CHAPTER 4—Management Direction

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A snowy owl perches on a sign in the Lake Andes National Wildlife Refuge.

The Service developed objectives in support of goals identified in chapter 2 to carry out the proposed action (alternative B) for management of the Lake Andes National Wildlife Refuge Complex. This chapter presents suggested strategies to achieve objectives; rationale supporting the goals, objectives, and strategies; and assumptions used in developing the CCP.

Biological goals and objectives emphasize management of plant communities as habitat for wildlife, especially migratory birds, and are organized by major habitat types that occur on the refuge complex. Goals and objectives are habitat-based (rather than wildlife-based) because wildlife often responds to factors beyond control of local refuge management. (For example, disease outbreaks or habitat conditions on important staging or wintering sites can affect populations of migratory birds.) Furthermore, management practices such as fire, grazing, haying, tree removal, and water level manipulation focus on plant communities rather than wildlife populations. Habitat-based objectives emphasize monitoring of important vegetation attributes such as community composition and vegetation structure over time. In most cases, wildlife population responses to habitat changes are not directly monitored. Rather, site-specific inventories, applied research, and literature reviews allow for reasonable predictions of wildlife responses to habitat management.

Important to note is that in South Dakota, the Service places highest priority on two groups of species—together known as trust species—and holds special responsibility in managing and conserving these species. The first group contains those species that are State or federally listed as endangered or threatened. Some listed species pass through the refuge complex (for example, whooping crane) or occur in the general area (for example, least tern and piping plover); however, the refuge complex does not provide significant habitat (for example, breeding habitat) for any listed species.

The second group contains those species listed as migratory birds, a long list of birds that can be found in the Migratory Bird Treaty Act. For the most part, migratory birds include all bird species that occur in the U.S. with the exception of nonnative birds (for example, European starling, English sparrow, and Eurasian collared dove) and nonmigratory birds (for example, sharp-tailed grouse and greater prairie chicken). According to Section 7 of Service Director's Order 172, "Responsibilities of Federal Agencies to Protect Migratory Birds" (USFWS 2004):

> Many Service programs are actively involved in bird conservation activities. Our objective for migratory bird management and conservation is to minimize the potential adverse effects of migratory bird take, with the goal of striving to eliminate take, while implementing our mission. All Service programs strive to take an ecosystem approach to protection and restoration of species and their associated

habitats. As migratory birds is one of our trust resources, all programs must emphasize an interdisciplinary, collaborative approach to migratory bird conservation in cooperation with other Service programs, in addition to other governments, State and Federal agencies, and non-Federal partners. However, we recognize that direct or indirect actions taken by Service employees in the execution of their duties and activities as authorized by Congress may result in the take of migratory birds. In many instances, short-term negative impacts on migratory birds are balanced by long-term benefits. We will incorporate ecosystem integrity, reduction of invasive species, and long-term adaptive management in migratory bird management, using the best available scientific information.

Objectives in this chapter are written with trust species in mind.

4.1 Identification of the Proposed Action

The planning team has identified alternative B as the proposed action after determining that it accomplishes the following:

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

Under the selected alternative, management of the refuge complex will emphasize developing and implementing an improved, science-based priority system to restore prairie habitats for the benefit of waterfowl, State and federally listed species, migratory birds, and other native wildlife. Refuge complex staff will focus on high-priority tracts and, when possible, on lower-priority tracts. The focus will be to restore ecological processes and native grassland species to the greatest extent possible within the parameters of available resources and existing constraints. Refuge complex staff will seek to maintain and in some cases expand the existing levels and types of public use programs, ensuring that programs offered to the public are of consistently high quality.

4.2 Goals, Objectives, Strategies, and Rationale

The terms goal, objective, strategy, and rationale are defined below:

- A goal is a descriptive, broad statement of desired future conditions that conveys a purpose but does not define measurable units.
- An objective is a concise statement of what is to be achieved, how much is to be achieved, when and where it is to be achieved, and who is responsible for achieving it.
- A strategy is a way to achieve an objective.
- A rationale presents the background details used to formulate an objective. The rationale provides context to enhance comprehension and facilitate future evaluations.

The management direction presented in this chapter meets the purposes, visions, and goals of the refuge complex. Objectives and strategies to carry out the goals will support both resource needs and public use.

4.3 Prioritization for Waterfowl Production Areas

For its waterfowl production areas, the Lake Andes National Wildlife Refuge Complex primarily emphasizes habitat protection and restoration. Strategic planning enables the Service to make decisions on what habitats need protection and what landscapes have the greatest value to the health of waterfowl populations.

Based in Bismarck, North Dakota, the Habitat and Population Evaluation Team (HAPET) conducts research and develops predictive models. Through HAPET's research and modeling of the Plains and Prairie Pothole Region of South 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 conservation goal is to protect habitat capable of supporting 25 or more breeding duck pairs per square mile. Figure 19 shows the predicted concentrations of duck pairs throughout the refuge complex.

A 2007 report by the U.S. Government Accountability Office analyzed the effectiveness of Service acquisitions under the waterfowl production area program. As a consequence of this analysis, the Service recently

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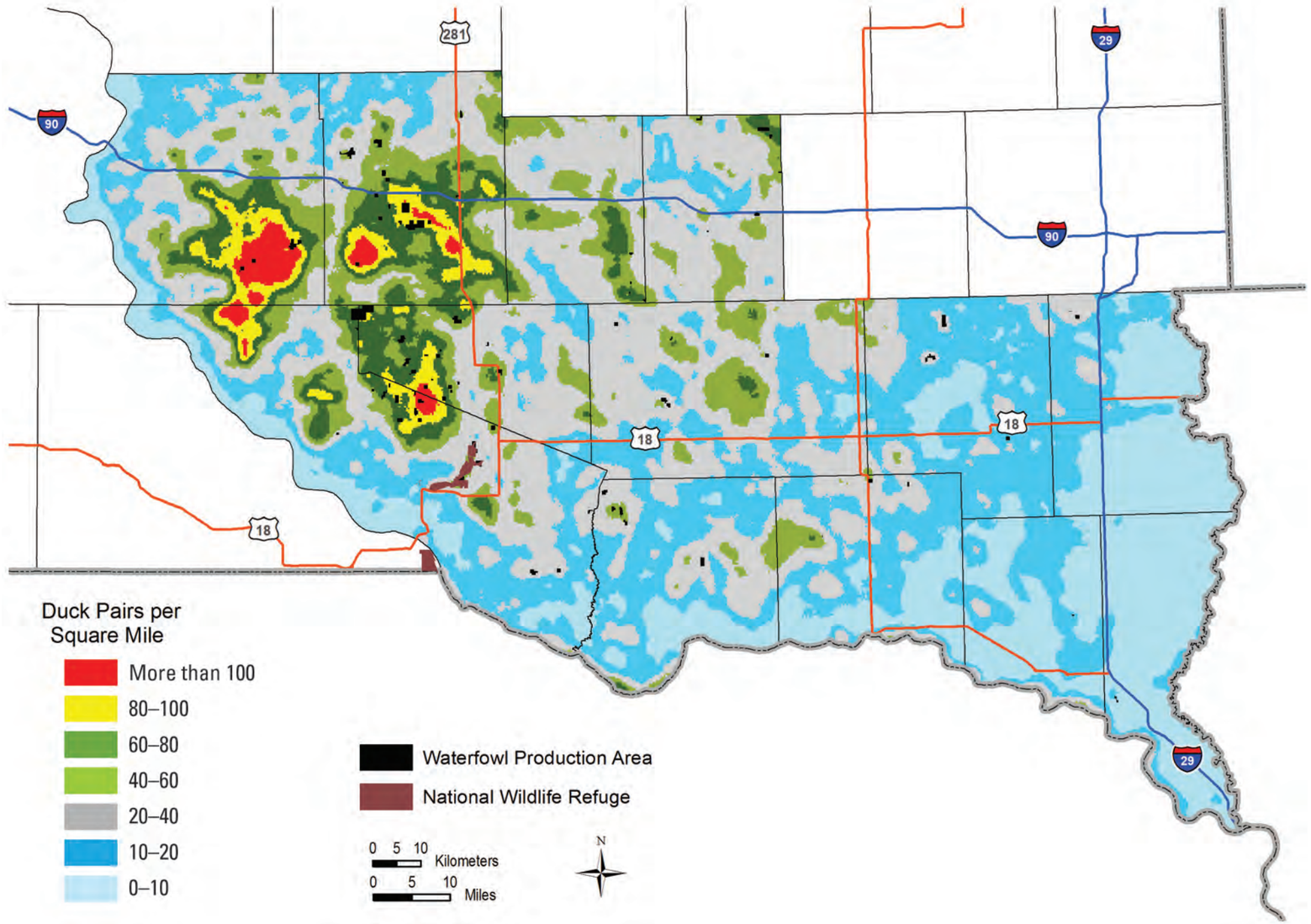


Figure 19. Predicted concentrations of duck pairs throughout the Lake Andes National Wildlife Refuge Complex, South Dakota. *Source: HAPET 2008.*

completed a decision tree matrix (figure 20) that outlines how to set priorities for grassland and wetland acquisitions. 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.

Prioritization objective

Implement the standardized, science-based prioritization decision tree developed for the CCP (figure 20) so that limited money and management resources are objectively allocated to waterfowl production areas according to the potential for that unit to benefit waterfowl and grassland birds. Focus allocation of limited resources to high priority units as discussed in selected objectives below. Refine the prioritization system as additional biological information becomes available; reevaluate the prioritization system 5 years and 10 years after CCP approval.

Strategies

- Apply multiple selection criteria for prioritizing waterfowl production areas according to the decision tree (figure 20) and as summarized below.

1. Primary Criterion—Duck Pairs per Square Mile or Native Sod Tract Size. Duck Pairs per Square Mile is divided into two levels of priority: more than or equal to 60 and fewer than 60. Native Sod Tract Size is divided into two levels of priority: larger than 70 acres and smaller than 70 acres.
2. Secondary Criterion—Waterfowl Production Area Tract Size or Planted Native Grass Tract Size. Waterfowl Production Area Tract Size is divided into two levels of priority: larger than 160 acres and smaller than 160 acres. Planted Native Grass Tract Size is divided into two levels of priority: larger than 100 acres and smaller than 100 acres.
3. Tertiary Criterion—Land Protection within 1 Mile of Waterfowl Production Area. There are two levels of priority: larger than 160 acres and smaller than 160 acres.

The result of objectively applying these three criteria using the decision tree (figure 20) is the assignment of a priority level for each waterfowl production area in the wetland management district (table 2). In all, there are eight priority levels. The highest priorities will receive the greatest focus when resources are limited. A range of priorities have been applied to selected objectives later in this chapter.

Rationale

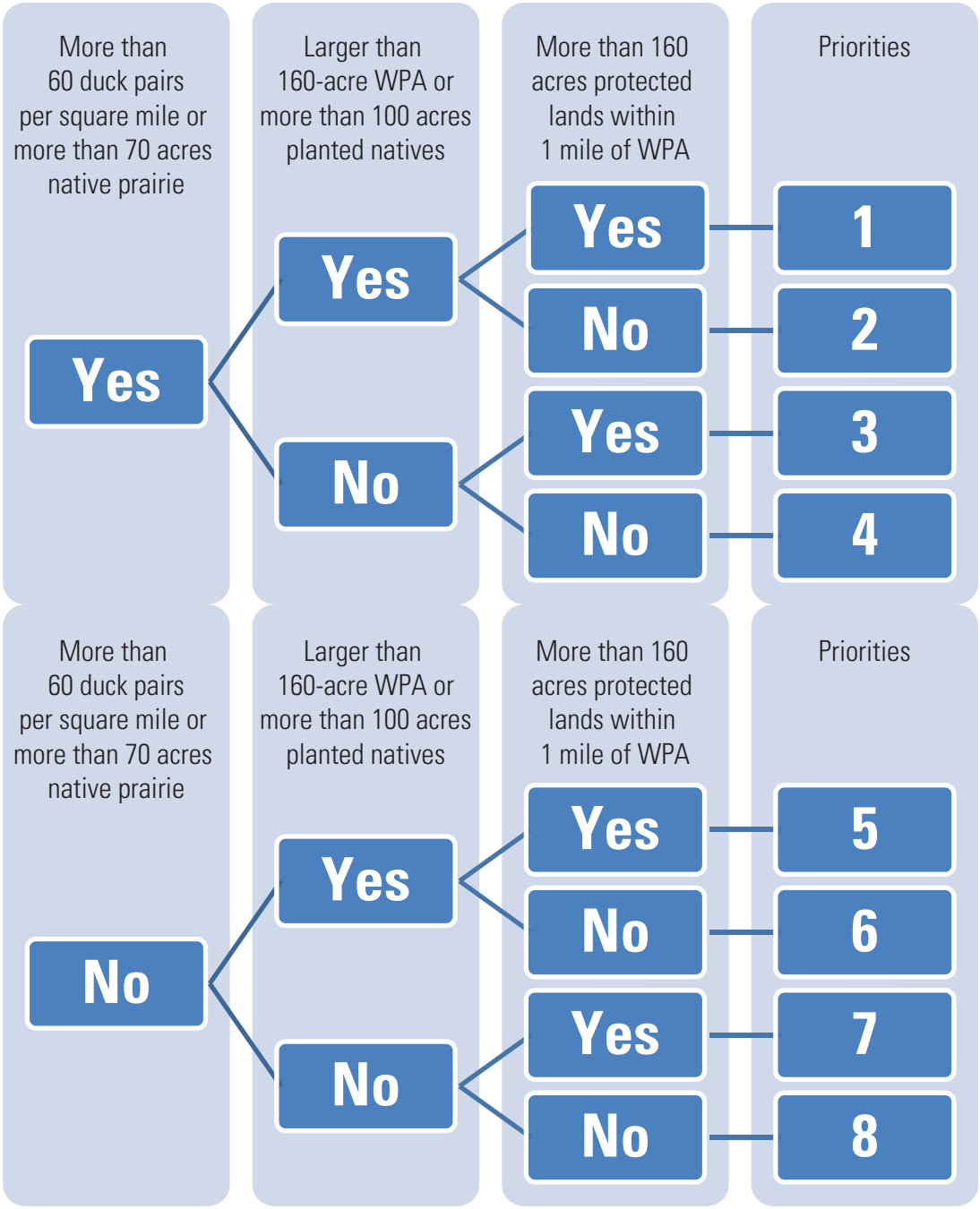
Most northern mixed-grass and tallgrass prairie has been destroyed. Key roles of the Refuge System include conservation of biological integrity, diversity, and ecological health (USFWS 2001). Accordingly, the refuge complex should contribute to the conservation of native prairie communities.

However, Service-owned native prairie is badly deteriorated, mainly through extensive invasion by introduced, cool-season grasses. Recent inventory data suggest that relatively intact native herbaceous flora is uncommon on Service-owned land in the Dakotas, with few remaining large tracts dominated by native grasses and forbs (Grant et al. 2009). Current inventory data for the refuge complex (2009) indicate that native grasses and forbs are evident on 20 percent of the native prairie (figure 21). As of April 2012, there are 5,793 acres of native prairie on the refuge complex.

It is likely that some native prairie vegetation has already passed a degradation threshold—in other words, restoration of a diverse, native herbaceous flora in such areas is an unrealistic and impractical goal. Multiple experiments in the northern Great Plains have found that fire and other control methods such as herbicide applications depend heavily for their success on the presence of a minimum of 20 percent of native species in the matrix (Dill et al. 1986, Willson and Stubbendieck 2000). A grass matrix dominated by a few introduced species inhibits the germination, establishment, and persistence of most native species. However, restoration may be possible on some tracts, especially where native grasses, sedges, and forbs are more common and widespread. Such tracts need to be identified by objective criteria that focus on (1) the diversity and prevalence of existing native plants and (2) landscape area and connectivity.

Both criteria underlie the quality of nesting habitat for grassland birds, a species guild of significant conservation concern. Grassland birds have become the fastest and most consistently declining guild of birds in North America (figure 22) (Herkert 1995, Knopf 1994, Peterjohn and Sauer 1999, Samson and Knopf 1994, Vickery and Herkert 2001); 48 percent of grassland species are of conservation concern and 55 percent show significant declines (North American Bird Conservation Initiative 2009). As a result, a multitude of grassland-dependent birds are of conservation concern (table 3). Johnson (2006) found that at current rates of decline, within 40 years only 10–25 percent of the population of these grassland bird species will remain. Accordingly, because South Dakota constitutes the central portion of many grassland-obligate bird species' geographical ranges (Sauer et al. 2008), managing habitat for grassland birds is of critical importance. The refuge complex staff has developed a list of focal species it is best positioned to help protect and maintain on the basis of the species' geographic ranges and specialized habitats; these species are identified in habitat management discussions throughout this chapter.

A recent evaluation of habitat use and requirements for grassland bird species of greatest conservation



WPA = waterfowl production area

Figure 20. Decision tree for prioritizing management of waterfowl production areas.

Table 2. Priorities for management of waterfowl production areas according to the decision tree (figure 20).

Waterfowl production area	*County*	*Priority*
Boggs	Hanson	1
Broken Arrow	Charles Mix	1
Coler	Douglas	1
Crystal Lake	Aurora	1
DeVelder	Douglas	1
Hieb	Bon Homme	1
Humphrey	Aurora	1
King	Douglas	1
Krell	Aurora	1
Lutz	Aurora	1
Maine	Aurora	1
New Holland	Douglas	1
Nielsen	Aurora	1
Plucker	Turner	1
Putnam	Charles Mix	1
Raysby	Charles Mix	1
Sherman	Charles Mix	1
Sorenson	Aurora	1
Stanley	Aurora	1
Star	Douglas	1
Trout	Charles Mix	1
DeCook	Douglas	2
Green	Charles Mix	2
Koss	Brule	2
Miller	Aurora	2
Somek	Douglas	2
Varilek	Charles Mix	2
Althen	Aurora	3
Cosby	Bon Homme	3
Delange	Douglas	3
Denning	Douglas	3
Foster	Aurora	3
Fuchs	Charles Mix	3
Korevaar	Douglas	3
Lindeman	Davison	3
Overweg	Aurora	3
Plooster	Douglas	3
Schneider	Hanson	3
Schute	Aurora	3
Stanek	Brule	3
Tucek	Charles Mix	3
Vanderpol	Charles Mix	3
VanZee	Charles Mix	3
Vogel	Davison	3
Zehnpfennig	Davison	3
Diede	Yankton	4
Huizenga	Douglas	4
Koch	Aurora	4
Kurtenbach	Davison	4
Mayer	Hutchinson	4
Novotny	Charles Mix	4
Pipal	Brule	4
Ziebart	Hutchinson	4
Atkins	Lincoln	5
Bertels	Hanson	5
Black Thunder	Charles Mix	5
Bucholz	Bon Homme	5
Edelman	Yankton	5
Huber	Charles Mix	5
Roth	Hutchinson	5
Youngstrom	Charles Mix	5
Fousek	Charles Mix	6
Hohn	Hutchinson	6
Kafka	Charles Mix	6
Miller	Turner	6
Scheffel	Bon Homme	6
Scott	Aurora	6
Welker	Hanson	6
Delger	Hanson	7
Dubes	Douglas	7
Henke	Hutchinson	7
North Unit	Charles Mix	7
Schaefer	Bon Homme	7
Soulek	Charles Mix	7
Anderson	Clay	8
Collar	Union	8
Freese	Lincoln	8
Hansen	Yankton	8
Juran	Charles Mix	8
Kayser	Hanson	8
Koupal	Charles Mix	8
Kuil	Douglas	8
Peterson	Turner	8
White Lake	Aurora	8

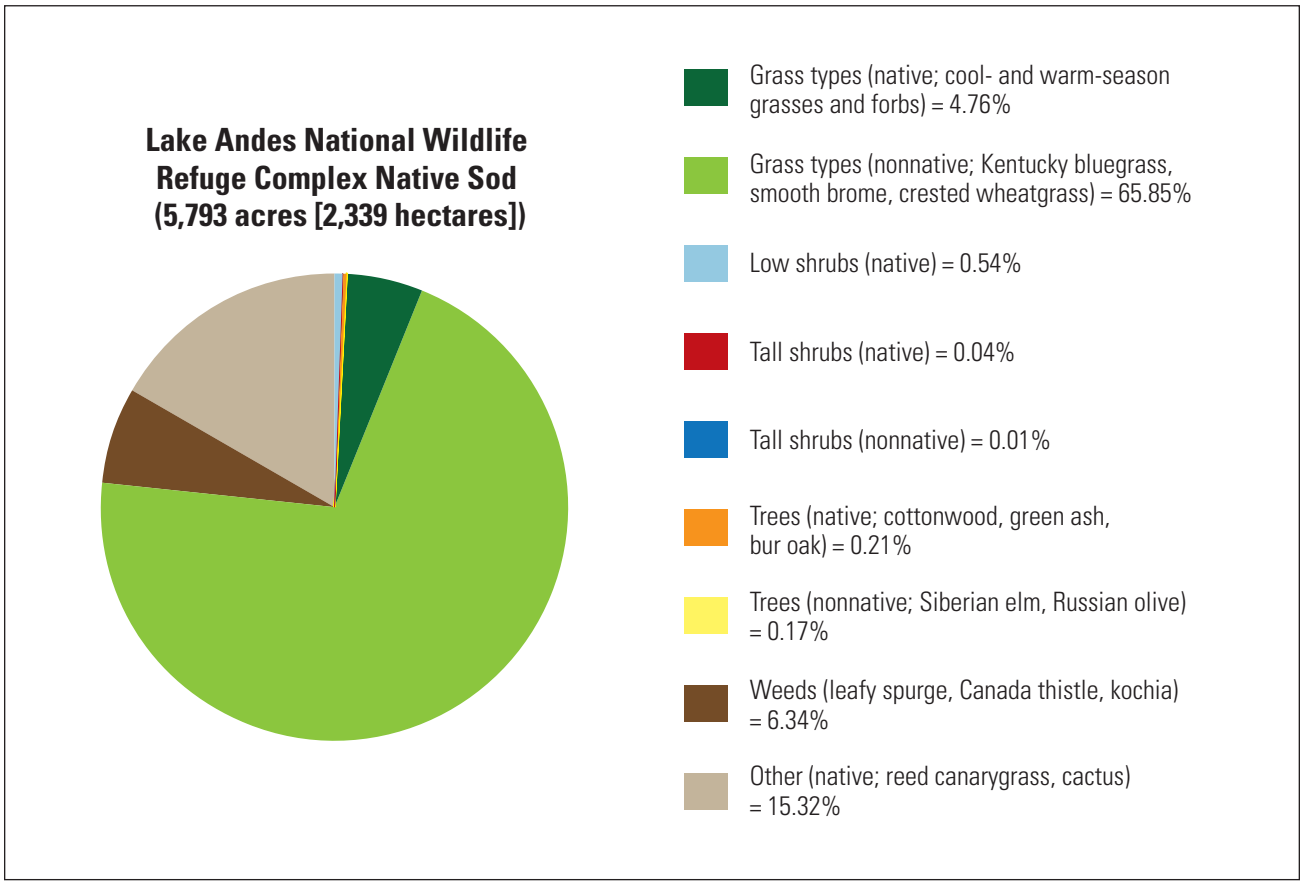


Figure 21. Dominant vegetation community types on native prairie on the Lake Andes National Wildlife Refuge Complex, South Dakota.

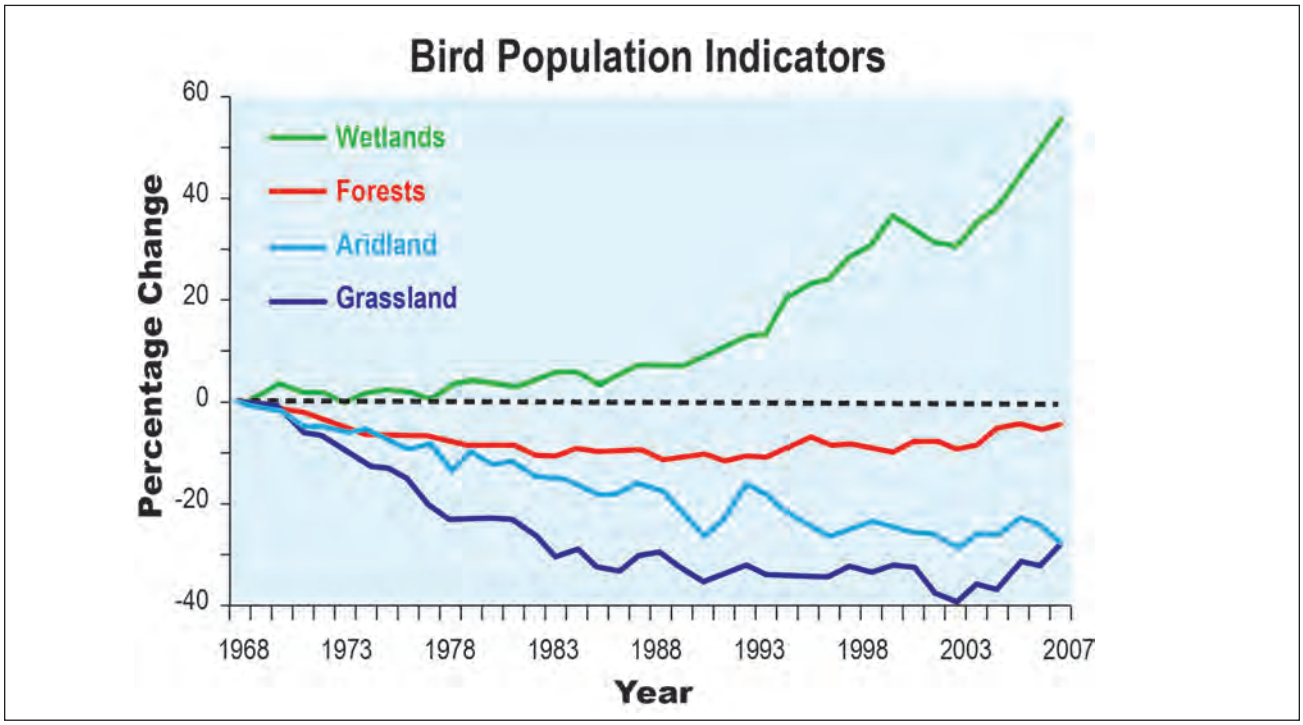


Figure 22. North American bird population indicators based on trends for obligate species in four major habitats.
Source: North American Bird Conservation Initiative 2009.

Table 3. Birds of conservation concern or priority species.

Species	*Prairie Pothole Region Birds of Conservation Concern*[1]	*Region 6 Birds of Conservation Concern*[1]	*South Dakota Priority Species*[2]	*Threatened or Endangered Species*
American bittern	X	X	X	
Bald eagle	X	X		
Bell's vireo		X		
Black tern	X		X	
Black-billed cuckoo	X	X	X	
Black-crowned night-heron			X	
Bobolink				
Burrowing owl		X	X	
Chestnut-collared longspur	X	X	X	
Dickcissel	X			
Ferruginous hawk		X	X	
Franklin's gull			X	
Golden eagle		X		
Grasshopper sparrow	X	X	X	
Greater prairie-chicken			X	
Horned grebe	X	X	X	
Lark bunting			X	
Least bittern	X	X		
Least tern				X
Loggerhead shrike		X		
Long-billed curlew	X	X		
Marbled godwit	X	X	X	
Northern harrier			X	
Piping plover				X
Red-headed woodpecker	X	X		
Savannah sparrow			X	
Sedge wren				
Sharp-tailed grouse			X	
Short-eared owl	X	X	X	
Swainson's hawk	X		X	
Upland sandpiper	X	X	X	
Virginia rail			X	
Western meadowlark			X	
Willet			X	
Willow flycatcher		X		
Wilson's phalarope			X	

[1] *USFWS 2008*
[2] *Bakker 2005*

need in central and western South Dakota provided the following recommendations to managers for preservation and restoration of grassland habitat to help maintain populations of grassland-obligate bird species. To maintain current populations and species diversity, it is critical that managers preserve as much native grassland as possible. Due to the diverse habitat requirements of these species of concern, grasslands should be under varying management regimes including rest, grazing (in varying intensities), haying, and prescribed fire. Reduction and removal of exotic plant species should be a key element in establishing habitat for grassland-obligate species as many are negatively affected by increases in exotic plant coverage. Preserved patches should be large in size as some species are area-sensitive and prefer patches between 618 and 3,954 acres or larger. Grassland patches should also have little to no woody edge. Finally, these patches should be located near one another, or in areas of little fragmentation, to help increase the amount of grassland habitat in the landscape, as many of these grassland bird species were positively associated with landscape variables, some up to 10,500 feet distant (Greer 2009).

A fundamental assumption is that, under current management—which lacks an objective, science-based system of identifying and prioritizing restoration of native prairie tracts—native herbaceous flora would continue to decline and disappear. Implementation of the prioritization objective and its supporting strategy will improve the chances that some native prairie will be restored.

4.4 Wetland Habitat Goal

Acquire, restore, manage, and protect wetlands for the conservation of migratory birds and other water-dependent species endemic to the Plains and Prairie Pothole Region.

Wetland Habitat Objective 1: Improve Water Quality in Lake Andes

Over the next 15 years, refuge complex staff will work with partners to improve the water quality of Lake Andes to sustain healthy fish and wildlife populations, in part by reducing phosphorus to less than 0.25 milligrams per liter and increasing dissolved oxygen to greater than 4 milligrams per liter.

Strategies

- Support the efforts of CMCLRO to improve water quality in the Lake Andes watershed.
- Support conservation programs that will reduce phosphorus, nitrogen, and sediment levels in the Lake Andes watershed.

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The black-crowned night-heron is a South Dakota Priority Species.

- Provide information to landowners in the watershed that explains the importance of water quality to fish and wildlife.
- Monitor levels of phosphorus and dissolved oxygen in Lake Andes.
- Investigate ways to control populations of common carp in Lake Andes.

Rationale

Studies have revealed that Lake Andes suffers from excessive levels of nutrients, especially phosphorus and nitrogen (Larson 2009, South Dakota Department of Environment and Natural Resources 1992). These nutrients cause robust algae blooms that reduce sunlight penetration through the water column. When the algae die, a chemical process results that significantly reduces oxygen in the water. The nutrient overload and the subsequent lack of oxygen kills fish and native aquatic plants that are important to fish and wildlife. These same studies indicate that nutrients continue to be deposited into the lake from the surrounding watershed. Larson (2009) recommended cleaning up the watershed before undertaking the costly and time-consuming process of removing nutrient-laden sediment from the lake. Livestock waste and fertilizer are the most significant sources of excess nutrients in the watershed (South Dakota Department of Environment and Natural Resources 1992).

Larson (2009) established water quality goals for Lake Andes. The primary goal is to maintain a dissolved oxygen level of greater than 4 milligrams per liter. The secondary goal is to maintain a total phosphorus level of less than 0.25 milligrams per liter. Modeling efforts indicate that this goal can be reached by reducing total phosphorus loads from the watershed by approximately 36 percent.

The feeding behavior of common carp contributes to the reduction of sunlight penetration into the water column. This limits the diversity and distribution

of beneficial aquatic plants. These fish also compete with sport fish (for example, yellow perch and northern pike) and migratory birds for food (Swanson and Nelson 1970). Carp have much lower requirements for dissolved oxygen than perch or pike, so they can more easily persist during periods of poor water quality. Controlling populations of carp in Lake Andes will improve water quality; however, it will be a considerable challenge. Tributaries to Lake Andes will have to be gated in such a way that carp will not recolonize the lake during runoff events. Reduction of carp populations within the lake might have to wait until drought dries the lake completely.

WETLAND HABITAT OBJECTIVE 2: IMPROVE WATER QUANTITY AND WATER LEVEL MANAGEMENT IN LAKE ANDES

Over the next 15 years, refuge complex staff will work with partners to improve the water quantity and water level management of Lake Andes to benefit fish and wildlife populations. Water quantity enhancements will target additions greater than 5,000 acre-feet per year. Water levels in the Center Unit will average approximately 3 feet in depth. Improving water quantity and quality will depend on (1) developing a clean water source and (2) constructing a pump station, respectively. Each will require a significant amount of money that will likely be difficult to obtain.

Strategies

- Support the efforts of CMCLRO to develop a reliable source of clean water for Lake Andes.
- Investigate and, if feasible, construct a pump system that will allow water levels to be increased in the South Unit for sport fishing while decreasing water levels in the Center Unit for waterfowl.

Rationale

Lake Andes has no perennial water supply. It is dependent on runoff in the watershed. Currently there is no way to significantly vary the water depth between the lake's South Unit and Center Unit. It will be beneficial to fish to create deeper water levels in the South Unit and beneficial to migratory birds to create shallower water levels in the Center Unit. When water levels are moderate, pumping water from the Center Unit to the South Unit will provide better habitat for fish and wildlife. Given the size of Lake Andes, it is not known if a pump station could move enough water from the Center Unit to the South Unit to create a significant difference in depth.

American bittern, blue-winged teal, and American avocet are wetland focal species for this plan. Collectively their preferred water depths range from 0 inches to 15 inches (Dechant et al. 2002, 2003; Sousa 1985). During most years much of Lake Andes is far deeper than this. If a pump station proves practical, then water depths in the Center Unit and North Unit can be managed for migratory birds.

WETLAND HABITAT OBJECTIVE 3: CONTROL INVASIVE PLANTS ON REFUGE COMPLEX WETLANDS THROUGH EARLY DETECTION–RAPID RESPONSE

Over the life of this plan, refuge complex staff will identify and strive to eradicate all infestations of new and emerging invasive and noxious plant species (for example, nonnative phragmites, purple loosestrife, and saltcedar) that are not well established on refuge complex wetlands.

Strategies

- Survey for presence of invasive plant species and use Global Positioning System (GPS) and Geographic Information System technologies to map and monitor infestations of invasive plants.
- On discovery, attempt eradication of highly invasive plants that are not well established on the refuge complex (for example, saltcedar, purple loosestrife, and nonnative phragmites).
- Use all appropriate methods (for example, herbicides, mechanical removal, biological control, and fire) to eradicate invasive and noxious plants.

Rationale

Identifying infestations early and eradicating them while they are small is the most efficient way to control invasive and noxious plants.

Exotic species are a major threat to native ecosystems in the United States and considered second only to habitat destruction in significance. Control of invasive species is a management priority because they have a direct negative effect on the ability of refuges to fulfill their wildlife conservation mission, including migratory waterfowl and songbird production, species recovery, biological diversity, biological integrity, and ecosystem function.

Prevention is considered the highest priority under a successful integrated invasive plant management program. Public and private landowners work very hard to address the spread of invasive plants yet rarely have sufficient resources to manage all populations. When prevention fails, rapidly responding to new invaders is critical to limiting impacts and costs of new invasions. This process—termed early detection–rapid response (EDRR)—involves surveying land, identifying new invaders to an area, and pursuing treatment as quickly as possible.

The "USFWS Invasive Species Strategic Plan" (USFWS 2003) recommends focusing on early detection and completely eradicating smaller infestations rather than trying to control large, well established infestations. It has been shown to be far less costly to control invasive plants through eradicating new

invasions or small patches than by trying to control well established invasions (Chippendale 1991 in Hobbs and Humphries 1995, Frid et al. 2011, Keller et al. 2007, Leung et al. 2002). Small satellite populations of invasives often expand more rapidly and potentially cover more area than the front of a source population (Cousens and Mortimer 1995, Moody and Mack 1988). (A fitting analogy is fire: many spot fires may occupy or "fill" an area more quickly than the advancing front of the fire.) Additionally, since most invasive plants have a long lag period following introduction, they can usually be eradicated at this early stage if recognized. Rejmanek and Pitcairn (2004) note that early detection can make the difference between employing feasible offensive strategies and retreating to defensive strategies that usually require ongoing financial commitments.

For example, treating two new small patches of a species when discovered would most likely result in successful eradication, preventing them from spreading and adding to the existing management burden. On the other hand, treating a large existing patch with all available resources for years may only result in a slight decrease in patch size or density—moreover, during that time the two new invasions would continue to grow and spread, creating an even greater need for more resources.

Resources must be directed at detecting early invasions in cooperation with refuge complex partners and responding rapidly to new invasions. If resources are not directed to EDRR, then invasions are allowed to outpace management efforts, leading to greater areas of infestations that are costly and time-consuming to treat.

Although prevention and EDRR are important components of an integrated invasive species management strategy, certain large, well established infestations should also be targeted at least for containment. For these species, prioritization by species or area must occur first to determine which species have the greatest impact on trust resources and whether infestations are in areas of high conservation value. Containing those infestations will maximize the effectiveness of limited resources.

Wetland Habitat Objective 4: Protect Wetlands through Easement Acquisition

Provided adequate money is available, the refuge complex's wetland district manager will lead annual efforts to secure perpetual conservation easements on more than 300 acres of unprotected, high priority wetland acres to benefit migratory birds, to provide water storage for flood protection, to improve water quality, and to recharge ground water—all of which benefit indigenous plant and animal species and State- and federally listed species throughout the life of the CCP.

Strategies

- Focus the protection of wetlands (and associated grasslands) with conservation easements in areas of high waterfowl nesting densities. Use the current Upland Accessibility for Breeding Duck Pairs in the Lake Andes National Wildlife Refuge Complex map (figure 23) to geographically guide acquisition priorities.
- Use the Partners for Fish and Wildlife Program as a way to inform prospective sellers of the Service's conservation easement program.
- Use the Service's strong partnerships with Ducks Unlimited, North American Wetlands Conservation Act, and other conservation organizations to generate non–Duck Stamp money to buy conservation easements.
- Examine data from HAPET, The Nature Conservancy, Ducks Unlimited, and others to identify geographic areas valuable to waterfowl and other migratory birds.

Rationale

Wetland drainage and filling continues to be a conservation issue in eastern South Dakota. Approximately 20,000 acres are drained or filled annually in the Plains and Prairie Pothole Region (Dahl 2000). Acquisition of an easement on private land rather than outright fee purchase results in more conservation "bang for the buck." In short these easements protect wetlands from draining, filling, or nonpermitted burning. The primary source of money for easement purchases is the Migratory Bird Conservation Fund from the sale of Duck Stamps. All migratory bird hunters 16 years of age and over must annually purchase and carry a Federal Duck Stamp. Many collectors, art enthusiasts, and other conservationists (especially bird watchers) also buy duck stamps to support migratory bird conservation. Approximately 98 cents of every duck stamp dollar goes directly into the Migratory Bird Conservation Fund to purchase wetlands and wildlife habitat for inclusion into the National Wildlife Refuge System.

In most cases acquisition of wetland easements will be in concert with grassland easements on the same tract of land. Protecting the nesting habitat that surrounds wetlands is critically important.

HAPET has identified wetlands that are especially at risk of drainage. These are temporary and seasonal wetlands, 1 acre in size, that are completely or partially embedded in cropland. The pressure to drain and fill these wetlands to support tillage agriculture puts these basins at higher risk of conversion than those in grasslands. At the same time, these wetlands have important value for waterfowl. Based on predictive models developed by HAPET, the Service

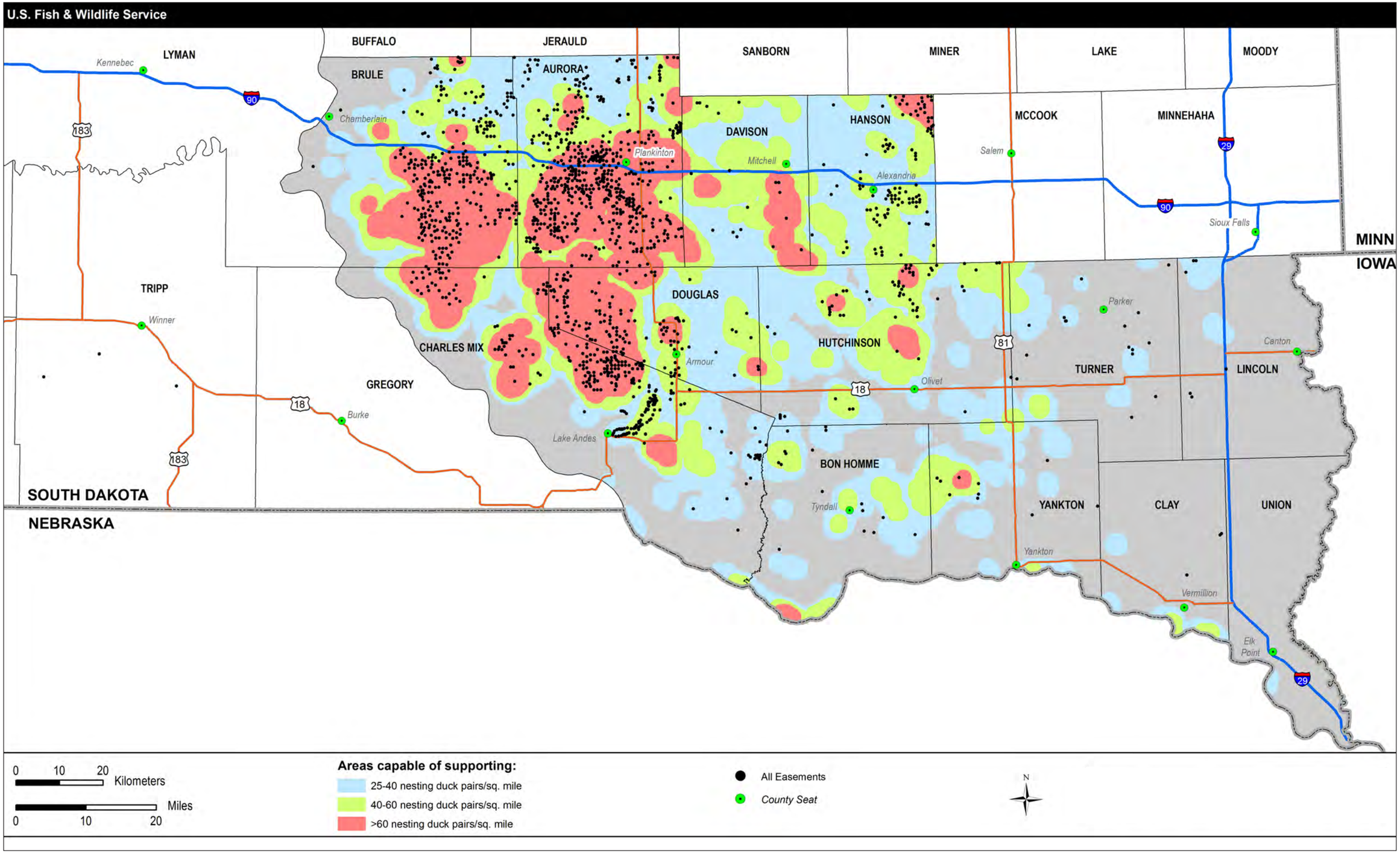

Figure 23. Upland accessibility for breeding duck pairs in the Lake Andes National Wildlife Refuge Complex, South Dakota. *Source: HAPET 2008.*

has prioritized conservation easement acquisitions to focus on the following:

- wetlands that are not protected
- wetlands capable of supporting more than 25 breeding duck pairs per square mile
- wetlands embedded in cropland, where the risk of degradation is especially high
- wetland types at greatest risk of degradation: seasonal and temporary basins
- semipermanent and permanent wetlands less than 1 acre in size

According to HAPET, waterfowl pairs in the Plains and Prairie Pothole Region are supported on 7.33 million wetland acres, of which 1.49 million acres are currently protected by wetland easements or waterfowl production areas. An estimated 1.15 million duck pairs reside in these wetlands, leaving the majority of pairs (3.10 million, or 73 percent) dependent on wetlands that are currently unprotected (except through the "Swampbuster" provision of the Farm Bill). Using the criteria above, HAPET identified 1.4 million acres of priority wetlands within the area encompassed by the Plains and Prairie Pothole Region that are in greatest need of protection; these wetlands would support 1.5 million duck pairs. This number has been adopted as a protection goal by both the Dakota Working Group (a team consisting of refuge managers and project leaders from refuges and districts in South Dakota and North Dakota) and the PPJV (Ringelman 2005).

Established in 1987 as one of the original six priority joint ventures under the North American Waterfowl Management Plan, the PPJV protects, restores, and enhances high priority wetland and grassland habitats to help sustain populations of waterfowl, shorebirds, waterbirds, and prairie landbirds.

The "North American Waterfowl Management Plan," an international agreement developed in 1986, recognizes the recovery and perpetuation of waterfowl and other wetland wildlife that depend on the restoration of wetlands and associated ecosystems throughout North America. As a result, it established cooperative initiatives (joint ventures) to reverse declines in wetland habitats and associated wildlife.

The PPJV is a dynamic partnership that functions as a network and seeks partners at the local, regional, national, and international levels. The partnership involves Federal and State agencies, nongovernmental conservation groups, private landowners, scientists, universities, policy makers, resource managers, corporations interested in conservation, communicators, tribes, resource conservation districts, and land trusts, among others. The PPJV is constantly seeking additional talent and organizations or private individuals interested in prairie habitat conservation.

Protection of priority wetlands with conservation easements will not only benefit waterfowl but will also have benefits for other migratory waterbirds. Niemuth et al. (2006) demonstrated the importance of temporary and seasonal wetlands embedded in agricultural landscapes to migrant shorebirds in the Plains and Prairie Pothole Region.

To calculate offers for a conservation easement, the Service uses the assessed value of the land and a multiplier derived from the relationship between the sale price and assessed values of similar properties in the area. This acquisition process works most efficiently, then, when the Service focuses its acquisition efforts in one area before moving onto other areas. Accordingly, targeting areas with high waterfowl nesting densities not only ensures that conservation easements have high value for wildlife, it also reduces administrative burden because the Service can focus its efforts in one area.

To inform prospective sellers of the Service's conservation easement program, the Service will use the Partners for Fish and Wildlife Program. Often times, a biologist from this program is the first point of contact for landowners who would otherwise be unaware of the available conservation programs.

WETLAND HABITAT OBJECTIVE 5: RESTORE WETLANDS

Over the next 15 years, the Partners for Fish and Wildlife biologist and refuge complex staff will strive to restore 300 drained wetland basins on private lands (either Partners for Fish and Wildlife projects or easements) and refuge complex lands to provide more wetland habitat for blue-winged teal, American bittern, and American avocet (the three focal species for wetland habitats) and other migratory birds.

Strategies

- Use refuge complex staff and equipment or private contractors to restore drained wetlands.

Rationale

When eastern South Dakota was settled, many wetland basins were drained for agricultural purposes. Today many landowners are interested in the values that wetlands provide such as erosion control, flood prevention, water table recharge, and wildlife habitat. As a result many drained wetlands are being restored, primarily through Partners for Fish and Wildlife, which uses grant money to cost-share wildlife habitat improvements on private lands. Restoration typically involves placing an earthen plug in the ditch that drains a wetland. The site is surveyed and the ditch plug constructed to restore the natural hydrology of the wetland basin without exceeding its natural depth. Restored wetlands provide additional habitat for migratory birds and all the other values mentioned above.

WETLAND HABITAT OBJECTIVE 6: MANAGE WETLAND WATER ON THE PRAIRIE PONDS

Over the next 15 years, refuge complex staff will manage the water levels of the Prairie Ponds to provide ideal habitat for a great diversity of migratory birds. In particular, from March through July levels will be managed for blue-winged teal and American bittern, which prefer water depths of 2–15 inches and hemimarsh conditions. From mid-July through early October, levels will be managed for American avocet, which prefers water depths of 0–4 inches and sparsely vegetated mudflats. Water levels will vary between years and within years depending on water depths in Owens Bay and Lake Andes.

Strategies

- Use the Owens Bay artesian well to provide water to the Prairie Ponds as needed.
- Conduct periodic drawdowns using water control structures to provide ideal habitat for migratory birds.
- Use an adaptive management process to evaluate and improve management treatments.
- Control cattails as needed to provide hemimarsh habitat.
- Develop and implement monitoring protocols to gather baseline data on wetlands, such as information on plant communities, invertebrate populations, and water quality on wetland habitats throughout the refuge complex.
- Use the floristic quality assessment and vegetation transects to inventory wetland vegetation.
- Use invertebrate traps to inventory species and populations.
- Conduct a critical thinking process that lists, describes, and prioritizes biological information needs for wetlands on the refuge complex that will be best addressed through outside research to inform and improve refuge management. This information will be provided to potential research partners and the research community. Use resources such as the zone biologist, past research partners, and other research contacts to develop the biological information needs list.

Rationale

The Prairie Ponds are four small ponds approximately 1–4 acres in size within the Owens Bay Unit of Lake Andes Refuge. They are managed to provide attractive habitat for migratory birds during spring and fall migration. Water control structures provide some control of water levels in the ponds. The Owens Bay artesian well is the only source of water for the Prairie Ponds. The well was drilled in 1985 and on completion was flowing at 900 gallons per minute. As is typical for artesian wells in this area, flows have gradually decreased as the well casing has collapsed. Currently the well flows at 250 gallons per minute, a rate that is barely adequate to manage water in the ponds. The well is nearing the end of its useful life and needs to be replaced.

The chief value of the Prairie Ponds is wildlife-dependent recreation in the form of wildlife observation and photography and environmental education and interpretation. Management of water levels and the interspersion of emergent vegetation (like cattails) with open water are to provide ideal conditions during migration. Blue-winged teal, American bittern, and American avocet are focal species for wetlands on the refuge complex. These species were selected in part for their diverse habitat preferences. Blue-winged teal prefers water depths between 2 and 10 inches and a 50:50 mix of emergent vegetation and open water (that is, hemimarsh). American bittern prefers a water depth of 4 inches and dense emergent vegetation 3–5 feet in height; it also prefers a block of this habitat less than 7 acres in size. American avocet prefers shallow wetlands with a water depth less than 4 inches and sparse vegetation. Habitat needs cannot be provided for each of these three focal species on the same pond at the same time; however, these conditions can be provided as water supply and vegetation conditions change year to year.

Developing and implementing monitoring protocols, inventorying wetland vegetation, and identifying and prioritizing biological information needs for wetlands will enable the refuge complex staff to use the best available science to inform management decisions. Knowledge gaps regarding natural resources the refuge complex has been entrusted with managing and protecting are many and varied.

WETLAND HABITAT OBJECTIVE 7: CONTROL AVIAN DISEASE IN WETLANDS

During spring and fall migration periods, the refuge complex biologist will continue to lead avian disease surveillance and response efforts to outbreaks (for example, avian botulism or avian cholera) as necessary to limit wildlife losses throughout the life of this plan.

Strategies

- Annually review and ensure that the refuge complex's wildlife disease contingency plan is up to date.
- Follow the monitoring and response protocols outlined in the wildlife disease contingency plan and the "Field Manual of Wildlife Diseases" (Friend and Franson 1999).
- Maintain a supply of staff protective equipment for emergency cleanup operations.
- Cooperate with U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service's

Wildlife Services and SDGFP for highly pathogenic avian influenza monitoring when necessary.

- Consult with the Service's Region 6 Wildlife Health Office for advice on wildlife health issues.

Rationale

Lake Andes Refuge suffered a duck virus enteritis outbreak in 1973 that led to the death of 40,000 migratory birds. At the time, refuge management was attempting to provide wintering habitat for waterfowl and this led to unusually high concentrations of birds. Disease passed easily from bird to bird in the close quarters. After the die-off, measures were taken to discourage birds from attempting to winter on the refuge. Disease outbreaks since 1973 have been few and far between (table 4).

Routine surveillance has led to early detection and rapid response to outbreaks. Response includes collecting and sending a sample of dead birds to the USGS National Wildlife Health Center in Madison, Wisconsin, for diagnosis. Response also includes removal of dead birds from the environment. Such action has proven effective for controlling disease outbreaks on the refuge complex. Evelsizer (2002) has suggested that carcass removal did not appear to be an effective technique for managing botulism outbreaks on large wetlands where less than 30 percent of the dead birds could be found and collected. This is something to keep in mind when conditions significantly restrict the ability to remove dead birds. Avian botulism and avian cholera are the two most prevalent documented diseases that have occurred on the refuge complex.

Bird disease response is a readily evolving process. Before 2006, districts dealt primarily with two diseases in the avian communities: West Nile virus and avian botulism. West Nile virus is a flavivirus with an enzootic cycle that involves primarily mosquitoes and birds. It was introduced into the Plains and Prairie Pothole Region in 2002. By 2003, West Nile virus had been shown to affect 162 species of birds. The ecology of the northern prairie seems to offer favorable conditions for its continued enzootic transmission (Centers for Disease Control and Prevention 2003).

Avian botulism is a disease that affects the peripheral nerves and results in paralysis of voluntary muscles. It is contracted when a bird ingests toxin produced by the bacterium *Clostridium botulinum*. Outbreaks of avian botulism have occurred in the United States since at least the beginning of the twentieth century. Botulism outbreaks are often characterized by lines of

Table 4. History of documented wildlife disease outbreaks on the Lake Andes National Wildlife Refuge Complex, South Dakota.

Date	*Disease*	*Species affected*	*Number of dead animals*	*Location*
September 1947	Botulism	Ducks	300	Lake Andes area
January 1973	Duck virus enteritis	Geese and ducks	40,000	Owens Bay and Missouri River below Fort Randall Dam
Spring 1980	Avian cholera and botulism	Mallard, redhead, lesser scaup, pintail, Canada goose, white-fronted goose	1,515	Lake Andes
October 1980	Botulism	Not reported	4	Lake Andes
March 1981	Botulism	Lesser scaup, shoveler, pintail, redhead, ring-necked	286	Lake Andes
August 1984	Botulism	Coot, blue-winged teal, green-winged teal, gadwall, mallard, pintail	3,350	Lake Andes Refuge South and Center Units
September 1985	Botulism	Shoveler, gadwall, mallard, wood duck, ruddy, unknown, widgeon, blue-winged teal, green-winged teal	614	Lake Andes Refuge Center Unit
August 1987	Botulism	Coot, shoveler, gadwall, mallard, pintail, widgeon, blue-winged teal, green-winged teal, yellowlegs, sandpiper species	750	Owens Bay
August 1987	Epizootic hemorrhagic disease	White-tailed deer	13	Karl E. Mundt Refuge area
March 2003	Avian cholera	Mallard, Canada goose	5	Owens Bay, Prairie Ponds
August 2011	Botulism	Blue-winged teal, pintail, shoveler, great blue heron, coot	500	Sorenson Waterfowl Production Area, Koss Waterfowl Production Area

carcasses on wetland peripheries during the summer when ambient temperatures are high and water levels are receding. Filter-feeding and dabbling waterfowl and probing shorebirds appear to be among the species at greatest risk (Friend and Franson 1999). With safe handling practices, birds affected by botulism and West Nile virus pose a relatively minor threat to the health of individuals directly handling the infected individuals (Domek 1998, Friend and Franson 1999).

The most common causative agent of botulism is a type-C toxin produced by the bacterium *Clostridium botulinum* (Friend and Franson 1999). The disease appears to be exacerbated through what is commonly referred to as "the carcass–maggot cycle," which includes the following events:

1. *Clostridium botulinum* (from previously ingested spores) vegetates and produces toxin in response to biochemical changes associated with death and decomposition.
2. Maggots feed on carcasses and concentrate toxin.
3. Toxic maggots are ingested by birds.
4. Toxicity leads to death, producing additional carcasses and perpetuating the cycle.

Because of the toxin's extremely high potency, these events lead to rapid acceleration in the rate of deaths due to botulism. Consumption of as few as one or two toxin-laden maggots may be adequate to kill an otherwise-healthy bird (Friend and Franson 1999).

The presumed significant role of the carcass–maggot cycle in the epizootiology of botulism has been the central factor in development of field procedures for reducing impacts of the disease on migratory bird populations. Botulism management typically involves late-summer surveillance of lakes that are prone to botulism, and intensive carcass retrieval with the goal of removing dead birds from the affected lake as quickly as possible. Carcass pickup has been widely accepted as the best approach to minimizing botulism-induced mortality of waterbirds and has been recommended by wildlife health professionals based on knowledge of botulism epidemiology (Friend and Franson 1999).

With each new disease presenting itself as a threat to Service staff and the public (for example, the highly pathogenic H5N1 strain of highly pathogenic avian influenza), concurrent disease responses are developed to coincide with each threat. Highly pathogenic avian influenza is a disease caused by a virus that infects both wild birds (such as shorebirds and waterfowl) and domestic poultry. Each year, there is a bird flu season just as there is an influenza season for humans and, like human influenza, some forms of avian influenza are worse than others (USGS 2006). Recently, the H5N1 strain of highly pathogenic avian influenza has been found in an increasing number of countries in Europe, Asia, and Africa. This strain is not present in the United States, but is likely to spread to this country (Dr. Thomas Roffe, veterinarian, USFWS, Montana, personal communication). There are a number of ways that the H5N1 strain could potentially reach the United States: (1) wild bird migration, (2) illegal smuggling of birds or poultry products, and (3) travel by infected people or people traveling with virus-contaminated articles from areas where H5N1 already exists (USGS 2006).

Avian cholera is widely distributed and poses a constant threat to migratory bird populations, especially where dense concentrations of birds occur. Avian cholera epizootics (diseases affecting large numbers of animals) were found to be inversely related to densities of semipermanent wetland basins. It is not known with certainty what environmental or physiological factors trigger an outbreak, but it appears to be associated with physiologically stressed birds that are concentrated on a limited number of wetlands (Smith and Higgins 1990).

4.5 Riparian Habitat Goal

Acquire, restore, manage, and protect riparian habitats characteristic of the lower Missouri River for the conservation of bald eagles, other species of concern, and migratory birds.

Riparian Habitat Objective 1: Manage Woodlands for Bald Eagles and Red-Headed Woodpeckers on Karl E. Mundt Refuge

Over the next 15 years, refuge complex staff will plant more than 5 acres of eastern cottonwoods (where 70 percent of the total tree population is above 30 feet height with a canopy cover of less than 40 percent) to provide habitat for resident, nesting, and winter roosting bald eagles and maintain snags to provide suitable habitat for red-headed woodpeckers, equaling four or five snags larger than 8 inches diameter at breast height per acre.

Strategies

- Identify sites to plant cottonwoods that will benefit bald eagles and red-headed woodpeckers. Plant cottonwood seedlings at a density that will result in a canopy cover of less than 40 percent when the trees mature to a height of greater than 30 feet.
- Inventory the density of snags per acre greater than 8 inches diameter at breast height within the woodlands of the Karl E. Mundt Refuge. Protect these snags from fire or cutting. Monitor snag density every 5 years over the life of the plan. Collect

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Birds at the Lake Andes National Wildlife Refuge.

baseline information on canopy cover and compare native forest to planted forest.

- Use the Floristic Quality Index and vegetation transects to inventory existing woodlands and monitor long-term vegetation changes.
- When planting, use native genotypes when possible.
- Protect planted seedlings from herbivory by enclosing them in deer- and rabbit-resistant fences.
- Draft a habitat management plan for Karl E. Mundt Refuge to guide habitat restoration and reconstruction efforts.
- Conduct a critical thinking process that lists, describes, and prioritizes biological information needs for the Karl E. Mundt Refuge that will be best addressed through outside research to inform and improve refuge management. This information will be provided to potential research partners and the research community.

Rationale

Two of the three focal species for riparian habitats, bald eagles and red-headed woodpeckers, rely on cottonwoods for suitable habitat on the Karl E. Mundt Refuge. The bald eagle was recently removed from the endangered and threatened species list. Red-headed woodpecker populations have suffered widespread rapid declines throughout their range for a number of years (4.6 percent per year since 1980) (Smith et al. 2000). Cottonwoods are largely dependent on highly varying river flows and deposition of sediment to replace old dying trees with young trees that can survive to attain mature height and diameter. Cottonwoods evolved alongside the dynamic forces of rivers. An adequate level of natural cottonwood regeneration no longer occurs due to dams erected on the Missouri River. The dams strain out the sediments that form sandbars where cottonwood seeds germinate after a flood, and they attenuate the high flows that establish cottonwood seedlings high above the elevation of lesser floods in subsequent years. Under today's conditions planting is necessary to reestablish cottonwoods in the riverbottom. Such mature trees are important to bald eagles and red-headed woodpeckers for roosting and nesting sites (Smith et al. 2000). Mature trees also provide the shade necessary for the establishment of other understory trees and shrubs on which Bell's vireo, the third riparian habitat focal species, and other species of migratory birds depend.

Planting cottonwoods and other riparian trees and shrubs is necessary to ensure availability of suitable habitat for these species in the future. In the past cottonwood restoration has been conducted in an opportunistic fashion as money and staff availability allowed. The refuge complex staff will develop a habitat management plan for restoration of native trees, shrubs, grasses, and forbs on Karl E. Mundt Refuge to provide ideal habitat for nesting and migrating birds and high quality wildlife observation opportunities. Such a plan will provide specific guidance and facilitate additional partnerships and supplementary money. Techniques will be used that protect young trees and shrubs from browsing and competition.

Riparian Habitat Objective 2: Restore Woodland Understory on Karl E. Mundt Refuge

Throughout the life of this plan, refuge complex staff will restore, protect, and enhance the native understory (especially 1–10 feet above ground) of the Karl E. Mundt Refuge cottonwood floodplain (for example, roughleaf dogwood, American plum, narrow-leaf willow, Missouri gooseberry, and black raspberry) by 10 percent to provide high quality nesting and migration habitat for Bell's vireo, yellow-billed cuckoo, spotted towhee, ovenbird, and other woodland migratory birds.

Strategies

- Restore native understory plants within established (higher than 30 feet and greater than 8 inches diameter at breast height) cottonwood plantings.
- Diversify the existing understory by adding native shrub species.
- Build species lists for restoration using current vegetation inventories conducted on the refuge by the University of South Dakota and the University of Nebraska–Lincoln.
- When planting, use native genotypes when possible.
- Draft a habitat management plan for Karl E. Mundt Refuge to guide habitat restoration and reconstruction efforts.
- Protect existing understory plants from fire and domestic grazing.
- Restore American plum thickets to both riverbottom and appropriate upland sites on the refuge.

Rationale

Many migratory birds rely on the forest understory for nesting, foraging, and migration. It is not enough to restore cottonwoods without restoring the plants that are commonly found in their understory. Reestablishing shrubs that can thrive without overhead shade (such as American plum) will also provide important foraging and nesting sites. Many of these plants were cleared for farming (along with cottonwoods) years ago.

Bell's vireo prefers a shrubby understory for nesting, foraging, and migration.

Riparian Habitat Objective 3: Control Invasive Plants on Karl E. Mundt Refuge

Over the next 15 years the refuge complex staff will attempt to annually treat 100 percent of invasive forb infestations (for example, Canada thistle, musk thistle, leafy spurge, and common mullein) on Karl E. Mundt Refuge to improve habitat for migratory birds. One hundred percent of nonnative invasive trees and shrubs (for example, Russian olive, Siberian elm, white mulberry, and saltcedar) will be removed over the next 10 years. Eastern redcedar (an invasive native tree) will be controlled where it is invading grasslands on the refuge. Smooth brome and other invasive grasses will be controlled through grassland reconstruction on lands that were previously plowed and through restoration techniques on native sod over the life of the plan, as described in the grassland section of this chapter.

Strategies

- Use GPS and Geographic Information System technologies to map and monitor infestations of invasive plants. Document areas treated in the Service's Refuge Lands Geographic Information System database.
- Continue using grazing, haying, prescribed fire, herbicides, insects, cutting, and seeding as part of an integrated pest management strategy to control invasive plants.
- Continue to work with cooperators to apply grazing, haying, and farming treatments
- Use vendors to apply herbicide aerially where necessary to reach areas inaccessible to ground-based equipment. (Such use will be rare on the refuge.)
- Conduct an annual riparian survey to detect and treat saltcedar and purple loosestrife.

Rationale

Invasive plants degrade the quality of habitats on refuge lands. Native migratory birds including Bell's vireo, red-headed woodpecker, and bald eagle thrive in high quality habitats of native vegetation. Infestations of invasive forbs, trees, and shrubs are currently limited. Invasive plants degrade the quality of surrounding habitat. Typically they compete with native plants for nutrients and water. Treating all the known invasive forb infestations annually and all the known tree and shrub infestations over the next 10 years will clear the way for the much more intensive effort required to change grasslands from smooth brome to native grasses and forbs. Controlling invasive plants improves the quality of wildlife habitat on the refuge.

Riparian Habitat Objective 4: Protect Woodlands and Riverbanks on Karl E. Mundt Refuge

Throughout the life of this CCP, refuge complex staff will protect mature cottonwoods (including snags) from herbivory and riverine erosional effects to provide adequate habitat for resident, nesting, and winter roosting bald eagles, red-headed woodpeckers, and other woodland-dependent species.

Strategies

- Use trapping or shooting when necessary to control beaver damage. Enlist the services of experienced beaver trappers. Coordinate control efforts with SDGFP.
- Experiment with the use of different materials on or around the trunks of selected cottonwoods alongside the Missouri River, to protect them from beaver herbivory and to provide a nonlethal alternative.
- Conduct annual riverbank surveys on the refuge in the fall to monitor and document erosion and beaver damage.

Rationale

Cottonwoods are not replacing themselves in the riverbottom like they were before Fort Randall Dam was completed on the Missouri River in 1956. The dam has largely eliminated the natural flooding and deposition processes with which cottonwoods evolved. The result is riparian woodland that is slowly diminishing. Beaver fell mature cottonwoods every year, which makes these trees unavailable for bald eagles, red-headed woodpeckers, and other migratory birds. In a natural system, beaver herbivory would be compensated by numerous young cottonwoods replacing the older trees. Given the lack of regeneration, controlling beaver is sometimes necessary to protect the woodland.

A significant issue on the Karl E. Mundt Refuge, which lies approximately 4 miles downstream of the Fort Randall Dam, is riverbank erosion. Approximately 80 percent of the refuge's riverbank is protected by rock riprap. During high-flow water releases from the dam, erosion is substantial where the bank is unprotected. Mature cottonwood trees, some of which are used by bald eagles, often fall into the river when the soil holding them erodes. Protecting these mature trees from loss is necessary to ensure there will be enough available as wildlife habitat in the future. Protection

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Protecting and restoring woodlands on Karl E. Mundt Refuge will be a focus of management.

coupled with periodic replanting should ensure continuation of these important woodlands.

Rock riprap can be considered a blessing or a curse depending on one's perspective. When it is protecting the riverbank, it is a blessing for the landowner. However, research has shown that often the river's energy is merely reflected downstream where it erodes another site. The Missouri National Recreational River includes the boundary of the Karl E. Mundt Refuge and the Missouri River corridor between Fort Randall Dam and Sioux City (100 river miles). This river is part of the National Wild and Scenic River System. Protecting the free-flowing condition of the Missouri River, including channel migration and stream bank erosion, is a mandate for the Missouri National Recreational River. Bank stabilization goes against this mandate. Given the recovery and delisting of the bald eagle, riprapping the remaining 20 percent of the riverbank is not currently justifiable; however, in the future, where trees along the riverbank are identified as critically important to eagles or some other species, bioengineering bank stabilization techniques will be considered on a case-by-case basis. The refuge complex staff will work closely with National Park Service staff who will annually monitor the riverbank to document erosion.

Riparian Habitat Objective 5: Form Protection Partnerships for Karl E. Mundt Refuge

Over the next 15 years, the Karl E. Mundt Refuge manager will enhance the protection of the refuge from nearby development by seeking new and expanded partnerships with agencies and individuals (for example, the U.S. Army Corps of Engineers, SDGFP, Yankton Sioux Tribe, the Missouri National Recreational River, and neighboring landowners) to conserve lands within and surrounding the refuge.

Strategies

- Work with agencies, tribes, and individuals who manage lands next to the refuge complex to manage their lands for protection from harmful development.
- Continue to pursue acquisition of a conservation easement or fee-title purchase on approximately 2,000 acres (within the approved refuge boundary) between the two units of the Karl E. Mundt Refuge, to protect the refuge from development that will negatively affect wildlife, wildlife habitat, and wildlife-dependent recreation.
- Pursue acquisition of conservation easements or fee-title purchases next to the Karl E. Mundt Refuge (figure 8, chapter 2).
- Facilitate woodland restoration on lands next to the Karl E. Mundt Refuge to protect wildlife habitat for bald eagle, red-headed woodpecker, Bell's vireo, and other trust species.

Rationale

Many species of migratory birds and other wildlife prefer a block of appropriate habitat of a certain minimum size to meet their life needs. When that block of habitat is continuous and large, the local population will likely thrive. If that habitat is fragmented, the local population will likely suffer.

Currently the Karl E. Mundt Refuge is fragmented. Its two units—the North Unit (677 acres) and South Unit (282 acres)—are considered relatively small for many wildlife species, and these tracts are separated by a tract of private land approximately 2,000 acres in size.

Furthermore, within the last 10 years home construction has occurred next to the refuge, and such development could degrade the quality of the habitat on the refuge. Fortunately this development has occurred far from the riverbottom—the area of critical use for bald eagles, red-headed woodpeckers, and other migratory birds.

Protection of neighboring lands is critical to the protection of the relatively small refuge. Given this circumstance, the refuge complex staff will continue to pursue conservation protection on neighboring lands through formal and informal partnerships, associated easements, or purchase in fee.

4.6 Upland Habitat Goal

Acquire, restore, manage, and maintain a diverse mix of native grassland habitats to support migratory birds and resident wildlife found in the northern mixed-grass prairie ecosystem.

Upland habitat objective 1: control invasive plants on refuge complex grasslands (early detection–rapid response)

Over the life of this CCP, the refuge complex staff will identify and strive to eradicate all infestations of noxious plant species (for example, yellow toadflax, Russian mallow, common mullein, knapweed species, houndstongue, and chicory) that are not well established on refuge complex grasslands.

Strategies

- Survey for presence of invasive plant species and use GPS and Geographic Information System technologies to map and monitor infestations of invasive plants.
- Use EDRR principles.
- Seek money for an invasive species strike team for South Dakota refuges and wetland management districts.

Rationale

Exotic species are a major threat to native ecosystems in the United States and considered second only to habitat destruction in significance. Control of invasive species is a management priority because these species have a direct negative effect on the ability of refuges to fulfill their wildlife conservation mission, including migratory waterfowl and songbird production, species recovery, biological diversity, biological integrity, and ecosystem function.

Public and private landowners work very hard to address noxious weed spread yet rarely have sufficient resources to manage all populations of all nonnative species on their land. Prevention is considered the highest priority under a successful integrated invasive plant management program. Prevention of new infestations must occur to prevent threats to habitat and additional management burden. However, when prevention fails, quickly finding and responding to new invaders is critical to limiting costs and impacts of invasions.

EDRR is a method of surveying areas, identifying new invaders, and pursuing treatment as quickly as possible. The "USFWS Invasive Species Strategic Plan" (USFWS 2003) recommends focusing on early detection and completely eradicating smaller infestations rather than trying to control large, well established infestations. It has been shown to be far less costly to control invasive plants through eradicating new invasions or small patches than by trying to control well established invasions (Chippendale 1991 in Hobbs and Humphries 1995, Frid et al. 2011, Keller et al. 2007, Leung et al. 2002). Small satellite populations of invasives often expand more rapidly and potentially cover more area than the front of a source population (Cousens and Mortimer 1995, Moody and Mack 1988). (A fitting analogy is fire: many spot fires may occupy or "fill" an area more quickly than the advancing front of the fire.) Additionally, since most invasive plants have a long lag period following introduction, they can usually be eradicated at this early stage if recognized. Rejmanek and Pitcairn (2004) note that early detection can make the difference between employing feasible offensive strategies and retreating to defensive strategies that usually require ongoing financial commitments.

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Controlling the spread of invasive species on refuge complex lands will help prevent these species from spreading to neighboring private lands.

For example, treating two new small patches of a species when discovered would most likely result in successful eradication, preventing them from spreading and adding to the existing management burden. On the other hand, treating a large existing patch with all available resources for years may only result in a slight decrease in patch size or density—moreover, during that time the two new invasions would continue to grow and spread, creating an even greater need for more resources.

Resources must be directed at detecting early invasions in cooperation with refuge complex partners and responding rapidly to new invasions. If resources are not directed for EDRR, then invasions are given time and allowed to outpace management efforts, leading to greater areas of infestations that are costly and time-consuming to treat.

Although prevention and EDRR are important components of an integrated invasive species management strategy, certain large, well established infestations should also be targeted at least for containment. For these species, prioritization by species or area must occur first to determine which species have the greatest impact on trust resources and whether infestations are in areas of high conservation value. Containing those infestations will maximize the effectiveness of limited resources.

UPLAND HABITAT OBJECTIVE 2: CONTROL INVASIVE FORBS ON REFUGE COMPLEX GRASSLANDS

Over the next 15 years, the refuge complex staff will annually treat invasive forb infestations (for example, leafy spurge, Canada and musk thistle, wormwood, and other State-defined noxious weeds) on the highest priority (Priorities 1 and 2) refuges and waterfowl production areas to improve habitat quality for mallard, upland sandpiper, grasshopper sparrow, and other migratory birds. Priority 3 and 4 units will be treated every 2–3 years. Priority 5–8 units will be treated as necessary or as dictated by county weed boards.

Strategies

- Run the prioritization model every 5 years as data are added to the duck upland accessibility model.
- If money and staff availability allow, consider moving lower priority units (Priorities 3 and 4) to an annual treatment protocol.
- Use GPS and the Refuge Lands Geographic Information System database to map and monitor infestations of invasive plants.
- Continue using grazing, haying, prescribed fire, herbicides, insects, mowing, and seeding as part of an integrated pest management strategy to control invasive plants.
- Continue to work with cooperators to apply grazing, haying, and farming treatments.
- Use aerial application vendors to reach areas inaccessible to ground-based equipment.
- Focus control efforts on non-EDRR areas with more than 5 percent invasive plant cover or infestations larger than 0.25 acre.
- When appropriate, use Burned Area Rehabilitation funds to control and prevent the spread of invasive plant species.

Rationale

Typically invasive plants treated once every 3 years die the first year but recover to their former strength by the third year, resulting in no change in the number of acres occupied by invasive plants. Plants treated and then monitored and retreated annually in subsequent years can eventually reach a "maintenance level" where the time and cost to monitor and treat infestations is significantly reduced. This level is reached when weeds are reduced to a density where they are efficiently treated from sprayers mounted on off-road vehicles instead of large boom sprayers. Prioritizing refuge complex grasslands (and associated wetlands) and treating the highest priorities annually should result in reaching a maintenance level for this select group in approximately 15 years. Assuming funding is not significantly reduced, additional lands will be added to the annual treatment group until all grasslands are treated annually. The long-term goal is to reach a maintenance level for all invasive plant infestations on the refuge complex.

UPLAND HABITAT OBJECTIVE 3: CONTROL INVASIVE WOODY SPECIES ON REFUGE COMPLEX GRASSLANDS

Over the life of this plan, refuge complex staff will annually remove invasive trees (for example, Russian olive, eastern red cedar, Siberian elm, and white mulberry) and shrubs on refuges and one of the highest priority waterfowl production areas (Priorities 1 or 2) to improve nesting habitat for mallard, upland sandpiper, grasshopper sparrow, and other grassland migratory birds.

Strategies

- Use tree shears, chainsaws, and other heavy equipment to remove invasive trees and shrubs. Apply herbicide immediately to deciduous tree stumps to prevent resprouting.
- Burn eastern red cedars when they are young and when suitable fuels exist to carry fire. Use backing fires to increase heat duration and intensity for more effective control.
- Apply appropriate herbicide to saltcedar (leaf or basal bark application) without cutting and leave standing for two full growing seasons for optimal uptake and effective control.
- Make wood available to the public through a permit process to reduce disposal costs.
- Use fire crews to burn slash piles and reduce woody debris.
- Map invasive trees on the refuge complex using GPS and the Refuge Lands Geographic Information System database.
- Remove trees invading grasslands as the first priority.
- Remove shelterbelts and planted trees as the second priority. Removal of shelterbelts on refuges and waterfowl production areas will be considered on a case-by-case basis using established regional guidelines.
- Invasive trees (for example, Russian olive, Siberian elm, and eastern red cedar) may be removed regardless of their location.
- When there is a choice between favoring tree-nesting and grassland-nesting migratory birds, in most cases manage for the grassland birds because of their declining populations and their dependency on the grassland habitat refuge complex lands provide.

Rationale

Historically, the northern Great Plains was a grassland-dominated ecosystem where fire and grazing restricted natural tree growth to riparian floodplains, wooded draws, islands in lakes, and small patches along leeward wetland edges (Higgins 1986). These patches and corridors of trees and shrubs were the only woodland features in the prairie landscape (Rumble et al. 1998).

The prevalence of fire in the presettlement prairie created an environment inhospitable to trees (Higgins 1986, Severson and Sieg 2006). The growing points of most grassland species are usually protected at the base of the plant. In contrast, woody vegetation possesses elevated growing points that are more vulnerable to injury or fatality from fire. Grassland plants persist and expand with frequent and repetitive burns, whereas woody plants tend to decrease (Vogl 1974). The tallgrass and mixed-grass prairie types that cover South Dakota produce large quantities of fuel that dry quickly and burn easily (Steuter and McPherson 1995). Specifically, bluestem prairies recover quickly post-fire and can even provide enough fuel for multiple burns in a single growing season (Bragg 1982).

Climate also played a pivotal role in the development of grasslands—particularly the limiting effect of periodic drought on the growth and expansion of trees (Weaver and Albertson 1936). Herbivory and hoof action of grazing animals also constrained the establishment and expansion of woody vegetation. The effects of ungulates, fire, and drought combined to inhibit tree growth and expansion across the grasslands of South Dakota.

Presently, however, grassland fragmentation is escalating at an alarming rate. During 2008, in eastern South Dakota, the USDA and County Conservation Districts planted 255 miles of trees, covering 2,801 acres of land with 1,115,780 trees (G. Yapp, USDA, personal communication, 2009).

The response of grassland birds to unnatural tree conditions has received recent research emphasis. Grant et al. (2004a) determined that the probability of occurrence of breeding grassland birds decreased notably for 11 species as the percentage of woody vegetation increased. Further, negative effects on grassland bird communities increased as the height of woody plants increased (that is, brush giving way to tall shrubs giving way to trees). By most accounts, the grasslands became unsuitable for nine species of grassland birds as woodland cover exceeded 25 percent (Grant et al. 2004a). A recent study in North Dakota and South Dakota determined that bobolink, Savannah sparrow, and sedge wren specifically avoided tree plantings; however, these species would use the same areas after tree belts were removed (Naugle and Quamen 2007).

Nest predators and nest parasite species increase near woody habitat edges (Burger et al. 1994, Johnson and Temple 1990); in other words, planting woody vegetation in previously treeless grasslands exacerbates these problems. Tree plantings in grasslands create den and foraging sites for predators historically uncommon to grasslands (Kuehl and Clark 2002, Pedlar et al. 1997, Sargeant 1972, Sargeant et al. 1987). Gazda et al. (2002) indicated that duck nest success decreases near planted woodlands as a result of increased predation by mammal and bird species associated with trees and shrubs. Waterfowl and waterbirds have been shown to avoid wetlands where trees and shrubs occur along wetland margins, presumably to evade predation (Rumble and Flake 1983, Shutler et al. 2000). Johnson and Temple (1990) determined that nest predation rates were lower for five species of grassland songbirds in areas where nests were more than 148 feet from woody vegetation.

Brown-headed cowbird is a nest parasite whose population has increased in recent decades to the detriment of other birds (Shaffer et al. 2003). Cowbirds lay eggs in the nest of other birds, and the host birds act as foster parents to the cowbird young, thus reducing survival of the host bird's young (Lorenzana and Sealy 1999). Studies in mixed-grass prairie and tallgrass prairie determined that grassland birds nesting close (less than 541 feet) to wooded edges incur higher rates of brood parasitism from cowbirds than nests farther away (Johnson and Temple 1990, Patten et al. 2006, Romig and Crawford 1995). Shaffer et al. (2003) documented that brown-headed cowbirds parasitize 24 of the 36 North American grassland bird species.

Service-owned lands in South Dakota are part of this historically grassland-dominated ecosystem, where fire, grazing, and drought restricted natural tree growth to limited areas (Higgins 1986). Now, planted or volunteer trees and shrubs occur in many waterfowl production areas. Although most woody plantings existed before Service ownership of these lands, the Service did establish tree planting after acquisition in attempts to improve wildlife habitat. Volunteer trees are prevalent primarily due to lack of fire. Planted trees and shrubs such as green ash, cottonwood, and buffaloberry are native to North America; however, many others, such as caragana, Russian olive, and Siberian elm, are nonnative species. The most troublesome species planted in South Dakota is eastern red cedar. The species' extreme adaptability has enhanced its spread into areas where it was formerly rare or absent. Additional increases in its spread are due to tree plantings and the selection of the most aggressive cultivars (Ortman et al. 1996). Most of these plantings are considered unnatural components of the historical habitat. Additionally, nonnative species such as Russian olive and Siberian elm are invasive and also readily spread from both Service-owned and non–Service-owned plantings into new areas.

Preventing the encroachment and planting of woody vegetation into grassland ecosystems contributes significantly to the recovery of grassland bird populations (Herkert 1994). Recent research indicates that the elimination and reduction of invasive and planted woody vegetation will benefit most grassland-dependent bird species (Bakker 2003, Grant et al. 2004a, Johnson and Temple 1990, Naugle and Quamen 2007, Patten et al. 2006, Shaffer et al. 2003, Sovada et al. 2005). Although many woodland bird species might nest in planted woodlands, few are of management concern (Kelsey et al. 2006), suggesting that the loss of planted woodlands will have negligible effects on woodland bird species whose populations are stable or expanding.

In view of the research that has highlighted the negative effects of woody vegetation on prairie ecosystems, systematic removal of invasive and planted woody vegetation from Service lands is critical to the improvement of habitat for grassland-dependent birds. Sites for tree removal on waterfowl production areas are prioritized on the basis of landscape characteristics; the majority of removal is targeted in areas with the largest blocks of grassland, with emphasis on native prairie tracts and areas to be restored to planted native vegetation. Reducing fragmentation in these core areas has the potential to provide the most benefits to grassland-dependent birds. In addition, the removal of woody species more than 3.28 feet tall should target the removal of the larger shrubs and trees that pose the greatest ecological threat to grassland ecosystems on Service lands, rather than on small native shrubs, such as prairie rose, leadplant, and western snowberry, which are important components of grassland ecosystems.

Before Euro-American settlement in South Dakota, woody vegetation primarily occurred in riparian or streamside areas in broken topography in the upper drainages of streams, as well as on escarpments and in sandhills. These areas often had increased soil and leaf moisture, standing water, and relatively steep topography that provided protection from fires (Severson and Sieg 2006).

Although numerous patches of native woodlands still exist in the northern Great Plains, today, large expanses of once nearly treeless prairie are now intermixed with cropland and scattered small (less than 5-acre) linear and block-shaped tree plantings (also commonly referred to as windbreaks, shelterbelts, and tree belts). Baer (1989) estimated that these plantings cover 3 percent of the landscape in the State. Tree plantings are designed to reduce soil erosion from croplands (Baer 1989) and to provide shelter for farm sites and livestock, and are viewed by many as striking landscape features that symbolize settlement of the western United States. However, they also further fragment remaining grasslands by creating abrupt boundaries that exacerbate edge effects (O'Leary and Nyberg 2000, Ribic and Sample 2001, Winter et al. 2000). Additionally, the suppression of ecological processes such as fire and grazing has allowed an increase in the encroachment of woody plants into grasslands (Bakker 2003). These factors have been linked to the deterioration of grassland bird populations, which are declining faster and more consistently than any other group of North American birds (Herkert 1995, Samson and Knopf 1994). Research indicates that native grassland birds need large, contiguous tracts of treeless grasslands to maintain populations (Bakker et al. 2002, Herkert 1994, Winter et al. 1999). The literature overwhelmingly indicates that invasive and planted trees in prairie landscapes often adversely affect a variety of bird groups (Bakker 2003). Specifically, trees on the prairie are correlated with adverse consequences for ducks (Rumble and Flake 1983), wetland birds other than ducks (Naugle et al. 1999), prairie grouse (Hanowski et al. 2000, Niemuth 2000), grassland songbirds (Grant et al. 2004a, Winter et al. 2000), and ring-necked pheasants (Schmitz and Clark 1999, Snyder 1984).

UPLAND HABITAT OBJECTIVE 4: MANAGE NATIVE PRAIRIE HABITAT

Over the next 15 years refuge complex staff will annually treat at least 500 acres of native mixed-grass prairie habitat that has been invaded by tame grasses (for example, smooth brome, Kentucky bluegrass, and crested wheatgrass) using habitat management treatments such as grazing, haying, prescribed fire, and interseeding to facilitate competition from native grasses and forbs and to enhance nesting and migration habitat for upland sandpiper, mallard, and grasshopper sparrow (the three focal species for upland and grassland habitats) and other migratory birds. Increase native plant groupings by 10 percent over 15 years. Efforts will focus on Lake Andes Refuge, Karl E. Mundt Refuge, and Priority 1–4 waterfowl production areas.

Strategies

- Participate in the Service's native prairie adaptive management study. Annually evaluate native prairie adaptive management units for the effectiveness of upland habitat management treatments.
- Where necessary, interseed native grasses and forbs to restore native vegetation species to prairies. Use native genotypes where possible. (Note that Service policy regarding refuge management implicitly promotes seeding to reestablish native plants in native prairie where such plants have become rare or absent [National Wildlife Refuge System Biological Integrity, Diversity, and Environmental Health, 601 FW 3, 2001]).

- Use prescribed fire, in appropriate times and with appropriate patterns, to reinvigorate native prairie grassland habitat.
- Develop a grassland habitat management plan that will guide prairie reconstruction and restoration on the refuge complex (figure 21). This plan will provide additional criteria for selecting and prioritizing refuge complex lands for reconstruction and restoration.

Rationale

One of the most important management standards of the Improvement Act is a provision directing the Secretary of the Interior to "ensure that the biological integrity, diversity, and environmental health of the System are maintained for the benefit of present and future generations of Americans," otherwise known as the ecological integrity provision. With the exception of the Refuge System mission, the ecological integrity provision is the most important and pervasive provision of the Improvement Act. Maintaining the biological integrity, diversity, and environmental health of protected lands is a fundamental concept widely recognized as basic to modern scientific resource management, and by virtue of the Improvement Act, the Service now has a fundamental legal duty to do so.

This objective focuses on restoration and maintenance of the floristic composition on tracts identified as high priorities. A fundamental assumption is that, with continued management focused on vertical structure over other prairie qualities and values, native herbaceous flora would continue to decline and disappear on native prairie tracts. This objective improves the chance that some native prairie will be restored by applying frequent and precisely timed disturbance.

Over the last several decades, rest or non-use (that is, lack of grazing, haying, and prescribed fire) was emphasized as a management approach to increase densities of duck nests in uplands on waterfowl production areas in North Dakota and South Dakota. In the short term (2–20 years), greater vertical structure may be maintained in northern grasslands that are rested. The structure of such idle vegetation is believed to be more important than plant species composition when the management goal is waterfowl production, in part because the density and survival of nests of prairie ducks are believed to be greatest on rested grasslands (Naugle et al. 2000, Schranck 1972).

However, a management approach for upland-nesting duck habitat that emphasizes rest has long-term implications that are often overlooked in short-term management studies, because continuous idling without periodic defoliation disturbance fails to promote long-term grassland health (Naugle et al. 2000). With extended rest, introduced grasses, especially smooth brome and Kentucky bluegrass, may more rapidly displace native vegetation (Murphy and Grant 2005). Monotypic stands of smooth brome and Kentucky bluegrass are less attractive to upland-nesting ducks than other types of grass-forb cover (Nenneman 2003).

Studies conducted on exotic plant species and habitat quality for grassland birds have shown that grassland bird species richness or abundance are lower in grasslands dominated by exotic species than in grasslands containing native species (Bakker and Higgins 2009, Greer 2009, Lloyd and Martin 2005, Pampush and Anthony 1993, Wilson and Belcher 1989). Recent South Dakota research reported that increasing coverage of grasslands by exotic plant species had a negative effect on the occurrence and densities of four of South Dakota's species of greatest conservation need—chestnut-collared longspur, western meadowlark, grasshopper sparrow, and lark bunting (Greer 2009). Bakker and Higgins (2009) found that intermediate wheatgrass monotypes and cool-season mixes of exotic species in South Dakota contained 40–60 percent fewer grassland bird species than did native sod prairie. Ribic et al. (2009) found that grasshopper sparrows occurred in higher densities in native prairie remnants with greater native plant coverage than in the Natural Resources Conservation Service's Conservation Reserve Program fields or hay fields containing greater amounts of exotic species. Increased vegetative heterogeneity in tracts of native sod prairie may support more arthropod prey for grassland birds (Hickman et al. 2006, McIntyre and Thompson 2003); arthropod prey diversity is positively associated with grassland bird richness (Hamer et al. 2006).

Losses of plant, bird, and arthropod species diversity are not the only consequences when introduced plants invade northern prairie. The long-term effect of introduced perennials does more than simply determine species composition; it also affects ecosystem processes (Wilson 2002). Ecosystem processes such as nutrient cycling and water-use patterns in prairies dominated by smooth brome and Kentucky bluegrass differ from those in native grasslands (Hunt et al. 1991, Trlica and Biondini 1990). Nutrient pools, energy flows, soil invertebrate and mycorrhizal relationships, and the water cycle can all be altered significantly (Christian and Wilson 1999, Seastedt 1995, Vinton and Goergen 2006, Wilson 2002).

Upland habitat objective 5: reconstruct prairie on previously farmed areas

Annually and for the next 15 years, refuge complex staff will begin the process of prairie reconstruction on 200 acres of previously tilled lands, to recreate native grasslands (including native forbs) and provide high quality habitat for mallard, grasshopper sparrow, upland sandpiper, and other migratory birds. Focus efforts on Lake Andes Refuge, Karl E. Mundt Refuge, and waterfowl production areas that are within Priorities 1–4.

USFWS

Prescribed fire is one tool wildlife managers use to emulate the defoliation process with which prairie plants evolved.

Strategies

- Create partnerships with cooperative farmers to farm areas identified for reconstruction for two or more growing seasons to eliminate invasive grasses and provide a clean seedbed for replanting.
- As needed, monitor refuge complex lands reconstructed to native prairie grasses and forbs to evaluate the effectiveness of upland habitat management and reconstruction efforts, especially in the early stages of reconstruction.
- Develop a grassland habitat management plan that will guide prairie reconstruction and restoration on the refuge complex. This plan will provide additional criteria for selecting and prioritizing refuge complex lands for reconstruction and restoration.
- Significantly reduce invasive plants before the reseeding phase of reconstruction.
- Using the best available science, determine which plant species were native to individual tracts of each refuge complex unit. Replant a diverse mix of grasses and forbs using genotypes that are from the local area where possible.

Rationale

Prairie reconstruction and prairie restoration are two different processes. Prairie reconstruction refers to reestablishing (replanting) native plants (grasses, forbs, shrubs) on sites that were tilled. Typically sites are farmed for 2 or more years to eliminate invasive plants, and then reseeded with a mixture of native plant species. Prairie restoration involves applying management treatments to bring a native prairie remnant (never tilled) back to a point where native plants thrive. This objective concerns prairie reconstruction.

Native migratory birds fare best in native vegetation (Bakker and Higgins 2009). Refuge complex grasslands have been invaded by nonnative grasses such as smooth brome, Kentucky bluegrass, and crested wheatgrass. An intensive reconstruction effort is necessary to eliminate competition from invasive grasses and reestablish native plant species.

The establishment of native-dominated perennial herbaceous cover, in concert with prescribed application of periodic fire and grazing, resists the encroachment and establishment of invasive species. Sources in the literature suggest that species-rich seed mixtures may reduce weed invasion on native seeded grasslands (Blumenthal et al. 2003, Carpinelli 2001, Pokorny 2002, Sheley and Half 2006, Tilman et al. 1996). In a study by Pokorny et al. (2005), the investigators determined that indigenous forbs resisted invasion by spotted knapweed better than grasses did. The overall theory in the literature indicates that seeding a species-rich seed mixture increases the inclusion of various functional groups among plant species. The more species included in a mixture, the higher the probability of providing competition to resist invasion by nonnative plants. Moreover, native vegetation is preferred over nonnative vegetation by a number of grassland birds (Bakker and Higgins 2009). Mark Sherfy of USGS found that ducks nesting in Conservation Reserve Program fields in North Dakota and South Dakota showed no significant preference for tame grass–seeded fields—that is, dense nesting cover (DNC)—over native seeded fields. In addition, nest success was slightly higher in native seedings than in tame grass seedings. According to Klett et al. (1984), nest initiation rates for mallard, gadwall, and blue-winged teal in North Dakota and South Dakota were as high or higher in native-seeded fields than in seeded fields that lacked natives. Similarly, nest success was not significantly different in native-seeded than in tame grass–seeded study fields (Klett et al. 1984).

Ultimately, reconstruction success (habitat improvement) is dependent on monitoring and management efforts. Monitoring determines the nature and the appropriate timing of the management action. Effective management (prescribed fire, grazing, mowing, or chemical treatment) of reconstruction sites is critical for establishment, productivity, and longevity of the grassland stands. The refuge complex's focus on using native plants to reconstruct waterfowl production areas is consistent with the Improvement Act, which includes an integrity policy that states that Refuge System units are to promote biological integrity, diversity, and environmental health and attempt the restoration of historical conditions on Refuge System lands (Schroeder et al. 2004).

Upland habitat objective 6: improve tame grasses

On lands not slated for grassland restoration or reconstruction (Priority 5–8 waterfowl production areas), refuge complex staff will apply management treatments (for example, grazing, fire, haying, and interseeding) to improve tame grass habitat for migratory birds throughout the life of this CCP. Interseeding of nonnative forbs such as alfalfa will not exceed an average of 50 acres per year on tracts that were previously cropped and are dominated by tame grass.

Strategies

- Use grazing, haying, fire, and interseeding of forbs to keep tame grass vigorous and beneficial for migratory birds.
- Avoid treatments and locations that are relatively time-consuming.
- When interseeding, use forb species that are inexpensive, noninvasive, and easily controlled (for example, alfalfa). Invasive nonnative plant species like sweet clover or red clover will not be interseeded.

Rationale

Tame grass is defined as nonnative grass species. In this area the typical tame grass species are smooth brome, Kentucky bluegrass, intermediate wheatgrass, and crested wheatgrass.

Grasslands with a forb component, including legumes like alfalfa, are attractive to invertebrates. Invertebrates are very important to breeding migratory birds and their young. The nutrition they provide is especially important to egg-laying females and young of the year.

Certain upland areas were seeded back to an herbaceous cover of introduced vegetation known as DNC. Traditionally, these seed mixtures comprised cool-season introduced grasses and legumes (intermediate wheatgrass, tall wheatgrass, alfalfa, and sweetclover) that establish well under a wide variety of soil, moisture, and climatic conditions that exist across the Plains and Prairie Pothole Region. Such a mixture provides nesting cover for generalist birds including upland-nesting ducks (Duebbert et al. 1981), northern harrier, and sedge wren (Johnson et al. 2004). DNC provides attractive nesting cover for waterfowl for 6–8 years after seeding and up to 15 years with proper management (Duebbert and Frank 1984, Higgins and Barker 1982, Lokemoen 1984).

Ideally, the majority of these tracts planted to DNC will be seeded back to a native mixture; however, certain situations may limit the opportunity to do so. If a DNC mixture is used, intermediate wheatgrass and tall wheatgrass are viable grasses to select, and alfalfa is an appropriate legume. Under no circumstances should smooth brome, Kentucky bluegrass, crested wheatgrass, or sweetclover be used in DNC mixtures. DNC tracts must also be managed to maintain optimal vigor throughout the life cycle of the planting. Especially in cropland-dominated areas, invasive plant threats will persist and will require appropriate treatments to control. Management methods such as grazing and fire may be used to stimulate the height and density of DNC mixtures. Mechanical methods such as haying may also benefit plantings by removing the litter layer. Finally, the most productive stands of DNC are those that are reseeded approximately every 10–15 years, including appropriate crop rotation frequency as seedbed preparation (Duebbert et al. 1981). Before a tract is planted back to DNC, the Service's integrity policy and the sustainability of native grasslands should be considered.

Tame grass tracts that have not begun the seedbed preparation process will be maintained in an idle state that generally consists of a predominance of introduced cool-season grass species. Before seedbed preparation for seeding to native grass, these sites are of relatively low priority. Management efforts can be better directed toward higher priority upland areas such as native prairie, tracts already reseeded to native grass, and tracts being prepared for native reseeding. According to Mark Sherfy of USGS, there is evidence that, despite the presence of introduced cool-season perennial grass cover, DNC likely supports multiple plant species and generalist birds, including upland-nesting ducks.

Upland habitat objective 7: manage grassland structure

Over the life of this CCP, refuge complex staff will maintain a minimum of 40 percent of all grassland acres in a high visual obstruction reading (VOR) category (greater than 8 inches; Robel et al. 1970), a minimum of 25 percent in a medium VOR category (4–8 inches), and a minimum of 5 percent in a low VOR category (less than 4 inches) to provide a mosaic of habitat types for the broadest possible variety of grassland migratory birds.

Strategies

- Manage grasslands with prescribed fire, grazing, haying, rest, or a combination.
- Monitor VOR using a method modified from Robel et al. (1970) once every 5 years on a representative portion of refuge complex grasslands.
- Use the Floristic Quality Index to monitor vegetation quality and changes before and after grassland habitat treatments, restorations, and reconstructions. Use the Refuge Lands Geographic Information System database to document habitat treatments and store vegetation data.
- Use resources such as the Refuge Inventory and Monitoring Office in Fort Collins, Colorado, to improve the effectiveness and efficiency of monitoring.
- Conduct a critical thinking process that lists, describes, and prioritizes biological information needs for grasslands on the refuge complex that will be best addressed through outside research to inform and improve refuge management. This information will be provided to potential research partners and the research community. Use resources such as the Service's zone biologist, past research partners, and other research contacts to develop the biological information needs list.

Rationale

Focal species were selected for refuge complex grasslands. These include the mallard, which prefers high grass height (VOR of greater than 8 inches); the grasshopper sparrow, which prefers medium grass height (VOR of 4–8 inches); and the upland sandpiper, which prefers low grass height (VOR of less than 4 inches). Providing habitat for each of these three species will benefit many other grassland migratory bird species (for example, dickcissel, northern harrier, gadwall, sedge wren, blue-winged teal, northern shoveler, bobolink, northern pintail, western meadowlark, marbled godwit, and willet). Quantitative measurements of VOR of upland nesting species are shown in figure 24.

Managing for 40 percent or more in the high VOR category (greater than 8 inches) will provide a grassland habitat that is underrepresented in the surrounding private landscape, and one that is ideal for many species of waterfowl and other migratory birds. Medium VOR (4–8 inches), and especially low VOR (less than 4 inches), are well represented in the surrounding private landscape.

Gathering information specific to refuge complex lands will enable refuge complex staff to use the best available science to guide management decisions.

Upland habitat objective 8: protect grasslands through easements

Provided adequate money is available, the wetland district manager will lead annual efforts to secure perpetual conservation easements on 3,000 acres of unprotected, high priority grassland acres, to benefit migratory birds; sequester carbon; improve soil stabilization and water quality; and benefit indigenous plant and animal species, resident wildlife, and federally and State-listed species throughout the life of this plan.

Strategies

- Focus the protection of grassland (and associated wetlands) with conservation easements in areas of high waterfowl pair densities. Use the current Upland Accessibility for Breeding Duck Pairs in the Lake Andes National Wildlife Refuge map (figure 23) to guide acquisition priorities.
- Use the Partners for Fish and Wildlife Program as a way to inform prospective sellers of the Service's conservation easement program.
- Use the Service's strong partnership with Ducks Unlimited, North American Wetlands Conservation Act, and other conservation organizations to generate non–Duck Stamp money to buy additional conservation easements.
- Maintain prioritized lists of willing sellers whose lands have been approved for easement acquisition.
- Work closely with the Huron Wetland Acquisition Office to process high priority easement evaluations and to communicate acquisition priorities for the Lake Andes District.
- Examine data from HAPET, The Nature Conservancy, Ducks Unlimited, and others to identify geographical areas valuable to trust species. Pursue acquisition of easements to promote wildlife conservation.

Rationale

The initial focus of the Service's Small Wetland Acquisition Program was the protection of wetlands through purchasing land in fee title and acquiring perpetual wetland easements. However, data also revealed the importance of upland grasslands to successful nesting of waterfowl. With the continued conversion of grassland to cropland and consistent declines in the populations of grassland-dependent birds, the need to protect neighboring grassland habitats became evident. The Service received authorization and began to acquire grassland easements in South Dakota in 1989. Like a wetland easement, a grassland easement transfers limited perpetual rights to the Service for a one-time, lump-sum payment. The purpose of a grassland easement is to prevent the conversion of grassland to cropland, while minimally restricting existing agricultural practices. More specifically, the purposes of a grassland easement are:

- to improve the water quality of wetlands by reducing soil erosion and the use of chemicals and fertilizers on surrounding uplands;

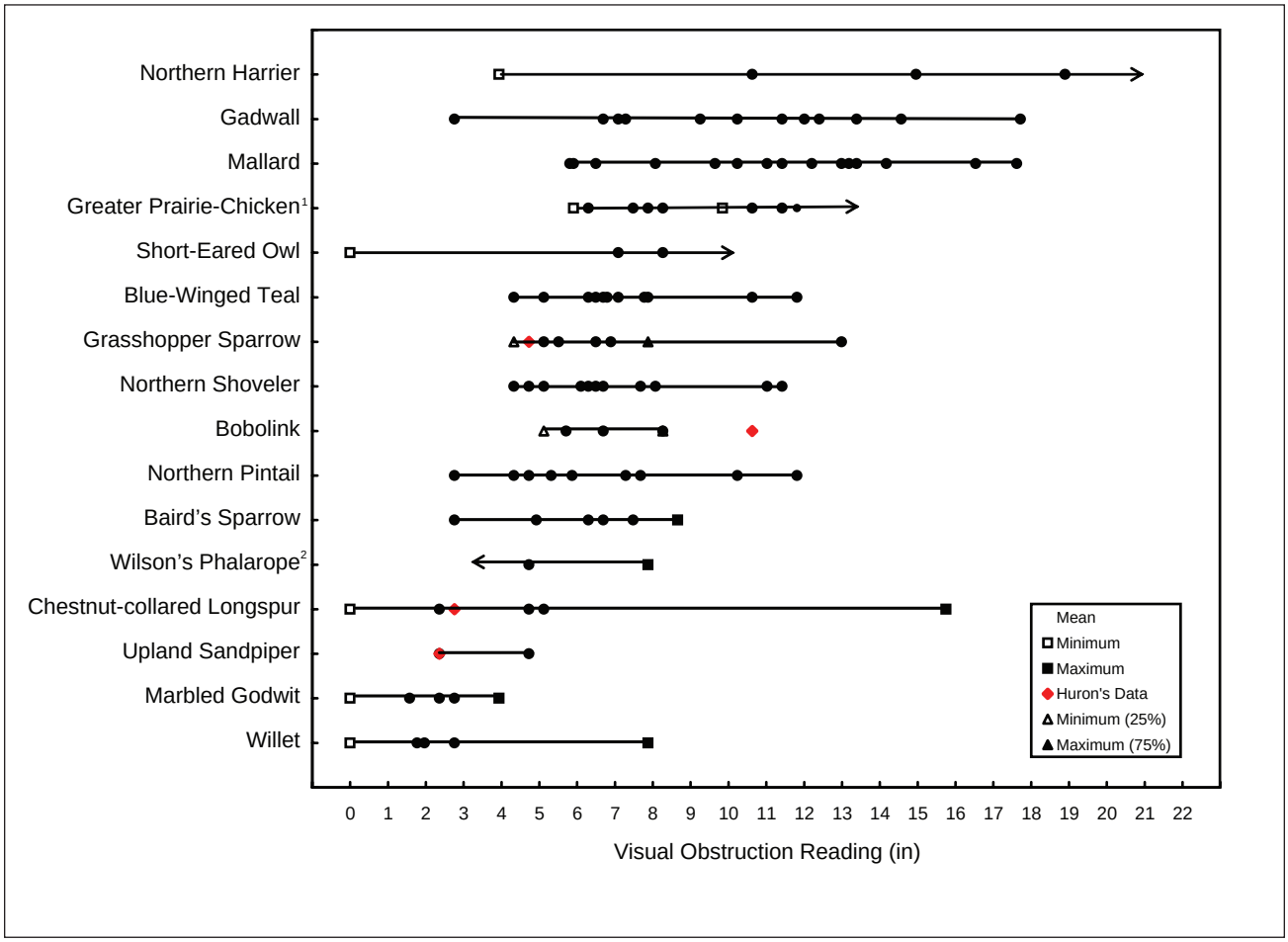

Figure 24. Quantitative measurements of visual obstruction readings of upland nesting species. *Source: Laubhan et al. 2006, except [1]Svedarsky et al. 2003 and [2]Dechant et al. 1999.*

- to improve upland nesting habitat for all ground-nesting birds, especially waterfowl, and enhance nesting success on private lands;
- to perpetuate grassland cover established by other Federal programs (for example, Conservation Reserve Program);
- to provide an alternative to the purchase of uplands in fee title, thus maintaining lands in private ownership.

Grassland easements restrict the landowner from altering the grass by digging, plowing, disking, or otherwise destroying the vegetative cover. Haying, mowing, and seed harvest are restricted until after July 15 of each year. The landowner can graze without restriction (appendix J).

Considering the strong and ongoing partnership with Ducks Unlimited and the consistent success of using its non-Federal money to help acquire North American Wetlands Conservation Act grants, it is likely the Service's grassland easement program will enjoy stable, if not increasing, funding over the next 15 years. Under these circumstances and using an average acquisition target based on 2008 Division of Realty data, the Service will secure protected status for more than 500,000 grassland acres in South Dakota.

HAPET has developed a model that shows the distribution of priority grassland patches (at least 55 acres) in relation to breeding duck pairs (at least 25 per square mile) (figure 25) and predicts that for every 1 percent decline of priority grassland in the Plains and Prairie Pothole Region, there will be 25,000 fewer ducks in the fall. Protection of priority grassland patches not only benefits waterfowl, but also a wide variety of grassland-dependent migratory birds such as western meadowlark (Johnson and Igl 2001).

HAPET identified 11.56 million acres in the PPJV area of North Dakota, South Dakota, and eastern Montana that meet the above criteria. By subtracting grasslands already protected on waterfowl production areas or grassland easements, HAPET identified 10.4 million grassland acres in need of protection. The Dakota Working Group and the PPJV (Ringelman 2005) have adopted this figure as a protection goal. Securing protected status on 500,000 acres of priority grassland in the next 15 years will help the Service advance toward meeting this goal.

Additionally, the HAPET model has identified larger grassland areas with respect to area-dependent, grassland-nesting birds such as northern harrier, upland sandpiper, and grasshopper sparrow (Johnson and Igl 2001). These areas consist of contiguous grass cover encompassing at least 640 acres with at least 30 percent of the area comprising permanent or semipermanent wetlands. Protection of these large, contiguous blocks of grass within a larger, grassland-dominated landscape should provide adequate protection for a wide range of grassland-dependent migratory bird species that are of management concern (Estey 2007).

To inform prospective sellers of the Service's conservation easement program, the Service will use the Partners for Fish and Wildlife Program. Often times, a biologist from this program is the first point of contact for landowners who would otherwise be unaware of the available conservation programs.

Upland habitat objective 9: protect grasslands through fee acquisition

Throughout the life of this CCP, the refuge complex's wetland district manager will strive to secure additional land in fee title as waterfowl production areas from willing sellers, at an average annual rate of 0.5 percent over the existing land base, within high priority sections of the Grassland Bird Conservation Area (figure 25) and areas shown in HAPET's Upland Accessibility for Breeding Duck Pairs in the Lake Andes National Wildlife Refuge Complex map (figure 23) for migratory bird conservation.

Strategies

- Purchase standalone or roundout properties with habitat values equal to or greater than existing high-priority waterfowl production areas.
- Standalone properties could be purchased ahead of a roundout property or any easement.
- Continue to use the Service's strong partnership with others to acquire waterfowl production areas through purchase and donation.
- Consider exchange proposals with other conservation organizations with the goal of improving management capability.

Rationale

Waterfowl production areas are public lands purchased by the Federal Government for increasing the production of migratory birds, especially waterfowl. The purchase of land—or ownership in fee title—entails the Federal Government holding ownership of land on behalf of the American public. Money to buy waterfowl production area lands typically comes from the public purchase of Federal Duck Stamps. This important program aims to ensure the long-term protection of waterfowl and other migratory bird breeding habitat—primarily in the Plains and Prairie Pothole Region of the northern Great Plains. Waterfowl production areas are open to the public for hunting, fishing, wildlife (bird) watching, photography, and trapping.

The majority of waterfowl production areas in the Lake Andes District were purchased in the 1960s. Historically, acquisition of waterfowl production areas focused on larger semipermanent wetlands; often, very little associated upland was included in the tract. As grassland cover was converted to cropland, the Service recognized the importance of purchasing uplands next to wetlands for waterfowl production. When considering a waterfowl production area purchase from willing sellers, the Service ranks sites with native prairie, rare wildlife and plant species, a diversity of temporary and semipermanent wetlands, and areas near or next to another waterfowl production area as high priorities for acquisition. Currently, the Service purchases on average one waterfowl production area in each district every 3 years.

Upland habitat objective 10: evaluate wildlife values of refuge complex lands

Throughout the life of this CCP, refuge complex staff will evaluate the biological integrity and value to wildlife populations of lands suspected of no longer meeting the Service's purposes, and will pursue legal means to exchange tracts of land to ensure limited Refuge System resources are focused on conserving the most valuable habitats for Service trust resources.

Strategies

- Examine interests currently held in fee title and identify those that are clearly of low value to trust species. Pursue exchange of these interests to ensure that limited Refuge System resources are focused on conserving the most valuable habitats.
- Use proceeds from exchanges to acquire high priority habitats. All purchases will be from willing sellers and subject to approval from the Service.
- Apply the waterfowl production area prioritization model to identify fee tracts that are of low priority for conservation. Consider starting a process to exchange these lands.

Rationale

Compared with today, years ago the Service was less selective when it came to acquiring and accepting lands for the Refuge System. Techniques and information have evolved and as a result there are many more tools available to determine the value to wildlife conservation of a tract or interest.

In the past land acquisition has proceeded through a reactive process. Landowners approached the Service when they were interested in selling their land. Years ago lands were acquired with very little information relevant to an individual tracts value for migratory birds. In hindsight this sometimes resulted in acquisition

of lands that had marginal wildlife value. Resources to manage these lands are very limited and not expected to increase appreciably in the near future. A process that identifies valuable lands for future acquisition and current holdings for future divestiture will allow limited resources to be focused on the most valuable land for migratory bird conservation.

Consideration will be given for the exchange of the following waterfowl production areas: Freese, Diede, Collar, Anderson, Kayser, and White Lake.

Upland habitat objective 11: control nest predators on Lake Andes Wetland Management District

Throughout the life of this CCP, the refuge complex will support and facilitate opportunities for control of nest predators (for example, raccoons, striped skunks, red fox, opossum, and other vermin) led and carried out by partner organizations, to facilitate higher nest success (greater than 35 percent Mayfield nest success) among mallards and other waterfowl across the wetland management district.

Strategies

- Investigate support from Delta Waterfowl and other potential partners.
- Facilitate control efforts where waterfowl nesting density is greater than 40 pairs per square mile.
- Allow control of nest predators by partner organizations during the nesting season.
- Facilitate nest monitoring by partner organizations, on a representative sample of the control area before, during, and after control.
- Remove predator habitat from waterfowl production areas that could harbor nest predators (for example, abandoned buildings, rock piles, and abandoned shelterbelts).

Rationale

Animals that prey on migratory bird nests are abundant on the Lake Andes District. Raccoon, striped skunk, opossum, and red fox have the most significant negative effect on migratory bird nesting success in this area. Food and cover in the agricultural landscape results in "bumper crops" of these three species nearly every year. Control of nest predators during the nesting season in habitats similar to that of the district has been shown to significantly increase nesting success of waterfowl. The refuge complex does not have the resources to control nest predators and monitor nesting success in a significant way across the vast landscape of the district. Such an effort would have to be performed by an outside organization that is committed to improving the nesting success of ground-nesting birds in the Plains and Prairie Pothole Region. This type of activity has occurred on other districts in the Plains and Prairie Pothole Region in the past 10 years.

According to Beauchamp et al. (1996), nest success of upland nesting ducks has declined from a mean of 30 percent in 1935 to a mean of 10 percent in the early 1990s. This decrease in nest success can likely be attributed to multiple factors, including a substantial long-term loss, fragmentation, and degradation of wetland and grassland habitat, as well as an unbalanced predator community. According to Sovada et al. (2004), habitat conversions have changed predator–prey relationships and increased populations of certain waterfowl predators. In addition to waterfowl, predation is an important cause of nest failure for passerines, shorebirds, ground-nesting raptors (for example, northern harrier and short-eared owl), and upland gamebirds (Helmers and Gratto-Trevor 1996, Martin 1988, 1995).

Several studies support the hypothesis that removal of predators like striped skunk, raccoon, and red fox increases waterfowl nest success (Garrettson and Rohwer 2001, Garrettson et al. 1996, Hoff 1999, Mense 1996), productivity (Sovada et al. 2001), and brood production (Balser et al. 1968, Duebbert and Lokemoen 1980, Garrettson et al. 1996, Sargeant et al. 1995). Greenwood and Sovada (1996) suggested that lethal control of predators can potentially improve waterfowl production across large landscape areas. Predator removal can be a viable alternative where habitat management actions are not sufficient to support waterfowl nest success at or above maintenance levels (Sovada et al. 2004). Reynolds et al. (2001) suggested that on average (dependent on multiple variables) the landscape must contain 40 percent grass cover or more for mallards to achieve a nest success of 15–20 percent (population maintenance level). Sovada et al. (2001) stresses that predator management activities must provide for flexibility across the landscape because of the dynamic nature of factors (like climatic conditions) that influence waterfowl recruitment. Additionally, Sargeant et al. (1995) and Garrettson and Rohwer (2001) both concluded that predator control on large blocks is more effective than on smaller areas.

Past surveys of upland duck nest success on refuge complex lands indicate that in some years duck nests suffer predation at levels that suppress nest success to a point below a minimum maintenance threshold (15–20 percent). Additionally, several studies have shown that the nest success for ducks on refuges and waterfowl production areas throughout much of the Plains and Prairie Pothole Region is often less than the recommended minimum nest success values of 15–20 percent (Cowardin et al. 1985, Greenwood 1986, Greenwood et al. 1990, Klett et al. 1988). Furthermore, Klett et al. (1988) suggested that while conservation programs may curb grassland and wetland losses, only a minimal increase in duck nest success will occur

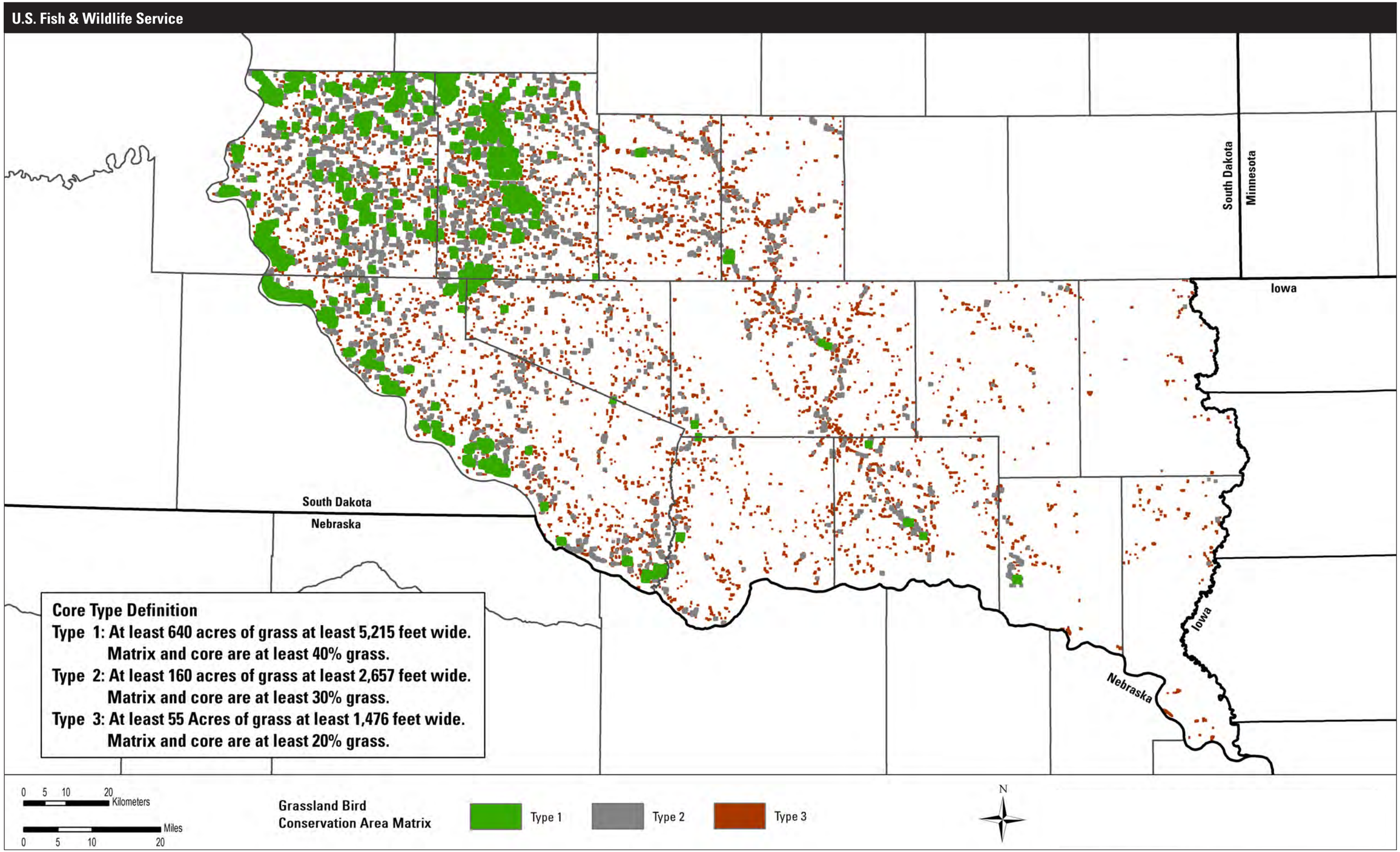

Figure 25. Grassland bird conservation area matrix. *Source: HAPET 2008.*

unless mammalian predation is reduced. According to Dixon and Hollevoet (2005) nest predator control will be most effective on areas with more than 60 duck pairs per square mile and from 20 to 40 percent grassland cover. Predator control will occur between March 15 and July 15.

4.7 Visitor Services Goal

Provide opportunities for high quality and compatible hunting, fishing, environmental education, environmental interpretation, photography, and wildlife observation for persons of all abilities and cultural backgrounds by fostering an understanding and appreciation of the importance and purposes of the Lake Andes National Wildlife Refuge Complex and the missions of the Service and the Refuge System.

VISITOR SERVICES OBJECTIVE 1: IMPROVE LAKE ACCESS ON LAKE ANDES NATIONAL WILDLIFE REFUGE

Within 5 years of plan approval, and with assistance of partners, refuge complex staff will design ice-resistant, functional boat ramps to provide access to the Center, South, and North Units of Lake Andes Refuge over a wide range of water depths to furnish adequate access for waterfowl hunting, fishing, management activities, and other compatible uses.

Strategies

- Pursue cooperative funding to cover the cost of engineering and construction.
- Use boat ramp designs that have performed well in northern climates with shallow water depths.
- Use partners such as CMCLRO and the SDGFP.
- Created parking areas as needed to accommodate increased lake usage.

Rationale

Two primitive boat ramps were constructed on the Center Unit of Lake Andes Refuge years ago. They were built using concrete planks. During winter, ice and wave action moved the planks and made the ramps inoperable.

To improve access to Lake Andes, boat ramps are needed that are not prone to ice damage and have sufficient length and slope to provide access at a wide range of water depths. Ramps will be developed on the North and South Units; these ramps will be used for fishing, hunting (Center Unit only), maintenance, and other compatible uses. The ramp on the North Unit will be restricted to Service use only.

VISITOR SERVICES OBJECTIVE 2: INVESTIGATE INCREASING HUNTING OPPORTUNITIES

Throughout the life of the CCP, refuge complex staff will maintain or enhance hunting opportunities on refuges and waterfowl production areas and continue to provide information about public opportunities for hunting in accordance with State and Federal regulations.

Strategies

- Work with the State and other partners to ascertain if any new types of hunting opportunities (for example, archery hunting, muzzleloader hunting, or hunting opportunities for youth and hunters with disabilities) can be provided in a compatible way where they are currently prohibited, specifically Karl E. Mundt Refuge and Lake Andes Refuge's North, South, and Owen's Bay Units.
- Determine criteria that are currently used by SDGFP and the Service to classify people as hunters with disabilities.
- If new types of hunting are prudent and compatible, modify the Lake Andes National Wildlife Refuge Hunting Plan and make changes to refuge-specific regulations (50 CFR) to accommodate new hunting opportunities.
- Determine if a biological need exists to control populations of resident species within areas currently closed to hunting.
- Participate in updating Waterfowl Production Area Mapper, a Service Web site that provides electronic information on locations and features of waterfowl production areas.
- Explore options to develop or improve infrastructure to support hunting opportunities.
- Explore opportunities for development of universally accessible facilities and locations for hunters with disabilities. Work with partners to help fund such facility development.
- Keep data current to allow the State to incorporate district information into the SDGFP hunting guide. Meet with SDGFP staff annually to discuss joint issues (for example, ensuring that printed hunting information is accurate).
- Pursue the addition of a park ranger to the refuge complex staff.
- Find refuge complex sites that are normally closed to public vehicle access and that can support, on a case-by-case basis, opportunities for people with disabilities to participate in compatible wildlife-dependent recreational opportunities.

Rationale

Hunting ring-necked pheasant, prairie grouse, waterfowl, other gamebirds, and deer on the refuge complex is very popular. The primary hunting seasons for

all species occur from October through December. A light goose conservation order hunting season provides hunters an opportunity to harvest snow geese during the spring migration.

Waterfowl production areas are open to hunting as authorized by 50 CFR, part 32.1. This provision states that waterfowl production areas shall be open to the hunting of migratory gamebirds, upland game, and big game subject to the provisions of State law and regulations.

Because the popularity of hunting on public lands is increasing, crowding is becoming an issue that affects the quality of the hunting experience. Crowds of hunters lead to unsafe hunting conditions and compromise harvest opportunities as game is dispersed.

Pressure for hunting is intensifying on Service lands. The number of nonresident hunters is increasing. In addition, the extent of private property off limits to hunting is increasing, while Conservation Reserve Program grassland acres on private lands are decreasing.

To ensure a high-quality hunting experience, it is essential to maintain healthy populations of resident wildlife and migratory birds through habitat management. There is a growing demand for hunting opportunities for hunters with disabilities (for example, wheelchair-bound hunters). Youth hunting already occurs in accordance with State regulations.

The recreational benefits of areas closed to hunting will be considered when determining whether or how to open new areas to hunting. The capability of the refuge complex law enforcement staff to patrol additional areas open to hunting and to manage special hunts will also be considered.

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A bench for wildlife observation on the refuge complex.

Visitor Services Objective 3: Investigate Increasing Fishing Opportunities

Within 5 years of CCP approval, refuge complex staff will work with the State and other partners to ascertain if additional compatible fishing opportunities can be provided on Lake Andes.

Strategies

- Draft a compatibility determination for fishing on the North Unit of Lake Andes.
- Work with and support the efforts of CMCLRO to restore a high quality fishery on the South Unit of Lake Andes.
- Continue to work with SDGFP and the Service's Fisheries Assistance Office to allow fish stocking on the South Unit of Lake Andes and on Scheffel and Schaefer Waterfowl Production Areas in Bon Homme County. Limit stocking to these waters due to the ephemeral nature of the refuge complex's wetlands and the competition for food between fish and waterfowl.
- If compatible, make changes to refuge-specific regulations (50 CFR) to open all of Lake Andes, including the North Unit, to fishing.

Rationale

During the 1920s, visitors came from miles around to fish in Lake Andes for black bass. The fishing was so good that numerous resorts were built on the shores of the lake, and tourism dominated the local economy. The drought of the 1930s dealt a heavy blow to tourism. Since this time, fishing has continued to be good during wet cycles but poor during dry cycles.

Many changes have been made to Lake Andes and its surrounding landscape since the 1920s. When the refuge was expanded to include Lake Andes in 1939, local supporters envisioned a refuge that would provide quality fishing, waterfowl hunting, and waterfowl conservation. Recognizing the differing needs of fish and waterfowl (for example, water depth) led many refuge managers to focus management on waterfowl only. More recently, managers and partners have come to appreciate that water quality, not quantity, is the limiting factor for both fish and waterfowl. Excessive nutrients and turbid water caused by carp feeding have limited the growth of wetland vegetation that is critical to invertebrate populations—the food of fish and waterfowl. Many people remember how good the fishing can be during wet cycles and are interested in improving it. Refuge complex staff recognize the cyclic nature of water depths in Lake Andes and want to provide habitat that is good for fish during wet cycles and good for waterfowl and other waterbirds during dry cycles.

VISITOR SERVICES OBJECTIVE 4: IMPROVE ENVIRONMENTAL EDUCATION AND INTERPRETATION BY HIRING AN OUTDOOR RECREATION PLANNER

If money becomes available, within 10 years of CCP approval, retain an outdoor recreation planner to expand and manage onsite and offsite environmental education and interpretation programs that support youth and nature Service programs, increase students' exposure and knowledge of the Refuge System, and reconnect children and adults with nature.

Strategies

- If necessary, share the outdoor recreation planner with SDGFP, The Nature Conservancy, or other conservation groups.
- Forge partnerships and all necessary contacts with local school districts and other educational institutions to facilitate school-based outdoor lab activities.
- Promote self-guided tours, led by educators, targeting onsite environmental education for school-age children.
- Develop an educator's guide to self-guided refuge tours, which provides a menu of options and lessons for site-specific environmental education tours. The educator's guide will be tailored to the needs of various class levels with varied levels of complexity, depending on the age level/class of the students.
- Continue to actively participate in the Fort Randall Birding Festival by facilitating bird watching tours at Karl E. Mundt Refuge and at the Owen's Bay Unit of Lake Andes Refuge, as well as exploring the possibility of opening other sites where festival participants can engage in wildlife observation and photography.
- Continue to actively participate in the Youth Outdoor Expo by providing staff to demonstrate outdoor activities such as shotgun skills, fishing, and turkey hunting.
- Create interpretive exhibits at Atkins Waterfowl Production Area and other sites within the refuge complex that emphasize ecological processes within natural plant and animal communities, refuge habitat management practices, and restoration of upland, wetland, and riparian habitats.
- Develop, print, and distribute refuge complex–specific brochures and Web-based materials (for example, species lists, visitor services facilities and regulations, and waterfowl production area regulations) to inform the public and increase awareness of the refuge complex and Refuge System's missions, as well as promote visitation to refuge complex lands.
- Promote greater understanding among diverse public groups of the refuge complex's refuges and waterfowl production areas, as well as the other units, and their values, uses, management, and vital roles in the Refuge System mission.
- Communicate key issues to offsite audiences through radio, television, newspapers, and the Internet.
- Maintain a current and dynamic Web page for the refuge complex.
- Remodel the refuge complex headquarters to provide a visitor center and classroom.

Rationale

The Service made connecting people with nature one of its highest priorities in 2007. Working to connect people to nature, the Service also strives to help the public understand that they have a role in natural resource conservation. The Service recognizes that its commitment to connecting people to nature is critical to the future of both the agency and to the conservation legacy of the Nation's fish and wildlife resources. The initial focus for the Service's work in this area is to connect children with nature. Environmental education is one of several ways the Service commits to public service and the future. The importance of environmental education in the Refuge System is further underscored by the fact that it is one of the six priority wildlife-dependent recreational activities supported by the Refuge System Improvement Act of 1997.

The Service's definition of environmental education for the Refuge System is as follows: a process designed to teach citizens and visitors the history and importance of conservation and the biological and the scientific knowledge of our Nation's natural resources. Through this process, we can help develop a citizenry that has the awareness, knowledge, attitudes, skills, motivation, and commitment to work cooperatively toward the conservation of our Nation's environmental resources. Environmental education within the Refuge System incorporates onsite, offsite, and distance learning materials, activities, programs, and products that address the audience's course of study, unit purpose(s), physical attributes, ecosystem dynamics, conservation strategies, and the Refuge System mission (USFWS policy 605 FW 6).

The staff of the refuge complex is currently involved in two America's Great Outdoors projects, Dakota Grasslands and Missouri River String of Pearls. One of the overriding goals of America's Great Outdoors is to reconnect people with nature, especially on working landscapes when humans live sustainably with nature.

Expansion of environmental education and interpretation will provide a benefit for visitors, foster understanding of and support for refuge complex management, and help reconnect people with nature.

VISITOR SERVICES OBJECTIVE 5: COMMERCIAL BAIT HARVESTING

Within 5 years of CCP approval, the wildlife refuge manager will determine the compatibility of commercial bait harvesting with trust wildlife species conservation, and act appropriately to safeguard trust resources.

Strategies

- Develop a compatibility determination for commercial bait harvesting.
- Prevent commercial bait harvesting (or stocking of bait fish) on Service-managed wetlands that do not currently support a fishery, due to competition for food between fathead minnows and waterfowl. Scheffel Waterfowl Production Area, Schaeffer Waterfowl Production Area, and Lake Andes are the only waters that currently support a fishery.
- If bait harvesting is deemed incompatible, identify and phase out existing operations.

Rationale

Commercial bait harvesting occurs on Lake Andes where the Service's jurisdiction had been in question until recently. Lake Andes has long been a part of the Refuge System, primarily through an easement from the State of South Dakota. It was recently determined that the Administration Act applied to this easement. This Federal law provides authority and guidelines relevant to secondary uses such as commercial bait harvesting on refuges. On Lake Andes, secondary uses must be compatible with the purpose of the refuge, which is migratory bird conservation. In addition, commercial uses must be a benefit to the purpose of the refuge.

According to Bouffard and Hanson (1997) waterfowl marshes traditionally have been managed for both waterbirds and fish based on the assumption that fish, except carp, are compatible with waterfowl (Johnson 1964, Poff 1985). Their review of the scientific literature indicated that this assumption is often incorrect. Armstrong and Leafloor (1990) studied fish–waterfowl interactions in the Plains and Prairie Pothole Region and recommended keeping fish out of wetlands that are managed for waterfowl such as waterfowl production areas.

Semipermanent wetlands throughout the upper-midwestern United States are commonly used as commercial rearing ponds for bait fish, including fathead minnows (Carlson and Berry 1990; Dobie 1956, 1972; Peterson and Hennagir 1980; Van Eeckout 1976). Fathead minnows have potential to use a large proportion of a wetland invertebrate food resources because they (1) are present and feed year round, (2) forage in the entire water column, and (3) consume invertebrates throughout their life cycle (Held and Peterka 1974, Price et al. 1991).

Commercial bait harvesting typically involves the sustainable removal of fathead minnows from wetlands. Hanson and Riggs (1995) evaluated the effects of fathead minnows on wetland invertebrates. Indices of aquatic invertebrate abundance, biomass, and taxon richness were all lower in wetlands containing fathead minnows. At high densities fathead minnows reduced the suitability of wetlands as seasonal foraging areas for waterfowl. Competition for macroinvertebrates between fish and waterfowl influences habitat selection by female ducks and may be a major determinant of duckling feeding efficiency and growth rates on some waters in Canada and Scandinavia (DesGranges and Rodrigue 1986; Eadie and Keast 1982; Eriksson 1979, 1983; Perhsson 1984, 1991). Fish are often major determinants of aquatic invertebrate abundance and community structure.

VISITOR SERVICES OBJECTIVE 6: IMPROVE OPPORTUNITIES FOR WILDLIFE OBSERVATION AND PHOTOGRAPHY

Within 3 years of CCP approval, refuge complex staff will assess the compatibility of opening limited portions of areas currently closed to public entry on Karl E. Mundt Refuge and Lake Andes Refuge for wildlife observation and photography.

Strategies

- Draft a simple plan that outlines access geographically and temporally to ensure compatibility.
- Complete a compatibility determination for this new use.
- Investigate the possibility of providing a self-guided nature trail on Karl E. Mundt Refuge.
- Use the strategies for accessibility found in Visitor Services Objective 7.

Rationale

Some areas that are currently closed to public entry offer excellent opportunities for wildlife observation and photography. The Karl E. Mundt Refuge has not been opened to public entry since its establishment in 1974. This was intended to minimize disturbance to bald eagles that wintered and nested on the refuge. Since that time, the bald eagle population has recovered and the species was removed from the list of threatened and endangered species.

Woodland habitat on the refuge provides migration and nesting habitat for a variety of migratory bird species that are not commonly seen outside of woodlands. Such areas are prized by birdwatchers. With bald eagle populations secure, now may be the time to allow limited public entry on the refuge. Entry could still be prohibited in sensitive areas and during sensitive seasons, such as near eagle nests when they are nesting. Access will be by foot. A trailhead parking lot and a foot trail will have to be developed to provide

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A footpath on the refuge complex.

access to the North Unit of the refuge. The South Unit is surrounded by private land with the exception of its shared boundary with the Missouri River and due to difficult access will remain closed to public entry.

Visitor Services Objective 7: Improve Accessibility for Wildlife Observation and Photography

When supplemental money becomes available, refuge complex staff will improve accessibility of selected portions of existing foot trails (the Prairie Ponds within the Owens Bay Unit of Lake Andes Refuge and Atkins Waterfowl Production Area) by paving the surface, to allow access for people with disabilities and improve their wildlife observation and photography opportunities. The refuge complex staff will also develop accessible observation and photography blinds and towers.

Strategies

- Seek funding through the Education and Visitor Services Branch of the Service's Region 6 Refuges Program.
- Provide wildlife observation and photography blinds in strategic sites on refuges and waterfowl production areas including some that are accessible to people of all abilities. Allow the compatible use of personal portable blinds.
- Construct, place, and manage blinds using guidelines provided in the "Welcoming Photographers to National Wildlife Refuges Handbook."
- Construct blinds that are semipermanent so they can be moved with heavy equipment as habitat conditions change.
- Notify the public of blind locations and proper use upon construction and placement.
- Construct observation towers and platforms on strategic sites, some of which are accessible to people of all abilities.

Rationale

Most people have some form of disability during their life, whether it is permanent or temporary. Providing access for people with disabilities is not only the right thing to do, it is also the law. Generally speaking facilities and recreational activities need to be accessible for people of all abilities. If a foot trail is provided, then a portion of that foot trail or another one nearby must be accessible.

Blinds and observation towers and platforms in strategic locations facilitate up-close views of wildlife for photography or observation. When properly placed and used such facilities limit disturbance of wildlife.

4.8 Operations Goal

Provide money, staff, infrastructure, protection of cultural resources, partnerships, and a safe working environment to achieve the purposes and objectives of the Lake Andes National Wildlife Refuge Complex.

Operations Objective 1: Expand Staff and Infrastructure

Throughout the life of this plan and as additional funding allows, the project leader will prioritize and fill the positions identified in the Refuge Operation Needs System to fulfill the visions, goals, and objectives of this plan (see appendix I for a complete staff list). Infrastructure will be expanded as needed to accommodate additional staff.

Strategies

- Review the priorities for positions listed in the Refuge Operation Needs System periodically and reprioritize as necessary.
- When funding allows, remodel and expand the headquarters building to provide a visitor center and to accommodate additional staff.
- When funding allows, remodel and expand the maintenance shop to correct deficiencies and accommodate additional staff and equipment.
- Acquire additional small and heavy equipment and replace existing worn-out equipment.
- Pursue the addition of the following positions to the refuge complex staff: one deputy wildlife refuge manager, one outdoor recreation planner, one park ranger, one biological technician, and one prescribed fire technician; additionally, pursue the conversion of one career seasonal maintenance worker position to a full-time position.

Rationale

An expansion of staff and infrastructure is necessary to achieve the visions, goals, and objectives of this plan. Additional conservation work is directly dependent on additional money. Expansion of the maintenance shop will improve the condition of infrastructure throughout

the refuge complex, and employees will work in a safer and healthier environment. Additional equipment will enhance the efficiency of refuge complex operations.

New or replacement equipment and facilities needed for the implementation of this CCP in the next 15 years includes two 150 horsepower (or larger) tractors, a skid-steer loader, a tracked excavator, an articulating loader, a small bulldozer, 4x4 vehicles (one every other year), two herbicide sprayers, a semitractor with lowboy trailer, a roller packer, a native grass drill, an amphibious Argo vehicle, off-road vehicles (one every other year), a boat herbicide sprayer, a pull-behind scraper (also known as a soil scraper), an equipment storage shed, a fence post pounder, and two Trimble GPS units (and associated software and equipment).

Operations Objective 2: Build a Prairie Reconstruction Facility

Throughout the life of this CCP and as additional funding allows, a prairie reconstruction facility will be built to process, clean, dry, and store native grass and forb seeds and related equipment.

Strategies

- Seek partnerships, grants, and other opportunities for supplementary money to accomplish this objective.

Rationale

Prairie reconstruction is a major part of this CCP. Space to process, clean, dry, and store native grass and forb seeds is not available. Additional facilities and equipment are needed to efficiently implement prairie reconstruction on the refuge complex. Using local genotypes requires harvesting, processing, and storing seed. Purchasing seed for reconstruction is very costly. Harvesting and replanting seed is more cost-effective.

Equipment needed and that will be stored here includes a seed stripper, combine, hammer mill, seed dryer, seed cleaner, seed separator, and other general use equipment.

Operations Objective 3: Replace Artesian Well

As soon as additional funding allows, refuge complex staff will replace the existing artesian well on Owen's Bay to provide water for the Prairie Ponds and Owen's Bay and the wildlife and plant species dependent on it.

Strategies

- Seek partnerships, grants, and other opportunities for supplemental money to accomplish this objective.

Rationale

The Prairie Ponds are a series of small ponds that were created for wildlife observation, environmental education, and interpretation near refuge complex headquarters. An artesian well provides the only water source for these ponds. Flow from the well has been steadily decreasing since it was drilled in 1985. Currently, flow from the well is barely adequate to provide the water needed to make habitat conditions attractive to migratory birds in the ponds. Replacement of the well is expensive (approximately $150,000 to $250,000) and will be dependent on supplemental money.

Operations Objective 4: Protect Cultural Resources

For the duration of the CCP, significant cultural resources will be preserved and protected within refuge complex lands.

Strategies

- Adhere to all Federal laws associated with cultural resources.
- Consult a Service archeologist before any landscape management disturbance or activity occurs that might affect structures older than 50 years or disturb the soil surface. These activities must undergo a Section 106 review under the National Historic Preservation Act.
- Consult a Service archeologist on appropriate site mapping, data storage, site preservation, and protocols to follow regarding newly discovered sites.
- Consult a Service archeologist on cultural resource research and study requests.
- Avoid areas of known cultural resources (and potentially sensitive areas when practical) during management actions. While cultural resources information should not be readily available to the public, refuge complex staff and law enforcement officers should know the locations of sensitive resources so they can be managed and protected.
- Continue to coordinate National Historic Preservation Act Section 110 Cultural Resource Inventories on refuge complex lands.
- Avoid or conduct noninvasive (archival or oral history) investigations of cultural sites such as historic graves.
- Whenever possible, document interviews with local people and long-term refuge complex staff.
- Protect structures that are eligible for the National Register of Historic Places.
- Educate staff on cultural resource issues and the importance of National Historic Preservation Act compliance, because staff awareness is vital to preservation and protection of resources.
- Conduct post-burn cultural resources inventories on the refuge complex's fee-title lands.
- Consult with Service archeologists whenever old buildings are planned for removal, or ground-disturbing

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Staff and infrastructure will be expanded.

activities are planned. If after consultation and clearance cultural resources are found anyway, cease construction immediately and contact Service archeologists. Assist Service archeologists with documentation of cultural resources as needed.

- Consult tribal archeologists to identify and avoid sensitive cultural resource areas.

Rationale

Cultural resources include archaeological sites (prehistoric and historic and their associated documentation), buildings and structures, landscapes, objects, and historic documents. These assets form tangible links with the past. The refuge complex is responsible for protecting and managing these irreplaceable resources for future generations.

The Service established a cultural resources management program to manage the rich collection of cultural resources under its jurisdiction. Some of the primary goals related to refuge management include the (1) identifying, evaluating, and encouraging preservation of cultural resources and (2) consulting a broad array of interested parties.

Operations Objective 5: Expand Partnerships—Seek Additional Partners

Throughout the life of this plan, refuge complex staff will seek to expand existing partnerships and develop new ones to enhance wildlife conservation and wildlife-dependent recreation on the refuge complex.

Strategies

- Contact nongovernmental organizations and other potential partners that could facilitate the implementation of this CCP (for example, Pheasants Forever and Ducks Unlimited).

Rationale

Many of the objectives in this CCP require additional money for implementation. Conservation partners can sometimes provide supplemental money to accomplish a project that is of mutual interest to the partner and the Service.

Operations Objective 6: Expand Partnerships—Develop a Friends Group

Within 10 years of plan approval, the refuge complex's project leader will seek to establish a friends group to support and advocate for the refuge complex's programs and needs.

Strategies

- Contact conservation groups and conservation-minded individuals in or near the refuge complex's 14-county area and determine their interest, willingness, and capability to advocate for the refuge complex.

Rationale

Field stations often must compete for additional staff and money. At times friends groups can advocate for a field station when the station itself cannot. Such groups can be a significant benefit to a field station's wildlife conservation and wildlife-dependent recreation programs.

Operations Objective 7: Law Enforcement—Easements

Throughout the life of the CCP, protect all wetland and grassland areas under perpetual easement through active monitoring and law enforcement in accordance with the provisions of the conservation easement contracts.

Strategies

- Based on existing law enforcement needs for the refuge complex, add a full-time Federal wildlife officer (GL–1801) to the refuge complex staff. This will prevent protected wetlands and grasslands from being lost through violations as a result of insufficient law enforcement staff.
- Following the guidelines contained in the "Easement Manual" for enforcement procedures, conduct annual surveillance flights to detect potential conservation easement violations and promptly follow up with needed enforcement action.
- If staff and money are available, annually send letters to new landowners informing them of existing conservation easements on their property, including associated easement provisions.
- Proactively map pre-1976 wetland easements and provide maps to landowners along with a copy of the easement contract containing provisions.
- Work with HAPET to provide each county USDA office within the wetland management district a map of Service interests showing waterfowl production areas and easements. USDA staff use maps to identify Service easements before granting any

wetland drainage or grassland alteration requests. Update maps as needed.

- If staff and money are available, conduct aerial flights to obtain digital photography of all wetland and grassland easements.
- Seek assistance from HAPET for spatial data requests on the locations of Service interests in the pre-planning of wind generator farms, fuel pipelines, overhead distribution power lines, or other large-scale commercial developments.

Rationale

When the Small Wetlands Acquisition Program was initiated more than 50 years ago, the Service believed that conservation easements would require little to no maintenance or enforcement efforts. However, it soon became evident that to protect the government's interest in these easements, a systematic approach was necessary for easement administration and enforcement. "Swampbuster" provisions of the Farm Bill (which prohibit conversion of wetlands for the production of commodity crops by Farm Bill participants) notwithstanding, pressures to drain and fill wetlands have continued to intensify. As farm implements such as drills, sprayers, and tractors become larger, landowners increasingly view small isolated wetlands as nuisance spots because they are tired of working around them. Other Farm Bill programs can also unintentionally increase pressure to violate wetland easement provisions. One such USDA program, Prevented Planting, provides compensation to a landowner for acres that cannot be seeded to a crop. To qualify for payment, the operator must only make an attempt to farm the acres (oftentimes, these are wetland acres). Simply plowing the ground once in the fall, when wetlands are naturally dry, can constitute an attempt. To facilitate plowing, landowners often burn off the wetland vegetation. It is common for these burns to occur on conservation easement–protected wetlands without the required permit from the administering district, which is a violation of the easement provisions.

In the absence of active and effective enforcement, the Service's conservation easement interests could be lost forever, in contrast to resources that the government owns outright. A 15-year hiatus in enforcement action would likely result in irreparable harm to the Service's easement interests and permanent loss of habitat.

Because most grassland easements protect native prairie, the major enforcement concern is cultivation. While violations involving the conversion of native prairie to cropland are extremely rare, full restoration is arguably impossible (although restoration of grassland is possible to regain compliance with grassland easement provisions, which do not specify native prairie). Accordingly, enforcement is essential to the protection of these habitats. Haying, mowing, or harvesting seed before July 15, in violation of the conservation easement provision, could cause direct losses of grassland-nesting birds, including waterfowl. Haying is not common on native prairie, but it is more likely to occur on tamegrass grasslands. Enforcing early hay violations affords another opportunity to meet and visit with landowners and operators. These contacts may serve to remind landowners and operators of the conservation easement provisions and hopefully prevent more serious violations in the future. Like any law enforcement action, the ultimate goal is voluntary compliance.

Operations Objective 8: Law Enforcement—Public Uses

Throughout the life of the CCP, the refuge complex will protect natural and cultural resources pursuant to all relevant laws, Executive Orders, regulations, and policies. The refuge complex will provide law enforcement for all public uses on Service lands.

Strategies

- Provide adequate law enforcement coverage for all hunting, fishing, and trapping seasons to ensure compliance with laws and regulations while providing for public safety and welfare.
- Develop extensive methods for signage to facilitate information transfer, and to address communication needs through the use of kiosks, public use leaflets, and tear sheets explaining regulations and prohibited activities.
- Develop, coordinate, and maintain working relationships with State and local law enforcement authorities and fire departments to protect refuge complex properties and Federal trust species.
- Continue to coordinate with SDGFP conservation officers and Yankton Sioux tribal game wardens to conduct law enforcement patrols and ensure compliance with regulations.

Rationale

Law enforcement is necessary to ensure protection and compliance with laws and regulations. Sharing resources and information with other officers increases the effectiveness of the law enforcement program.

Operations Objective 9: Manage Wildland Fires

Throughout the life of the CCP, provide adequate collaboration and teamwork between the fire program and refuge program to ensure that the objectives of Department of the Interior fire policies and other Federal policies are met and that prescribed fire remains a viable tool for habitat management.

Strategies

- Safely suppress all wildfires within the refuge complex.
- Maintain fire qualifications for all capable refuge complex staff.
- Utilize Burned Area Emergency Response and Burned Area Rehabilitation funding as needed.
- Update the fire district fire management plan as needed to accommodate this CCP.
- Make treatment of refuge complex lands near the wildland-urban interface high priorities for reduction of hazardous fuels.

Rationale

Having long recognized fire as a key process that shapes wildlife habitat structure and function, the Service has managed and used fire extensively for the past 70 years. Guiding principles of fire management in the Service include responsible stewardship, hazardous fuel reduction, wildland–urban interface management, and habitat management strategies based on conserving ecological integrity, meeting the objectives of the "National Fire Plan," and establishing effective partnerships.

The emphasis of the Service's fire management program has shifted from one of suppression to the use of prescribed fire and wildfire as management tools to achieve national fire policy objectives, habitat objectives, and landscape-level change.

Fuel treatments need to be properly planned using an interagency and interdisciplinary approach when possible and practical, using an integrated approach across different programmatic areas.

The "2010 U.S. Fish and Wildlife Service Fire Management Handbook" established a statement of intent: "Fuels treatments should properly be planned on an interdisciplinary basis and be integrated as much as practicable with other resource management activities, and serve to implement the appropriate Comprehensive Conservation Plan. With the guidance from the Service Fire Management Handbook, fire management staff will strive to work closely with all other staff in the district to plan prescribed fire activities in a way that will reduce the risk of wildfires and also have positive results in the area of habitat management."