manner. Maintenance of these facilities will require some additional funding but most importantly, an additional permanent seasonal maintenance person (see Staff Objective 1).

4.3 STAFFING AND FUNDING

Current staffing at the refuge consists of five permanent full-time employees. Table 8 shows the current staff and proposed additional staff required to fully implement the CCP. Due to the area of responsibility and added complexities of this plan all grade levels for current staff will be evaluated. If all positions are funded, the refuge staff will be able to carry out all aspects of this CCP, which will provide maximum benefit to wildlife, improve facilities, and provide visitor services. Projects that have adequate funding and staffing will receive priority for accomplishment. Staffing and funding are requested for the 15-year life of this CCP.

4.4 STEP-DOWN MANAGEMENT PLANS

The CCP is intended as a broad umbrella plan that provides general concepts and specific wildlife, habitat, visitor services, and partnership objectives over the next 15 years. The purpose of the step-down

Table 9. Step-down management plans for Red Rock Lakes National Wildlife Refuge, Montana

Plan	*Completed Plan, Year Approved*	*New or Revised Plan, Completion Year*
Habitat Management	—	2015
Fire Management	2002	2011
Disease Contingency	2006	2017
Wilderness Management	1986	2015
Refuge Safety	2008	2011
Visitor Services	1986	2014
Wildlife Inventory and Monitoring	—	2016
Spill Prevention Control and Countermeasures	2006	2013

management plans is to provide greater detail to managers and employees for carrying out specific actions and strategies authorized by the CCP. Table 9 presents the plans needed for the refuge, their status, and the next revision date.

4.5 PARTNERSHIP OPPORTUNITIES

A major objective of this CCP is to establish partnerships with landowners, volunteers, private organizations, and county, state, and federal natural resource agencies. In particular, landowners will be informed of opportunities to participate in compensated habitat protection programs (such as conservation easements). Opportunities exist to enhance or establish new partnerships with nonprofit organizations, sporting clubs, community organizations, and educational institutes. Strong partnerships already exist with The Nature Conservancy, MFWP, Montana State University, Beaverhead County Weed District, Centennial Valley Association, and Centennial Valley Historical Society.

4.6 MONITORING AND EVALUATION

The Service proposes that the uncertainty surrounding habitat management can be dealt with most efficiently within the framework of adaptive resource management (ARM) (see figure 16) (Holling 1978; Kendall 2001; Lancia et al. 1996; Walters and Holling 1990). This approach provides a system within which objective decisions can be made and the uncertainty surrounding those decisions reduced. Briefly, the key components of an ARM plan follow:

1. Clearly defined management goals and objectives.
2. A set of management actions with associated uncertainty as to their outcome.
3. Various alternative working hypotheses describing the response of species or communities of interest.
4. Monitoring and assessment of the response of target organism(s).
5. Use of monitoring and assessment information to direct future decision making through the selection of a best model.

The first three components (goals, actions, and models) are largely defined before initiation of an ARM plan, while the latter two (monitoring and directed decision making) comprise an iterative process, whereby each year the predictive ability of models are tested against what was observed during monitoring. This may result in a new best model, greater support for the existing best model, or new models constructed from emerging hypotheses. In this way, habitat management "evolves" as more information about the refuge is gained and uncertainty is reduced.

Development of ARM plans for habitat management will allow the refuge to "learn by doing," while maintaining a focus on management objectives. Knowledge gained from assessing management actions is considered as integral to the process as the management actions themselves. This emphasis on gaining knowledge about the refuge creates a situation whereby the refuge can refine its habitat management in a feedback between management and assessment. Reducing the uncertainty of habitat management via ARM plans will greatly help the refuge in development of long-term habitat management plans.

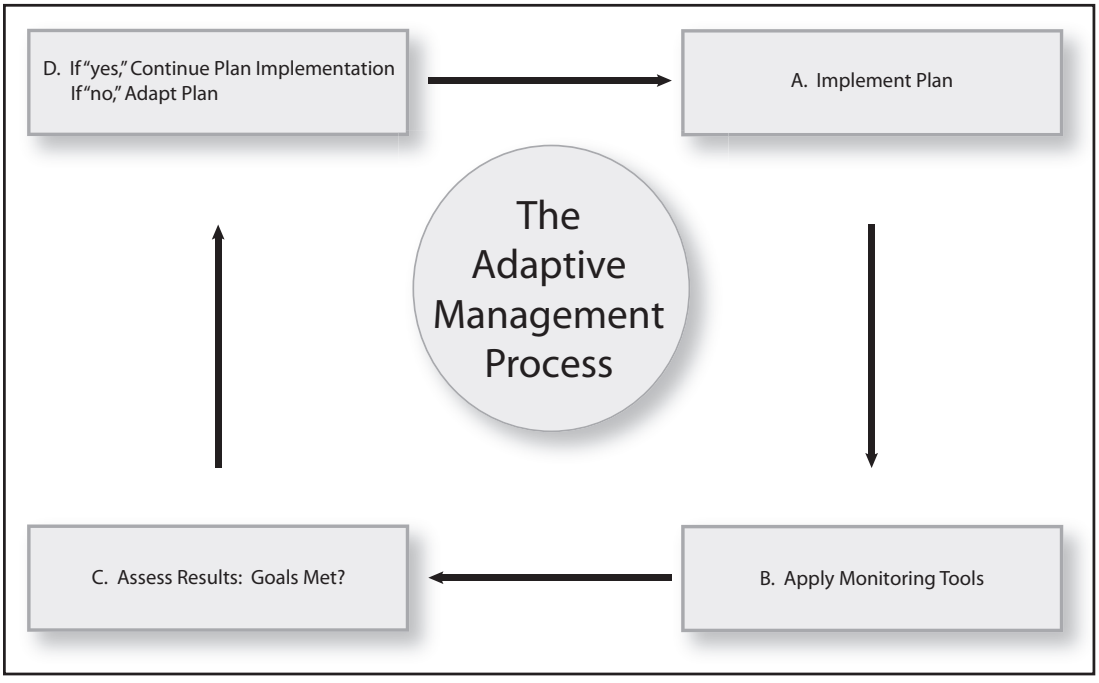

Figure 16. Adaptive management process.