CHAPTER 3—Refuge Complex Resources and Description

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Grasslands characterize much of the Karl E. Mundt National Wildlife Refuge.

This chapter describes the refuge complex's environmental resources that may be affected by the implementation of the CCP. It describes the physical environment and biological resources of refuge complex lands as well as its fire and grazing history, cultural resources, visitor services, socioeconomic environment, and operations.

3.1 Physical Environment

Located in southeastern South Dakota, the Lake Andes National Wildlife Refuge Complex includes two refuges and 85 waterfowl production areas (within one wetland management district) scattered throughout 14 counties (Aurora, Bon Homme, Brule, Charles Mix, Clay, Davison, Douglas, Gregory, Hanson, Hutchinson, Lincoln, Turner, Union, and Yankton). The refuge complex staff manages thousands of noncontiguous tracts of Federal and private land totaling 110,925 acres: 21,193 acres of refuges and waterfowl production areas and 89,732 acres of conservation easements (figures are current as of September 2010). The geology, topography, soils, and climate of refuge complex lands are discussed below. Unless otherwise noted, information in this section has come from Bryce et al. (1998).

Geology and Topography

The Lake Andes Refuge is situated in a partially buried bedrock valley (Kume 1977). All refuge complex lands are part of the Northern and Northwestern Glaciated Plains, whose landscape was created by the most recent continental glaciation event, the Late Wisconsin, which occurred 25,000–20,000 years ago. Glaciation left the landscape rich in moraine and numerous wetlands. The refuge complex consists of grasslands; riparian forests; upland habitat; native prairie; and temporary, seasonal, and semipermanent and permanent wetlands.

The majority of the refuge complex's waterfowl production areas and grassland and wetland easements fall within the Southern Missouri Coteau and Southern Missouri Coteau Slope ecoregions. The Southern Missouri Coteau ecoregion, the southern fringe of continental glaciation, exhibits gentle undulations in topography, smaller areas of wetland density, and more stream erosion. The Southern Missouri Coteau Slope ecoregion has a good amount of rock-free loess. The remaining waterfowl production areas and easements exist in the eastern portion of the Lake Andes District within the James River Lowland ecoregion. This ecoregion exhibits a flat to gently rolling topography, high density of wetlands, and warmer temperatures.

Karl E. Mundt Refuge in Gregory County is the only part of the refuge complex that lies west of the Missouri River. As such, the landscape of the refuge differs from that of the other refuge complex lands. This area falls in the Southern River Breaks ecoregion characterized by more temperate conditions with heavily wooded deciduous forests. The topography is characterized by dissected hills and canyons with

slopes of high relief bordering the Missouri River and its alluvial plains. Cretaceous Pierre Shale is the primary surface geology.

The refuge complex lies within the westernmost extent of continental glaciation (Pre-Late Wisconsin Glaciation and Late Wisconsin Glaciation). The melting ice from this glacial stagnation and retreat formed most of the prairie potholes found throughout the refuge complex. The geological materials underlying the refuge complex lands consist of Wisconsinan glacial till and loess over Cretaceous Pierre Shale (exposed bedrock is present throughout the city of Lake Andes and along the bluffs of the Missouri river) and sandstone of Niobrara Formation (primary bedrock of the refuge complex lands in the eastern portion of the Lake Andes District) (Johnson and Higgins 1997).

Soils

Soils differ in the four ecoregions—the Southern Missouri Coteau, Southern Missouri Coteau Slope, James River Lowland, and the Southern River Breaks—in which refuge complex lands lie. The main soil series in the Southern Missouri Coteau ecoregion are Eakin, Highmore, Java, Beadle, Dudley, DeGrey, and Zahl. These soils are deep and moderately to well drained and formed in silty or clayey material over glacial till with permeability ranging from slow to moderate.

The main soil series in the Southern Missouri Coteau Slope ecoregion are Highmore, Mobridge, Houdek, and Ethan. Deep, well drained soils formed in loamy glacial till, silty glacial drift, or silty alluvium on uplands. Permeability ranges from moderate to moderately slow.

The James River Lowland ecoregion is made up of the Beadle, Dudley, Hand, Bonilla, Houdek, and Prosper soil series. These soils are generally deep, moderately to well-drained, loamy, or silty soils on uplands. These soils range in permeability from very slow to moderate.

The Southern River Breaks ecoregion mainly consists of the Tuthill, Sansarc, Okaton, and Manter soil series. With the exception of Manter (a deep soil), these soils are generally shallow, well drained and formed in clayey shale residuum on uplands. Permeability ranges from slow to moderately rapid.

Climate

Relative to the rest of the Northern and Northwestern Glaciated Plains, the southern location of the refuge complex results in milder winters with longer, warmer summers. Temperatures range from –16 °F to 104 °F and average 51 °F. Annual rainfall varies from 17 inches to 24 inches while annual evaporation can amount to 36 inches, resulting in some years of marginal to poor wetland conditions. Precipitation on Karl E. Mundt Refuge averages 20–22 inches, and average snowfall is 60 inches.

3.2 Water Resources

Surface water

Lake Andes and the Missouri and James Rivers are the primary sources of water supply for the refuge complex. Two roadway dikes separate Lake Andes into the North Unit, Center Unit, and South Unit. Lake Andes has a drainage area of about 230 square miles. Andes Creek flows into the North Unit and is the largest contributor of inflow into the Lake Andes Basin. The remaining units receive inflow from several unnamed tributaries. Tributaries to Lake Andes are ephemeral (Sando and Neitzert 2003). The water level of Lake Andes is solely dependent on watershed runoff, thus fluctuations between flooding and a completely dry lake bed are common.

Agriculture is widespread throughout the fourteen-county region of the refuge complex. Unfortunately, some agricultural activities—especially feedlot operation and crop production—cause nutrient enrichment, siltation, and algal growth that, together with other causes, have impaired the quality of water basins, streams, and Lake Andes over the years. Poor water quality significantly degrades the quality of fish and wildlife habitat in the lake. Refuge complex staff are participating in meetings with CMCLRO and supporting and guiding its efforts to improve water quality and quantity in Lake Andes. CMCLRO seeks to improve water quality through the following actions:

1. Sediment removal. CMCLRO seeks to remove sediments from Lake Andes that are laden with high levels of nitrogen and phosphorus—nutrients that lead to frequent algae blooms that cloud the water and block sunlight penetration to a degree that many species of aquatic plants cannot grow. When the algae decompose, the oxygen content of the lake water is reduced to a level at which sport fish species and other aquatic animals and plants cannot survive.
2. Supporting soil conservation practices. CMCLRO is supporting ongoing government efforts to clean up the Lake Andes watershed through cost-shared, voluntary soil conservation practices (for example, planting buffer strips to reduce agricultural runoff, fencing livestock out of seasonal drainages, cost-sharing agricultural waste containment systems).
3. Controlling the rough fish population. CMCLRO intends to remove carp and bullhead species of rough fish that persist in oxygen-poor waters. The feeding behaviors of these fish agitate the water to the degree that sunlight penetration is blocked, thereby reducing aquatic vegetation.

Ground water

The Lake Andes Basin and Choteau Creek Basin reach across the following counties: Aurora, Charles Mix, Gregory, Davison, Douglas, Hutchinson, and Bon Homme (Sando and Neitzert 2003).

The Dakota Aquifer, one of the classic artesian aquifers, covers most of central North America and is part of the Great Plains Aquifer System (Bredehoeft et al. 1983). The Dakota Aquifer in southeastern South Dakota consists of Dakota Formation overlain by Cretaceous shales (Gosselin et al. 2003).

In 1985, an artesian well was placed 960 feet into the Dakota sandstones of the Dakota Aquifer. This free-flowing well drains ground water into Owens Bay. When first installed, this well pumped 900 gallons per minute. Today, this rate has decreased by about 70 percent to 250 gallons per minute.

Wetlands

Wetlands are lands where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface (Cowardin et al. 1979). Wetlands are extremely productive and important as breeding and nesting habitat for migratory birds and as wintering habitat for many resident wildlife species.

Wetlands are classified using a number of attributes including vegetation, water regimes (the length of time water occupies a specific area), and water chemistry. Prairie potholes are described using the following nontidal water regime modifiers (Cowardin et al. 1979):

- Temporarily flooded: surface water is present for brief periods during the growing season. The water table usually lies below the soil surface most of the season, so plants that grow in both uplands and wetlands are characteristic.
- Seasonally flooded: surface water is present for extended periods especially early in the growing season, but is absent by the end of the season in most years.
- Semipermanently flooded: surface water persists throughout the growing season in most years. When surface water is absent, the water table is usually at or very near the land surface.
- Permanently flooded: water covers the land throughout the year in nearly all years. Vegetation comprises obligate hydrophytes, such as cattails.

Even though drainage and other wetland-decimating factors have taken their toll, wetlands are still a prominent feature of the landscape within the refuge complex. Wetlands on the refuge complex range from temporarily flooded to permanently flooded. Surface hydrology of these wetlands is influenced by a combination of precipitation, surface runoff, surface water, and ground water inputs.

Water rights

The following is a summary of water rights associated with refuge complex lands:

- Lake Andes holds water rights filed April 22, 1940, for a total of 20,534 acre-feet, of which 13,721 acre-feet are for storage and 6,813 acre-feet are for seasonal use.
- Owens Bay Well holds water rights filed July 6, 1956, for 2.22 cubic feet per second from the Dakota Sandstone artesian aquifer to be stored in Owens Bay.
- Varilek Waterfowl Production Area holds water rights filed December 27, 1988, for 139 acre-feet of storage.
- Sherman Waterfowl Production Area holds water rights filed December 27, 1988, for 271 acre-feet of storage.
- Broken Arrow Waterfowl Production Area holds water rights filed October 7, 1985, to impound 131.2 acre-feet of storage from Joubert Drain through the means of Dam #7.
- Roth Waterfowl Production Area holds water rights filed July 30, 1997, for 323 acre-feet of storage and 212 acre-feet of seasonal use.
- The Lake Andes District holds 904 wetland easement contracts protecting 37,985 acres of naturally occurring wetlands.

3.3 Vegetation Communities

Vegetation communities associated with the refuge complex's wetland, upland, and riparian areas are discussed below. Figures 15–18 show the various land cover types found on and around refuge complex lands.

Wetlands and associated vegetation communities

Wetlands throughout the refuge complex provide both resting cover and food resources for migratory birds. Substantial emergent and submergent aquatic vegetation occurs in freshwater wetlands. Sago pondweed, coontail, and duckweed occur in the deeper, more permanently flooded zones, while cattail, bulrush, bur-reed, and smartweed grow in shallow areas that may go dry due to a drawdown. Poor water quality is a limiting factor for aquatic vegetation in individual wetlands scattered throughout the refuge complex. The poor quality can lead to algae blooms, reducing sunlight penetration and thus restricting growing potential for aquatic plants.

Most palustrine basins exhibit concentric zones of vegetation that are dominated by different plant species (Kantrud et al. 1989). The terms commonly used

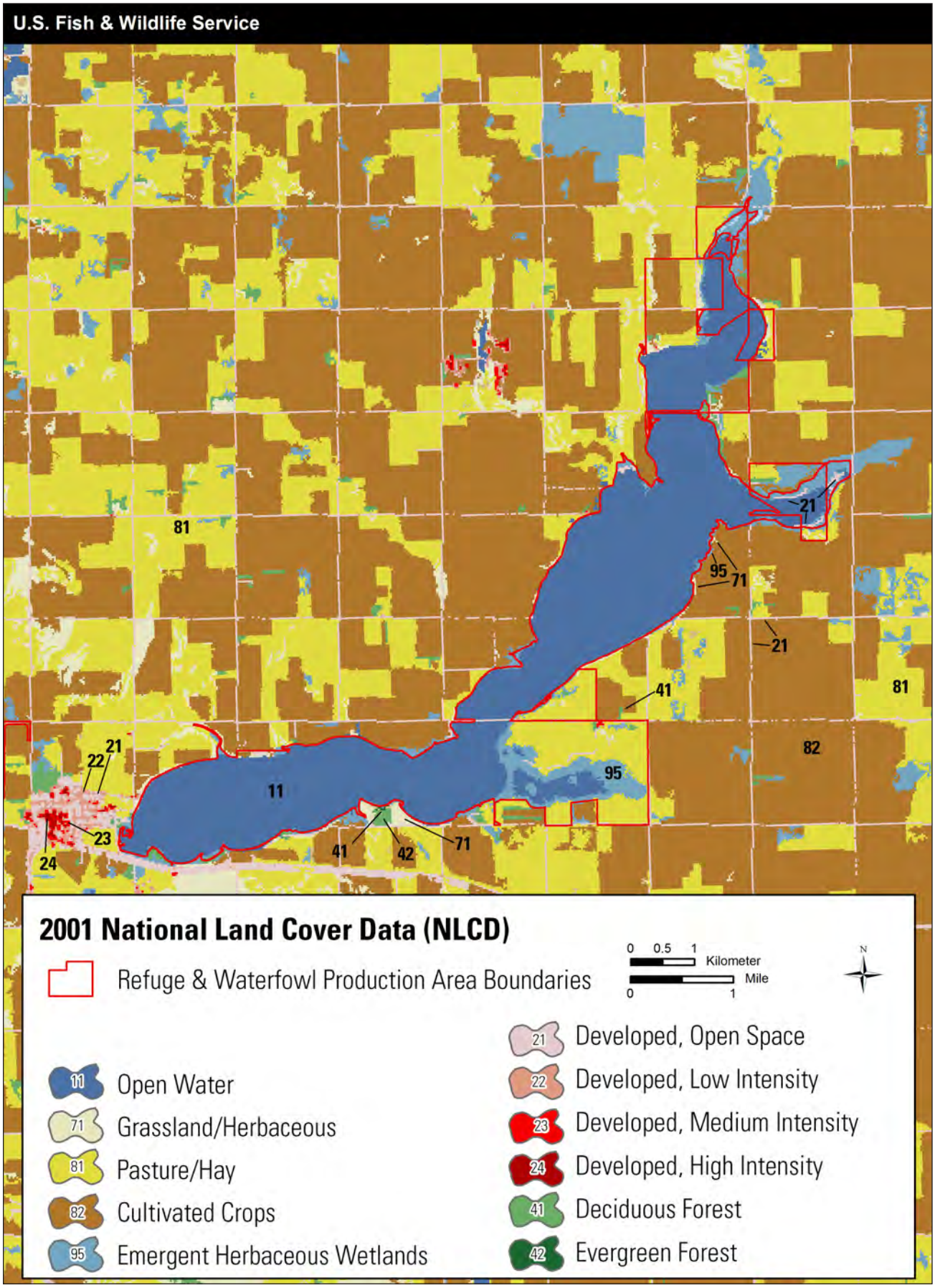

Figure 15. National Land Cover Data for the Lake Andes National Wildlife Refuge, South Dakota.

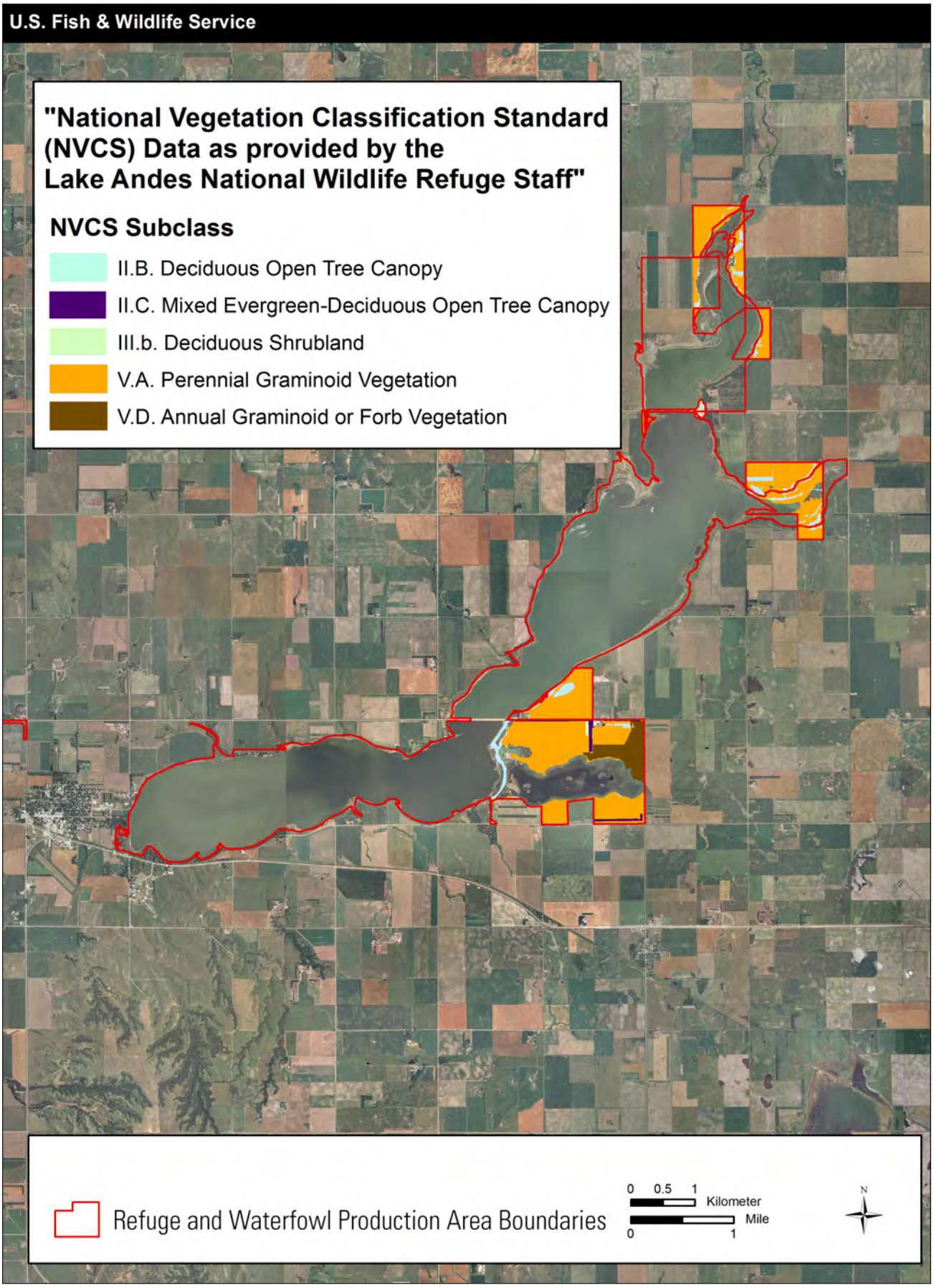

Figure 16. National Vegetation Classification Standard vegetation on the Lake Andes National Wildlife Refuge, South Dakota.

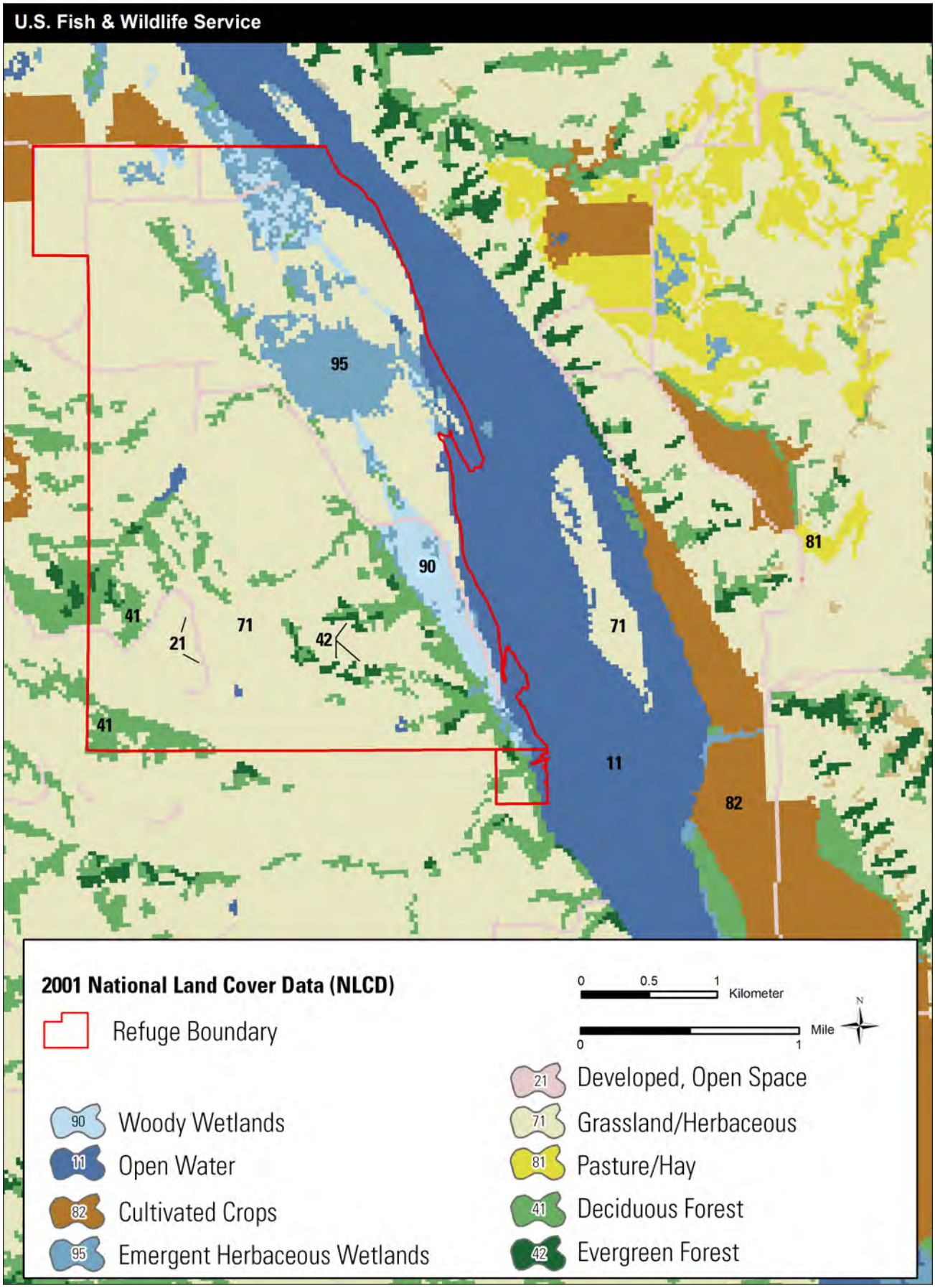

Figure 17. National Land Cover Data for the Karl E. Mundt National Wildlife Refuge, South Dakota.

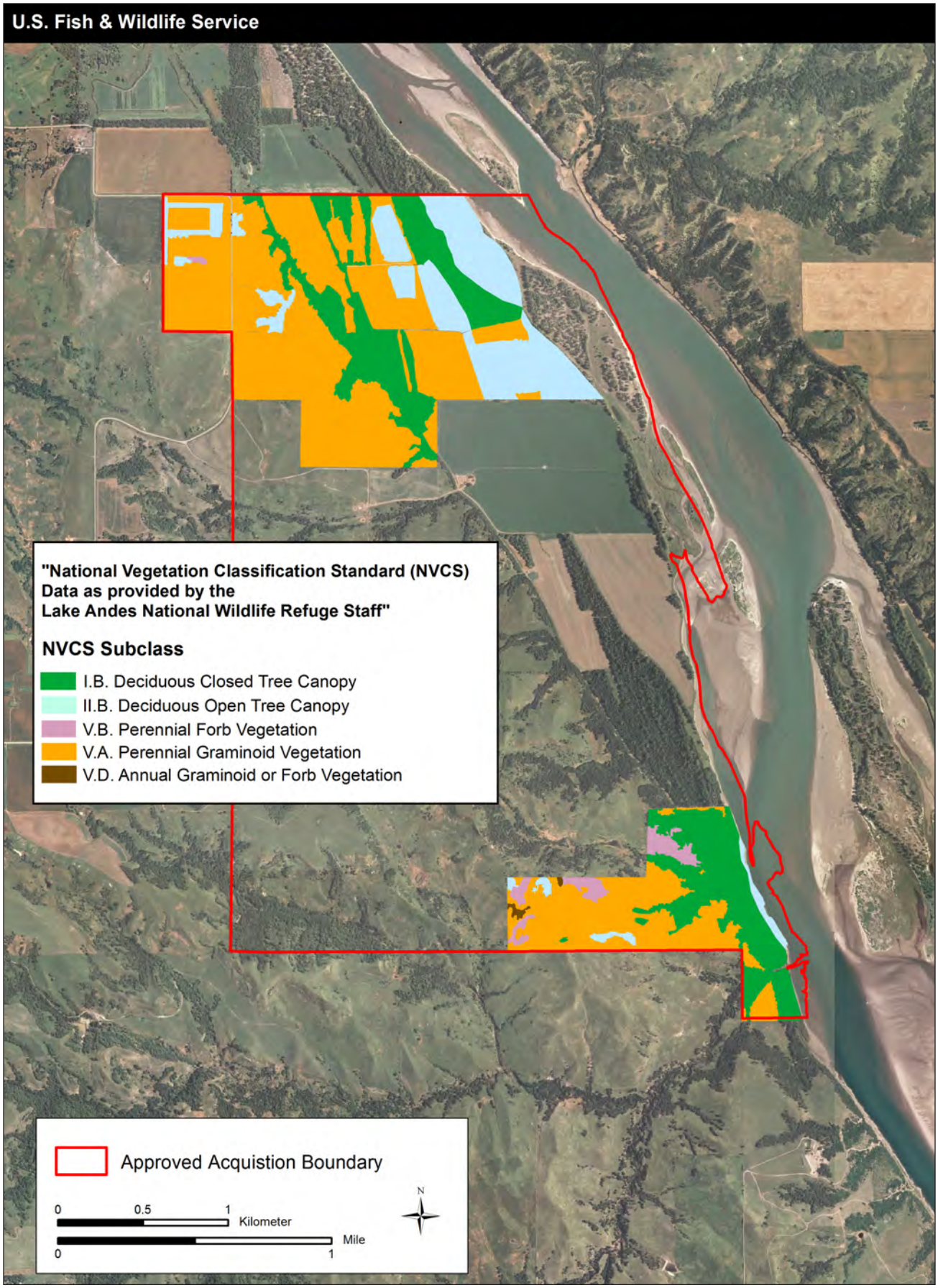

Figure 18. National Vegetation Classification Standard vegetation on the Karl E. Mundt National Wildlife Refuge, South Dakota.

in reference to these zones are, in decreasing order of water permanency, deep marsh, shallow marsh, and wet meadow (Kantrud et al. 1989). The water regime in a deep marsh zone is usually semipermanent. Dominant plants include cattail, bulrush, submersed or floating plants, and submersed vascular plants, but this zone also may be devoid of vegetation if bottom sediments are unconsolidated. Shallow marsh zones are usually dominated by emergent grasses, sedges, and some forbs, but submersed or floating vascular plants also may occur. Wet meadow zones also are typically dominated by grasses, rushes, and sedges, whereas submersed or floating plants are absent.

Management of wetlands in the refuge complex where facilities have been developed (Owens Bay and Broken Arrow Waterfowl Production Area) simulates natural (that is, historical) wet–dry cycles by raising and lowering water levels to meet specific management objectives. This encourages emergent and submergent aquatic vegetation growth, increases invertebrate biomass, improves water clarity, breaks down and cycles accumulated nutrients in bottom sediments, and augments control of common carp. Extensive mudflats are created when wetlands are in the initial drawdown phase. Mudflats provide optimal feeding opportunities for migrating shorebirds, wading birds, and other waterbirds.

The wetland easement program has provided perpetual protection for 37,985 acres of wetlands on private lands in the wetland management district. A current total of 54 Farmers Home Administration easements protect 3,834 acres of wetlands. This has secured a landscape-level habitat base for migratory birds. While normal farming practices may have erased some of the smaller, temporary, and seasonal wetland basins, most of the habitat here remains intact.

Uplands and Associated Vegetation Communities

Upland vegetation is essential in providing nesting habitat for migratory and resident bird species. Upland habitats also provide necessary habitat requirements for resident wildlife throughout the year. The Lake Andes District holds 199 grassland easement contracts, providing perpetual protection for 38,103 acres of privately owned grasslands within the district. The program continues to expand the acreage protected annually.

The refuge complex currently uses a variety of management techniques to maintain and enhance upland habitat conditions on fee-title uplands including the use of prescribed fire, grazing, haying, native grass seeding, and invasive species management.

During the 1930s, large fields formerly planted to crops were planted with nonnative grasses, including smooth brome, crested wheatgrass, and Kentucky bluegrass species, to minimize soil erosion.

In the early 1970s, habitat management techniques were developed to provide dense nesting cover for waterfowl. Several areas on the refuge were planted to grass species such as tall and intermediate wheatgrass, sweet clover, and alfalfa. These fields initially provided good cover for nesting birds; however, over time they deteriorated and were prone to invasion by Canada thistle and other problem species (for example, smooth brome). The refuge complex has begun the process of restoring these grasslands to native grasses and forbs. The native grass restoration process generally involves cropping the field for 3 or more years to eliminate exotic cool-season grass seeds and rhizomes, control Canada thistle and other noxious weeds, and prepare a seedbed for planting native grass seed.

Uplands historically were comprised of warm-season grasses characteristic of the shortgrass prairie to the west and the cool- and warm-season grasses characteristic of the tallgrass prairie to the east (Samson et al. 1988); thus, the area represented a zone of ecotonal mixing that included a diversity of short grass, intermediate grass, and tallgrass species (Bragg and Steuter 1996). The most common mixed-grass prairie grass species within the refuge complex include western wheatgrass, slender wheatgrass, witchgrass, blue grama, sideoats grama, needle and thread, Indiangrass, switchgrass, big bluestem, little bluestem, and Canada wildrye. Smooth brome and Kentucky bluegrass are nonnative, invasive species that are dominant throughout many refuge complex lands. Chemical, mechanical, and biological control of these species is of high priority. Common upland forbs include American licorice, annual sunflower, Canada goldenrod, curlycup gumweed, heath daisy, hemp dogbane, leadplant, Maximilian sunflower, meadow anemone, Missouri goldenrod, showy milkweed, silverleaf scurfpea, smartweed, stiff goldenrod, stiff sunflower and woolly verbena. Prairie rose and prickly rose are the most prevalent shrubs found throughout refuge complex uplands.

Many native prairie uplands (grasslands without a farming history) on the refuge complex have been invaded by non-native grasses, especially smooth brome, Kentucky bluegrass, and crested wheatgrass. These monotypic stands are less attractive to nesting grassland birds including waterfowl. Grassland management (burning, grazing and haying) is necessary to restore the quality of these habitats.

In efforts to emulate these natural regimes that sustained wildlife populations before pioneer settlement, land managers must attempt to simulate the ecological processes that maintained the habitat before settlement. A strategy to improve competitive advantages of native herbaceous plants should match the types, timing, and frequencies of prescribed disturbances to those under which these plants evolved. Several

sources indicate that native grasslands devoid of grazing and fire deteriorate quickly (Anderson et al. 1970, Kirsch and Kruse 1973, Kirsch et al. 1978, Schacht and Stubbendieck 1985). The grasslands function similarly to living organisms in that they respond to activities within the ecosystem. Specifically, the forbs and grasses covering the landscape have developed biological adaptations to thrive in the presence of herbivory and fire. Wildlife managers use various tools—including prescribed fire and prescribed grazing—to emulate the defoliation process with which prairie plants evolved. The frequency of certain activities depends on the particular habitat components. For instance, a pristine native prairie tract may require a burn every 3–5 years and intermittent, prescribed grazing of domestic cattle, whereas areas that are heavily invaded require more frequent management treatments. Prescribed fire, mowing, and herbicide application can reduce the abundance of smooth brome, but without sustained control efforts, the species is remarkably persistent (Willson and Stubbendieck 2000).

In determining restoration actions, vegetation composition is considered along a habitat continuum, where plant communities can be separated by degree of invasion by undesirable plants. A continuum for native prairie in eastern South Dakota (beginning with the least desirable vegetation) could be shown as: noxious weeds (for example, Canada thistle or leafy spurge) → nonnative, woody species (for example, Russian olive or Siberian elm) → invasive, volunteer woody species (for example, eastern red cedar) → smooth brome → Kentucky bluegrass → native low shrubs (for example, western snowberry) and native herbaceous vegetation. With management, less desirable plant species are replaced by more desirable plant groups. For example, it is acceptable in the short term to increase Kentucky bluegrass in areas where leafy spurge is reduced. Conversely, replacement of Kentucky bluegrass by smooth brome is undesirable.

Therefore, restoration management should focus more on strategies to reduce smooth brome. Smooth brome generally seems more difficult to control than other introduced cool-season grasses (Murphy and Grant 2005). Smooth brome, Kentucky bluegrass, and crested wheatgrass are all "strong invaders" (Ortega and Pearson 2005), able to become community dominants and form nearly monospecific stands. However, smooth brome more significantly alters the quality and structure of native prairie than does Kentucky bluegrass (Blankespoor 1987); may have a competitive advantage over native grasses, particularly in high nitrogen soils (Vinton and Goergen 2006); and can modify soil microbiota to directly facilitate its own invasion and subsequently impede restoration of native communities (Jordan et al. 2008).

A strategy to decrease the competitive abilities of Kentucky bluegrass and smooth brome should focus on the combined use of prescribed fire and prescribed grazing. Kentucky bluegrass responds well to fire, decreasing in abundance as fire frequency increases until it is nearly absent in annually or biannually burned plots in both low-productivity (Knops 2006) and high-productivity prairies (Smith and Knapp 1999, Towne and Owensby 1984). Fire has the greatest negative effect on Kentucky bluegrass during stem elongation or in dry years (Murphy and Grant 2005). Conversely, Kentucky bluegrass tends to increase under prolonged rest or with grazing (Murphy and Grant 2005). Smooth brome also increases under rest but, in contrast to Kentucky bluegrass, appears sensitive to repeated grazing but unaffected or variably affected by prescribed fire (also reviewed in Murphy and Grant 2005). Periodic monitoring will ensure that the appropriate management treatment is applied for the invasive species and severity of the infestation on the given management unit.

Historically, the prairie was a treeless landscape. Trees and tall shrubs can diminish the survival of nests of grassland birds by harboring potential nest predators. They also provide perches from which brown-headed cowbirds can find other species' nests in which to lay eggs. Relatively small areas of tall woody vegetation can effectively fragment grassland habitats and cause many grassland bird species to avoid entire landscapes. Based on these findings, elimination of tall woody cover is a logical strategy for restoration of landscape structure and plant community composition, as well as a means to improve the attractiveness and security of the habitat for a variety of grassland-breeding bird species.

Although the focus of this objective is the restoration and maintenance of floristic composition in native prairie, wildlife will also benefit. The contemporary breeding bird community on waterfowl production areas in eastern South Dakota is characterized by species that tolerate introduced, cool-season grasses and relatively tall, dense, herbaceous cover. Habitat for a broader array of northern prairie birds (including several endemics and other species characteristic of the historical native prairie community) may be significantly increased by providing frequent disturbance and the resulting increases in early successional stages.

Nevertheless, there are often tradeoffs in wildlife response to consider when reintroducing major habitat disturbances such as fire and grazing; short-term losses should be weighed against net gains over longer periods. For example, management treatments might influence the survival of grassland bird nests—directly by burning nests or through livestock trampling, or indirectly through increased predation or brood parasitism rates—when nest site vegetation is modified by fire or grazing.

Despite declines in densities during the first growing season following a prescribed burn, Murphy et al. (2005) found that most species of grassland-breeding birds in northern mixed-grass prairie are adapted to recurring fire (every 4–6 years) by nesting in unburned patches and returning to pre-burn levels of abundance and nest density after the first growing season. Further, the authors found that fire had almost no discernible impact on nest survival for all species of grassland birds examined, with the exception of the Savannah sparrow in the first post-burn growing season.

Murphy et al. (2005) found similar results for waterfowl; duck nest densities were reduced during the first growing season following a fire, but recovered 2–3 years post-fire. Similarly, Kruse and Bowen (1996) found that grazing alone reduced nest densities during the grazing years, but the vegetation and ducks recovered quickly after grazing ended. However, studies of nesting success have reported neutral to positive responses of waterfowl to grazing and prescribed fire. Murphy et al. (2005) found greater nest survival for mallards and gadwalls during the first post-fire growing season than in subsequent years and no fire effects on nest survival in other duck species, regardless of how recently fire had occurred. Kruse and Bowen (1996) found that waterfowl nest success was not influenced by prescribed fire and grazing treatments, while several studies have reported greater nesting success in grazed grasslands than in other habitats in the Plains and Prairie Pothole Region (Barker et al. 1990, Greenwood et al. 1995). Warren et al. (2008) found that nesting females were most successful at sites with above-average vegetation density that are in fields with increased grazing intensity (that is, nesting in clumps of vegetation in areas more generally characterized by low levels of residual cover). Grazed areas may attract fewer predators because of low densities of some types of prey, such as small mammals (Grant et al. 1982, Runge 2005), less cover for concealment, or both. Higher nesting success in grazed fields may occur because predators respond negatively to low prey density (Clark and Nudds 1991, Lariviére and Messier 1998).

South Dakota upland plant associations are shown in appendix G.

Riparian areas and associated vegetation communities

The riparian areas of the refuge complex fall mostly within the Karl E. Mundt Refuge, located along the Missouri River. The broken topography of the river breaks provide valuable riparian habitat. Draws and northern aspects are heavily wooded with deciduous forests that provide essential roosting and nesting sites for bald eagles and many other migratory birds.

Cottonwood forests were historically a major component of the floodplains of the Missouri River. Floods supported a healthy ecosystem by offering moisture to sustain trees and wetland plants, depositing sediment and nutrients to enhance soils and providing seedbeds for establishing new cottonwood stands. The use of flow-regulating facilities (for example, levees and dams) has led to major cottonwood declines with existing cottonwood stands aging and being replaced by later-successional species. Bald eagles are highly dependent on mature cottonwoods for roosting and nesting. A cottonwood restoration plan is essential for the restitution of riparian diversity and habitat for bald eagle and other migratory bird species.

Dominant trees of the riparian woodlands include prairie cottonwood, green ash, American elm, box elder, hackberry, peach-leaved willow, bur oak, white mulberry, common hackberry, and honey locust. Russian olive and eastern red cedar are invasive tree species that are beginning to dominate the landscape. The presence of these species can reduce the integrity of the riparian habitat. Emphasis is placed on the eradication of these species on refuge complex riparian lands.

Common shrubs include roughleaf dogwood, riverbank grape, woodbine, narrowleaf willow, and sandbar willow. Riverbottom grasses and forbs are primarily Canada wildrye, prairie sandreed, big bluestem, switchgrass, dogbane, milkweed, white snakeroot, Downy brome, sand dropseed, sedge, ragweed, sweetclover, and prairie cordgrass. Canada thistle has infested almost all riparian margins in eastern South Dakota, including those that lie within the refuge complex. Leafy spurge and musk thistle are also becoming widespread invaders in these areas. This is particularly troublesome because invasive plants in riparian areas provide a constant supply of seed to downstream areas through water movement. Chemical, mechanical, and biological control of Canada thistle and other herbaceous weed infestations are of high priority.

Dominant plants of the uplands of riparian areas include switchgrass, big bluestem, little bluestem, sideoats grama, western wheatgrass, green needlegrass, silver buffaloberry, and yucca. Invasive species such as Canada thistle, musk thistle, and leafy spurge are also invading these uplands and are being targeted with control methods.

3.4 Wildlife

Mammals

A total of 57 mammals have been recorded in South Dakota (appendix H); of these, 48 mammal species have been recorded on the refuge complex. Representative species include coyote, red fox, white-tailed jackrabbit, white-tailed deer, thirteen-lined ground squirrel,

badger, raccoon, mink, muskrat, striped skunk, deer mouse, masked shrew and meadow vole.

Birds

Numerous bird species occur in South Dakota (appendix H); more than 220 bird species have been documented throughout the refuge complex. There are 85 bird species known to breed within the refuge complex, 13 of which are waterfowl species. The six most abundant of the breeding duck species include mallard, blue-winged teal, northern pintail, gadwall, American widgeon, and northern shoveler. When habitat conditions are favorable, breeding duck densities exceed 60 pairs per square mile in several portions of the refuge complex. The Service began conducting annual breeding waterfowl population surveys throughout North Dakota, South Dakota, and northeastern Montana in 1987, focusing on 13 duck species that are the primary breeding species in the Plains and Prairie Pothole Region. Based on survey data, a strong positive relationship exists between wetland condition (that is, wet area or number of wet ponds) and both breeding pairs and duck recruitment.

Twenty-eight species of shorebirds have been documented throughout the refuge complex. Three shorebird species are regular breeders on refuge complex lands: killdeer, spotted sandpiper, and upland sandpiper. Regionally rare species such as marbled godwits are commonly observed on the refuge complex. A number of songbirds migrate through or nest on the refuge complex. Declining species, such as grasshopper sparrow, bobolink, western meadowlark, and dickcissel, are commonly observed on refuge complex grasslands.

The Karl E. Mundt Refuge was established after discovering nearly 300 endangered bald eagles—the largest population of wintering bald eagles at that time—spending the winter below the Fort Randall Dam. In 1992, the refuge became the site of the first successful nesting attempt in South Dakota in over a century. Since that time more than 30 eaglets have been recruited to the population from the refuge. Beginning with that first nest 20 years ago, the bald eagle nesting population in South Dakota has expanded to more than 20 active nests. The high recruitment rate and the close proximity of nests on the refuge are testimony to the quality of the habitat.

Fish

Most of the wetlands on the refuge complex are too shallow to support a fishery. However, there are wetlands in the Schaeffer Waterfowl Production Area and Scheffel Waterfowl Production Area in Bon Homme County that are typically deep enough to support a fishery. These wetlands are regularly stocked for fishing.

Historically, Lake Andes was one of the best bass fishing lakes in South Dakota. It was a well-stocked fishery supporting species such as northern pike, largemouth bass, yellow perch, bluegill, black crappie, walleye, and channel catfish. Today, the lake suffers from low dissolved oxygen levels and high concentrations of algae. The poor water quality of Lake Andes has reduced the high species richness that once characterized the lake. Carp and black bullhead are the only species that can tolerate the poor quality of the lake. These species are further degrading the water quality through their aggressive feeding behavior that agitates the water to the degree that sunlight penetration is blocked, which impairs aquatic vegetation growth.

Threatened and Endangered Species

Endangered whooping cranes sometimes use refuge complex lands for feeding and resting during their spring and fall migrations. Additionally, there are two federally delisted species commonly observed on Service lands within the refuge complex. Recently delisted from the endangered species list, bald eagles and peregrine falcons frequently use the refuge complex lands. Bald eagles regularly use the mature cottonwood habitat of Karl E. Mundt Refuge for roosting and nesting. Peregrine falcons benefit from the abundance of prey such as small birds and ducks.

The American burying beetle, which was listed as an endangered species in 1989, has recently been discovered inhabiting Gregory County; however, none have been documented on the Karl E. Mundt Refuge, which lies within Gregory County, nor on any other unit of the refuge complex.

3.5 Visitor Services

The refuge complex offers a variety of recreational opportunities to local residents and other visitors centered on the wildlife resources. Opportunities on the refuge complex include wildlife-dependent and wildlife compatible uses legislated by Congress and outlined in the Improvement Act. These uses include hunting, fishing, wildlife observation, photography, environmental education, and interpretation.

Hunting

The Center Unit of Lake Andes and all waterfowl production areas are open to hunting for white-tailed deer, ring-necked pheasant, and other State game. The peak period for hunting is during ring-necked pheasant hunting season in the fall.

Fishing

Fishing is permitted year-round on the Center and South Units of Lake Andes and on the wetlands of Schaeffer and Scheffel Waterfowl Production Areas in Bon Homme County. The water level of the lake

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and wetlands are highly dependent on surface runoff. Thus, cycles of wet and dry periods commonly affect fishing opportunities.

The wetlands at Schaeffer and Scheffel Waterfowl Production Areas are typically deep enough to support a fishery and are regularly stocked with yellow perch. The poor water quality of Lake Andes today (low dissolved oxygen levels and high algal growth) can only support carp and black bullhead during dry cycles.

Environmental Education and Interpretation

Refuge complex staff members provide educational talks and tours for schools and other groups on request. Informational brochures and refuge complex maps are available at the refuge complex headquarters and at information kiosks located outside of the headquarters and at the beginning of the nature trail. Throughout the Atkins Wetland Interpretive Trail interpretive signs illustrate the importance of conserving wetlands and restoring native grasslands. An estimated 1,058 environmental education and interpretation participants visit the refuge complex each year.

Wildlife Observation and Photography

The refuge complex provides great opportunities for viewing and photographing wildlife, particularly views of migrations of waterfowl, shorebirds, and neotropical migratory birds. Ducks and geese begin concentrating in large numbers in October, and numbers generally peak in December. The abundance and variety of wildlife species combined with relatively low visitation provides many opportunities to view wildlife close up.

Lake Andes Refuge offers a 1-mile foot trail that winds around the Prairie Ponds (four small ponds about 1–4 acres in size) and runs along Owens Bay. The trailhead is next to the refuge complex headquarters, and an observation platform provides an elevated view of the ponds, which are managed to provide attractive habitat for migratory birds during spring and fall migration. Waterfowl, shorebirds, grassland birds, and white-tailed deer are common along this route.

The 1-mile Atkins Wetland Interpretive Trail offers self-guided opportunities to observe 160 acres of wetlands and native prairies on the Atkins Waterfowl Production Area. Interpretive signs along the trail present information about the importance of conserving wetlands and restoring native grasslands as well as describing some of the birds visitors may encounter. The trail leads to an overlook where visitors can admire native prairies. Waterfowl, grassland birds, and white-tailed deer can easily be spotted on this trail.

3.6 Socioeconomics

The 14-county area of the Lake Andes National Wildlife Refuge Complex is home to over 154,000 persons. Since 1990, the population has grown by 1.1 percent per year (BBC Research & Consulting 2008). This 14-county area employs over 70,000 workers mostly in trades, transportation, utilities, government, education and health services, and manufacturing (BBC Research & Consulting 2008).

The refuge complex employs six full-time equivalent employees and one part-time employee, for a total of 6.7 full-time equivalents (appendix I). The most current budget totaled $687,400, of which about $544,000 went toward salaries.

An estimated 15,000 hunting visits occur on the refuge complex each year—about 81 percent of all visitations to the refuge complex. It is estimated that total expenditure by hunters at the refuge complex is about $570,400 per year (BBC Research & Consulting 2008). An estimated 741 fishing visits occur each year on the refuge complex. The expenditure from these visits has been estimated to generate about $12,800 per year (BBC Research & Consulting 2008). There are an estimated 2,800 wildlife observation and photography visits to the refuge complex each year. Total expenditure by these nonconsumptive recreational activities—including environmental education and interpretation—is estimated to be $36,800 per year (BBC Research & Consulting 2008). A report titled "Banking on Nature" evaluated the impacts of refuges on local economies. Lake Andes National Wildlife Refuge Complex was estimated to generate about $620,000 per year in total visitor expenditures (BBC Research & Consulting 2008).

3.7 Operations

Operations includes infrastructure and staff, cultural resources, partnerships, law enforcement, and fire and grazing history and management.

INFRASTRUCTURE AND STAFF

The refuge complex includes three government residences. Other buildings on the refuge complex include a headquarters building that provides office space for staff and a small visitor contact area with a public restroom and a maintenance building that provides office space for staff, vehicle maintenance facilities, a woodworking area, a metalworking area, a wash bay, and some heated vehicle storage. Two unheated garages with concrete floors provide additional motor vehicle storage. The remaining buildings include a dirt floor garage and an open pole shed. Expanding visitor services on the refuge complex would require an expansion of the headquarters to provide a visitor center and to support additional staff.

Grass seed used in native prairie restoration efforts is currently stored in a portion of the wash bay in the maintenance building. The area is inadequate in size to store seed or equipment needed to prepare grass and forb seeds for planting. It is also prone to mouse invasion. Expanding prairie reconstruction would require additional equipment and infrastructure.

An artesian well adjacent to Owens Bay is the primary water source for the prairie ponds—a series of small wetlands that are managed for wildlife observation, environmental education, and interpretation. The current well was developed in 1985. Upon completion it flowed at 900 gallons per minute. Since that time much of the casing has collapsed, and the flow has diminished to 250 gallons per minute, which barely provides enough water to adequately manage the prairie ponds. To maintain the prairie ponds for visitor services, a new well will need to be developed.

The refuge complex staff totals 6.7 full-time equivalent positions. The staff includes a wildlife refuge manager, a deputy wildlife refuge manager, a station wildlife biologist, a Partners for Fish and Wildlife biologist, a budget analyst (administrative officer), and two maintenance workers. The current staff is reduced from previous years and is not adequate to manage habitat or provide appropriate visitor services.

CULTURAL RESOURCES

Humans have occupied central North America for more than 12,000 years and have left a diverse cultural material legacy on the landscape. Several researchers have summarized our understanding of the prehistory and history of the northeastern plains (DeMallie, R. J. 2001, Jackson and Toom 1999, Lehmer, D. J. 1971, Schneider, M. J. 2002, Gregg, Michael L., David Meyer, Paul R. Picha, and David G. Stanley 1996; Wedel 1961, Winham and Hannus 1989; Wood 1998), and only a brief review will be provided here.

The cultural chronology can be divided into six basic periods:

- Paleoindian (ca. 9500–5500 B.C.)
- Plains Archaic (ca. 5500–500 B.C.)
- Plains Woodland (ca. 500 B.C.–A.D. 1000)
- Plains Village (ca. A.D. 1000–1780)
- Protohistoric and Early Historic Period (ca. A.D. 1780-1880)
- Modern Historic (ca. A.D. 1880–)

The first three periods refer to prehistoric nomadic and seminomadic cultural traditions with the fourth period defined by a semisedentary horticultural Plains Village Tradition which extends into historical times. Next, for many peoples the Protohistoric and Early Historic Periods encompass the decline of the Plains Village Tradition and the rise of the Plains Equestrian Tradition which developed as a consequence of the introduction of the domestic horse and European manufactured trade goods into the northeastern plains. At the end of the Plains Equestrian Tradition, ca. A.D. 1880, the modern Euro-American Tradition becomes the dominant tradition.

Portions of five archeological regions, the Big Bend, Fort Randall, Lower James, Vermillion Basin, and the Lower Big Sioux and the Yankton region in its entirety are included within the Lake Andes Wetland Management District. These regions, based on drainage units, are defined in the 'South Dakota State Plan for Archeological Resources: Introduction and Overview to Study Units and Archeological Management Regions' (Winham and Hannus 1989). This State plan identifies, with more specificity, information about the known archeological resources, cultures, and gaps in our current understanding (Winham and Hannus 1989) of the past of the resources within the wetland management district than this summary.

Cultural developments are often influenced by movements of people or ideas from adjacent areas. The Big Sioux and James Rivers accessed the Lower Missouri River Valley lifeways, while hunters followed the bison onto the plains from the eastern woodlands, and peoples and ideas trailed up the Missouri River. Gregg, Meyer, Picha, and Stanley document the central portion of the wetland management district, the lower James River Valley, as prominent in the origin and development of the Plains Village cultures in both the northeastern plains and the middle Missouri, while the eastern portion of the wetland management district exhibits strong ties to the central plains cultural area in later prehistoric times (Gregg, Meyer, Picha, Stanley 1996).

Paleoindian Period (9500–5500 B.C.)

The first inhabitants of the area arrived during the Paleoindian period which has been provisionally dated to approximately 9500–5500 years B.C. The age range of this period is based mainly on Paleoindian finds elsewhere in the Great Plains because the Paleoindian

artifacts identified in Southeast South Dakota have been surface finds where the age cannot be defined by other means. This period began with the initial entry of humans into the northeastern plains following the retreat of the last of the Pleistocene glaciers. These Paleoindian peoples exhibited highly nomadic settlement patterns and subsistence economies based on hunting now-extinct species of mammoth and bison and gathering plants that were adapted to late Pleistocene and early Holocene climates.

Plains Archaic Period (5500–500 B.C.)

The Plains Archaic period followed the Paleoindian period from approximately 5500 B.C. to 500 B.C. Relatively few Plains Archaic sites have been identified in the Lake Andes area, and even fewer have been extensively investigated. This period is characterized as an extension of the nomadic hunting and gathering adaptation from the preceding period, but it was adapted to essentially modern (Holocene) climate, fauna, and flora. Bison remained the principal quarry of these people, although deer and elk were exploited along the prairie–woodland transition. There is also evidence of intensified seed and plant gathering and processing during the Plains Archaic period. Other changes included the adoption of the atlatl and dart and an overall decline in the quality of flint knapping from the Paleoindian period.

Plains Woodland Period (500 B.C.–A.D. 1000)

Plains Woodland lifeways are thought to have shared many similarities with those of the Plains Archaic period, particularly subsistence economies based on hunting and gathering. However, the practice of mound burial, possibly indicative of more complex ceremonialism; the production and use of ceramic vessels; and the first use of the bow and arrow all appear to have been developments that distinguish the Plains Woodland period. It is also possible that horticulture made its first appearance during Plains Woodland times, but direct evidence of this is lacking in the Northern Plains (Jackson and Toom 1999). It also has been suggested that Plains Woodland peoples enjoyed a somewhat more settled lifeway, shifting from the fully nomadic settlement pattern of the Plains Archaic period to a seminomadic pattern.

The appearance of the Plains Woodland Tradition in the northeastern plains is an extension or diffusion of the general woodland lifeway that flourished throughout the Midwest (to the east and southeast) during this period. Artifact assemblages of the Plains Woodland Tradition reflect the introduction of ceramic technology and the acquisition of exotic trade materials. Late in the tradition, the transition from dart or spear points to arrow points can be seen in weapons technology. The lifeway is characterized by increased sedentism, population growth, and the construction of earthen burial mounds. Again, adaptation to the plains or prairie environment of the eastern woodland influences resulted in a distinctive subsistence pattern that relied heavily on bison hunting. Plains Woodland campsites are generally identified where river and stream valleys extended into the plains proper, affording a riparian setting for the establishment of base camps (Jackson and Toom 1999).

Plains Village Period (A.D. 1000–1780)

In the Northern Plains a semisedentary horticultural way of life, the Plains Village Tradition, is best known from its many village sites that have been found along the Missouri River trench in the Dakotas. The Plains Village Tradition first appeared in the middle Missouri about A.D. 1000. It flourished there throughout most of the late prehistoric period and persisted in attenuated form well into historic times. Direct links or continuums have not been identified between the local Plains Woodland folks and these Plains Village peoples (Gregg, Meyer, Picha, Stanley 1996).

Some Tribal groups, such as the Middle Dakota, Assiniboine, and Plains Ojibwa continue the previous woodland adaptations into historic times while others, such as the Awaxawi Hidatsa and Ioway, lived as Plains Villagers. Others, such as the Cheyenne, had people living both woodland and Plains Villager adaptations (Gregg, Meyer, Picha, Stanley 1996). The Plains Village period is brought to a close at A.D. 1780 following the decimation of the Plains Village population base along the Missouri River by a smallpox epidemic.

Plains Village culture was distinctly different from its Plains Woodland antecedent. It was characterized by the construction of substantial, permanent dwellings known as earth lodges arranged into villages along major streams with the broad valley floors required for gardening. Later these villages became fortified as drought conditions apparently reduced the extent of limited amounts of arable land and there were food shortages. Plains Village sites in southeastern South Dakota were abandoned at this time (Gregg, Meyer, Picha, Stanley 1996).

Subsistence was based on a mixed strategy of horticulture, or garden agriculture, including the cultivation of maize, beans, squash, and sunflowers; bison hunting; and generalized hunting and gathering, or foraging. Continued elaboration and sophistication in ceramic manufacture also typify the period, with well-made, globular-shaped and shouldered pots exhibiting a wide variety of stylistic variability typifying most village collections.

The Plains Village settlement pattern is interpreted as semisedentary, with people residing in their villages at various times of the year, especially during times of important horticultural activity, and leaving their villages at other times to go on extended hunts. A key element in the Plains Village adaptation was the production of a dependable, storable, surplus food supply.

This surplus consisted of both meat and garden produce that was usually stored in subterranean storage pits, commonly called cache pits, another identifying attribute of the tradition.

Considerable archeological and ethnohistorical evidence indicates direct connections between the prehistoric Plains Village Tradition; the related Oneota settlements that may have included the Ioway, Oto, and Omaha; the related Coalescent Tradition in the Northern Plains; and the historically known Mandan, Hidatsa, Arikara, and Cheyenne peoples.

Protohistoric And Early Historic Period (A.D. 1780–1890)

Protohistoric refers to the time of initial Euro-American cultural impact on native cultures prior to actual contact. European cultural influence may have come as early as A.D. 1650 with the introduction of trade goods filtering into the area via native trade networks. Horses were introduced from the south by the mid-1700s. By the end of the eighteenth century and the beginning of early historical times, fur trade expansion had profoundly influenced Native American lifeways in the Dakotas. Participation in the fur trading system brought changes in material culture and subsistence practices just as interaction with Euro-Americans intensified.

The Plains Equestrian Tradition, also referred to as the Equestrian Nomadic Tradition, evolved during the Protohistoric Period and early historical times following the introduction of the domestic horse via trade networks extending into the Spanish Southwest. In the Northern Plains, acquisition of the horse by Native American peoples was well underway by about A.D. 1750. The Plains Equestrian Tradition represents the well-known nomadic bison hunters of early historical times who spent much of the year in tipi camps. During this period, there was greater cultural interaction among native groups due to improved transportation by horse and an ever increasing trade influenced by Euro-American trade.

When Lewis and Clark traveled through the Lake Andes area in the summer of 1804 they were met by the Yankton Sioux. Further upstream on the Missouri River were the Dakota and Lakota and downstream were the Ponca (South Dakota Archeological Research Center 1977). Fifty years later, by 1858, the Yankton were confined to a four hundred thousand-acre reservation that exists today (Nesheim 2009, Schneider 2002).

By A.D. 1880, Euro-American cultural domination of what was to become North and South Dakota was complete. Permanent non-Indian settlement of the States came about with the construction of railroads and the security of military protection. Military occupation of the Dakotas accelerated in response to the 1862 Sioux Uprising in Minnesota. The establishment of permanent forts in the Dakota Territory prepared the way for increased settlement by Europeans. In addition to the military complement and their families, a civilian population was employed to supply goods and services to the army. Railroads penetrated the territory in the 1870s, and homesteaders immigrated to the area partly because transportation and military protection were assured. Settlers acquired land from the railroads or from the government through the Homestead, Pre-emption, and Timber Culture acts in the 1870s and 1880s. Agricultural settlement followed a cyclical pattern of boom and decline. Settlement spread generally from east to west, and in 1889 the Dakotas achieved statehood.

Modern Historic (ca. A.D. 1880–)

The refuge complex's early 20th century history is tied to the Works Progress Administration, which was the program responsible for building the two roadway dikes that split Lake Andes into three separate units. These dikes are considered historic resources.

Many of the old homesteads that existed on Lake Andes Refuge, Karl E. Mundt Refuge, and several waterfowl production areas have been removed. Before any groundbreaking activities, such as removing these homesteads, the refuge complex staff complies with Federal and State laws and regulations, specifically Section 106 of the National Historic Preservation Act of 1966. Under these provisions, local archeologists inspect and record the area of interest to determine if the groundbreaking disturbance would affect any historic properties.

Wetland Management District Archeological Investigations

Approximately sixteen linear archeological surveys have crossed Service lands within the Lake Andes wetland management district. The surveys followed the path of proposed telephone lines, power lines, water pipelines and road and bridge projects (South Dakota Archaeological Research Center 2011). Many small block surveys have been conducted on the wetland management district and the refuges by Service and contracted archeologists. Two major surveys were for the Lake Andes-Wagner Irrigation Project and the survey of the headquarters and residence at Lake Andes Refuge and Karl E. Mundt Refuge (Church, McCallister, and Williams 1984; Zimmerman, Werner, Park, and Tudehope 1978). Additionally, the Broken Arrow WPA was surveyed in 1985 (Winham 1985).

Reporting of sites from the archeological surveys within Service lands has been disappointing, with only eight sites being reported. Four isolated finds, two artifact scatters, and two historic farmsteads have been recorded. The isolated finds include stone flakes, choppers, and knife fragments. The two artifacts scatters of undated antiquity are prehistoric campsites.

Partnerships

The refuge complex does not have a friends group to support and advocate for its conservation and visitor services programs. Such groups have almost become a necessity to help a refuge program achieve its potential. In rural areas it is a challenge to find individuals interested in volunteering their own time to support a refuge; however, the planning process has made identifying such individuals easier.

Law enforcement

Law enforcement officers monitor the many conservation easements managed by the refuge complex to ensure that wetlands and grasslands critical to wildlife are protected. They also perform the more traditional role of checking visitors to ensure compliance with conservation laws. Two officers are required when contacting individuals regarding a conservation easement violation. The current refuge complex staff only includes one member whose position is eligible for law enforcement authority. An additional law enforcement officer is needed to efficiently enforce and protect conservation easements.

Fire and grazing history and management

Before European settlement, wildfires, grazing (primarily by bison, prairie dogs, and insects), and drought were the primary ecological disturbances that revitalized grasslands. Ignitions for these wildfires were caused by both lightning and Native Americans, with most wildfires likely occurring during the summer and fall. Depending on weather conditions, a wildfire could burn thousands of acres, creating a mosaic of burned, unburned, and grazed areas. Historical fire frequency was probably highly variable but has decreased since settlement (Umbanhowar 1996); however, little information is available on the presettlement occurrence of fire within the refuge complex area. For the mixed-grass prairie, fire-return interval evidence seems to point to about every 5–10 years on the moist portions of mixed-grass prairie and around 25 years on dry portions (Frost 1998, Wright and Bailey 1982). In general, where precipitation is limited, such as in the western and central grasslands, a long-term decline in grass production occurs when burning is more frequent than every 5–10 years. This fire frequency may be best for natural fire management of grasslands, such as the short- or mixed-grass prairies, although fire exclusion may be best for other purposes (Bragg 1995). Tallgrass prairie tends to have a quicker fire-return interval than mixed-grass prairie. Science seems to indicate roughly a 3- to 7-year fire-return interval for most of the tallgrass prairie.

After settlement by Europeans, wildfires were suppressed. Today, most local fire departments and area farmers and ranchers still aggressively suppress wildfires. It has also been the policy on Service lands within the refuge complex to aggressively suppress wildfires.

The refuge complex uses prescribed fire to simulate the historical influence fire had on plant communities. Burning removes layers of residual cover; this action can reduce plant species diversity and increase a wildfire's resistance to control. Even though prescribed fire can occur at any time of year, most prescribed fires are currently applied in April and May, depending on the prescribed fire's objectives and the associated impacts on flora and fauna. The refuge complex's use of this tool is limited by many factors including plan development, staff availability, and weather. Because of these limiting factors, prescribed fire is rarely used on refuge complex lands. Since 2001, the refuge complex has treated about 3,800 acres with prescribed fire.

Although prescribed fires are infrequent on the refuge complex, air quality is still an issue when burns do occur. The National Ambient Air Quality Standards include maximum allowable pollution levels for particulate matter, ozone, sulfur dioxide, nitrogen dioxide, lead, and carbon dioxide. Particulate matter is a measure of tiny liquid or solid particles in the air that can be breathed into the lungs. Carbon from automobiles and diesel engines, prescribed fire activities on refuge complex lands, and dust associated with wind-blown sand and dirt from roadways and fields contribute to particulate matter.

Similar to fire, grazing greatly influences the structure and composition of grassland communities. Most plant species have developed growing points located at or near the ground surface, which allows the plant to be clipped off without killing it.

Refuge complex staff work with cooperators to mimic grazing disturbances such as grazing by bison. Grazing is generally conducted during the spring and early summer for about 6 weeks, and again in the fall in upland habitats, to stress exotic cool-season grasses and favor native warm-season grasses and forbs. In this instance, overgrazing is beneficial as it damages invasive grasses to the point where native seeds have a better chance to grow with less competition.