3 Refuge Resources and Description

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A Female Canvasback with Her Brood

The prairies of North Dakota have become an ecological treasure of biological importance for waterfowl and other migratory birds. The prairie potholes of North Dakota and South Dakota support a wide diversity of wildlife, but they are most famous for their role in waterfowl production. Although the Prairie Pothole Region occupies only 10% of North America's waterfowl-breeding range, it produces approximately 50% of the continent's waterfowl population.

This chapter describes the physical environment and biological resources of lands within the 12 national wildlife refuges. In addition, this chapter addresses the fire and grazing history, cultural resources, visitor services, socioeconomic environment, and operations of the refuges.

3.1 Physical Environment

The refuges are located across North Dakota from the Canadian border south to the state line of South Dakota.

Global Warming

The U.S. Department of the Interior (DOI) issued an order in January 2001 requiring federal agencies under its direction that have land management responsibilities to consider potential climate change effects as part of long-range planning endeavors.

The Department of Energy's report, "Carbon Sequestration Research and Development," concluded that ecosystem protection is important to carbon sequestration and may reduce or prevent loss of carbon currently stored in the terrestrial biosphere. The report defines carbon sequestration as "the capture and secure storage of carbon that would otherwise be emitted to or remain in the atmosphere."

The increase of carbon dioxide (CO_2) within the earth's atmosphere has been linked to the gradual rise in surface temperature commonly referred to as global warming. In relation to comprehensive conservation planning for Refuge System units, carbon sequestration constitutes the primary climate-related effect to be considered in planning.

Vegetated land is a tremendous factor in carbon sequestration. Large, naturally occurring communities of plants and animals that occupy major habitats—grasslands, forests, wetlands, tundra, and desert—are effective both in preventing carbon emission and in acting as biological "scrubbers" of atmospheric CO_2.

One Service activity in particular—prescribed burning—releases CO_2 directly to the atmosphere from the biomass consumed during combustion yet results in no net loss of carbon because new vegetation quickly germinates and sprouts to replace the burned-up biomass. This vegetation sequesters an approximately equal amount of carbon as was lost to the air (Dai et al. 2006). Several other effects of climate change may need to be considered in the future:

- Habitat available in lakes and streams for cold-water fish such as trout and salmon could be reduced.
- Forests may change, with some plant species shifting their range northward or dying out and other trees moving in to take their place.
- Ducks and other waterfowl could lose breeding habitat because of stronger and more frequent droughts.
- Changes in the timing of migration and nesting could put some birds out of synchronization with the life cycles of their prey.

Climate

The normal average annual temperature in North Dakota ranges from 37° Fahrenheit (F) in the northeast to 43°F along the southern border. January is the coldest month with average temperatures ranging from 2°F in the northeast to 17°F in the southwest. July is the warmest month with temperatures averaging 67°F in the northeast to 73°F in parts of the south. The range of normal average monthly temperatures between the coldest and warmest months is 54°F in the southwest and 65°F in the northeast. These large annual ranges attest to the continental nature of North Dakota's climate (Jensen, no date).

The highest temperature ever recorded in North Dakota was 121°F at Steele on July 6, 1936, and the lowest temperature measured was –60°F at Parshall on February 15, 1936. Temperatures of 100°F or higher occur nearly every year somewhere in North Dakota. Chances of this occurring are greatest in the south-central area where in about 85% of the years maximum temperature will equal or exceed 100°F. These temperatures of 100°F or more last only for a day or two. In the northeast, temperatures reach 100°F or higher in only 3 years out of 10 (Jensen, no date).

Annual precipitation ranges from less than 13 inches in the northwest to more than 20 inches in parts of the Red River Valley and southeast. The lines of equal precipitation, although subject to some meandering, are oriented north–south; as a generalization, precipitation increases about 1 inch for every 50 miles of eastward movement.

There are two areas where the general increase of precipitation in an easterly direction does not apply:

- One area is located in the southwest where the annual precipitation of more than 16 inches is higher than the surrounding area. This area of higher precipitation is largely a result of topographic uplift.
- The other area is in the north-central part of the state, where the annual precipitation of less than 16 inches is lower than surrounding areas. This area is caused primarily by air moving downhill from all but a southerly direction, which works against the precipitation process (Jensen, no date).

Annual snowfall in North Dakota ranges from less than 26 inches in parts of Mountrail and McLean counties (west-central part of the state) to about 38 inches in a belt extending diagonally across the state northeast–southwest (Jensen, no date).

Physiography, Geography, and Soils

Because the refuges cover such a large geographic area, the physical environment and biological resources are described in terms of physiographic region (or level 3 and level 4 ecoregions) (Bryce et al. 1996) in which each refuge is located. Five physiographic regions occur in the 12-refuge area: Red River Valley, glaciated plains, Missouri Coteau, and coteau slope (see figure 18, map of physiographic regions). These physiographic regions correspond closely to the level 3 ecoregions described below.

Ecoregions

Four level 3 ecoregions cover the 12 refuges: Lake Agassiz basin, northern glaciated plains, northwestern glaciated plains, and northwestern Great Plains. The differences in ecosystem properties and functions in the level 3 ecoregions are distinguished by the patterns of biotic and abiotic phenomena: vegetation, climate, soils, land use, wildlife use, and hydrology. Local biotic and abiotic factors have further refined the ecoregions. Each level 3 ecoregion is subdivided into several level 4 ecoregions (see figure 19); level 4 ecoregions are the finest level in the hierarchy (Bryce et al. 1996). Table 3 displays the level 3 ecoregions in which each refuge occurs.

Descriptions of each of the four level 3 ecoregions follow (see figure 19), along with their level 4 ecoregions relevant to the refuges. Most text and graphics in this section are from "Ecoregions of North Dakota and South Dakota" (USGS 2006).

Northwestern Glaciated Plains Ecoregion 42 (Level 3)

Audubon, Chase Lake, Lake Nettie, Lake Zahl, McLean, and Shell Lake national wildlife refuges occur within this ecoregion.

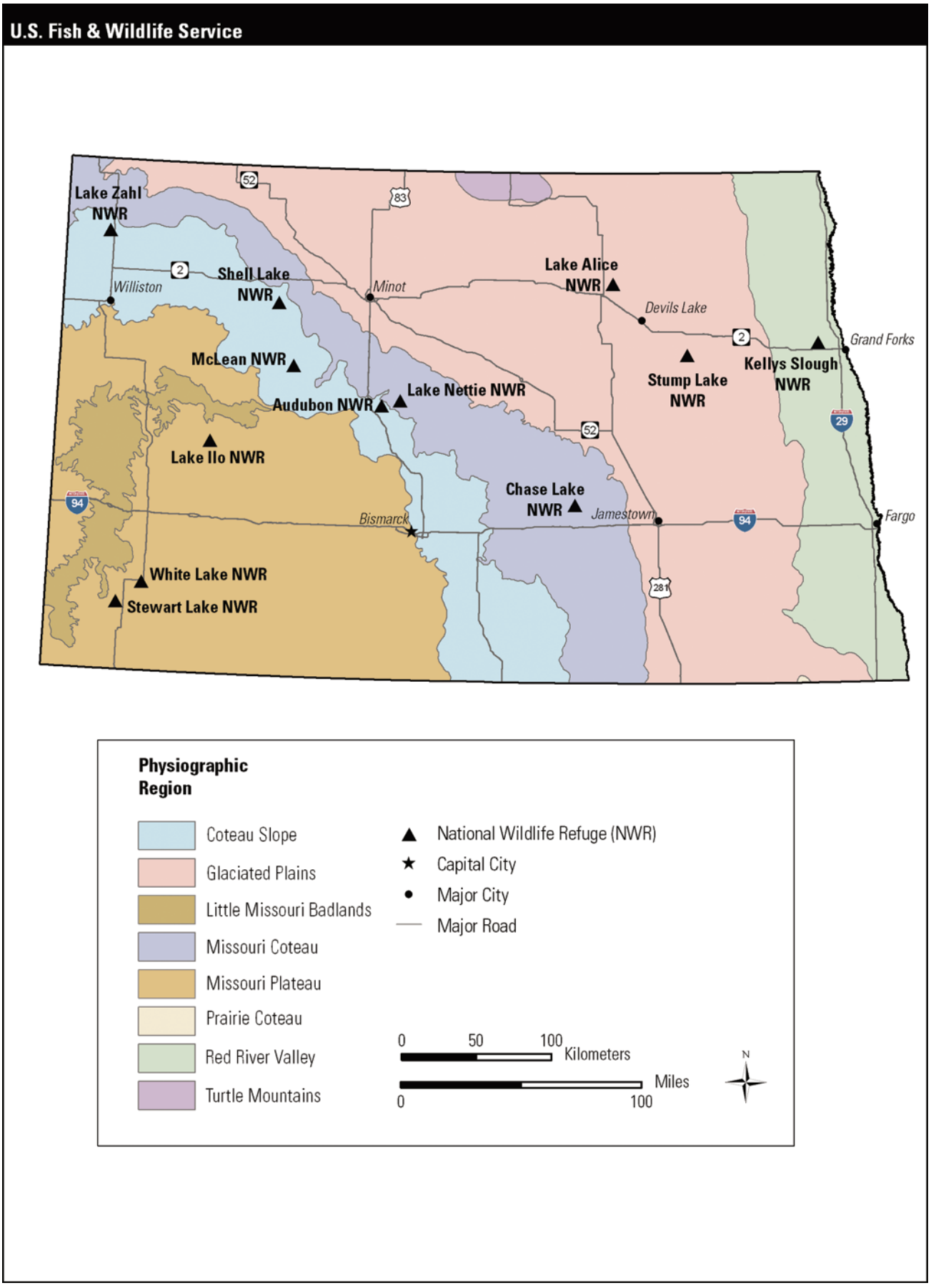

Figure 18. Map of the physiographic regions in North Dakota.

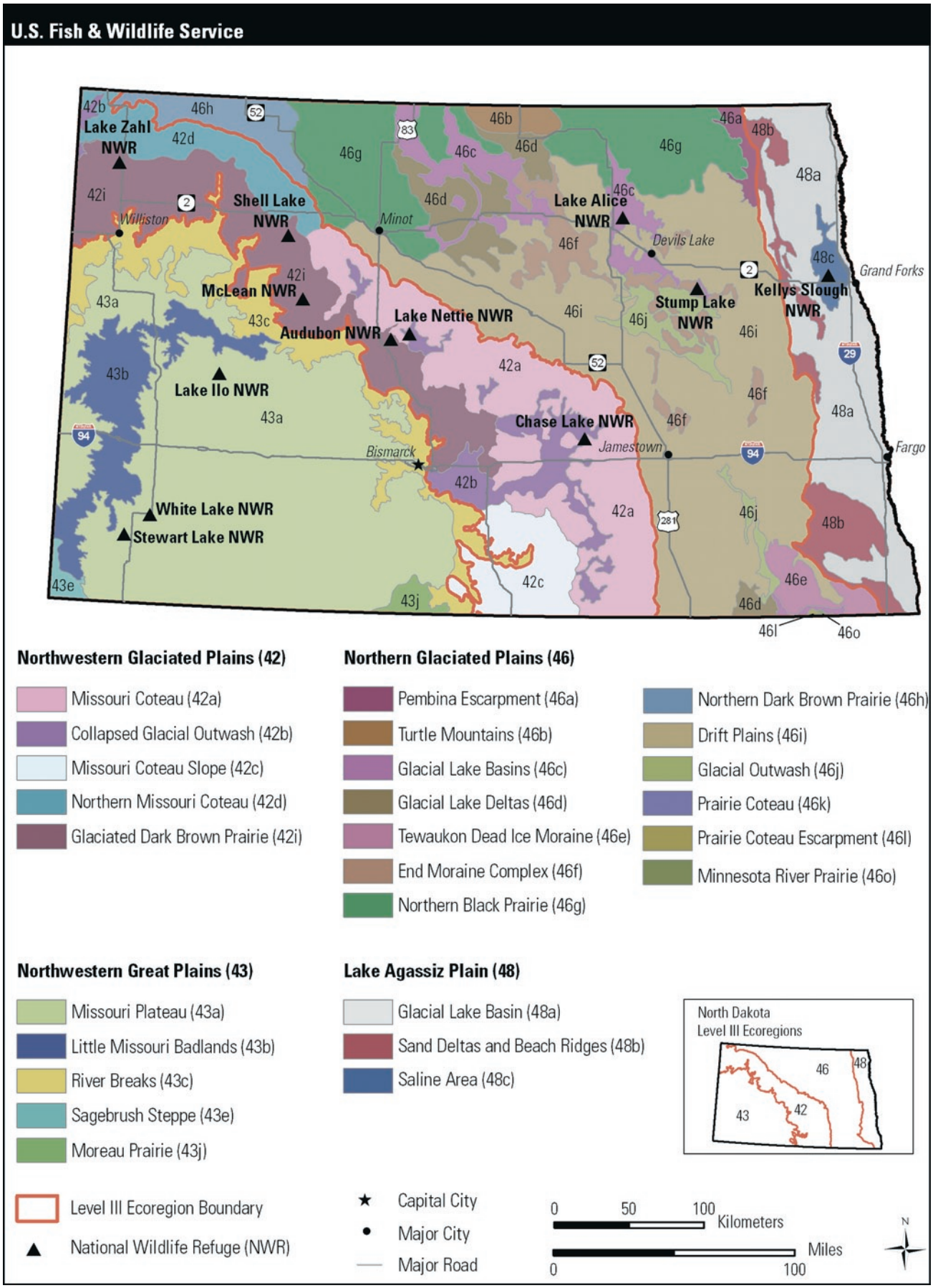

Figure 19. Map of the level 4 ecoregions in North Dakota.

Table 3. Ecoregions of the 12 Refuges, North Dakota.

National Wildlife Refuge	*Level 3 Ecoregion Name and Number*
Audubon	Northwestern glaciated plains, 42
Chase Lake	Northwestern glaciated plains, 42
Kellys Slough	Lake Agassiz basin, 48
Lake Alice	Northern glaciated plains, 46
Lake Ilo	Northwestern Great Plains, 43
Lake Nettie	Northwestern glaciated plains, 42
Lake Zahl	Northwestern glaciated plains, 42
McLean	Northwestern glaciated plains, 42
Shell Lake	Northwestern glaciated plains, 42
Stewart Lake	Northwestern Great Plains, 43
Stump Lake	Northern glaciated plains, 46
White Lake	Northwestern Great Plains, 43

The northwestern glaciated plains ecoregion marks the westernmost extent of continental glaciation. The youthful morainal (ridges of rock debris at the margins of glaciers) landscape has significant surface irregularity and high concentrations of wetlands. The rise in elevation along the eastern boundary defines the beginning of the Great Plains. Land use is transitional between the intensive dryland farming in Drift Plains ecoregion 46i (below) to the east and the predominance of cattle ranching and farming to the west in the northwestern Great Plains ecoregion 43 (below).

Collapsed Glacial Outwash Ecoregion 42b (Level 4)

Areas of collapsed glacial outwash formed from gravel and sand that was deposited by glacial meltwater and precipitation runoff over stagnant ice. Many large, shallow lakes are found in these areas; these lakes and wetlands tend to be slightly to very alkaline depending on the flow path of groundwater moving through the permeable outwash deposits. They attract birds preferring large areas of open water such as American white pelican, black tern, and Forster's tern, as well as those living in brackish water such as American avocet and tundra swan.

Glaciated Dark Brown Prairie Ecoregion 42i (Level 4)

The boundary of the glaciated dark brown prairie marks a transition to drier conditions. This ecoregion has a well-defined drainage system and fewer wetlands compared with the more recently glaciated Missouri Coteau slope ecoregion 42c to the east. Land use is a mosaic of cropland and rangeland.

Lake Ilo, Stewart Lake, and White Lake national wildlife refuges occur within this ecoregion.

Northwestern Great Plains Ecoregion 43 (Level 3)

The northwestern Great Plains ecoregion encompasses the Missouri Plateau section of the Great Plains. It is a semiarid rolling plain of shale, siltstone, and sandstone punctuated by occasional buttes and badlands. Native grasslands persist in areas of steep or broken topography, but they have been largely replaced by spring wheat and alfalfa over most of the ecoregion. Agriculture is limited by erratic precipitation patterns and limited opportunities for irrigation.

Missouri Plateau Ecoregion 43a (Level 4)

On the Missouri Plateau west of the Missouri River, the landscape displays the wide open spaces of the American West. The topography of this ecoregion was largely unaffected by glaciation and retains its original soils and complex stream drainage pattern. A mosaic of spring wheat, alfalfa, and grazing land covers the short-grass prairie where herds of bison, pronghorn, and elk once grazed.

Northern Glaciated Plains Ecoregion 46 (Level 3)

Lake Alice and Stump Lake national wildlife refuges occur within this ecoregion. Also commonly referred to as the Drift Plains or Drift Prairie, this area was subject to scouring and deposition due to prolonged glacier activity between 70,000 and 10,000 years ago.

A flat to gently rolling landscape of glacial drift characterizes the northern glaciated plains ecoregion. The subhumid conditions foster a grassland transition between the tall- and short-grass prairies. High concentrations of temporary and seasonal wetlands create favorable conditions for duck nesting and migration. Although the tilled soil is very fertile, agricultural success is subject to annual climatic fluctuations.

Glacial Lake Basins Ecoregion 46c (Level 4)

Lake Souris, Devils Lake, and Lake Dakota once occupied the glacial lake basins. These proglacial (adjacent to a glacier) lakes were formed when major stream or river drainages were blocked by glacial ice during the Pleistocene era. The smooth topography of the glacial lake basins—even flatter than the surrounding Drift Plains (ecoregions 46g, 46i, and 46n)—resulted from the slow buildup of water-laid sediments. The level, deep soils in the lake plains are intensively cultivated. In the north, the primary crops are spring wheat, other small grains, and sunflowers; in the Lake Dakota basin of South Dakota, corn and soybeans are more prevalent.

Lake Agassiz Basin Ecoregion 48 (Level 3)

Kellys Slough National Wildlife Refuge occurs in this ecoregion.

Glacial Lake Agassiz was the last in a series of proglacial lakes to fill the Red River Valley since the beginning of the Pleistocene era. The Lake Agassiz plain is comprised of thick lacustrine (formed in lakes) sediments underlain by glacial till. It is extremely flat and has fewer lakes and pothole wetlands than neighboring ecoregions. The historical tall-grass prairie has been replaced by intensive agriculture. The preferred crops

in the northern half of the region are potatoes, beans and wheat; soybeans and corn dominate in the south. Sugar beets are grown throughout the ecoregion.

Saline Area of the Lake Agassiz Ecoregion 48c (Level 4)

In the saline area of the Lake Agassiz basin, salty artesian groundwater flows to the surface through glacial till and lacustrine sediments from the underlying beds of Cretaceous sandstone. The regional boundary of the saline area of the Lake Agassiz basin delineates an area where salt effects are most evident. Other saline areas occur along the tributaries of the Park, Forest, and Turtle rivers in northeastern North Dakota. Salt-affected soils in the saline area reduce crop productivity. Many areas are not suitable for farming, but are used for range or wildlife habitat.

Soils

Data for soil temperature and frost penetration in North Dakota are scarce. Dr. Guy Wilkinson of the department of soils at North Dakota State University did the most complete study of soil temperatures. Wilkinson measured soil temperature at Fargo, North Dakota, continuously over a 4-year period (Jensen, no date).

At Fargo, the average date of soil surface freezing was November 26. Freezing progressed to greater depths throughout the winter until the average maximum frost penetration depth of 4.5 feet was reached April 1. Surface thawing in the spring began on March 26, a few days earlier than the occurrence of maximum frost penetration. After April 1, soil thawing proceeded both downward from the surface and upward toward the surface from the deeper unfrozen soil until May 1, when the last of the frozen soil at about the 3-foot level was thawed (Jensen, no date).

The lowest average soil temperature of 8.2°F was found at a depth of 0.25 inch on January 17. The time of minimum soil temperature for deeper soil depths was progressively later, with minimum soil temperatures at the 4.5-foot depth occurring on April 1. Highest average soil temperature at the 0.25-inch depth reached the low 80s during the third week in July. As in winter, soil temperatures at greater depths reached their highest levels later in the season. For instance, soil temperatures at the 2-foot depth did not reach their highest levels until about August 6, while 3-feet deep maximum temperatures were reached August 15 (Jensen, no date).

Water Resources

This section has descriptions of the drainages in which the refuges occur (North Dakota State Water Commission 2005), water quality of the area, and water rights for each refuge.

North Dakota is separated into two major drainage basins by a continental divide running from the northwest and through the central and southeastern part of the state. The northeastern portion of the state falls generally within the Hudson Bay drainage basin, while the southwestern part is drained by the Missouri River into the Gulf of Mexico.

Hudson Bay Drainage Basin

The Hudson Bay drainage basin includes the Souris and Red river systems plus the large, currently noncontributing, Devils Lake basin. Of the 12 refuges, Kellys Slough, Lake Alice, and Stump Lake national wildlife refuges fall within these basins.

The Souris River originates in Saskatchewan, Canada, and forms a 357-mile loop through North Dakota before it reenters Canada west of the Turtle Mountains. The Souris River drains portions of Saskatchewan, Manitoba, Montana, and North Dakota. There are seven major tributaries in North Dakota; the principal tributary is the Des Lacs River. Annual mean precipitation ranges from 13 inches in the west to 17 inches in the east.

The Red River is the principal river of the basin. From its origin at the confluence of the Ottertail and Bois de Sioux rivers at Wahpeton, North Dakota, and Breckenridge, Minnesota, the Red River winds northerly almost 400 river miles, forming the boundary between North Dakota and Minnesota. From the International Boundary, the Red River flows about 155 river miles to Lake Winnipeg in Manitoba. The valley through which the river flows is actually the bed of glacial Lake Agassiz. The lake bed is very flat and accounts for the meandering course and low gradient of the river. The headwaters of most of the eight major tributaries in North Dakota begin in the drift prairie in the western part of the basin where valleys are narrow and steep-sided. As the tributaries enter the lowlands of the lake bed, the river slopes become very flat, with poorly-defined watershed boundaries.

The Devils Lake basin is currently a noncontributing subbasin within the Red River basin. This basin became a closed basin after the last continental ice sheets receded and southerly drainage to the Sheyenne River ceased. The drainage system of the Devils Lake basin is formed by chains of waterways and connecting lakes, with the majority of the basin's water reaching its ultimate collection point at Devils Lake. Because of the poorly-defined drainage system, approximately 1,300 square miles do not contribute runoff to Devils Lake.

Missouri River Drainage Basin

The Missouri River drainage basin includes the Missouri and James rivers. Nine of the 12 refuges are within this basin: Audubon, Chase Lake, Lake Ilo, Lake Nettie, Lake Zahl, McLean, Shell Lake, Stewart Lake, and White Lake national wildlife refuges.

The Missouri River basin is the largest in the state, draining approximately 48% of North Dakota's total area. The basin coincides roughly with the part of the state having a semiarid climate. The tributaries on the south and west sides of the Missouri River typically occupy small but sharply defined valleys. This area

is well drained with very few natural lakes. The topography is characterized by numerous flat-topped, steep-sided buttes and hills. The area east of the Missouri River is characterized by numerous small lakes and wetlands. Annual mean precipitation in the basin ranges from 13 inches in the northwest to 17 inches in the east.

The James River, a major tributary of the Missouri River, begins in central North Dakota but does not join the Missouri River until it reaches Yankton, South Dakota. The James River in North Dakota is 260 miles long. Ninety-two percent of the James River basin is used for agricultural purposes.

Watershed drainage is the primary source of water supply for the refuges. Water levels in refuge impoundments depend on spring runoff. Impoundments range from natural depressions to those that have structures to control the water level within a lake or pond. Impoundments with control structures function as artificial freshwater wetlands. By varying the water levels in the impoundments, refuge staffs can influence the types of plant and animal communities living in or near the impoundments. Through the change in water level, refuge staffs can also reduce the occurrence of botulism in waterfowl. All surface water control occurs under the jurisdiction of a state permit issued to the refuges.

Water Quality

Some wetland basins function as groundwater recharge areas; such basins tend to be temporarily or seasonally flooded. These basins hold water for only a few months each year, and the water is generally low in dissolved solids. Some basins are through-flow systems with respect to groundwater; that is, groundwater flows in through parts of their bed while other parts recharge groundwater. Through-flow basins hold water over longer periods and the water tends to have higher concentrations of dissolved solids. Some basins serve only as discharge areas for groundwater. Lakes that receive discharge from both regional and local groundwater flow systems and do not lose water to seepage or surface outflow are highly saline (Kantrud et al. 1989).

Human-related disturbance such as drainage and cultivation are the most extreme disturbances seen in most prairie wetlands in North Dakota and South Dakota. In some instances, fill (earth or rocks) or use for solid waste disposal has also destroyed the basins (Kantrud et al. 1989).

Water Rights

During the 1930s, the U.S. Bureau of Biological Survey on behalf of the federal government submitted declarations of filing in North Dakota for many impoundments on national wildlife refuges. Such filing applies for and documents the claim of ownership of the right to use water for current purposes. In 1930, there was a fire at the state capitol that destroyed most of these early filings, and, subsequently, new legislation was introduced to alter the way in which water rights were applied for and processed. As a result, there are many old declarations of filing that have not been entered into the state's water rights database and have never been perfected (described in the following paragraph) in the same manner as the newer water right permits.

USFWS

Wetland Sunset

The state of North Dakota currently issues a conditional water permit when an application for a water right is made. This permit grants the claimant the right to develop the structure or structures necessary to put the water to beneficial use. After the claimant has developed the necessary structures and put the water to beneficial use, the North Dakota State Water Commission has to inspect the project and verify that the water as claimed is being put to beneficial use. The North Dakota State Engineer then issues a perfected water permit.

Early water rights usually included a storage amount as well as an amount for seasonal use. The seasonal use is the water needed to offset evaporation and is generally seen only in connection with a reservoir. The state instituted a one-time fill rule, eliminating the ability to offset evaporation. This rule was waived in some cases, but many of the later water rights only list a storage volume.

Some water rights—particularly groundwater rights, but also some surface water rights—have an associated flow rate. If there is a decreed flow rate, this is the maximum rate at which water can be pumped or diverted.

The following section is a summary of water rights for each of the 12 refuges.

Audubon National Wildlife Refuge

A letter of understanding between the Bureau of Reclamation, U.S. Fish and Wildlife Service, NDGF, and U.S. Army Corps of Engineers outlines the

operation, including water levels, of Lake Audubon. The Bureau of Reclamation secured Conditional Water Permit Number 1416, which includes 230,000 acre-feet for fish, wildlife, and recreation purposes.

The Service holds four perfected water permits, all for fish and wildlife purposes, for the Audubon National Wildlife Refuge as follows:

- Perfected Water Permit Number 3804, priority date June 27, 1985—325.0 acre-feet for storage plus 52.0 acre-feet to offset evaporative losses.
- Perfected Water Permit Number 3805, priority date June 27, 1985—5.7 acre-feet for storage plus 4.8 acre-feet to offset evaporative losses.
- Perfected Water Permit Number 3378, priority date January 29, 1981—17.1 acre-feet to offset evaporative losses in a 5.7-acre impoundment.
- Perfected Water Permit Number 3379, priority date January 29, 1981—26.9 acre-feet for storage plus 100.0 acre-feet to offset evaporative losses.

Chase Lake National Wildlife Refuge

A water right claim was filed by the U.S. Department of Agriculture on May 25, 1938. The water right is for all creeks, intermittent streams, and other watersheds and their tributaries that empty into Chase Lake, sufficient to maintain the water level at its meander line, which includes approximately 2,576 acres of water surface.

The Service recorded a declaration of filing with the North Dakota State Engineer, priority date September 1, 1934. Records need to be updated and water rights perfected.

Kellys Slough National Wildlife Refuge

A water right claim was filed by the U.S. Department of Agriculture on August 30, 1937, priority date September 1, 1934. The 585.0-acre-foot claim was for 195.0 acre-feet for storage plus 390.0 acre-feet for seasonal use. Inadvertently, the state issued Perfected Water Permit Number 169-59 on August 12, 1992, for 190.0 acre-feet for storage plus 90.0 acre-feet for annual use for fish and wildlife purposes, which abandoned and voided the additional amount of water the Service had claimed.

The Service holds four perfected water permits, all for fish and wildlife purposes, for the Kellys Slough National Wildlife Refuge as follows:

- Perfected Water Permit Number 4761, priority date March 4, 1994, Upper Pool 1—1,228.0 acre-feet for storage minus 266.0 acre-feet to offset evaporative losses.
- Perfected Water Permit Number 4471, priority date May 14, 1991, Lower Pool 1—404.0 acre-feet for storage minus 100.7 acre-feet to offset evaporative losses.
- Perfected Water Permit Number 4309, priority date October 22, 1990, Pool 5—21.0 acre-feet for storage minus 5.3 acre-feet to offset evaporative losses.

Lake Alice National Wildlife Refuge

The Service recorded a declaration of filing with the North Dakota State Engineer February 21, 1935, claiming use of unappropriated water in the Mauvais Coulee watershed to be used on six projects including Lac Aux Mortes (Lake Alice). The right was filed for record on May 12, 1938, claiming 23,940.0 acre-feet (10,260.0 acre-feet for seasonal use and 13,680.0 acre-feet for storage). Perfected Water Permit Number169A (Lake Alice control structure)—dated November 21, 1967—recognized a priority date of May 25, 1938, for the refuge's water right. However, it established the right for 10,260.0 acre-feet for annual use and 9,200.0 acre-feet for storage, the amounts indicated on the Service's application for a permit (169A) filed in 1966. The purposes stated on the permit are waterfowl wetlands and flood control.

In addition to the declaration of filing, table 4 lists the conditional water permits that Lake Alice National Wildlife Refuge has for fish and wildlife purposes.

Table 4. Conditional Water Permits for Lake Alice National Wildlife Refuge, North Dakota.

Permit Number	*Structure Name*	*Priority Date*	*Water Flow Rate*	*Storage (acre-feet)*	*Seasonal Use[1] (acre-feet)*
4565	Outlet Marsh	March 9, 1992	24 cfs[2]	229.0	126.0
5060	Pintail Marsh	September 30, 1996	10,000 gpm[3]	243.0	93.0
5075	Jerome Marsh	November 21, 1996	—	45.2	25.0
5076	Kenner Marsh	November 21, 1996	—	87.1	42.0
5077	Redhead Slough	November 21, 1996	—	77.0	39.0
5142	Elsperger Marsh	July 28, 1997	10,000 gpm	175.0	175.0
5143	West Chain Lake	July 28, 1997	10,000 gpm	357.6	270.0
5493	Hansen Marsh	April 2, 2001	10,000 gpm	270.6	96.1

[1]*To offset evaporative losses.*
[2]*cfs=cubic feet per second.*
[3]*gpm=gallons per minute.*

Lake Ilo National Wildlife Refuge

The Service recorded a declaration of filing with the North Dakota State Engineer, priority date September 1, 1934, for 10,850.0 acre-feet from Spring Creek: 7,130.0 acre-feet for storage and 3,720.0 acre-feet for seasonal use as a refuge and breeding ground for migratory birds and other wildlife. Spring Creek is a tributary to the Knife River in the Missouri River watershed. A 1994 review of the original filing documents, more recent survey information, and a more accurate net evaporation calculation resulted in an updated surface acreage, capacity at spillway, and seasonal use. Records should be updated to reflect a total of 6,850.0 acre-feet: 5,157.0 acre-feet for storage and 1,693.0 acre-feet for seasonal use. Records need to be updated and water rights perfected with the North Dakota State Engineer.

Lake Ilo National Wildlife Refuge has Perfected Water Permit Number 4746, priority date January 18, 1994, for 15.9 acre-feet from Spring Creek for storage. For fish and wildlife use, 7.0 acre-feet will be used to offset evaporative losses in borrow areas created during repair and reconstruction of the Lake Ilo dam.

Lake Nettie National Wildlife Refuge

For Lake Nettie National Wildlife Refuge, the Service recorded a declaration of filing with the North Dakota State Engineer, priority date September 1, 1934, for 3,528.0 acre-feet from Turtle Creek in the Missouri River watershed: 2,268.0 acre-feet for storage and 1,260.0 acre-feet for seasonal use. Records need to be updated and water rights perfected with the North Dakota State Engineer.

Lake Zahl National Wildlife Refuge

For Lake Zahl National Wildlife Refuge, the Service recorded a declaration of filing with the North Dakota State Engineer, priority date September 1, 1934, for 6,903.0 acre-feet from the Little Muddy Creek in the Missouri River watershed as a refuge and breeding ground for migratory birds and other wildlife: 3,003.0 acre-feet for storage and 3,900.0 acre-feet for seasonal use. Records need to be updated and water rights perfected with the North Dakota State Engineer.

McLean National Wildlife Refuge

For McLean National Wildlife Refuge, the Service recorded a declaration of filing with the North Dakota State Engineer, priority date September 1, 1934, for 358.0 acre-feet from Deep Water Creek in the Missouri River watershed: 148.0 acre-feet for storage and 210.0 acre-feet for seasonal use. Records need to be updated and water rights perfected with the North Dakota State Engineer.

Shell Lake National Wildlife Refuge

For Shell Lake National Wildlife Refuge, the Service recorded a declaration of filing with the North Dakota State Engineer, priority date September 1, 1934, for 3,096.0 acre-feet from Shell Creek in the Missouri River watershed as a refuge and breeding ground for migratory birds and other wildlife: 1,500.0 acre-feet for storage and 1,596.0 acre-feet for seasonal use. Records need to be updated and water rights perfected with the North Dakota State Engineer.

Stewart Lake National Wildlife Refuge

For Stewart Lake National Wildlife Refuge, the Service recorded a declaration of filing with the North Dakota State Engineer, priority date September 1, 1934, for 1,393.0 acre-feet from Deep Creek, tributary to the Little Missouri River, as a refuge and breeding ground for migratory birds and other wildlife: 802.0 acre-feet for storage and 591.0 acre-feet for seasonal use. Records need to be updated and water rights perfected with the North Dakota State Engineer.

The Service acquired Perfected Water Permit Number 4891, priority date April 17, 1995, for 5.0 acre-feet for storage from an unnamed tributary to Deep Creek. For fish, wildlife, and livestock use, 5.0 acre-feet will be used to offset evaporative losses.

Stump Lake National Wildlife Refuge

The Service has not secured any water rights for the Stump Lake National Wildlife Refuge. There are conflicts with the Bureau of Reclamation and state of North Dakota about the operating level for the lake.

White Lake National Wildlife Refuge

For White Lake National Wildlife Refuge, the Service recorded a declaration of filing with the North Dakota State Engineer, priority date September 1, 1934, for 1,315.0 acre-feet from an unnamed tributary to the Cannonball River in the Missouri River watershed as a refuge and breeding ground for migratory birds and other wildlife: 760.0 acre-feet for storage and 555.0 acre-feet for seasonal use. Records need to be updated and water rights perfected with the North Dakota State Engineer.

This pied-billed grebe—one of many migratory birds that use the refuges—makes a courtship display.

Air Quality

Air quality receives protection under several provisions of the Clean Air Act, including the national ambient air quality standards and the prevention of significant deterioration program. The standards include maximum allowable pollution levels for particulate matter, ozone, sulfur dioxide, nitrogen dioxide, lead, and carbon dioxide.

North Dakota is one of only a handful of states that meets all the NAAQS and has been given attainment status. Attainment status is based on data collected through an ambient air-monitoring network, which has various sites throughout the state. North Dakota is rural, with monitoring data stations throughout the state. Although the data is not on a county-by-county basis, data collected in one county is representative of other areas. North Dakota has energy facilities operating in the central part of the state and oil and gas activity in the western portion of the state. Even with the influence of the energy production activity, North Dakota still has some of the cleanest air in the nation. Some of the monitoring locations are in North Dakota's class 1 area, which includes the three units of Theodore Roosevelt National Park and the Service's Lostwood Wilderness (Terry O'Clair, director, Division of Air Quality, North Dakota Department of Health, personal communication; August 10, 2007).

Prescribed burning is the management activity that has the greatest effect on air quality (find more information in the description of the fire management programs in appendixes F and G). Planning for use of prescribed fire incorporates the management of smoke. To the extent possible, suppression of wildfires also addresses smoke management. The Service identifies sensitive areas and takes precautions to safeguard visitors and local residents. Smoke dispersal is a consideration in determining whether a prescribed burn is within prescription. Generally, the fine-grass fuels and small burn size (80–600 acres) generate low volumes of smoke for short durations (4–5 hours).

3.2 Biological Resources

This section contains descriptions of the vegetative communities and wildlife at the refuges. The vegetation section includes discussions about invasive plants, fire, and grazing, each of which has a major influence on native vegetative communities.

Vegetative Communities

Prairies, or grasslands, in North Dakota and throughout the Great Plains have been gaining public interest over the last few years as more people become aware of their decline (see table 5). Before the 1870s, prairies covered more than a third of the United States and almost all of North Dakota. What once was a mosaic of grasses and forbs (flowering plants) where bison roamed is now predominantly agricultural land. With the arrival of increasing numbers of settlers in the late

Jennifer Anderson/USDA–NRCS PLANTS Database

Big bluestem is the predominant native grass of the tall-grass prairie.

1800s, the landscape started to change and continued to change at such a great extent that now only 0.5% of those areas in the United States remain.

Table 5. Prairie Decline in North Dakota.

Prairie Type	*Historical Acreage*	*Present Acreage*	*% Decline*
Mixed grass	35,088,200	11,119,500	68.3
Tall grass	321,230	297	99.9

Source: National Wildlife Federation (2001).

A combination of factors is to blame for this loss. Large-scale agriculture and intensive grazing are often criticized but fire suppression, introduction of invasive plants, altered hydrology, and modified animal communities have contributed. The loss of diversity and distribution of prairie grass and forbs are of great concern, but it is not just plants that have suffered. Grasslands not only provide primary nesting habitat for a variety of bird species, but also are very important staging and feeding areas for waterfowl and shorebirds during long migratory flights. In addition, prairies provide an important food source for small mammals and insects that, in

turn, support larger wildlife species. From a human standpoint, prairies can help to maintain clean air and water, control erosion, provide rich soil, are rich in history and folklore, and provide community income from wildlife-related recreation and tourism. All this combined makes it easy to see why prairies are considered the most endangered ecosystems.

Historically, North Dakota was predominantly mixed-grass prairie in the southwest and tall-grass prairie in the northeast. As the total annual precipitation increases eastward across the state, conditions allow for taller, more robust grasses. Today, some of the best places to find prairie plants in North Dakota are federal grassland refuges, state-owned land, railway rights-of-way, ditches, old cemeteries, pastures, and private property throughout the Missouri Coteau in the central and western parts of the state (Grondahl and Evelsizer 2002).

Many prairie birds currently show population declines. The western prairie fringed orchid is now a rare flower of the tall-grass prairie. The Dakota skipper butterfly is another prairie inhabitant whose numbers are decreasing. Each of these declines is directly related to the loss of prairie.

Prairie provides important values to people. It contains dozens of wildlife species, hundreds of different plants, and thousands of insects. These species provide genetic diversity important to agriculture and medicine. Planted grasslands do not begin to match the diversity found in native prairie.

In addition to its importance to wildlife, prairie is also crucial for soil and water conservation. Prairie provides a reminder of the nation's rural and pioneer heritage; it provides recreational activities such as hunting, hiking, and bird watching; and it offers living laboratories for scientific research. Prairie also provides economic benefits through cattle grazing, haying, and native seed harvesting. When prairie is lost, the nation's natural heritage is lost, along with a valuable resource (North Dakota Parks and Recreation Department, no date).

Mixed-grass Prairie

The mixed-grass prairie is one of the largest ecosystems in North America, with significant areas preserved for natural values in national wildlife refuges, waterfowl production areas, state game management areas, and nature preserves (Johnson 2006a). The predominant grassland vegetation within the mixed-grass prairie is prairie Junegrass, little bluestem, needle and thread, blue grama, green needlegrass, porcupine grass, prairie cordgrass, northern reedgrass, plains muhly, western wheatgrass, and Kentucky bluegrass (NDGF 2005).

One can envision the short-grass and tall-grass prairies intergrading just east of an irregular line that runs from northern Texas through Oklahoma, Kansas, and Nebraska, and then northwestward into west-central North Dakota and South Dakota. The perimeter is not well defined because of the array of short-stature, intermediate, and tall-grass species that make up an ecotone between the short-grass and tall-grass prairies (Bragg and Steuter 1996). In general, the mixed-grass prairie is characterized by the warm-season grasses of the short-grass prairie to the west and the cool- and warm-season grasses (which grow much taller) to the east. Because of this ecotonal mixing, the number of plant species found in mixed-grass prairies exceeds that in other prairie types. Estimated declines in area of native mixed-grass prairie, although less than those of the tall-grass prairie, range from 30.5% in Texas to more than 99.9% in Manitoba (Austin 1998).

The landscape component across the refuges includes the mixed-grass prairie of the Missouri Coteau and associated wetlands. This area marks the boundary of the western limits of glaciation in North Dakota. The hummocky, rolling hills of the Missouri Coteau dramatically rise 150–500 feet above the Drift Prairie. A high concentration of wetlands are present, roughly 800,000 basin acres. Alkaline lakes are also more prevalent here. Streams and rivers are nearly absent as are upland deciduous forests, but tracts of aspen parkland occur in the north. A considerable amount of native prairie remains, and this area provides primarily for cattle grazing. Areas of reduced slope, particularly the western edge, have been converted to cropland for small grains, sunflowers, corn, and alfalfa hay land. The coteau is known for supporting some of the highest numbers of breeding ducks in North America. Due to the large amount of grassland and wetland that remain or have been restored, this area is especially crucial to many other species and constitutes the focus area, Missouri Coteau breaks. Much of the coteau is classified as good to outstanding for wind energy potential, which could pose the threat of habitat fragmentation. Irrigation and new advances in cropland could allow farming of native prairie. There is established oil and gas activity in the extreme northwest.

Tall-grass Prairie

Tall-grass prairie is the wettest of the grassland types and predominantly contains sod-forming bunchgrasses. Like other grasslands, the tall-grass prairie has species originally from different geographical sources (Sims 1988). Grassland groupings of the tall-grass prairie are (1) the bluestem prairie from southern Manitoba through eastern North Dakota and western Minnesota south to eastern Oklahoma, and (2) the wheatgrass, bluestem, and needlegrass area from south-central Canada through east-central North Dakota and South Dakota to southern Nebraska. The predominant grass vegetation within this area is big bluestem, little bluestem, switchgrass, Indiangrass, prairie dropseed, slender wheatgrass, porcupine grass, mat muhly, fescue sedge, and meadow sedge.

Since 1830, there have been estimated declines of 82.6%–99% in tall-grass prairie within specific states and provinces. These declines exceed those reported for any other major ecological community in North America (Austin 1998).

Less than one-tenth of 1% of all tall-grass prairie in North Dakota lies intact. Nationwide, just 1% remains. No other major ecosystem on the North American continent—not Pacific Northwest old-growth forest, not tundra, not southwestern desert, not eastern deciduous forest—has been so fully altered by people (Domek 1998).

Located in southeastern North Dakota (Richland and Ransom counties), the 70,000-acre Sheyenne grassland straddles the ancient Sheyenne River Delta, where prehistoric meanders of the river flowed into the glacial Lake Agassiz forerunner to the Red River Valley. Just a century ago, this area hosted native grasses, some as high as a human: big bluestem, switchgrass, Indiangrass, and prairie cordgrass (Domek 1998).

Prairie landscapes are shaped by disturbance regimes such as drought, fire, and grazing. That meant wildland fire and bison 130 years ago. On the tall-grass prairie, fire probably played a larger role than did bison in shaping the vegetative mosaic. Fire swept through the area every 3–5 years, burning plant material, and thus recycling nutrients into the soil and setting the stage for diverse, healthy plant growth (Domek 1998).

The tall-grass prairie and associated wetlands within the refuges were historically found predominantly in the eastern fourth of North Dakota. The Red River of the North forms the state line between North Dakota and Minnesota. This area is referred to as the Red River Valley. Until just 10,000 years ago, a large glacial lake named Lake Agassiz covered this area. The flat topography and rich soil of the glacial Lake Agassiz basin provides for excellent but intensive agricultural production including potatoes, beans, sugar beets, corn, and wheat. By the 20th century, much of the tall-grass prairie had been converted to farmland. Few tracts of native vegetation remain; places where small natural areas remain intact are remnants of Lake Agassiz. The shoreline of Lake Agassiz created diagonal striations of sand and gravel a few feet high that are visible in aerial and satellite imagery. The Red River Valley has few wetlands compared with the mixed-grass prairie to the west, with roughly 150,000 total wetland basin acres. Farmland with woodlot and shelterbelt plantings is now prevalent, particularly in Grand Forks County (NDGF 2005).

Wetland Habitat

Wetlands once covered about 4.9 million acres of North Dakota—11% of the state. By the 1980s, the acreage had decreased to about 2.7 million acres, a loss of about 45%. Most of the losses have been caused by drainage for agricultural development. The rate of agricultural conversions in the future will likely depend on crop prices and other economic factors. Most of North Dakota's wetlands are prairie potholes, which provide nesting and feeding habitat for migratory waterfowl and wading birds. About one-half the nation's duck population originates in the Prairie Pothole Region of North Dakota and other prairie states.

Prairie potholes, or sloughs, are water-holding depressions of glacial origin that occur in 300,000 square miles of prairies in north-central United States and south-central Canada. These potholes provide the most productive wetland habitat for waterfowl in North America. Although comprising only 10% of the continental waterfowl breeding, the Prairie Pothole Region produces about 50% of the duck crop in an average year and much more in bumper years. Potholes also furnish water for other wildlife and livestock (USGS 2007).

Invasive Plants

North Dakota has designated the invasive plants in table 6 as noxious weeds because they pose serious threats to agriculture and the environment. The North Dakota Weed and Pest Control Commission has designated certain weeds as noxious because of their difficulty to control and the costs associated with loss of agricultural production. All of the state-listed noxious weeds were introduced from other ecosystems and have flourished in the absence of natural controls.

The Service considers state-listed noxious weeds as a priority for control efforts. However, many other invasive plants are threatening wildlife habitat and interfering with the Service's management objectives. Refuge staffs deal with these species on a case-by-case basis, depending on available money, time, and resources.

G.A. Cooper/USDA–NRCS PLANTS Database

Dalmatian toadflax is a state-listed noxious weed.

Table 6. State-listed Noxious Weeds Found at National Wildlife Refuges in North Dakota.

Common Name	*Scientific Name*	*State-listed Noxious Weed*	*Invasive Characteristics*	*Present on Service Lands*
Canada thistle	*Cirsium arvense*	Yes	Yes	Yes
musk thistle	*Carduus nutans*	Yes	Yes	Yes
absinth wormwood	*Artemisia absinthium*	Yes	Yes	Yes
leafy spurge	*Euphorbia esula*	Yes	Yes	Yes
purple loosestrife	*Lythrum salicaria*	Yes	Yes	No
Dalmatian toadflax	*Linaria genistifolia* ssp. *dalmatica*	Yes	Yes	No
diffuse knapweed	*Centaurea diffusa*	Yes	Yes	No
Russian knapweed	*Acroptilon repens*	Yes	Yes	No
saltcedar	*Tamarix ramosissima*	Yes	Yes	Yes
spotted knapweed	*Centaurea maculosa*	Yes	Yes	Yes
yellow star-thistle	*Centaurea solstitialis*	Yes	Yes	No
field bindweed	*Convolvulus arvensis*	Yes	Yes	Yes

The "North Dakota Department of Agriculture Cooperative Weed Management Plan–January 2004" identifies nine goals:

1. Prevent the introduction, reproduction, and spread of designated noxious and invasive nonnative plants into North Dakota.
2. Develop cooperative weed management partnerships with public and private partners to attack shared weed problems.
3. Carry out the most effective, economical, and environmentally appropriate weed control methods for the target weeds.
4. Carry out an early detection and rapid response system; this will include mapping and control of infestations.
5. Reduce the extent and density of established weed infestations to the point that economic and environmental impacts are minimized or eliminated.
6. Educate and inform the public, private landowners, public land managers, and decision makers about invasive weeds and their economic and environmental impacts.
7. Coordinate and standardize the mapping of infestations of all noxious and invasive weeds in North Dakota, and develop and maintain a database of noxious and invasive weed infestations.
8. Seek voluntary compliance with North Dakota weed laws. When necessary, apply enforcement of these laws in a fair and consistent manner.
9. Develop a system to determine the invasiveness of weeds in North Dakota.

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The state-listed noxious weed, field bindweed, is present on Service lands.

The Service's "North Dakota Integrated Pest Management Plan" will be reviewed for possible modification to incorporate the state's goals that fit with Service policy, goals, and objectives of habitat management.

Invasive plants on Service lands have reduced wildlife habitat and biodiversity. The presence of invasive plants can alter the functioning of ecosystems by loss of wildlife habitat, displacement of native species, change in carrying capacity from reduced forage production, lower plant diversity, and increased soil erosion and sedimentation. These plants are not only problematic on the Service's fee-title lands, but invasive plants infest rangelands and croplands across North Dakota. The spread of invasive plants occurs by root spread or by seed dispersal via wind, water, refuge visitors, humans, equipment, or animals.

Fire

Historically, grasslands in the northern Great Plains co-evolved with various disturbance regimes such as fire and large-mammal grazing. Whether lightning-induced or deliberately set by Native Americans, historical fires have influenced the composition of the plant communities. A handful of fire-tolerant shrubs such as chokecherry, American plum, and leadplant were present, while other fire-sensitive woody species were restricted to areas that were protected from fire. A number of grass and forb species dominated the plant communities.

It is estimated that the historical wildland fire frequency for the North Dakota prairie was 5–7 years (Bragg 1995), although little information is available on the occurrence of fire during the early years on each of the refuges. Potential exists for large wildland fires to occur; however, this has generally not been the case. Local fire departments and area ranchers aggressively suppress wildfire. It is also the refuges' policy to control all wildfires occurring on Service lands.

The refuge staffs use prescribed fire to simulate the historical influence wildland fire had on plant communities. Historically, wildfires likely occurred during the summer and fall. Most prescribed fires are applied in spring through early summer or in early fall to allow for some recovery of vegetation before winter. These periods present opportunities to use fire for management of invasive cool-season grasses, to open up shorelines and vegetation-choked wetlands, and to provide areas of green browse attractive to migratory waterfowl. During the last 15 years, prescribed fire has been increasingly used.

The combination of prescribed burning and grazing is a practice used to reduce the accumulation of organic litter. A fire creates a "flush" growth of new vegetation, which is then grazed to extend treatment of problem plants such as Kentucky bluegrass and smooth brome. Invasive plants including Canada thistle, absinth wormwood, and leafy spurge can be managed similarly. The refuges have occasionally used this management strategy; however, the strategy shows promise for more frequent use in the future. Overall guidance for use of prescribed fire and management of wildland fire is in the description of the fire management programs (appendixes F and G).

Grazing

Grazing greatly influences the structure and composition of grassland communities. Herbivores such as bison, elk, deer, pronghorn, and black-tailed prairie dog interact with soils, plants, other animals, and other processes to produce unique successional patterns in the northern Great Plains landscape at multiple scales.

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Refuge staffs use prescribed fire to simulate the historical fire regime.

USFWS

Prescribed grazing can mimic the natural disturbance that historically occurred.

Most plant species have growing points located at or near the ground surface, which allows the plant to be clipped off without killing it. Some contain bitter or toxic substances that cause animals to avoid grazing on them. Some species have spines to cause injury to grazing animals' mouths. It is likely that herds of bison historically spent a considerable amount of time grazing native prairie found in the refuges. Their grazing, trampling, trailing, and related activities likely had a significant effect on the development and maintenance of certain plant communities.

Free-ranging bison and elk are no longer present within the refuges. Instead, refuge staffs work with local ranchers to mimic natural disturbances through livestock grazing. Seasonal grazing of the uplands stresses the invasive cool-season grasses and favors native grasses and forbs. The timing of grazing is also used to stress invasive plants and is prescribed seasonally during periods when specific plants are most palatable to livestock.

Wetland grazing reduces accumulations of organic litter at the surface. A large amount of organic litter often favors invasive plants such as Canada thistle. Grazing can also be used as part of an integrated pest management (IPM) program. Follow-up treatments tend to be easier to complete and are more effective after grazing. Grazing and prescribed burning are practices used to reduce the accumulation of organic litter.

Wildlife

This section describes the birds and mammals that are common within refuge lands, as well as the threatened and endangered species that occur in North Dakota and have habitats in refuge lands. Strategic planning for waterfowl is also described.

Birds

Lush, pristine, grasslands and wetlands that are dominated by a rich assortment of native grasses and sedges occur throughout the refuges. This diverse grassland landscape holds an impressive concentration of waterfowl, shorebirds, and other open-water bird species. Within the upland prairie grassland, many species of raptors and songbirds breed and are widely distributed on protected refuge lands—making North Dakota a primary destination for outdoor enthusiasts. Bird species that occur at the refuges are listed in appendix H.

Complexes of wetlands scattered throughout the refuges attract breeding duck pairs. While semipermanent and permanent wetlands provide brood-rearing habitat and migratory stopover habitat, respectively, it is the smaller temporary and seasonal wetlands that draw breeding duck pairs to the North Dakota prairies and other parts of the Prairie Pothole Region.

Two vegetative groups distinguish the refuges—mixed-grass prairie and tall-grass prairie—and embrace a suite of primary and secondary bird species that are associated with each area (see appendix I). These areas are defined primarily based on major proportional differences in prominence of plant and animal groups. The following text is from "Breeding Birds of North Dakota" (Stewart 1975).

Mixed-grass Prairie

Bird habitats of the mixed-grass prairie include a variety of shallow basin wetland, constructed wetlands, isolated small tracts of deciduous forest, and residential areas. Fluviatile (of river origin) wetlands include permanent and intermittent streams and their associated oxbows. Constructed wetlands are represented by stock ponds, dugouts, large shallow-stream impoundments, reservoirs, and sewage lagoons. Deciduous forests include (1) narrow bands of floodplain forest along the Sheyenne, James, and Mouse rivers and their tributaries, (2) local upland forests on river bluffs and high moraines and along margins of permanent lakes, (3) scattered thickets of small trees or aspen groves on the prairie, and (4) tree claims, shelterbelts, and other wooded habitats established by humans. Farmsteads, towns, and city suburbs commonly represent the partially wooded residential areas.

The breeding birds are mostly upland and wetland species that are characteristic of the north-central avifauna (bird species found in a particular geographic region), including endemic (restricted to a geographic region) and pandemic (prevalent over a region) species. Species typical of the eastern avifauna are common along permanent streams and in other wooded habitats on the northeastern and southern Drift Plains, but occur more sparingly elsewhere. Small local populations of a few species that belong to the western and northern avifaunas also occur in this area.

The characteristic breeding birds of this area include 16 primary species, 52 secondary species, and 79 tertiary species. The primary and secondary species in mixed-grass prairie are listed in appendix I.

Tall-grass Prairie

Because of the high fertility of the soils, agricultural development has modified nearly all of the cultivable land within the tall-grass prairie. Only a few, small, remnant tracts of the original, climax, tall-grass prairie remains. Large expanses of cropland are common throughout. The principal crops are small grains (chiefly wheat), corn, potatoes, sugar beets, soybeans, and sunflowers. Occasional narrow bands of floodplain forest along some of the larger streams break up the monotypic habitat. Brushy open woodlands that adjoin tracts of a distinct, sparsely vegetated type of prairie also occur on the limited areas of deltaic sand. In addition, wooded habitats established by people—including tree claims, shelterbelts, and landscaped yards—are found near farmsteads, towns, and city suburbs. Wetland habitats in this area include streams and associated oxbows, and a few widely scattered ponds and marshes.

The breeding birds are dominated by upland, pandemic species of the north-central avifauna in association with many species of the eastern avifauna. In addition, a few species of the northern avifauna and two species of the western avifauna (western kingbird and Brewer's blackbird) are common.

The characteristic breeding birds are categorized according to relative abundance and include 6 primary species that are often common or abundant, 29 secondary species that are fairly common, and 78 tertiary (minor) species that are uncommon or rare. The primary and secondary species for tall-grass prairie are listed in appendix I.

Strategic Planning for Waterfowl

Waterfowl habitat protection and restoration are the primary emphases of the national wildlife refuges. With strategic planning, the Service can make decisions on what habitats need protection and what landscapes have the greatest value to the health of waterfowl populations.

The HAPET in Bismarck, North Dakota, conducts research and develops predictive models. Through HAPET's research and modeling of the Prairie Pothole Region of North Dakota, the Service can predict duck pair density. This modeling tool provides the Service with information needed to conserve and restore wetland and grassland landscapes that will benefit waterfowl and other bird species. The Service bases its protection priority for wetland and grassland habitat on this modeling effort.

The Service's goal is to protect habitat capable of supporting 25 or more breeding duck pairs per square mile. Figure 20 shows the predicted concentrations of duck pairs throughout the refuges within the Prairie Pothole Region. The coteau across North Dakota has the highest predicted concentrations, with up to 100 or more duck pairs per square mile. Consequently, refuge staffs can prioritize habitat protection and management for refuge lands.

Strategic planning increases the likelihood of making cost-effective decisions by avoiding misapplications of management treatments or investing in areas with limited potential to affect populations.

Mammals

There can be little doubt that the activities of the wild bison, which was extirpated (exterminated) from the Prairie Pothole Region of North Dakota and South Dakota in the 19th century, had a major influence on prairie wetlands in pristine times. Unfortunately, there is no documentation of how wetlands were affected by the feeding, drinking, dusting, or other activities of millions of bison as they roamed the prairies. Other grassland mammals extirpated from the area are the grizzly bear, kit fox, and plains wolf. These carnivores probably made only minor use of prairie wetlands (Kantrud et al. 1989).

Today at the refuges, the representative group of mammal species includes coyote, red fox, white-tailed jackrabbit, eastern cottontail, deer mouse, badger, raccoon, muskrat, white-tailed deer, mule deer, thirteen-lined ground squirrel, striped skunk, mink, long-tailed weasel, prairie vole, and meadow vole.

In addition to these common mammal species, occasionally there are confirmed sightings of moose, elk, and pronghorn on or adjacent to refuge lands. Additionally, the refuge staffs have received unconfirmed reports of mountain lion and gray wolf on Service lands.

Threatened and Endangered Species

Habitats for five federally listed species occur within one or more refuges—piping plover, whooping crane, interior least tern, western fringed prairie orchid, and Dakota skipper (butterfly).

Laws passed in the late 1960s gave limited attention to endangered species; however, it was not until the Endangered Species Act was passed in 1973 that significant protection was granted to rare species. This landmark law, considered by some the most significant environmental law ever passed, has been amended and reauthorized by Congress on numerous occasions, most recently in 1988. The Service administers the law for all inland species and certain marine species.

When Congress authorized the Endangered Species Act they declared that species of "fish, wildlife, and plants are of aesthetic, ecological, educational, historical, recreational, and scientific value to the nation and its people." The purpose of the act is to provide a means whereby endangered species and their ecosystems may be conserved. The intent of the Endangered Species Act is not to just list species as endangered or threatened, but rather, to recover the populations of these species to a point where they can be removed from the list.

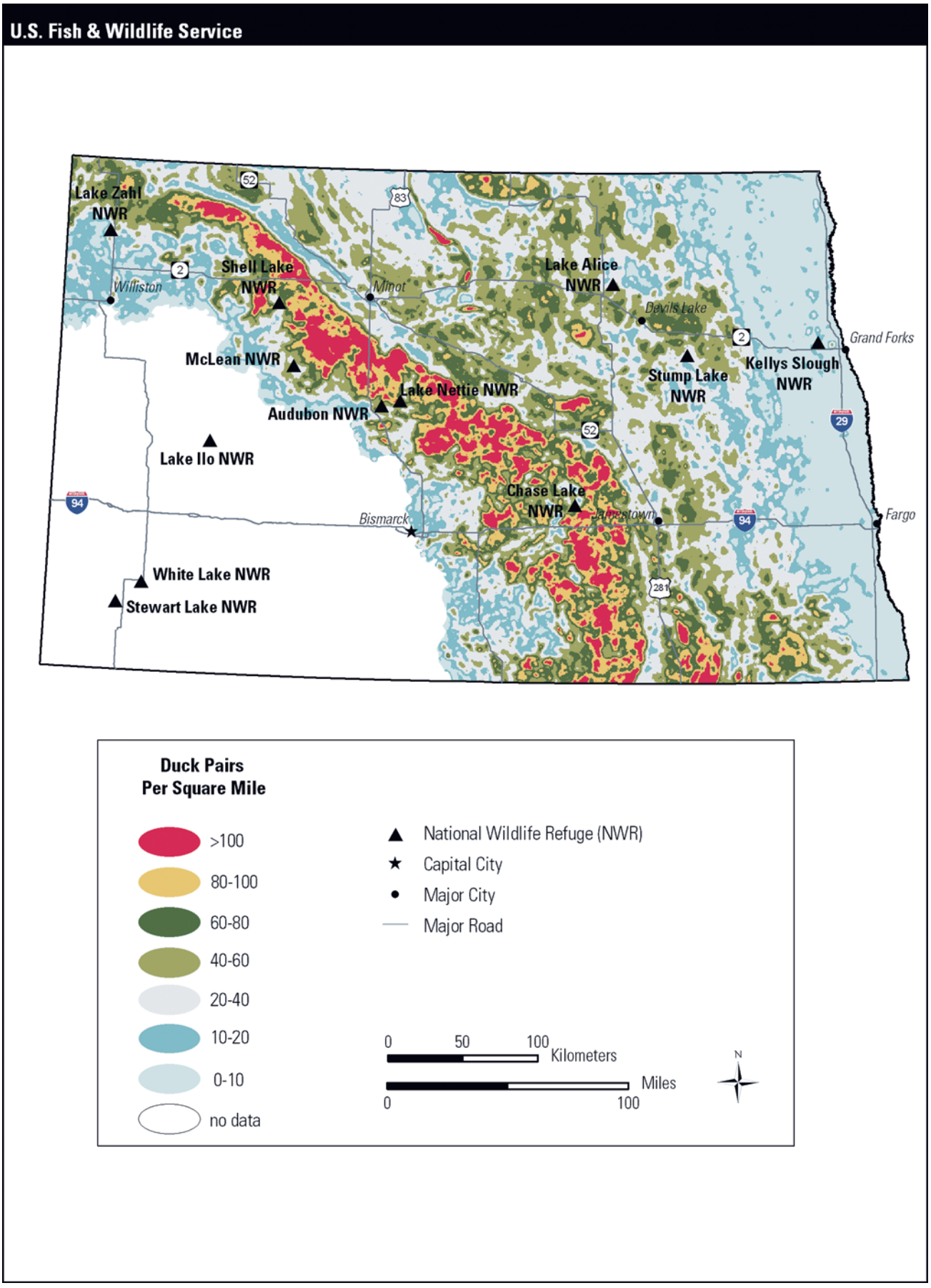

Figure 20. Map of the predicted duck-pair concentrations in North Dakota.

Appendix J shows the federally listed threatened and endangered species found in North Dakota.

Piping Plover (Threatened)

In any given year, 50%–80% of the piping plovers that nest in the United States portion of the northern Great Plains do so in a seven-county area in central North Dakota and extending into northeastern Montana (see figure 21, map of the core area for piping plover in North Dakota). Plovers in this core area breed on barren shorelines associated with alkali lakes and wetlands. Piping plovers use these habitats at nine of the refuges: Audubon, Chase Lake, Lake Ilo, Lake Nettie, Lake Zahl, McLean, Shell Lake, Stewart Lake, and White Lake.

Of the roughly 6,000 piping plovers left in the world, about half breed in the northern Great Plains. This population is declining between 6% and 12% annually (Larson et al. 2002, Plissner and Haig 2000, Ryan et al. 1993), and is expected to go extinct in 50–100 years unless significant conservation activities are started. The decline and poor prognosis led to the 1980s' listing of this population as threatened in the United States and endangered in Canada.

Ryan Hagerty/USFWS

Whooping Crane

Whooping Crane (Endangered)

The whooping crane is one of the most endangered birds in North America. The only naturally occurring wild, migratory population in the world now numbers fewer than 266 individuals (Martha Tacha, USFWS, personal communication; May 22, 2008).

Each spring and fall, whooping cranes use wetlands and agricultural fields in and around the 12 refuges as migratory stopover areas en route to their summer and winter grounds (see figure 22, map of whooping crane sightings).

Interior Least Tern (Endangered)

The interior least tern occurs in open-water habitat and on shorelines of all 12 refuges. This tern, the smallest member of the tern family, arrives on its breeding grounds in early May. The interior least tern nests in small, loosely defined groups on barren beaches of sand, gravel or shells, on dry mudflats and salt-encrusted soils (salt flats), and at sand and gravel pits along rivers. Nesting success depends on the presence of bare or nearly barren sandbars, favorable water levels during nesting and abundant food.

The terns nest in small colonies. The chicks leave the nest only a few days after hatching, but the adults continue to care for them, leading them to shelter in nearby grasses and bringing them food. The terns hover over and dive into standing or flowing water to catch small fish.

The interior least tern was federally listed as endangered in 1985, primarily due to the loss of nesting habitat as a result of dramatic alterations (channelization and impoundment) of important river systems. Water level fluctuations, vegetation of nesting habitat, and disturbance (from people, pets, predators, and livestock) continue to jeopardize nesting success.

Western Prairie Fringed Orchid (Threatened)

Kellys Slough National Wildlife Refuge is the only 1 of the 12 refuges within the range of and having suitable habitat for the western prairie fringed orchid, an endangered flower of the tall-grass prairie. However, there are no records of this orchid occurring in refuge lands. This orchid species is restricted to mostly west of the Mississippi River and currently occurs in Iowa, Kansas, Minnesota, Nebraska, and North Dakota in the United States and in Manitoba, Canada.

The orchids occur most often in wet, unplowed, tall-grass prairies and meadows but have been found in old fields and roadside ditches. The nocturnally fragrant flowers of these perennial orchids attract hawkmoths that feed on nectar and transfer pollen from plant to plant.

The greatest threat to the fringed orchid is habitat loss, mostly through conversion to cropland. Competition with invasive plants, filling of wetlands, intensive hay mowing, fire suppression, and overgrazing threatens these species.

USFWS

Western Prairie Fringed Orchid

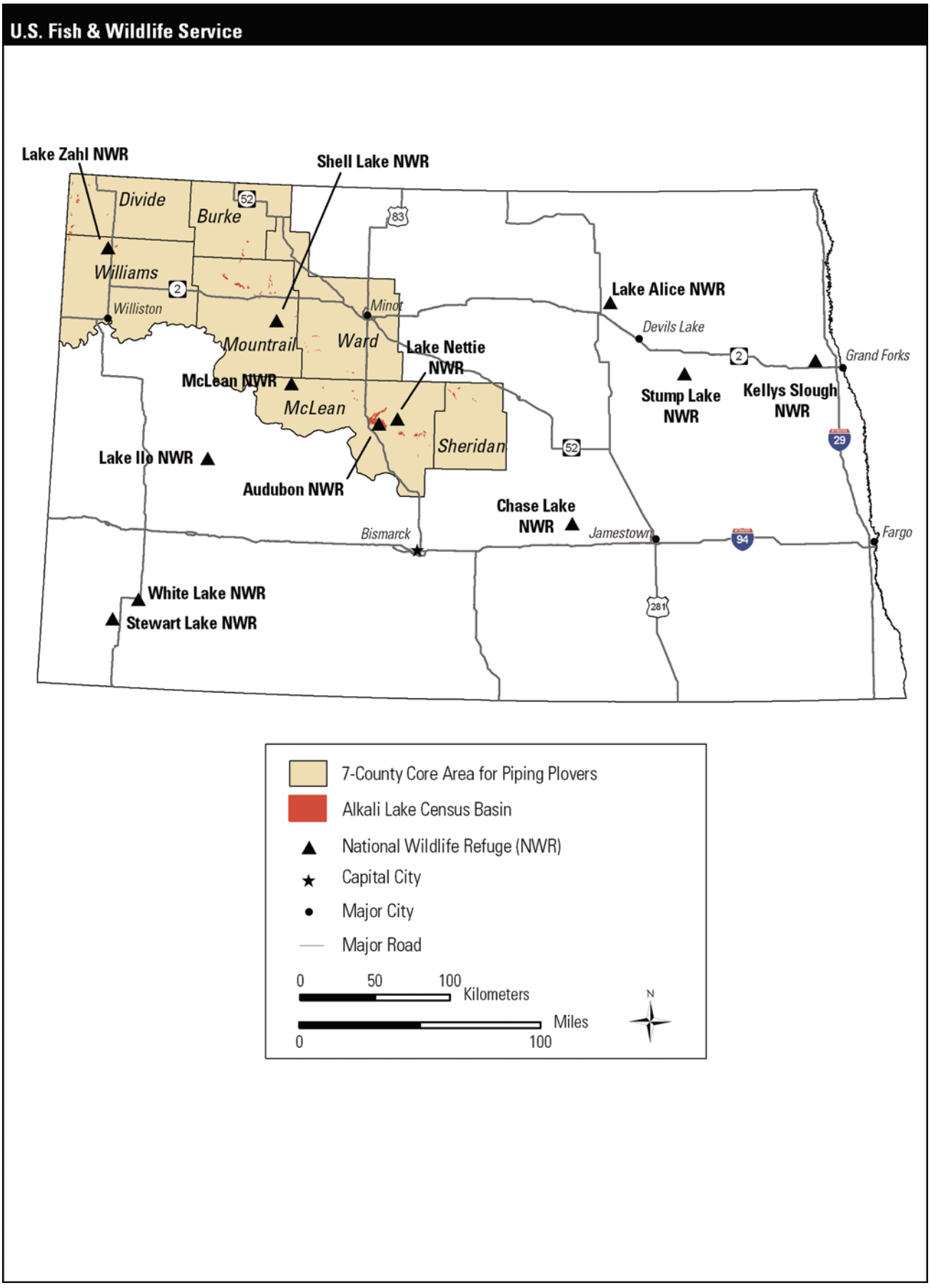

Figure 21. Map of the seven-county core area for piping plover in North Dakota.

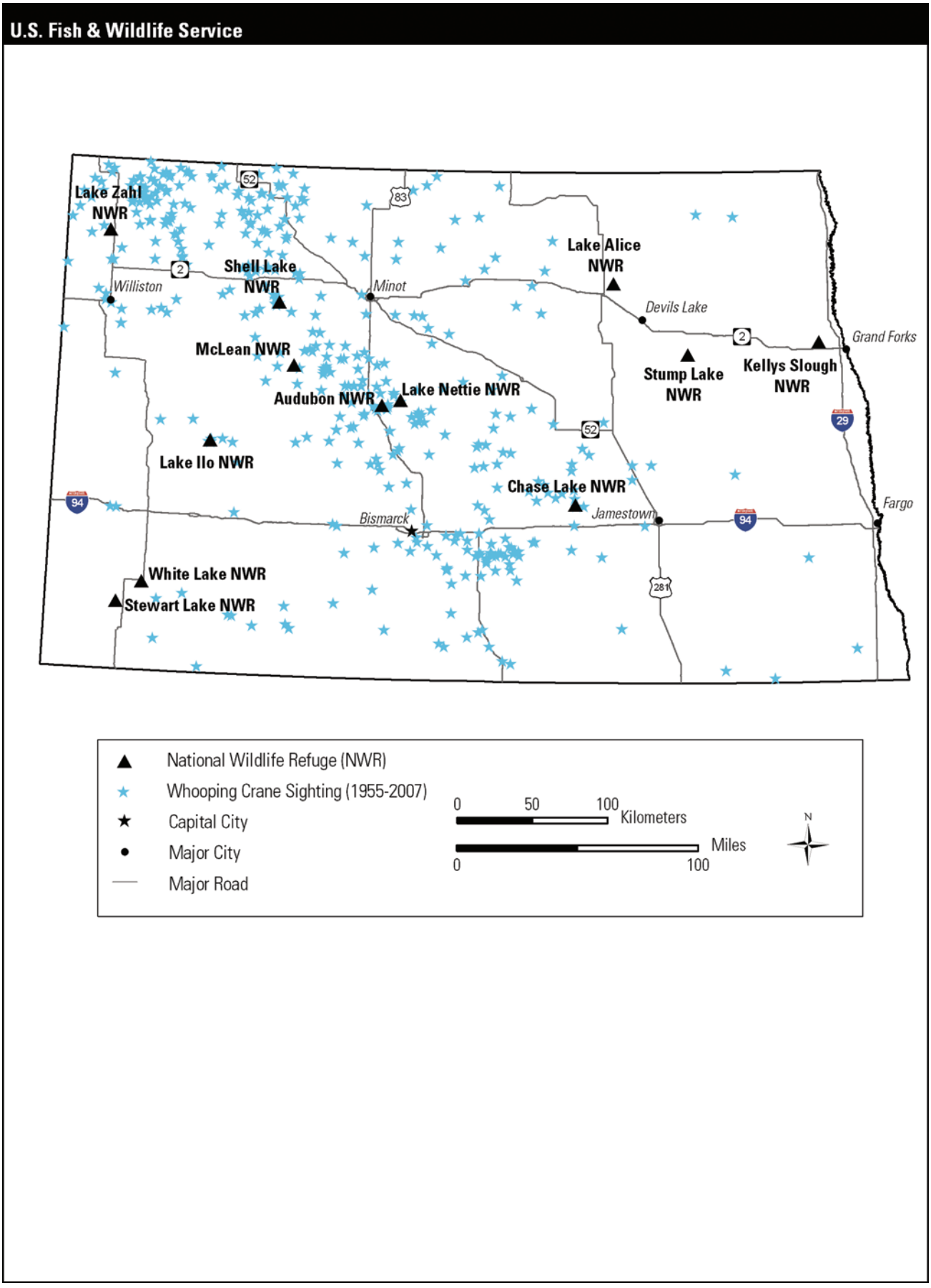

Figure 22. Map of the whooping crane sightings in North Dakota.

Dakota Skipper (Candidate)

Kellys Slough National Wildlife Refuge is the only 1 of the 12 refuges within the range of and having suitable habitat for the Dakota skipper. The skipper is a prairie inhabitant whose numbers have decreased. The skipper is a small butterfly with a 1-inch wingspan. It has a thick body and a faster and more powerful flight than most butterflies.

The skipper is likely to occur throughout a relatively unbroken and vast area of grassland in the north-central United States and south-central Canada, occurring only in scattered remnants of high-quality native prairie. The most significant remaining populations of Dakota skipper occur in western Minnesota, northeastern South Dakota, north-central North Dakota, and southern Manitoba. The skipper's current distribution straddles the border between tall-grass and mixed-grass prairie; it occurs in two types of habitat (USFWS 2002):

- Flat, moist, native bluestem prairie in which three species of wildflowers are usually present—stage-wood lily, harebell, and smooth camas.
- Upland (dry) prairie that is often on ridges and hillsides; bluestem grasses and needlegrasses dominate these habitats and three wildflowers are typically present in quality sites—pale purple, upright coneflowers, and blanketflower.

Dakota skipper populations have declined due to widespread conversion of native prairie for agriculture and other uses. This has left the remaining skipper populations isolated from one another in relatively small areas of remnant native prairie. In addition, many of the habitats where the species persists are threatened by overgrazing, conversion to cultivated agriculture, inappropriate fire management and herbicide use, woody plant invasion, road construction, gravel mining, invasive plant species, and historically high water levels in some areas.

3.3 Cultural Resources

This section is based on the cultural resource overview of the refuges developed for the Service in 2007 by RMC Consultants, Inc.

Prehistoric Resources

The cultural history of North Dakota spans over 10,000 years and has been divided into several cultural traditions. From earliest to most recent, these traditions are as follows:

- Paleo-Indian tradition
- Plains Archaic tradition
- Plains Woodland tradition
- Plains Village tradition
- Equestrian Nomadic tradition (Horse Culture)

The Equestrian Nomadic tradition is the most recent tradition and represents protohistoric (initial European contact) and early historic times. Each of these traditions is a way of life that is relatively distinct in terms of variation in technology and subsistence practices.

Perhaps the most dramatic cultural changes in North Dakota prehistory are associated with the Plains Village tradition. This period began at approximately AD 1000 and lasted until 1780, when disease introduced by Europeans decimated village populations. The onset of the Plains Village tradition marks the incorporation of horticultural production into the hunting and gathering subsistence base. Horticultural production allowed for the creation of food surpluses, primarily of corn, and facilitated the aggregation of households into larger, more sedentary earth lodge villages. In North Dakota, these earth lodge villages were most common in the southwestern and northwestern areas of North Dakota. Elsewhere in the state, settlement patterns were characterized by a combination of traits characteristic of the Plains Village tradition and the preceding Plains Woodland tradition. The generic term, Late Prehistoric, is used to describe post-Archaic resources that can be ascribed to neither the Plains Woodland nor Plains Village traditions.

Historical Resources

Before it was settled by Euro-Americans in the early 1800s, North Dakota was inhabited by several Native American tribes including Arikara, Assiniboine, Cheyenne, Hidatsa, Lakota, and Mandan.

Early Settlement

Scottish and Irish families along the Red River established the first community, Pembina, in the early 1800s (Info Please 2007). The location was originally that of trader Alexander Henry's Fort Pembina, a trading post that competed with the Hudson Bay Company (Robinson 1966). The area would eventually become northeastern North Dakota, but at the time was owned by Great Britain.

Trading posts were established at Fort Union and Fort Clark and at other lesser-known forts (Remele 1988). At these posts, meat and furs were exchanged for guns, metal, cloth, beads, and other trade goods. It was not long before the presence of the white traders was made evident in other ways; a high number of French-Canadian, Scottish, and English traders took Native American wives (mostly Chippewa, Cree, and Assiniboine). In time, a number of North Dakota trading posts and neighboring communities became predominantly populated by the offspring of these marriages, people referred to by the French as *bois brules* or *métis* (Robinson 1966).

Activity and settlement of European and Euro-American people had been consistent for some time in the North Dakota area, but was limited to discreet locations at and around military forts and trading posts. Increased settlement started in the late 1850s and

early 1860s when a concerted effort was undertaken to link St. Paul with trading posts in eastern North Dakota (Robinson 1966).

History of Development

The St. Paul and Pacific Railroad reached the Red River in 1871 and brought growing numbers of people looking toward the Red River Valley as a desirable location to settle. The Northern Pacific Railroad reached the Missouri River shortly after (Remele 1988, Robinson 1966). These two major events—as well as increased boat traffic on the Red River, new stage lines in the area, plus the establishment of a land office in Pembina—opened the door for major settlement.

Numerous towns and settlements sprang up along the new railroad routes. Between 1879 and 1886, the state underwent a settlement boom, mostly by homesteaders, with the formation of some large, organized, mechanized ("bonanza") farms (Remele 1988). The population of North Dakota increased more than 1,000% between 1878 and 1890, and a second boom occurred after 1905 (Remele 1988, Robinson 1966). Many of the settlers were immigrants of Scandinavian or Germanic origin as well as Norwegian, Russian, and Scotch-Irish-English (Remele 1988). In 1915, more than 79% of the population was immigrants or the children of immigrants (Remele 1988). North Dakota achieved statehood on November 2, 1889 (Remele 1988).

Improved weather conditions, a wartime economy, and federal construction projects related to flood control and irrigation resulted in another economic boom during the 1940s (Remele 1988). Crop yields increased, America entered World War 2, and several large-scale construction projects were carried out along the Missouri, James, and Sheyenne rivers, including the Garrison Dam in the Missouri River.

The development of the state's natural resources began in the 1950s. Oil was discovered near Tioga in the Williston basin in 1951, and coal resources were mined for use in newly constructed plants to generate electricity (Remele 1988). The communications and transportation networks were also expanded and improved throughout the 1950s (Remele 1988). North Dakota is "the most rural of all the states," and today 90% of the land is used for (1) farming including cultivation of crops such as wheat, barley, rye, sunflowers, beans, oats, flaxseed, sugar beets, and hay, and (2) for raising beef cattle, sheep, and hogs (Info Please 2007). The state also produces other resources including lignite, clay, sand, and gravel. Outdoor recreation is popular in North Dakota, particularly fishing and hunting.

3.4 Chase Lake Wilderness

In 1964, President Lyndon B. Johnson signed the Wilderness Act (Public Law [PL] 88-577) establishing the National Wilderness Preservation System. The Wilderness Act mandates that wilderness areas be "administered for the use and enjoyment of the American people in such a manner as will leave them unimpaired for future use and enjoyment as wilderness."

The Wilderness Act required the Secretary of the Interior to review federal lands to determine if they contained areas that were suitable for inclusion in the National Wilderness Preservation System. A review of Chase Lake National Wildlife Refuge was done, and it was determined that, because of its unique "roadless prairie" habitat and natural beauty, the area should be designated as a wilderness. In 1975, 4,185 acres of the 4,440-acre refuge were designated as Chase Lake Wilderness. Chase Lake Wilderness is one of only two wildernesses in the Refuge System in North Dakota; the other is Lostwood Wilderness.

The Chase Lake Wilderness receives very little public use, with about 300 visits per year. To preserve the integrity of the wilderness, no motorized vehicles or mechanical equipment are allowed in the wilderness portion of Chase Lake National Wildlife Refuge. Due to the American white pelican colony, visitors to Chase Lake Wilderness need a special use permit issued by the refuge staff. Deer hunting is permitted during the late fall, state firearm season. However, no other public use is permitted.

3.5 Visitor Services

The Improvement Act emphasizes the importance of compatible, wildlife-dependent recreation. The act identifies these six wildlife-dependent recreational uses: hunting, fishing, wildlife observation, photography, environmental education, and interpretation.

Hunting

Centuries ago, the Missouri Coteau was considered a prominent landmark to the Plains Indians and early European settlers who camped and hunted waterfowl and other game species within the wetland and pothole areas. With the settlement of the prairie states, certain hunting restrictions were established for the protection and propagation of wildlife.

Of the 12 refuges, hunting is permitted at Audubon, Chase Lake, Lake Alice, Lake Nettie, and Lake Zahl national wildlife refuges. Special regulations apply to each refuge and all federal and state regulations apply. Visitors wanting to hunt on one of these refuges should contact the particular refuge for species of take, open and closed areas, seasons of use, and regulations. A map showing areas open to hunting and regulatory text is available at refuge headquarters.

Areas open to hunting are generally open to bow, gun, and muzzleloader deer hunting in accordance with state regulations during state seasons. To reduce hunting group conflicts and migratory bird disturbance, these

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Duck hunters get an early start on a peaceful morning.

seasons do not open until late November. Nontoxic shot is required on all refuge lands. No lead shot may be used at or carried onto a refuge.

Fishing

Winter fishing only is allowed at Audubon National Wildlife Refuge. Fishing is permitted year-round at Lake Ilo National Wildlife Refuge: summer boat fishing and winter ice fishing. Permanent lakes at the refuges offer fishing for northern pike, walleye, yellow perch, and a few other species. The NDGF stocks the two refuge lakes, where anglers commonly seek yellow perch and northern pike. Due to the abundance of aquatic life in the permanent wetlands, growth rates of fish are often very high. During the winter months, ice fishing seems to be the most popular.

Vehicle access to the lakes at both refuges is limited to designated access points. There is no restriction to types of vehicles that may access Lake Audubon during the winter for ice fishing. Lake Ilo has an accessible boat ramp and a fishing pier.

USFWS

Ice houses dot Audubon Lake for ice fishing at Audubon National Wildlife Refuge.

Fishing at the refuges requires the angler to follow both state fishing regulations and special refuge regulations.

Wildlife Observation and Photography

The refuges provide outstanding opportunities for viewing wildlife. They offer optimal viewing for waterfowl, grassland birds, and shorebirds from April through early June and from late August through October. Seasonal highlights include the spring courtship dances of sharp-tailed grouse and western grebe, spring and fall shorebird migrations, daily fall movements of thousands of waterfowl, and winter activities of various bird and mammal species.

Many wildlife species can be observed from public roads. In addition, bird watchers and photographers can access the refuges by designated refuge roads and trails. In some areas, viewing blinds are available in the spring for visitors to observe wildlife in their native habitat. Highlights for bird watchers occur in the spring when breeding grassland birds—such as Baird's sparrow, Le Conte's sparrow, and Sprague's pipit—can often be seen.

Environmental Education and Interpretation

Each refuge headquarters facility has interpretative information associated with its visitor contact area. The visitor contact area includes exhibits and a variety of informational pamphlets about the Service, refuge, Refuge System, and other natural resources-related information. There are generally kiosks located in front of each headquarters facility; kiosks contain information about prairie wetlands and wildlife species found throughout the refuge.

Refuge staffs provide educational talks and tours for schools and other groups, on request. The environmental education and outreach programs expand beyond the boundaries of the refuges, and refuge staffs are involved in local, regional, and statewide programs.

Trapping

Each of the refuges has developed a predator management plan. These plans authorize predator control, performed by refuge staffs and their authorized agents, outside the normal trapping season. Trapping targets predators and maintenance of infrastructure. Recreational trapping is not allowed at the refuges.

3.6 Partnerships

The refuge staffs have established partnerships with local, state, and national groups in efforts to achieve habitat objectives and to improve and expand environmental education. Most refuges have local partnerships with the following groups for projects ranging from control of invasive plants to protection of piping plover nests:

- weed boards
- water resource boards
- rural volunteer fire departments
- law enforcement departments
- Scouts
- 4-H clubs
- private landowners

The refuges have worked closely with NDGF and North Dakota's health and agriculture departments on projects such as hunting and fishing opportunities, disease issues, and management of habitat and invasive plants.

The refuge staffs have partnerships with the following groups and agencies for habitat management, research, and environmental education:

- Army Corps of Engineers
- Bureau of Reclamation
- Delta Waterfowl
- Ducks Unlimited, Inc.
- The Nature Conservancy
- National Audubon Society
- National Turkey Federation
- National Wildlife Federation
- National Fish and Wildlife Foundation
- North Dakota Natural Resources Trust
- North Dakota Wildlife Federation
- USGS

The refuges have also developed working relationships with various oil and wind industry companies.

3.7 Socioeconomic Environment

This section is based on the socioeconomic impact analysis for the refuges that was completed for the Service in 2007 by BBC Research and Consultants.

The 12 national wildlife refuges cover an area of about 46,500 acres and vary in type of public use. Stump Lake and White Lake national wildlife refuges are closed to the public. Related visitor activity—such as spending on food, gasoline, and overnight lodging

USFWS

Visitors to Audubon National Wildlife Refuge have opportunities to view sharp-tailed grouse.

in the local area—provides local businesses with supplemental income and increases the local tax base. Management decisions about visitor services, expansion of services, and habitat improvements at the refuges may either increase or decrease visitation and, thus, affect the amount of visitor spending in the local economy.

Population and Demographics

The population of North Dakota has declined over the past 25 years, reaching a peak of about 677,000 in 1985 and declining to 634,600 in 2005, a decrease of 6.3%. This overall population decrease has been in nonmetropolitan areas of the state, while metropolitan areas have experienced steady growth (an average of 1.2% per year).

North Dakota has a rapidly aging population—a trend that is expected to become more marked in coming decades and have important policy implications as the baby boomer generation enters retirement.

Employment

The civilian labor force in North Dakota grew from 345,820 to 357,960 between 2001 and 2006. The government (federal, state and local) claimed the largest portion of employment (17%) in North Dakota, followed by health care (12%), retail trade (11%), and farming (8%).

According to the Bureau of Economic Analysis, unemployment in North Dakota fell from a high of 3.6% in 2003 to 3.2% in 2006. Local unemployment rates ranged from 2.1% in Williams County to 9.3 in Rolette County.

Operations and Activities

The 12 refuges in North Dakota are scattered throughout the state; only Audubon, Kellys Slough, and Lake Alice national wildlife refuges have field offices.

In 2000, the total budget for all Service activities in North Dakota totaled more than $11,508,000. The Service employs about 170 people throughout the state, 48 of which are involved with management of the 12 refuges. Because many refuge employees work for both national wildlife refuges and wetland management districts, they cannot be considered full-time equivalents (FTEs) when examining the socioeconomic impact of refuges alone. (A full-time equivalent is one or more job positions with tours of duty that, when combined, equate to one person employed for the standard government work-year). The 12 refuges alone support 22.4 FTEs in North Dakota.

The refuges offer many recreational and educational opportunities, which include hunting, fishing, and nonconsumptive activities such as hiking, photography, and wildlife observation. No camping is permitted at refuges in North Dakota.

Hunting is popular at some areas, especially at Audubon, Chase Lake, Lake Alice, Lake Nettie, and Lake Zahl national wildlife refuges. At most refuges, only hunting of deer and upland game birds (pheasant, grouse, and partridge) is permitted but, at Lake Alice National Wildlife Refuge and some other refuges, hunting of waterfowl is permitted as well.

Fishing is one of the most popular activities at the refuges. Audubon National Wildlife Refuge is a popular destination for ice fishing in the winter, and Lake Ilo National Wildlife Refuge is popular for fishing year-round. The most popular game fish at these refuges are walleye, perch and northern pike.

Nonconsumptive activities such as hiking and wildlife observation draw casual visitors, outdoor enthusiasts, educational tours, photographers, and others to the refuges. The array of songbirds and waterfowl at the refuges makes them popular for bird watching. Some areas offer auto tour routes, hiking trails, and picnic tables including Audubon and Lake Alice national wildlife refuges.

The 12 refuges welcomed 79 volunteers for a total of 814 volunteer hours in 2007.

Visitor Levels and Spending

The most popular areas in terms of total visitation are Audubon, Kellys Slough, and Lake Ilo national wildlife refuges.

As part of the Refuge Annual Performance Plan, North Dakota refuges track the number of visitors by purpose of visit (hunting, fishing, wildlife observation, or photography). For 2007, refuge staffs estimate total visitation to the 12 refuges to be almost 37,000 visitor days. Of these 37,000 visitor days, about 3,700 (10%) are for hunting, 18,900 (51%) are for fishing and 14,400 (39%) are for recreational activities. The 2004 "Banking on Nature" (Caudill and Henderson 2005) study estimates total visitation for eight national wildlife refuges in region 6, two of which are located in North Dakota (Arrowwood and Audubon national wildlife refuges). According to the study, about 44% of visitors are nonresidents of the local areas surrounding the refuges visited. Applying this rate to visitation statistics at the 12 refuges, 16,400 visitor days were from nonresidents (1,600 for hunting, 8,400 for fishing and 6,400 for nonconsumptive recreation).

The "Banking on Nature" study also breaks down visitor expenditure by activity (hunting, fishing or nonconsumptive). Among all region 6 refuges profiled in the study, average expenditure per nonresident visitor day is $55 for hunting, $34 for fishing and $18 for nonconsumptive recreation. Hunters and anglers have higher daily expenditures due to costs of supplies related to their activities.

Only nonresident visitor spending can be considered when calculating the socioeconomic impact of refuges on North Dakota's economy. The money spent by

North Dakota residents on visitation to a local refuge would likely be spent on other local recreational activities if the refuge did not exist, so it cannot be considered new expenditure in the local economy.

Baseline Economic Activity

Combining the effects of Service employment and visitor spending, the total economic activity generated by the 12 refuges on their local economies is approximately $1,483,000 per year (Caudill and Henderson 2005):

- The refuges affect their local economies through the visitor spending they generate and the employment they support. The 12 refuges support 22.4 FTEs in North Dakota. Based on data from federal wage and salary tables for each position, refuge employment accounts for $1,270,000 in employee compensation, or roughly $56,800 per FTE. Using the Bureau of Labor Statistic's Consumer Expenditure Survey data for individuals in these income categories, roughly 79% of annual income is spent locally. Under this assumption, the 12 refuges contribute about $998,000 to their local economies through employee spending.
- The 12 refuges currently experience total visitation of approximately 16,400 nonresident visitor days per year. Of these, roughly 1,600 are for hunting, 8,400 for fishing and 6,400 (39%) for nonconsumptive recreational activities. Combing these visitation numbers with nonresident spending averages from the "Banking on Nature" study, total visitor expenditure generated by the 12 refuges is estimated to be $485,000 per year. Of this total, approximately $89,000 (18%) comes from hunting, $282,000 (24%) from fishing and $115,000 (58%) from nonconsumptive recreational activity.

3.8 Operations

Funding for operations at the refuges is for the staff, facilities, and equipment needed to carry out management activities to meet the purposes, goals, and objectives for the refuges.

All refuges have staff and facilities that are shared to manage all the units in a complex (a complex is one or more refuges and one or more districts that are administratively grouped for management efficiency).

Because in most cases facilities are shared with complex staff and for administrative duties, office working conditions are tight and not conducive for conducting business. In addition, visitor centers and interpretive displays are inadequate and do not provide visitors an adequate space to learn about the benefits of the refuges and their resources.