4 Management Direction

Prairie Dog
Bob Savannah/USFWS

4 Management Direction

The management direction in this chapter meets the purposes, vision, and goals of the refuge complex. Objectives and strategies to carry out the goals will provide for ecosystem and resource needs and public use.

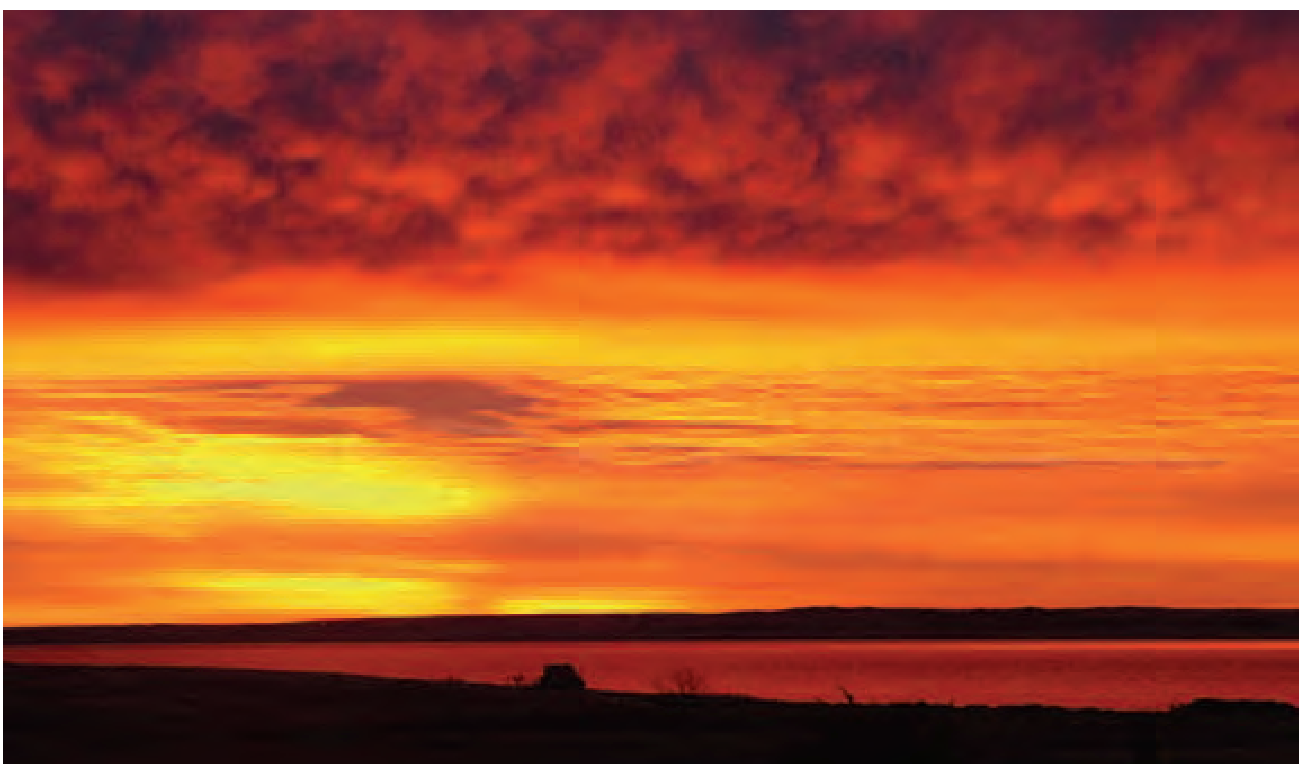
- A goal is a descriptive, broad statement of desired future conditions that conveys a purpose, but does not define measurable units.
- An objective is a concise statement of what is to be achieved; how much is to be achieved; when and where it is to be achieved; and who is responsible for achieving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

Development of refuge complex goals and objectives involved multiple sources of information:

- a review and interpretation of national plans
- a review of existing scientific literature
- an evaluation of habitat conditions
- the personal knowledge of planning team participants

MANAGEMENT SUMMARY

Wetland and upland habitats will be intensively managed, where warranted, throughout the refuge complex. Management objectives for various habitat types are based on habitat preferences of groups of target (indicator) species, which consist of members of various wildlife taxonomic groups (e.g., shorebirds, raptors, waterfowl, wading birds). Management objectives for a particular habitat type (e.g., native prairie) are, therefore, based on a compromised universal benefit concerning particular needs of multiple wildlife groups on an individual tract of land. Wetland and grassland habitats will also continue to be acquired through purchase of



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A Long Lake NWR sunset.

wetland and grassland easements, as well as fee lands.

Additionally, public use and environmental education and interpretation opportunities will be maximized to the extent compatible with other objectives. Expansion of the refuge complex's research and monitoring, staffing, operations, and infrastructure will likely be required to achieve this alternative's goals and objectives. Partnership opportunities will be maximized and will vary widely.

GOALS, OBJECTIVES, STRATEGIES, AND RATIONALE

The goals, objectives, strategies, and rationale listed below describe how management of Service lands will be carried out to meet the overall goals for the refuge complex.

Wildlife and Habitat Management Goal

Conserve, restore, and enhance the ecological diversity of the mixed-grass prairie ecosystem (including wetlands, grasslands, and native trees and shrubs) for migratory birds, with an emphasis on waterfowl and other grassland- and wetland-dependent species.

Developed Wetlands Sub-Goal (Long Lake Units I, II, and III):

Manage water to minimize the frequency, duration, and intensity of botulism outbreaks, while still providing a mosaic of habitats (e.g., open water, exposed shoreline, emergent vegetation patches) for wetland-dependent birds.

Background

Meeting the first developed wetlands sub-goal will require the refuge complex staff to manage water levels in a timely and appropriate manner and to address a variety of critical information needs.

Ideally, Long Lake will function as a self-sustaining system, (prone to only periodic botulism outbreaks) that affords a mosaic of wetland habitat types to a wide variety of wetland-dependent birds (e.g., waterfowl, shorebirds, wading birds) to satisfy the needs of nesting, molting, and migrant individuals, as well as waterfowl broods and other fledgling waterbirds.

For the developed wetland habitat type, the refuge complex has selected 10 bird species to serve as "target" or "indicator" species, which as a group reflect the quality wetland habitat on Service lands within the refuge complex. These species are the American avocet, American bittern, Baird's sandpiper, Franklin's gull, mallard, piping plover, redhead, sandhill crane, western grebe, and Wilson's phalarope. They were selected for a variety of reasons (see table 5), including that:

- eight species regularly nest on lands in the refuge complex;
- two species use lands in the refuge complex to a great extent as migratory staging and stopover areas;
- two species are endemic to the Great Plains (Mengel 1970);
- one species is federally threatened;
- six are North Dakota Species of Conservation Priority (Hagen et al. 2005);
- two species are Birds of Conservation Concern (Service 2002);
- four species are Service Focal Species (Service 2005a);
- two are species of high concern under the Northern Prairie and Parkland Waterbird Conservation Plan (Beyersbergen et al. 2004), and;
- three are species of concern under the United States Shorebird Conservation Plan (Skagen and Thompson 2003).

Developed wetland habitat objectives are geared toward the provision of quality habitats for these species. In addition to the target species, developed wetland habitats found on Service lands within the refuge complex should benefit a much broader group of "secondary" bird species (appendix L), as well as a variety of other nonavian wildlife.

Because structural and floristic habitat preferences (e.g., deep marsh, emergent vegetation, submergent aquatic vegetation, mudflat annuals) of both the target and secondary species vary widely, it is assumed that the needs of all species will not be met on a single wetland, or even a single tract of Service land (e.g., WPA), but rather the needs of the target and secondary species groups will be met by providing a diversity of vegetative structures across multiple tracts of Service land in the refuge complex. Because the numerous waterbird species that use lands in the refuge complex require varied habitat conditions, it is imperative that the integrity of wetlands of various regimes (e.g., temporary, semipermanent) is protected. This will ensure the presence of wetland complexes that are capable of

Table 5. Target species and their associated conservation plan listings

Species	*North American. Landbird Conservation Plan*	*Endangered Species List (Service)*	*North Dakota. Species of Conservation Priority*	*U.S. Shorebird Conservation Plan*	*Focal Species (Service)*	*Northern Prairie and Parkland Conservation Plan*	*Birds of Conservation Concern (BCR)*[1]
American avocet	—	—	Level 2	Species of concern (breeding and migrating)	—	—	—
American bittern	—	—	Level 1	—	—	High concern	BCR 11
Baird's sandpiper	—	—	—	—	—	—	—
Black-crowned night-heron	—	—	—	—	—	—	—
Black tern	—	—	Level 1	—	X	High concern	—
Bobolink	—	—	Level 2	—	X	—	Region 6
Chestnut-collared longspur	Stewardship species of regional and continental importance	—	Level 1	—	X	—	BCR 11, Region 6, national
Eared grebe	—	—	—	—	—	Moderate concern	—
Franklin's gull	—	—	Level 1	—	—	High concern	—
Grasshopper sparrow	—	—	Level 1	—	X	—	—
Mallard	—	—	—	—	X	—	—
Marbled godwit	—	—	Level 1	Species of concern (breeding and migrating)	X	—	BCR 11, Region 6, national
Northern harrier	—	—	Level 2	—	—	—	BCR 11, Region 6, national
Piping plover	—	Threatened	Level 2	Species of concern (breeding and migrating)	X	—	—

Species	*North American. Landbird Conser-vation Plan*	*Endangered Species List (Service)*	*North Dakota. Species of Conser-vation Priority*	*U.S. Shorebird Conser-vation Plan*	*Focal Species (Service)*	*Northern Prairie and Parkland Conser-vation Plan*	*Birds of Conser-vation Concern (BCR)[1]*
Redhead	—	—	Level 2	—	—	—	—
Sandhill crane	—	—	—	—	X	—	—
Sedge wren	—	—	Level 2	—	X	—	National
Sharp-tailed grouse	Stewardship species of regional and continental importance	—	Level 2	—	—	—	—
Upland sand-piper	—	—	Level 1	Species of concern (breeding and migrating)	X	—	BCR 11, Region 6, national
Western grebe						High concern	
Western meadow-lark	—	—	—	—	—	—	—
Wilson=s phalarope	—	—	Level 1	Species of concern (breeding and migrating)	X	—	BCR 11, Region 6, national

supporting varied habitats and meeting various waterbird life needs (e.g., vegetated, semipermanent wetlands for brood rearing).

Objective 1: Over the next 15 years, contact all individuals who own land within Long Lake NWR's acquisition boundary to gauge their interest in selling these lands to the Service.

Rationale 1:

Due to the artificially elevated pool level of Long Lake and the proposed water-management strategy, water unit III may at times surpass the refuge's present boundary and flood adjacent private land. This private-land flooding has occurred periodically since construction of the three earthen dikes in the 1930s. The majority of the private land that the Service periodically floods is within the refuge's acquisition boundary; therefore, the opportunity exists to purchase these lands in fee, so that they may become part of Long Lake NWR.

Strategy 1:

Project leader makes either personal or written contact (e.g., for nonresident landowners) with all applicable landowners to gauge their interest in selling their lands.

Objective 2: Over a 15-year period, predict and manage the annual water level in Long Lake unit III to be either full (1,715 feet above MSL) or, conversely, dry during the summer and fall. Re-evaluate Long Lake's water management strategy, based on acquisition of relevant scientific data at 5-year intervals.

Rationale 2:

Long Lake has a long and varied history of botulism. The lake's disease history played a major role in the decision to establish Long Lake NWR in 1932. Botulism mortality estimates were not kept for Long Lake prior to establishment of the refuge, but mortality estimates from 1941–1943 indicated that between 84,500 and 201,000 birds (primarily ducks, gulls, and shorebirds) perished in each of those years. The purpose of the three large, earthen dikes, which were constructed on Long Lake in the 1930s, was to improve water management flexibility and more specifically, separate Long Lake into units to prevent botulism outbreaks (Service 1988). From 1944 to 1959, the water management strategy was to fill unit I to 1,716.0 feet above MSL, unit II to 1,715.5 feet above MSL, and unit III to 1,715 feet above MSL. This strategy was deemed effective for units I and II, but unit III could not be reliably stabilized and frequently went dry.

Over the next 28-year period (1960–1987), the water management strategy remained unchanged for units I and II, but unit III was maintained as a dry basin, whenever possible. Because natural climatic cycles (i.e., periods of drought and deluge) annually influenced water level fluctuations to varying extents, it was determined that the water management capability of Long Lake was insufficient to support this strategy, despite the fact that unit III was dry during 9 of those years.

Presently, the Service bases annual water management actions on spring water elevations; if water levels exceed a certain threshold, unit III is flooded to the greatest extent possible; otherwise unit III is kept as dry as possible. The latter action restricts flows (i.e., spring runoff) to units I and II and, therefore, increases the likelihood that the water level in unit I will be sufficient to exceed the artificial sill and provide water to WPAs downstream (e.g., Adams, YMCA, McKenzie, Victor).

In moderate to low runoff years, water is more beneficial to wetlands that the Service manages in the drainage west of Long Lake NWR than it is in unit III, where it could promote conditions for botulism outbreaks. Due to substantial summer rain events or other environmental factors, however, years will occur where although an attempt is made


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Habitat and wildlife studies are ongoing.

to dry unit III through evaporative processes, this unit may remain in a shallow water state for the duration of the summer and fall. This unit may, therefore, incur periodic botulism outbreaks.

Prior to 2001, facilities did not allow efficient transfer of water from unit II to unit III. The 5 x 5 foot gated box WCS in C dike limited the flow and demanded long duration transfer of water into unit III. In 2001, the limitations in water management were lessened with the installation of a five bay, 10 x 6 foot box culvert with a stoplog WCS. Timely and efficient water transfer from unit II to unit III is now possible.

These three water management strategies, although somewhat different from one another, all aim to achieve the same thing—either stable, high water levels, or a dry basin (i.e., unit III) that will not attract waterbirds. This thought process is based on a wealth of past research which suggests that botulism outbreaks are associated with shallow, stagnant, saline wetlands with low dissolved oxygen

Several recent studies (Rocke et al. 1999, Rocke and Samuel 1999, Barras and Kadlec 2000) have attempted to identify more accurately factors that promote botulism outbreaks. Their results have identified several factors associated with botulism outbreaks, including: 1) increased water temperature; 2) increased invertebrate abundance; 3) lower oxidation-reduction potential; 4) pH; 5) amount of organic matter in the sediment; 6) salinity above the water-sediment interface, and; 7) high precipitation and increased water flow. However, not all of these seven factors have to occur together for an outbreak to occur (or be prevented) in the refuge complex's wetlands, according to a study by Rocke et al. (1999) on Sacramento NWR. Rocke et al. (1999) did find that outbreak wetlands have significantly lower oxidation-reduction potential than nonoutbreak wetlands.

The success of the refuge complex's water management actions in reducing botulism is not easy to interpret. Prior to initiating water management on Long Lake in 1944, the total estimated avian deaths from botulism between 1937 and 1943 exceeded 375,000, but varied widely each of the 7 years. In contrast, the total estimated loss between 1944 and 2005 (62 years) was less than 83,000 birds (range = 0 in 27 years to 18,700; McEnroe 1986, Service 1988, Service unpublished data). These data suggest that the refuge complex's ability to control water levels provided it with some ability to reduce the frequency and extent of botulism outbreaks; however, because the aforementioned environmental factors are so varied, poorly understood, and complicated, it is difficult to directly link water management efforts to the extent of botulism on Long Lake.

Additionally, because both past botulism deaths and various environmental factors were not recorded annually on a per unit basis (i.e., units I, II, and III), any conclusions regarding the impact of the refuge complex's water management activities are speculative.

Because the understanding of factors that influence the likelihood of botulism outbreaks is presently fragmentary and insufficient, refuge complex staff intends to continue to apply the current water management strategy, with the understanding that if future research indicates that a change in water management would be beneficial with respect to botulism, management can be adaptive (Walters 1986). Additionally, botulism outbreaks will occur in some years, despite the best management efforts.

Strategy 2:

If the Service anticipates, in any given year, that on approximately May 1, a water level 1,715.5 feet above MSL can be attained in unit III, then water will be released (through removal of stop logs in a WCS) at C dike into unit III, until it fills to the greatest extent possible. Conversely, if an anticipated May 1 water level in unit III is 1,715.5 feet above MSL, flows will be held in units I and II in an effort to dewater (through evaporative processes) unit III and augment water levels in downstream WPAs.

Objective 3A: Over a 1-year period, quantify the imports and exports of water and associated chemical constituents (e.g., sodium, mercury, arsenic, boron) in the three existing Long Lake units, to establish baseline estimates. Also, over a 2-year period, determine an appropriate hydrologic and chemical sampling scheme (i.e., frequency, horizontal and vertical stratification, priority chemical constituents) for subsequent years of monitoring Long Lake, through analysis of 1 year of monitoring data.

Objective 3B: Over a 15-year period, study the relationship of various hydrologic events (e.g., dramatic increase or reduction in water level) and chemical constituent levels (e.g., boron, sodium) to Long Lake botulism outbreaks. In addition, study the relationship of the concentration of various chemical constituents with observed changes in wetland vegetation or aquatic invertebrate community composition. Finally, evaluate multiple years of monitoring data related to various abiotic components of Long Lake and use these data for the detection of any noteworthy trends.

Rationales 3A and 3B:

Understanding how water management actions have altered or will alter water chemistry is critical to ensure the long-term health and sustainability of the Long Lake ecosystem. The composition of plant and invertebrate communities supported in Long Lake is directly related to hydrology and water chemistry and, in turn affects waterfowl habitat. Of major concern in Long Lake is that current management of water levels maximizes retention of various nutrients (e.g., phosphorous, nitrogen) and elements (e.g., arsenic, boron). Moreover, salinity is likely to increase to levels higher than would occur under natural conditions. Such changes in water chemistry may result in significant shifts in plant and invertebrate communities. For example, salinity can directly inhibit germination and growth of plants (Swanson et al. 1988, Kantrud et al. 1989) and excessive additions of phosphorus can lead to extensive algal blooms that inhibit growth of some submergent aquatic plants (Robel 1961, Kullberg 1974, Swanson et al. 1988). High levels of salinity can also exacerbate boron toxicity in several plant species (Wimmer et al. 2003). Further, suppression of primary production often impacts secondary productivity. Salinity, for example, can negatively influence invertebrate composition directly by affecting physiology (Newcombe and MacDonald 1991, Euliss et al. 1999) or indirectly by affecting habitat structure and foods (Krull 1970, Wollheim and Lovvorn 1996).

Other examples include documented reports that high concentrations of suspended silt and clay are toxic to zooplankton (Newcombe and MacDonald 1991) and agrichemicals can cause significant mortality of aquatic invertebrates (Borthwick 1988). Overall productivity in both the short- and long-term could be negatively impacted because plant community structure and composition influences use by both invertebrates and vertebrates (e.g., birds;

Laubhan and Roelle 2001), whereas both plants and invertebrates play significant roles in nutrient cycling and are integral to components in the food chains of a wide variety of vertebrates (Murkin and Batt 1987).

An unintended outcome of Long Lake's present management strategy (discussed in objective 2) is that it maximizes the amount of water available for evaporation, which results in the accumulation of salts and other dissolved solids. Prior to its establishment as a refuge, Long Lake was subject to sporadic flows and dynamic water-level fluctuations, which influenced concentration of salts and lake water chemistry. During periods of drought, evaporative processes resulted in the accumulation of salts and during wet periods high flows resulted in the removal of salts from the basin. Consequently, installation of dikes and management of water levels in Long Lake have likely altered natural hydrologic conditions that once controlled the range of salt concentrations that occurred during the wet and dry periods that frequent the prairies. This situation has likely been exacerbated by the development of freshwater impoundments on Long Lake's side drainages (i.e., G-19, Bob Meeks Marsh, G-12, unit II marsh) which restrict freshwater flows into Long Lake.

Information is currently lacking to quantify the extent to which human influences have altered levels of nutrients (e.g., phosphorus, nitrogen) and other elements (e.g., mercury, boron, arsenic) on Long Lake. However, because management actions have increased water storage volumes up to 3 feet above the historical natural sill in three lake units (units I, II, and III), the overall potential for accumulation of various ions, elements, and other dissolved solids is increased.

Laubhan et al. (2006) suggest that water management activities on Long Lake have promoted the concentration and bioaccumulation of evaporates in these units. The effects of concentrating various chemical constituents (e.g., nitrogen, arsenic, mercury) on biotic communities are currently unknown; however, it is reasonable to assume that in the near future certain biological thresholds may be breached that will cause a cascading collapse of the wetland ecosystem.

Historically, only limited water-quality information has been collected from Long Lake. For example, in March 1989, Olson and Welsh (1991) documented elevated levels of boron and mercury, as well as high sodium concentrations. Also, data related to temporal changes in Long Lake's wetland vegetation community—and the significance of, and cause for, any changes—are also scarce. A 1917 plant survey of Long Lake indicated the presence of several species of bulrush, as well as many shallow marsh plants (e.g., prairie cordgrass) and submergent aquatic species (e.g., common bladderwort; Metcalf 1931). Conversely, during an April 2004 site visit to Long Lake NWR, Laubhan et al. (2006) noted that emergent and submergent vegetation along the perimeter of several Long Lake pools was minimal at the locations that were examined, suggesting that resources (e.g., food, cover), available for waterbirds, were at least temporarily reduced. However, an insufficient number of sites were visited to characterize adequately the current composition or extent of wetland vegetation. Further information is needed to make any inferences about the possible change in Long Lake's vegetative community that may be related to changes in the system's hydrology and water chemistry.

Based on the concept of ecological fit, one approach to future management will consist of initiating monitoring programs to track fundamental ecological factors (e.g., water quality) that influence factors higher in the trophic system (e.g., plant germination and growth). This information would provide the means to identify future issues sufficiently early to allow corrective management actions to be carried out when effectiveness is greatest and costs are reduced. Priority Long Lake NWR information needs identified by Laubhan et al. (2006) are tied to three interrelated issues: 1) hydrology; 2) nutrients and water chemistry, and; 3) soils and sediments.

The refuge complex's ultimate interest is to determine whether Long Lake's past and present management has altered the system in such a way that certain biological thresholds have been breached, or will be in the near future, if a change in management is not instituted.

Strategies 3A and 3B:

- Establish gauging stations at both appropriate inflow and outflow sites at Long Lake.
- Initiate a long-term water quality monitoring program in cooperation with the USGS.

Objective 4: Within 10 years of the completion of this CCP, establish a monitoring plan for aquatic macroinvertebrates, and both emergent and submergent aquatic vegetation on Long Lake that will allow for monitoring changes in species diversity of these various biota, at a minimum of 3-year intervals for vegetation and 5-year intervals for aquatic macroinvertebrates.

Rationale 4:
Since Metcalf's (1931) wetland vegetation survey of Long Lake in 1917, little systematic inventory and monitoring has been conducted regarding the lake's flora. The paucity of knowledge is even more striking concerning Long Lake's aquatic macroinvertebrate (hereafter, invertebrate) community.

The vegetative community of a wetland is one of the most significant driving-forces in the make-up of that wetland's other biotic components (e.g., invertebrates, birds). Wetland vegetation structure and floristic composition is important to nearly all waterbirds from the standpoint of nesting, brood rearing, foraging, and migration stopover habitat (Laubhan and Roelle 2001). The same vegetative factors influence invertebrate community composition (Voigts 1976). Managing for a diversity of wetland flora in a wetland community generally equates to a corresponding diversity of waterbirds. Decreased waterbird use generally equates to decreased heterogeneity of a wetland's floral community. Variability in a wetland's floral community is driven in part by the temporal influence of climate (Euliss et al. 2004), but may also be tied to alterations that affect fundamental processes (e.g., hydrology, water chemistry, sediment dynamics) and might alter system tolerance with respect to the germination and growth of certain wetland plant species (Laubhan et al. 2006).

Metcalf's (1931) survey indicated that abundant emergent plants in Long Lake included cosmopolitan bulrush, tule bulrush and three-square bulrush. The survey also reported common spikerush as being widespread, seaside arrowgrass, common bladderwort, and prairie cordgrass as fairly common, and softstem bulrush as rare. Additionally, past aerial photos of Long Lake indicate that dense stands of emergent vegetation, including many species mentioned in the 1917 survey, have been present in the not-too-distant past. Presently, Long Lake's three principal units (I, II, and III) are largely devoid of emergent vegetation, with only minimal amounts of bulrush and other species scattered along portions of exposed shoreline.

Unfortunately, it is unknown whether the general lack of vegetation is a result of multiple high-water years since 1993 (Euliss et al. 2004) or the fact that certain biological thresholds have been exceeded and now preclude the growth of certain wetland plant species. Examples of these possible thresholds include high salinity levels, which that can directly inhibit germination of plants (Swanson et al. 1988, Kantrud et al. 1989) or exacerbate boron toxicity in several plant species (Wimmer et al. 2003), as well as excessive phosphorus additions, which can indirectly inhibit growth of certain submergent plants through excessive algal blooms (Robel 1961, Kullberg 1974, Swanson et al. 1988). Laubhan et al. (2006) suggested that the acquisition of both emergent and submergent wetland plant data and subsequent periodic monitoring on Long Lake is a priority need that may help to illustrate negative consequences of past and present water management actions.

The importance of invertebrates is substantial for a number of avian taxa. Invertebrates are a key food resource for shorebirds (Laubhan and Roelle 2001), cranes, grebes, herons, rails, and ibis (Laubhan and Roelle 2001), as well as a number of duck species (Bartonek 1968, Bartonek 1972, Krapu and Swanson 1975, Swanson et al. 1979, Meyer and Swanson 1982, Swanson 1984). According to Skagen and Oman (1996), over 400 genera of invertebrate prey are consumed by 43 species of shorebirds in the western hemisphere alone. A diversity of invertebrates is a critical supporting factor of a wetland bird community, not only with respect to various bird taxa, but also concerning various foraging guilds (e.g., gleaner, prober) within a specific taxon (e.g., shorebirds). Differences in foraging technique, as well as bill length and body size allow birds to partition themselves and use different invertebrate species, in order to avoid overlap in habitat use (Recher 1966).

While it is understood that invertebrates, in addition to their obvious role in the feeding ecology of various waterbirds, provide critical food chain support for many other organisms and play a substantial role in overall wetland productivity and nutrient cycling (Murkin and Batt 1987), Rosenberg and Danks (1987) point out that invertebrates of freshwater wetlands are poorly studied and there is a paucity of existing information.

Invertebrates that inhabit prairie wetlands are well suited to cope with the highly dynamic and harsh environmental conditions of this region (Euliss et al. 1999). The invertebrate community of the PPR is comprised mostly of ecological generalists that possess the necessary adaptations to tolerate environmental extremes. Invertebrates are, however, sensitive to agrichemicals, which can accumulate in wetlands (Borthwick 1988, Grue et al. 1989) and there is a strong interest in their use as indicators of wetland and landscape condition in the PPR (Adamus 1996). Therefore, in addition to simply providing a better overall understanding of the invertebrate community through inventory and monitoring efforts, it is important to determine if critical thresholds are being exceeded.

Invertebrate sampling data could be tied to water-quality data to determine if salinity levels are affecting invertebrate composition directly via physiology (Newcombe and McDonald 1991, Euliss et al. 1999) or indirectly by affecting habitat structure and foods (Krull 1970, Wollheim and Lovvorn 1996).

The acquisition of initial baseline data and subsequent periodic monitoring will hopefully allow for an improved understanding of the invertebrates that Long Lake supports across space and time.

Strategy 4:

- Randomly sample various vegetative zones (i.e., wet meadow, shallow marsh, deep marsh, open water; Stewart and Kantrud 1971) along transects, using a 2.7-square-foot (0.25 m^2) plot frame (Daubenmire 1959). Measure percent cover of different plant species.
- Use vertically oriented funnel traps (Swanson 1978) and benthic corers (Swanson 1983) to randomly sample invertebrate abundance and biomass in all major vegetative zones.

Developed Wetlands Sub-Goal (Other Developed Wetlands in the Refuge Complex):
Provide quality nesting, brood rearing, and migratory stopover habitats for a diversity of wetland-dependent birds.

Background:
Unit II marsh is a wetland impoundment, approximately 800 acres in size. It was created by Ducks Unlimited in 1995 through the creation of a low, earthen dike and a WCS across a bay on Long Lake unit II. Water levels are generally less than 3 feet deep and the unit does go completely dry in some years.

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A waterfowl production area.

Generally, when at least 50 percent of the unit holds water, it is a magnet for a tremendous diversity of shorebirds, particularly in the month of May and again from July through September. It also provides quality sanctuary for numerous waterfowl broods and in many years harbors several mixed-species colonies of breeding waterbirds, including white-faced ibis, black-crowned night-herons, Franklin's gulls, cattle egrets, Forster's terns, eared grebes, and western grebes. In late summer and early fall this unit affords quality roosting habitat to thousands of migrant Canada geese, ducks, and sandhill cranes. Endangered whooping cranes also occasionally use this unit as a roost site.

Six other smaller, managed impoundments exist in the refuge complex. They are located at Long Lake NWR (units G-12, G-19, and G-19a), Slade NWR, Rath WPA, and Schiermeister WPA. These impoundments are generally managed to support breeding and migrating waterfowl and shorebirds. Their relatively shallow depths and periodic flooding and drying nature makes for highly productive systems, with respect to invertebrates and wetland vegetation. Corresponding bird use is generally quite diverse.

Meeting the second developed wetlands sub-goal will require that water-level management is carried out in a timely and appropriate manner by refuge complex staff. Ideally, Long Lake's unit II marsh and other impoundments on Long Lake NWR and other Service lands in the refuge complex, will afford a mosaic of wetland habitat types to a wide-variety of wetland-dependent birds (e.g., waterfowl, shorebirds, wading birds) to satisfy the needs of nesting, molting, and migrant waterbirds, as well as waterfowl broods and other fledgling waterbirds.

Objective 1A: Provide between 30–70 percent coverage of emergent vegetation on unit II marsh, on average, over 11 of 15 years.

Objective 1B: Provide a unit II marsh water depth between 12 inches and 32 inches on approximately May 1 and a water depth between 4 inches and 16 inches on approximately August 15, achievable in at least 8 of 15 years.

Rationales 1A and 1B:

Previous research has indicated that wetlands with an approximate 50:50 ratio of open water and emergent vegetation (i.e., cattails, bulrushes), often termed "hemi-marshes," attract the highest densities and diversities of wetland birds (Weller and Spatcher 1965). Wetland birds frequenting Long Lake NWR that find hemi-marsh conditions favorable include various waterfowl and shorebird species, herons, gulls, terns, blackbirds, grebes, and cranes. All 10 of the refuge complex's target species for developed wetlands regularly use unit II marsh at various times of the year when hemi-marsh conditions exist. The refuge complex staff anticipates being able to achieve open water to emergent vegetation ratios close to the 50:50 ratio (i.e., 30:70 ratio, 70:30 ratio) as recommended by Weller and Spatcher (1965), in most years (approximately 11 of 15), through targeted water-level management. Because of the dynamics involved with prairie-wetland conditions over time, in certain years the coverage of emergent vegetation may fall well outside of staff's target range (30–70 percent coverage). During years of extreme drought, cover of emergents may exceed the upper-end target of 70 percent, whereas during extremely wet periods, unit II marsh may revert to a more open water state, supporting far less than 30 percent coverage of emergent vegetation.

With respect to water depth, staff in the refuge complex will provide depths preferred by a variety of nesting colonial waterbirds, immediately prior to peak nest initiation (approximately May 1-10; Gregory Knutsen, Service, unpublished data), as well as water depths preferred by roosting sandhill cranes, immediately prior to their arrival in late summer (approximately August 15-30; Clark Talkington, Mandan, ND, unpublished data).

Various literature indicates that nest site water depth for colonial-nesting waterbirds that breed in the PPR is highly variable, ranging from dry to 51 inches (130 centimeters) for five different species (Laubhan et al. 2006). However, depths ranging from 12–32 inches (30–81 centimeters) capture both the mean and median depths for target species, such as the western grebe and Franklin's gull (Nuechterlien 1975, Berger and Gochfeld 1994), as well as a number of other colonial (i.e., black tern, eared grebe, black-crowned night-heron; McAllister 1958, Bryant 1983, Boe 1993, Laubhan et al. 2006) and noncolonial (i.e., pied-billed grebe; Laubhan et al. 2006) waterbirds and over-water nesting waterfowl (i.e., canvasback, redhead; Laubhan et al. 2006).

Many thousand sandhill cranes stage at Long Lake NWR each fall, using certain wetlands primarily for roosting and loafing habitat. Sandhill cranes generally prefer to roost in water depths that range from 4–6 inches (10–15 centimeters) (Kinzel et al. 2005). However, they will sometimes roost on dry land surrounded by water and conversely in water as deep as 24 inches (61 centimeters) (Kinzel 2005).

In some years evaporative processes will have reduced water levels below 8 inches by mid-August, in which case a late summer addition of water to unit II marsh will be needed, if possible. In other years, the late summer target depth range will be met passively, through evaporative attrition of water levels from the deeper late spring target depth range. Because staff in the refuge complex does not have the capability to move water out of unit II marsh, some years will occur when water depths will exceed the refuge complex's target depths (due to wet conditions). Even in years when water-depth targets are not achieved, due to topographic variation, certain areas of the marsh could likely meet habitat requirements. Conversely, during periods of substantial drought, unit II marsh will be dry and staff will not feasibly be able to add water to it from unit II, due to exceptionally low water levels in that unit and a heightened risk of botulism. Additionally, water level augmentation to achieve fall water-level requirements will help facilitate ideal water levels in the spring for colonial waterbird nest initiation.

The refuge complex staff acknowledges that unit II marsh has had periodic botulism outbreaks since its creation in 1995; however, because of its relatively small size (in comparison to Long Lake units I, II, and III), unique characteristics, and overall ability to attract a diversity of birds, the staff elects to manage this unit to its fullest potential regarding habitat for a wide variety nesting and migrant waterbirds. Appropriate actions will be taken on this unit if a botulism outbreak does occur.

Strategies 1A and 1B:

- Add water to unit II marsh, as needed, via either gravity flow through a WCS or by pumping it from Long Lake unit II.
- Estimate percent coverage of emergent vegetation through either visual estimation or GIS area determination using aerial photos taken annually in early July.
- Measure target water depths at target dates (e.g., May 1, August 15) using multiple staff gauges installed in unit II marsh.

Objective 2: Capture snowmelt runoff and spring rains to fill wetland basins to 70–90 percent capacity on approximately May 1, during 8 out of 10 years. During 2 of 10 years, allow spring flows to exit basins, resulting in basin wet area 25 percent capacity.

Rationale 2:

The sharp increase in invertebrate populations when wetlands reflood following a dry phase is an important reason for artificially flooding and draining wetlands to enhance waterfowl habitat (Cook and Powers 1958; Kadlec and Smith 1992), and it is the basis for the modern-day practice of moist-soil management (Fredrickson and Taylor 1982). Invertebrates are an essential food source for many species of wetland-dependent animals and play important roles in other wetland functions (e.g., nutrient cycling) and overall wetland productivity (Knutsen and Euliss 2001). The refuge complex's target shorebird species for the developed wetland habitat (i.e., American avocet, Baird's sandpiper, Wilson's phalarope, piping plover) all rely heavily on invertebrates during migration and nesting periods (Helmers 1992).

Preferred foraging depths of both the American avocet and Wilson's phalarope overlap (3–8 inches [8–20 centimeters]), as do those of the piping plover and Baird's sandpiper (0–2 inches [0–5 centimeters]; Helmers 1992). These managed basins should provide suitable foraging habitat for all four of these target shorebird species, as well as several secondary shorebird species, during years when they are filled to between 70–90 percent capacity. Additionally, invertebrates are critical to target waterfowl species (i.e., mallard, redhead) during the breeding season (Bartonek and Hickey 1969, Swanson et al. 1985) and to their young later in the summer. For mallards and several other duck species, diets during the first two weeks of life consist almost entirely of invertebrates (Chura 1961, Perret 1962, Sugden 1973). Breeding and postbreeding foraging microhabitats for redheads generally consist of wetlands <3.3 feet (1 meter) deep (Low 1945, Bergman 1973), whereas optimal foraging depths for mallards normally range from dry to <12 inches (30 centimeters) (Laubhan et al. 2006). Foraging preferences for both of these species, as well as several other duck species, should be met in these managed basins when they are filled to between 70–90 percent capacity.

In addition to invertebrates, plant community composition is effectively manipulated via growing season drawdowns. Plant species composition, structure, and seed production can all be influenced by drawdowns and more specifically, drawdown intervals (Fredrickson 1991). Refuge complex staff anticipates that, depending on the uncontrollable forces of nature (i.e., periods of drought and deluge), it will have only moderate control over timing and duration of soil exposure during years that target dewatering of these units. Therefore, the 2 years in which refuge complex staff will attempt to dewater these units will be based upon the perceived moisture conditions (presnowmelt). Those years with particularly little snowpack will lend themselves to dewatering these units, whereas years with considerable snowpack lend themselves to capturing water in the basin.

Drying out these units will be done to stimulate production of a number of wetland plant species; predominantly those characteristic of the shallow marsh zone of prairie wetlands (e.g., sedges, smartweeds, sloughgrass, beggarticks, spikerush; Stewart and Kantrud 1971) which are often referred to as "moist soil" plants.

Plant species respond differently to exposed soil at different times of the growing season (Laubhan and Roelle 2001) and due to staff's limited control on certain managed basins, exposed soil could exist throughout the entire growing season or only at limited, but varied portions of the growing season. Plant response will likely fluctuate among years and basins, providing varied vegetation communities at different areas within the refuge complex. Griffith (1948) documented value in providing moist-soil plant species, which are preferred food by a variety of waterfowl. Swanson et al. (1985) illustrated the importance of plant matter, especially species of the grass family (Poaceae), in the overall diet of mallards. Woodin and Swanson (1989) showed a similar importance of plant matter in the diet of redheads.

It is anticipated that water management actions on these developed wetlands will provide a mosaic of highly productive shallow water habitats with breeding season and migration stopover benefits to a number of waterfowl, shorebird, and other waterbird species (e.g., American bittern).

Strategy 2:

- Estimate percent basin full through ocular estimation.
- Remove stop logs from WCSs in order allow spring flows to exit basins unimpeded.

Undeveloped Wetlands Sub-Goal

Conserve, protect, and enhance the integrity of wetlands throughout the refuge complex, with respect to waterfowl and other wetland birds.

Background

Both Service-owned and privately owned lands throughout Long Lake's WMD consist of a wide variety of wetland sizes and regimes (i.e., temporary, seasonal, semipermanent, permanent; Stewart and

Kantrud 1971). The majority of wetlands on both Service and other lands are undeveloped wetlands (i.e., those with no water-level management capabilities). Most undeveloped wetlands are dynamic systems; some are influenced by spring runoff and rainfall only (i.e., temporary and seasonal wetlands), whereas others are also influenced by groundwater interaction (i.e., semipermanent and permanent wetlands). However, all are at the mercy of nature with respect to temporal fluctuations in water levels, abiotic conditions (e.g., salinity), and biotic communities (e.g., plants, invertebrates). Euliss et al. (2004) stressed the need to consider the changes these prairie wetland systems undergo as a result of normal climatic variation when evaluating biological wetland data or a wetland's expressed condition (e.g., dry, devoid of emergent vegetation, choked with emergent vegetation) at a given point in time. Throughout the refuge complex's three-county district, differences in wetland density and regime abundance exist in different physiographic regions and ecoregions. Density of depressional palustrine wetlands (prairie potholes) in the district decreases from northeast to southwest as the Missouri Coteau physiographic region gives way to the Coteau Slope physiographic region. More specifically, densities of temporary, seasonal, and semipermanent wetlands all are greatest in the Missouri Coteau ecoregion, whereas the greatest density of large, shallow alkali lakes exists in the Collapsed Glacial Outwash ecoregion.

Meeting the undeveloped wetlands sub-goal will require that targeted acquisition, protection, and limited habitat management are conducted by a variety of Service staff. Ideally, the refuge complex will continue to acquire easements on high-risk wetlands in areas of high waterbird use, as well as protect the integrity of eased and fee-title (i.e., refuge, WPA) wetlands through active enforcement of easement regulations and management against wetland degradation (e.g., sedimentation, invasive plants) on refuges and WPAs.

For the undeveloped wetland habitat type, refuge complex staff has selected 10 bird species to serve as "target" or "indicator" species, which as a group reflect quality wetland habitat on Service lands. These species are the American avocet, American bittern, Baird's sandpiper, black-crowned night-heron, black tern, eared grebe, Franklin's gull, mallard, marbled godwit, and redhead. They were selected for a variety of reasons see table 5), including that:

- nine species regularly nest on lands in the refuge complex;
- one species uses lands in the refuge complex to a great extent as a migratory stopover area,
- two species are endemic to the Great Plains (Mengel 1970);
- six are North Dakota Species of Conservation Priority (Hagen et al. 2005)
- two species are Birds of Conservation Concern (Service 2002);
- three are Service Focal Species (Service 2005a);
- three are Species of High Concern under the Northern Prairie and Parkland Waterbird Conservation Plan (Beyersbergen et al. 2004)
- two are Species of Concern under the United States Shorebird Conservation Plan (Skagen and Thompson 2003).

Undeveloped wetland habitat objectives in this CCP are geared toward the provision of quality habitats for these species. In addition to the target species, undeveloped wetland habitats found on Service lands within the refuge complex should benefit a much broader group of "secondary" bird species (appendix L), as well as a variety of other nonavian wildlife.

Because structural and floristic habitat preferences (e.g., shallow marsh vegetation, wet meadow vegetation, submergent vegetation) of both the target and secondary species vary widely, it is assumed that the needs of all species will not be met on a single wetland or even a single tract of Service land (e.g., WPA), but rather the needs of the target and secondary species groups will be met by providing a diversity of vegetative structures across multiple tracts of Service land in the refuge complex.

Objective 1: Over a 15-year period, secure protected status on 2,000 wetland acres, with efforts focused on currently unprotected temporary and seasonal basins that are partially or totally embedded in cropland, and that occur in areas that support 25 breeding duck pairs per square mile.

Rationale 1:

Dahl (1990) estimated that between 7,000,000 and 8,000,000 acres of wetlands existed in the Dakotas in the late 1700s. However, in the late 1800s the first wave farmers or "sodbusters" settled in the PPR. The central and eastern portions of the Dakotas were highly attractive to these settlers because of homesteading and agricultural opportunities. With settlement came agricultural, rural, and urban development, and a corresponding change in the face of the prairie landscape. Since the 1800s, countless acres of wetlands have been drained by farm operators to increase tillable area, eliminate nuisance areas (e.g., areas overrun with invasive plants), and “square-up” fields (Leitch 1980). The extent of wetland drainage has not necessarily been consistent since pioneer settlement. For example, the post-World War II era ushered in a transition to mechanized farming and increased equipment size, which led to a corresponding increase in wetland drainage (Johnson and Higgins 1997). Madsen (1986) stated that 87 percent of wetland losses in the Dakotas are a result of agricultural development. According to Leitch and Scott (1977), 77 percent of state farmers surveyed in 1975 felt that wetlands were a hindrance to their farm operations. Consequently, as of the 1980s, North Dakota had lost approximately 49 percent of its original wetland area (Dahl 1990).

The prairie potholes of the Dakotas support a wide diversity of wildlife, but they are most famous for their role in waterfowl production. Although the PPR occupies only 10 percent of North America’s waterfowl breeding range, it produces approximately 50 percent of the continent’s waterfowl population (Kantrud 1983). Complexes of depressional palustrine wetlands scattered throughout North Dakota attract breeding duck pairs, drive nesting and re-nesting intensity, and provide brood habitat (Kantrud 1989). While semipermanent and permanent wetlands best serve to provide brood rearing habitat and migratory stopover habitat, respectively, it is the smaller temporary and seasonal wetlands that draw breeding duck pairs to the Dakotas and other parts of the PPR. According to Reynolds (Service, pers. commun.), for every ten 1-acre wetland there will predictably be 20 duck pairs, whereas one 10-acre wetland will likely support only seven duck pairs. The availability of wetlands is a major factor driving duck breeding in the PPR (Reynolds, Service, pers. commun.).

Despite the extensive loss in wetland area that has occurred throughout North Dakota for so many years, there is ample opportunity for the Service, and more specifically the refuge complex, to protect a large percentage of the area’s remaining wetlands through the establishment of perpetual and long-term easements and the purchase of land for WPAs and refuges. Societal transformations that have been most evident in the state in the last half century (i.e., urban growth, out-migration of young people) may actually increase opportunities for acquiring and protecting critical wildlife habitats that are currently in private ownership (Dixon and Hollevoet 2005).

Presently, there is a strong public interest in protecting wildlife habitats, but insufficient funding to acquire easements and WPAs on all available lands; therefore, refuge complex staff acquisition decisions can benefit from science-driven predictive habitat models. The habitat and population evaluation team (HAPET) has developed a model which shows the distribution of priority wetlands relative to breeding duck pairs and cropland: 1) Purchase of easements and fee title wetland acres alike will be prioritized to focus on 1) those wetland regimes that are at the greatest risk of degradation (i.e., drainage, filling) – temporary and seasonal, 2) wetlands embedded (partially or totally) in cropland, 3) wetlands in areas capable of supporting 25 breeding duck pairs per square mile, and 4) wetlands that are currently not protected, and; 5) semipermanent and permanent wetlands (<1 acre). This acquisition strategy has been adopted by the Service’s Dakota Working Group (DWG). If, over a 15-year period, 2000 acres of “high-risk” wetland habitat can be protected, this will prevent the loss of habitat for a cumulative minimum of 17,640 breeding duck pairs, based on relationships between wetlands and breeding duck populations (circa 2000; Chuck Loesch, Service, unpubl. data).

According to state legislative authorization, the Service is bound to county-specific acreage limits for the purchase of wetland easements with Migratory Bird Conservation Fund (MBCF) dollars (i.e., in Kidder County, as of April 2006, approximately 1,006 acres remain under the current authorization to be protected using the MBCF). When these acreage ceilings are reached, high-risk wetlands will remain unprotected and new legislative authorization will be needed to continue to protect wetlands using this funding source. Other funding sources (e.g., Land and Water Conservation Fund [LWCF]) need to be explored as a way to continue wetland protection.

Strategy 1:

- Use an acquisition strategy developed by the Service’s DWG from HAPET model results, which identifies priority (high-risk) wetlands for waterfowl and other wetland birds to determine the amount and approximate location of priority wetland acquisition areas.

- Purchase land through fee-title acquisition (i.e., WPAs, refuges).

- Establish perpetual and long-term easements on existing privately owned wetlands. Use

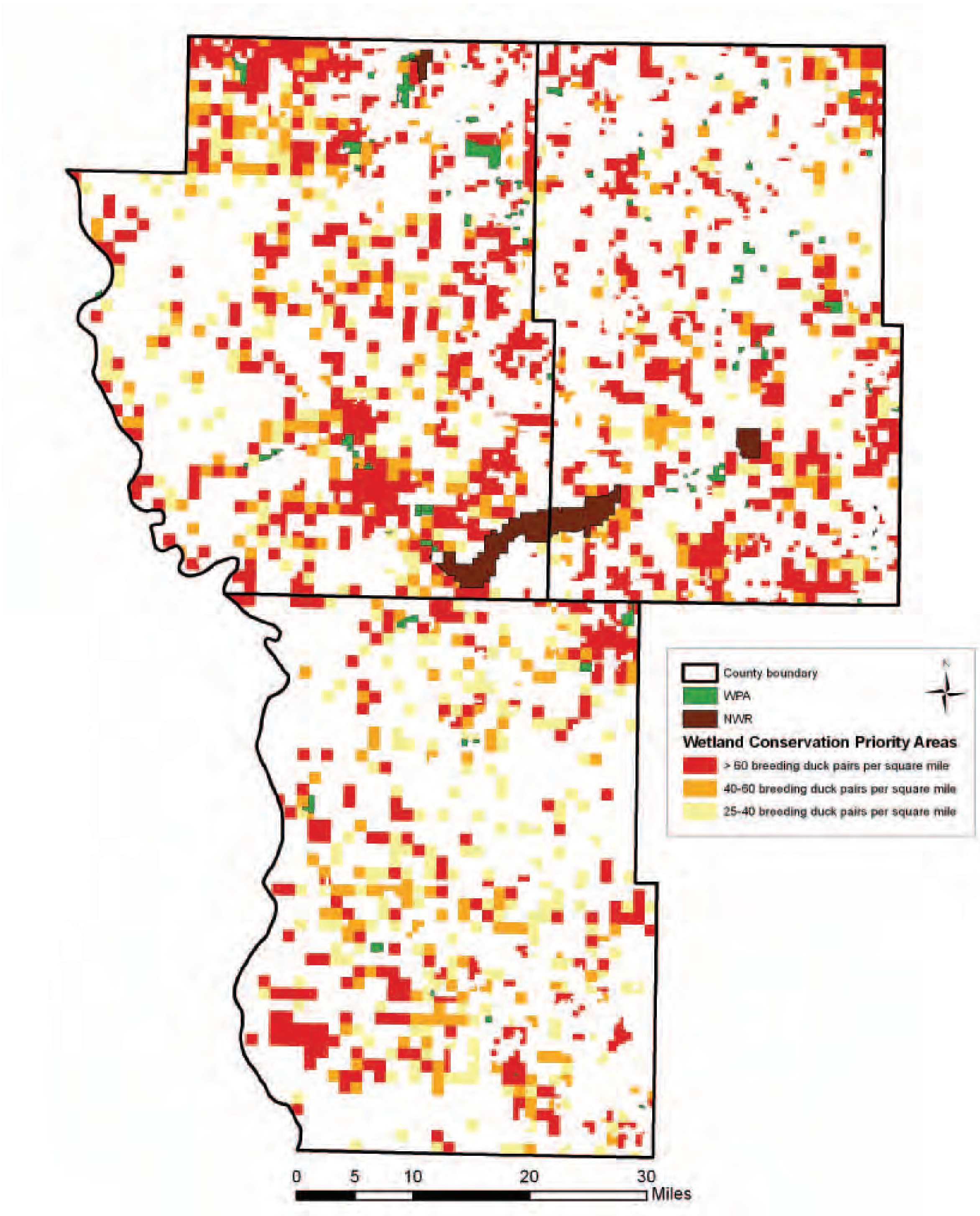

Figure 14. Distribution of 640-acre sections, which contain priority wetlands for conservation, relative to the number of breeding duck pairs per square mile and the existence of cropland

MBCF monies until the state's approved acreage limits for Burleigh, Emmons, and Kidder counties are reached.

- Seek additional funding through the LWCF and/or other sources.
- Seek legislative authorization to protect additional wetland acreage on those wetlands identified as "high risk."

Objective 2: Over a 15-year period, restructure (restore) 100 acres of degraded (i.e., drained, filled, leveled) wetlands for increased water-holding capacity on new or existing easements, WPAs, or refuges.

Rationale 2:

Historical losses of prairie wetlands in the state were discussed in detail in rationale 1, as was the idea that due to certain recent societal transformations (e.g., urban growth, out-migration of young people), there may be increased opportunity for acquiring and protecting critical wildlife habitats that currently exist on private lands. Potential also exists for the restoration of previously drained or filled wetlands on private land.

Relatively recently, societal interest has increased in restoring wetlands in the PPR (Knutsen and Euliss 2001). Results from telephone interviews of 305 landowners in 1996 revealed that most landowners would restore wetlands if they thought it were the right thing to do, if they could afford it, and if they had financial help (Whitaker 1996). Eighty-four percent of those interviewed said providing habitat for wildlife was important in their decision to restore wetlands, whereas only 10 percent gave financial profitability as an important reason. When landowners were presented with the following reasons for not restoring their wetlands, 58 percent stated a dislike of government programs, 50 percent believed the problem was a lack of awareness about available programs, and about 50 percent said they could not afford to sacrifice the farmland. However, some drained wetlands still hold too much water at times to be productive agricultural land and are also of low value to most wildlife. These drained wetlands could possibly be restored if participants were found and landowner skepticism cast aside (Knutsen and Euliss 2001).

Wetland managers in conjunction with a variety of natural resources agencies and organizations have been restoring prairie wetlands since the 1960s (Dornfeld 1988). Most wetland restorations in North Dakota are accomplished by plugging ditches with simple clay-core dams and seeding the surrounding upland to perennial grassland cover (Knutsen and Euliss 2001). Additionally, it has generally been concluded that, whenever possible, restoration efforts in the PPR should focus on restoring wetland complexes (groups of wetlands in relatively close proximity to one another that consist of multiple regimes [e.g., seasonal, permanent]), rather than individual basins. Knutsen and Euliss (2001) suggested that targeting large blocks of wetlands for restoration will increase the chances for the successful return of all wetland characteristics, including wildlife.

Strategy 2:

- Identify wetlands with restoration or enhancement potential prior to the purchase of easement and fee-title lands and initiate restoration actions through the Service's Partners for Wildlife Program.
- Search existing wetland easement contracts for drainage facility maps and contact current landowners to determine their willingness to restore specific wetlands.
- Fund restorations through the Service's Partners for Wildlife Program and fund easement purchases through the MBCF.
- Plug ditches on drained basins.
- Excavate filled and leveled basins.

Objective 3A: Within 1 year of the completion of this CCP, evaluate and determine the degree of infestation of Canada thistle and absinth wormwood within 75 feet of all Service-owned temporary and seasonal wetland basins in the refuge complex. Subsequent to this evaluation, and over a 5-year period, focus priority control efforts for wetland-associated Canada thistle and absinth wormwood infestations on those infestations that are more extensive (in acreage) than 75 percent of all wetland-associated infestations.

Objective 3B: Within 15 years of the completion of this CCP, determine on which Service-owned wetlands either reed canary grass or common reed is present and categorize the occurrence of these species at each applicable wetland as: 1) limited; 2) scattered, or; 3) dominant.

Objective 3C: Over a 15-year period, during routine day-to-day activities in the field, document any occurrences of problematic exotic wetland plant species (e.g., purple loosestrife, salt cedar, Eurasian watermilfoil) that have not yet been documented on lands in the refuge complex but have the potential to exist on them.

Rationales 3A, 3B, and 3C:

Wetland basins, which are dry due to their natural tendencies (i.e., temporary and seasonal wetland regimes, Stewart and Kantrud 1971), are often prone to invasion by a variety of invasive forbs, some of which are North Dakota State Listed Noxious Weeds (i.e., absinth wormwood, Canada thistle; Lym 2004). Absinth wormwood and Canada thistle both readily colonize sites that are devoid of vegetation (i.e., dry portions of wetland basins; Hutchinson 1992, Sedivec and Barker 1998, Liu et al. 2000). Additionally, Canada thistle thrives in moist, deep soil environments, such as the margins of prairie wetlands (Galatowitsch 1993, Sedivec and Barker 1998; Johnson and Larson 1999). Both of these plant species are aggressive alien invaders that are capable of crowding out and replacing native grasses and forbs (Wrage and Kinch 1981, Hutchison 1992). Where they become established, they can alter the natural vegetative structure and species composition.

New infestations of absinth wormwood and Canada thistle that are associated with wetland areas (i.e., dry basins, wetland margins) could potentially serve as a seed source for invasion into surrounding grassland areas. Therefore, refuge complex staff must identify these areas of wetland-associated infestation and target them for management, which will generally consist of a variety of integrated actions (i.e., mowing, chemical application, biological control agents).

Additionally, two other exotic wetland plant species can be especially problematic in PPR wetlands, because of their aggressive, invasive nature. Common reed is a native (The Northern

Great Plains Floristic Quality Assessment Panel 2001) deep-marsh perennial grass species that is widely distributed throughout the state (USDA 2006). This species is a "listed" noxious or invasive species in six states (USDA 2006). In the state, common reed is generally considered a troublesome species that can flourish in the most disturbed of all habitats (Northern Great Plains Floristic Quality Assessment Panel 2001). This species often develops monocultures in various wetland zones (e.g., shallow marsh, deep marsh; Kantrud 1986, Eggers and Reed 1987).

Similarly, reed canary grass is a native (Northern Great Plains Floristic Quality Assessment Panel 2001) shallow-marsh perennial grass species that is widely distributed throughout the state (USDA 2006). A European strain of this species has basically assimilated the native strain (Eggers and Reed 1987). Stewart and Kantrud (1971) classify reed canary grass as a dominant, secondary species in the shallow marsh zone of seasonal wetlands. However, like common reed, this species is also a "listed" noxious or invasive plant in three states (USDA 2006), but is essentially considered a troublesome species that can flourish in the most disturbed of all habitats in the state (The Northern Great Plains Floristic Quality Assessment Panel 2001). Reed canary grass is especially aggressive and often develops monocultures in various wetland zones (e.g., low-prairie, wet meadow, shallow marsh; Knutsen and Euliss 2001).

Biologists frequently equate decreased use of aquatic habitats by wetland birds to decreased habitat heterogeneity caused by a disruption (generally a reduction) in natural ecological processes (Kantrud 1986). The above wetland conditions generally result in vegetative domination by invasive hydrophyte species (e.g., common reed, reed canarygrass; Walker 1959, Jahn and Moyle 1964, Whitman 1976). Wetlands in the PPR are especially susceptible to the establishment of monotypic stands of hydrophytes because of little variability of soils or organic matter content within basins, low gradient shorelines, and the ability of many plant species to persist under a wide range of water conditions (Hammond 1961, Walker and Coupland 1968). Therefore, it is imperative that refuge complex staff develops a better understanding of the frequency and degree to which wetlands in the refuge complex have been invaded by the two aforementioned species. Currently, the refuge complex staff realizes that both species are not uncommon on wetlands throughout the refuge complex, but have a limited knowledge of what lands are especially impacted (e.g., Slade NWR) and what degree of problem this issue presents on lands in the refuge complex from a management standpoint (i.e., equipment, staff, and cost requirements). Although literature (Kantrud 1986, Payne 1992) suggests multiple management techniques for reducing the coverage of these species, the refuge complex does not necessarily intend to initiate formal management during this 15-year timeframe, but rather develop a better understanding of the problem these species currently present on lands in the refuge complex.

In addition to these four wetland and wetland-associated plant species of concern, refuge complex staff must be aware of the occurrence of other problematic wetland and wetland-associated plant species that have not previously been documented on lands in the refuge complex, but have potential to be—specifically salt cedar, purple loosestrife, curlyleaf pondweed, and Eurasian watermilfoil. Salt cedar and purple loosestrife are both North Dakota State Listed Noxious Weeds (Lym 2004), whereas Eurasian watermilfoil and curlyleaf pondweed are considered invasive plants (North Dakota Department. of Agriculture 2003).

Salt cedar is considered a shrub/tree and purple loosestrife is considered a forb, but both are perennial exotic species of Eurasian origin (USDA 2006). Salt cedar is an escaped ornamental that can transpire more than 200 gallons (757 liters) of water per day (Lym 2004). This species will rapidly choke waterways, artificially dry lakes, and other water bodies, and creates hypersaline soils that are not conducive to the growth of native plant species. As of 2003, it had been documented in Burleigh, Emmons, and Kidder counties (N.D. Dept. of Agriculture 2003). Another escaped garden plant, purple loosestrife, grows in moist or marshy areas and creates monotypic stands of cover (Lym 2004). Whitt et al (1999) concluded that purple loosestrife-dominated habitats at Lake Huron, Michigan, supported lower avian diversity than other area habitats. Purple loosestrife had been documented in Burleigh and Kidder counties, as of 2003 (North Dakota Department of Agriculture 2003).

Both Eurasian watermilfoil and curlyleaf pondweed are submergent aquatic species of Eurasian origin. Both of these species form dense underwater mats and ultimately rob water bodies of vegetative species diversity and dissolved oxygen (N.D. Dept. of Agriculture 2003, NDGF 2004). Additionally, both of these species are frequently spread from water body to water body through boating activities. A single plant fragment of either species can create an infestation in a new location (North Dakota. Department of Agriculture 2003, NDGF 2004). As of 2003, Eurasian watermilfoil had not been found in any of the refuge complex's counties and curlyleaf pondweed had been found only in Burleigh County (N.D. Dept. of Agriculture 2003).

Several exotic invertebrate species also exist that have the potential to colonize Service lands and subsequently alter water quality and biotic communities. These species include the zebra mussel, spiny water flea, and New Zealand mudsnail. All of them reproduce quickly and can rapidly overtake a water body, out competing native zooplankton populations for food and space (NDGF 2004). Similar to Eurasian watermilfoil and culyleaf pondweed, these invertebrate species often hitchhike from one water body to another on boats and trailers (NDGF 2004).

If the refuge complex staff maintains a constant vigil for these species while conducting other work (e.g., habitat surveys and/or management) on WPAs and refuges throughout the refuge complex, it will help ensure prompt and swift management action if any of these species are found. Consequently, the likelihood of large, unmanageable infestations of these species should be reduced through the suggested proactive approach.

Strategy 3A:

- Use the refuge complex's GIS and associated refuge lands geographic information system extension (RLGIS) cover-type data (circa 2003-2006) to create a 75-foot buffer around all temporary and seasonal wetlands that depicts Canada thistle and absinth wormwood invasions both within and adjacent to these wetland basins.
- Determine which wetland-associated infestations (Canada thistle and absinth wormwood combined) are larger (in acreage) than 75 percent of all wetland-associated infestations.
- Mow infested areas.
- Spray appropriate herbicides.
- Release biological control agents for Canada thistle.
- Prioritize control efforts based on sites of ecological importance (e.g., native sod areas, high-priority refuge complex WPAs) and sites that have the greatest potential of spreading to ecologically important areas.

Strategy 3B:

- Document the presence or absence of both species and assign a broad categorical coverage classification (e.g., limited, scattered coverage, dominant), at each Service-owned wetland in the refuge complex.
- Obtain GPS coordinates for areas of infestation.

Strategy 3C:

- Identify the visual characteristics of problem exotic wetland plant species that could potentially occur within Burleigh, Emmons, and Kidder counties.
- Maintain a heightened visual awareness for these species whenever working in wetland habitats.

- Collect specimens of any confirmed or likely problem exotic wetland plant species for further query.
- Obtain GPS coordinates for all confirmed and probable occurrences.
- Post informational signage at Service lands that may have boating activity (i.e., duck hunting, fishing) to warn the public about the possibility of transferring aquatic nuisance species (i.e., curlyleaf pondweed, Eurasian watermilfoil, zebra mussel, spiny water flea, New Zealand mudsnail) to new water bodies on portions of their watercraft.

Objective 4: Within 15 years of the completion of this CCP, determine the degree of sedimentation at 50 Service-owned wetlands in the refuge complex. Twenty-five of these wetlands will be "treatment" wetlands that have predictably high potential (defined in rationale 4) to receive excessive amounts of sediment and 25 will be reference wetlands that predictably accrue sediments at a rate similar to the presettlement era (defined in rationale 4). Through direct comparison of treatment and reference wetlands, staff will be able to determine quantitatively what defines "excessive sedimentation" within the refuge complex.

Rationale 4:

A large percentage of wetlands on WPAs and refuges in the refuge complex are surrounded by uplands that were at some point in the past cultivated for agricultural production. The temporal extent of agricultural cultivation varies from tract to tract and most of the upland area on WPAs and refuges in the refuge complex has been restored to perennial grass cover (the remaining areas in agricultural production exist because short-term [e.g., 2–3 years] cropping is part of the seedbed preparation prescription for eventual native grass reseeding); however, past cultivation in wetland catchment areas may have exacerbated soil erosion and resulted in partially filled wetlands with reduced functional integrity.

Wetlands embedded in agricultural fields receive more upland sediment than do wetlands embedded in intact grasslands (Gleason and Euliss 1998). Excessive sediment accrual has the potential to severely impact PPR wetlands. In fact, according to Baker (1992), sedimentation is the major pollutant of wetlands, as well as rivers and lakes in the United States. Gleason (1996) suggested that the primary source of sediments in PPR wetlands is wind and water erosion from crop fields. Adomatis et al. (1967) found that a mixture of snow and dirt, referred to as "snirt", accumulate in crop-bordered wetlands at twice the rate as in grass-bordered wetlands. Impacts of sedimentation include: 1) altered nutrient cycling; 2) altered aquatic food webs; 3) reduced primary production; 4) reduced invertebrate biomass, and; 5) shortened wetland lifespan (due to filling).

Additionally, because accelerated sedimentation reduces wetland depth, dense, monotypic stands of cattails can overwhelm a wetland (Bellrose and Brown 1941). Cattail-choked wetlands support relatively little biodiversity and exacerbate problems with agricultural producers because they serve as roost sites for large concentrations of blackbirds (i.e., common grackles, red-winged blackbirds, yellow-headed blackbirds) that depredate cereal crops (Linz et al. 1996).

Refuge complex staff suspects that several wetlands on lands in the refuge complex have been subject to accelerated sedimentation rates over time. These include wetlands on WPAs and refuges that are: 1) now embedded in grass, but were previously embedded in cropland; 2) flow-through wetlands that have potential to receive inputs from nearby agricultural lands; 3) wetlands that share both a Service and private land boundary, which is cropland on the private land portion, and; 4) wetlands with a minimal surrounding grassland area that is insufficient to buffer the effects of adjacent agricultural activities. Wetlands that meet one or more of the above four characteristics will be considered "treatment" wetlands. Conversely, wetlands that are fully embedded in native sod and further buffered by a landscape that is largely native sod will be considered 'reference' wetlands. Therefore, the refuge complex intends to work with staff from Northern Prairie Wildlife Research Center (NPWRC; USGS) to identify substantially silted-in wetlands in the refuge complex.

To satisfy long-term (>15 years) information needs, the staff also hopes to eventually determine how excessive sedimentation is impacting wetland functions on Service-owned wetlands within the refuge complex, as well as determine appropriate management actions (e.g., excavation, creation of grassland buffer) to restore pool depth and/or improve various wetland functions (e.g., growth of wet meadow plant species).

Strategy 4:

- Examine soil profiles in various wetland zones (e.g., wet meadow, deep marsh) to identify indicators of sedimentation (i.e., buried soil horizon; Gleason 2001).

- Collect wetland sediment core samples to determine depth of soil horizons.
- Determine degree of sedimentation (siltation) by comparing specific soil horizon depths (e.g., A Horizon) in wetlands with suspected sedimentation problems (treatment wetlands) to nonflow-through wetlands that are embedded in native sod and further buffered by a landscape that is largely native sod (reference wetlands).
- Determine sample wetlands through ground checks of adjacent current land use, as well as records of past land use and landownership boundaries.

Objective 5: Through active enforcement, protect all wetland basins under perpetual Service easement from drainage, filling, leveling, and unauthorized burning, over a 15-year period.

Rationale 5:

The Service's SWAP was authorized by Congress in 1958 as an amendment to the Duck Stamp Act (Service 2005b). Since the program began in the early 1960s, more than 2,000,000 acres of both wetland and grassland habitats have been protected through the easement program in North Dakota, South Dakota, Montana, and Minnesota (Service 2005b). As of 2005, 102,646 wetland acres were protected under perpetual Service easements in the refuge complex.

Generally, a Service wetland easement is perpetual in nature. The Service issues the landowner a one-time payment in order to acquire the exclusive right to burn, drain, fill, or level specific wetlands. This prevents landowners from burning, draining, filling, or leveling protected wetlands, without an SUP (e.g., allowing a wetland to be burned 1 in 3 years, allowing a temporary drain on a wetland to alleviate flooding of roads or residences). Any proposed use which may drain, burn, level, or fill a protected wetland should be pursued as a potential violation or evaluated under the Service's compatibility standards.

The concept behind the easement approach was to protect the landscape for waterfowl production, while minimally affecting the farming and ranching community (Service 2005b). However, because of the history of periodic violations throughout North Dakota, as well as other states, easement compliance work is vitally important to the continued success of the program (Service 2005b).

Annually, refuge complex staff documents an average of two to five easement violations in the district. The number of potential violations observed during aerial surveillance is generally three to four times that number, and therefore creates a substantial investigatory easement workload for refuge complex law enforcement officers. It is generally accepted that if easement compliance is not enforced annually through surveillance and necessary landowner contacts, violation rates in the state increase (Van Ningen, Service, pers. commun.).

Federal agricultural programs administered through the Farm Bill (U.S. Department of Agriculture) contain conservation provisions that affect other wetland protection measures, including the Service's wetland easement program. As these provisions are tightened and/or relaxed through the passage of subsequent Farm Bill legislation, violation rates on Service easements increase or decrease, correspondingly.

In addition to the reactionary measure of surveying the integrity of easement wetlands each year, the refuge complex also takes a proactive approach to easement enforcement by annually informing new landowners of existing Service easements on their property (since perpetual easements stay with the land, regardless of who owns it), as well as the associated regulations.

Through both proactive and reactive measures, the refuge complex can assure a high rate of landowner compliance within the district, which in-turn assures that more than 100,000 acres of privately owned wetland habitat in Burleigh, Emmons, and Kidder counties will be protected in perpetuity and will therefore be available to a wide variety of wetland-dependent birds.

Strategy 5:

- Send letters to new landowners informing them of existing easements on their property, along with the associated regulations.
- Annually conduct aerial easement enforcement surveys of all existing easements (survey two-thirds of the district in the fall and the remaining one-third in the spring, rotating counties each year).
- Follow protocols within the Service's easement manual to handle all potential violations.

Native Prairie Sub-Goal:
Restore floristic diversity to native grasslands, as well as provide a mosaic of vegetative structure to satisfy the habitat needs of grassland-dependent bird species.

Background:
Currently, much of the native prairie owned by the Service in the refuge complex is heavily invaded by a number of exotic invasive grasses (e.g., smooth brome, Kentucky bluegrass, crested wheatgrass) and forbs (e.g., Canada thistle, leafy spurge, absinth wormwood). In some areas, these and other exotic species have greatly reduced the coverage of native grasses and forbs, leading to reduced species and structural (height-density) diversity that is generally equated with a reduction in use by breeding grassland-dependent birds.

A few tracts of native prairie in the refuge complex, which have received relatively little management and are especially prone to invasion (e.g., those surrounded by crop fields or old crop fields, or those surrounded by or even bisected by roads), have regressed to monocultures devoid of almost any vegetative species richness and structural heterogeneity. Additionally, several of the refuge complex's native prairie tracts have been invaded to a greater-than-historical extent by certain native low shrub species (e.g., western snowberry, silverberry). Due to past management, or lack thereof, these native low shrub species have greatly increased their coverage, as compared to the presettlement era.

Conversely, there exist several tracts that still have a seemingly intact native prairie community. These sites are only modestly invaded by problem-plant species and support substantial stands of both cool- and warm-season native graminoid species (e.g., needle-and-thread, green needle grass, prairie junegrass, little and big bluestem, blue gramma), forb species (e.g., purple coneflower, blanket flower, blazing star, prairie coneflower, groundplum milkvetch), and an acceptable coverage of shrubs (e.g., leadplant, western snowberry). Certain plant species can be documented on these lands that indicate these areas have received relatively little past disturbance (e.g., white prairieclover, hoary puccoon, breadroot scurfpea, porcupine grass, leadplant; The Northern Great Plains Floristic Quality Assessment Panel 2001).

The remaining areas of native prairie have been identified as the refuge complex's highest priority upland sites. Through targeted and science-driven management, refuge complex staff plans to reverse the decline in vegetative heterogeneity such that with modest management, these tracts will resist invasion by exotic cool-season grasses and invasive plants.

Despite the most timely and successful management efforts, the rate of vegetative change on some heavily invaded lands will be slow and incremental, but positive. The native prairie goal is long-term (more than 15 years) in nature. Ideally, upland habitats in the refuge complex will, over time, consist of large expanses of contiguous grassland habitat that provide a diversity of native flora and a mosaic of vegetative structure across a broad landscape.

The Service has selected 10 bird species to serve as "target" or "indicator" upland species, which as a group reflect quality upland habitats on Service lands within the refuge complex. These species are the bobolink, chestnut-collared longspur, grasshopper sparrow, mallard, marbled godwit, northern harrier, sedge wren, sharp-tailed grouse, upland sandpiper, and western meadowlark. They were selected for a variety of reasons (see table 5), including that:

- all 10 species regularly nest on lands in the refuge complex;
- two species are endemic to the Great Plains and five others are secondary endemic species (Mengel 1970);
- eight are North Dakota Species of Conservation Priority (Hagen et al. 2005);
- six species are Birds of Conservation Concern (Service 2002);
- seven are Service Focal Species (Service 2005a);
- two are Stewardship Species under the North American Landbird Conservation Plan (Rich et al. 2004);
- two are Species of Concern under the United States Shorebird Conservation Plan (Skagen and Thompson 2003).

Upland habitat objectives in this CCP are geared toward the provision of quality habitats for these species. In addition to the target species, upland habitats found on Service lands within the refuge complex should benefit a much broader group of "secondary" bird species (appendix L), as well as a variety of other nonavian wildlife.

Because structural-habitat preferences (e.g., vegetative height-density) of both the target and secondary species vary widely, it is assumed that the needs of all species will not be met on a single tract of Service land (e.g., WPA), but rather the needs of the target and secondary species groups will be met by providing a mosaic of vegetative structures (e.g., tall, dense cover; short, sparse cover) across many tracts of Service land in the refuge complex.

Objective 1A: Establish permanent vegetation monitoring transects and collect baseline floristic composition data on all tracts with 25 upland acres, within one year of the approval of this CCP.

Rationale 1A:

Prairie areas throughout North America continue to decline in quantity and quality, due in part to invasion by exotic plant species (Samson and Knopf 1994, Bragg and Steuter 1995). Many native prairie areas on Service-owned lands in the refuge complex have been heavily invaded by a number of cool-season introduced grass species (e.g., smooth brome, Kentucky bluegrass, crested wheatgrass) and invasive plants (e.g., leafy spurge, Canada thistle, absinth wormwood). Vegetative cover type data collected on all Service-owned lands within the refuge complex suggest that approximately 64 percent of all native prairie acres is currently (circa 2003-2006) dominated by nonnative grasses (≥95 percent coverage) or invasive plants (>50 percent coverage; see appendix M for a complete list of cover type categories used between 2003 and 2006 on the refuge complex). Numerous scientific studies suggest that a number of grassland-dependent birds, including target species like the chestnut-collared longspur, marbled godwit, upland sandpiper, and western meadowlark, favor areas dominated by native vegetation (Lindmeier 1960, Fairfield 1968, Owens and Myres 1973, Maher 1974, Stewart 1975, Kaiser 1979, Ryan 1982, Faanes 1983, White 1983, Ryan et al. 1984, Wilson and belcher 1989, Kantrud and Higgins 1992, Dhol et al. 1994, Anstey et al. 1995, Skeel et al. 1995, Prescott and Murphy 1996, Davis and Duncan 1999). Johnson and Igl (2001) consider the degradation of remaining grassland areas in the northern Great Plains, due to inadequate or improper management, as one of the principle factors in the declining populations of numerous grassland bird species.

Smooth brome is a rhizomatous, sod-forming species that is also a prolific seed producer (Willson and Stubbendieck 1997). It often excludes other species, effectively altering the species composition and native species diversity and biomass of native prairie communities (Willson 1990; Willson and Stubbendieck 1997). Kentucky bluegrass and crested wheatgrass frequently have similar impacts on native prairie areas once they successfully invade them (Grace et al. 2001, Wilson and Partel 2003).

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Native seeding within the prairie.

Additionally, Christian and Wilson (1999) found that the effects of certain introduced grasses (i.e., crested wheatgrass) not only displace native species and consequently reduce diversity, but they also alter pools and flows of energy and nutrients in the prairie ecosystem. Leafy spurge, Canada thistle, and absinth wormwood are also problem plants that have the ability to form nearly monotypic stands and therefore, threaten native biodiversity (Watson 1985, Bedunah 1992, Trammel and Butler 1995, Svedarsky and Van Amburg 1996, Wrage and Kinch 1981, Hutchison 1992). Additionally, the negative effects on native prairie biodiversity related to the expansion of native woody vegetation (i.e., western snowberry, silverberry) have been documented by numerous authors.

Expansion of native, low shrubs has occurred over time since European settlement. The subsequent loss or misapplication of historical ecological disturbance regimes (i.e., fire and herbivory) have been a major contributing factor to the loss of plant diversity. Extirpation of bison (Campbell et al. 1994) and wildfire suppression are factors that have been tied to expansion of woody vegetation into the northern mixed-grass prairie (Grant et al. 2004b). According to Murphy (2005), invasion of native prairie by shrub species like western snowberry and silverberry is a principle threat to native plant diversity in the state.

Additionally, this phenomenon has many detrimental effects on grassland-nesting birds (discussed in detail in rationales 1D and 1E). Vegetative cover type data collected on Service-owned lands within the refuge complex suggest that several native prairie tracts have >43 percent of their upland acres classified as western snowberry (25 percent coverage; appendix M). Monitoring plant species composition changes is essential to determining whether the refuge complex's management practices (e.g., burning, grazing) and their associated timing (e.g., late fall, three-to-five leaf stage of smooth brome) benefit or harm native plant communities.

Grant et al. (2004a) have developed a method (the belt transect method) of documenting the status and trend of certain plant species and species groups (e.g., dry cool-season native grasses) that are of management interest in the mixed-grass prairie region of the northern Great Plains. This methodology can be applied rapidly, efficiently, and extensively, and is repeatable over the course of time, due to its permanent nature. Further, compared to other methods of evaluating plant species composition (e.g., Daubenmire 1959; Swink and Wilhelm 1994), the belt transect method can be more accurately accomplished by individuals of varied skill levels. This is important because the majority of the Service's vegetative field data collection in the state is completed by seasonal biological science technicians who often have relatively little botanical experience.

Rather than classifying vegetation solely on a species-specific level, Grant et al. (2004a) recommend classifying vegetation according to a moderately detailed, hierarchical breakdown of vegetative groups. Plant groups are based on regional references that describe common native plant community types for North Dakota uplands (Hegstad 1973). This approach is supported by several factors, including: 1) Service managers in the Dakotas are most concerned with relatively few exotic and/or invasive plant species; 2) sampling accuracy and efficiency among observers are compromised by increasing the complexity of classifications, and; 3) subtle shifts in the species makeup of native grasses and forbs occur continuously due to the always dynamic precipitation patterns in the northern Great Plains.

Transects will be established on all native prairie sites containing ≥25 upland acres to evaluate species plant group composition change over time. In addition to collecting baseline vegetative data at the time that transects are established, staff will re-survey each individual tract within 1 year of it being managed (e.g., burned, grazed), or every 3–5 years if no management occurs (Grant et al. 2004a), to support informed restoration decisions. A list of habitat associations that refuge complex staff will use in collecting belt transect data is provided in appendix I.

Strategy 1A:

- Establish one permanent 82-foot (25 meter) belt transect for every 10 acres of native prairie.
- Collect baseline plant species composition data along transects.
- Determine upland acreage of sites and employ systematic-random transect placement using the Service's RLGIS and associated data layers.
- If any doubt exists about the sod history (native versus previously cultivated) of a tract it shall be considered native, until proven otherwise.

Objective 1B:
Reduce the frequency of occurrence of exotic cool-season grasses (i.e., smooth brome, Kentucky bluegrass, crested wheatgrass) by 5 percent, over a 15-year period on 50 percent of all native upland portions (e.g., management units) of WPAs and refuges. Correspondingly, increase the frequency of occurrence of both cool- and warm-season native grasses (e.g., little bluestem, needle-and-thread, switchgrass, prairie junegrass) by 5 percent over the same timeframe on the same tracts.

Objective 1C: Reduce the total acreage of North Dakota State Listed Noxious Weeds (i.e., leafy spurge, Canada thistle, absinth wormwood; Lym 2004) by a total of 10 percent, over a 15-year period on 50 percent of all native portions of WPAs and refuges.

Rationales 1B and 1C:
The degree to which Service-owned native prairie in the refuge complex is invaded by exotic cool-season grasses and invasive plants (i.e., invasive forbs of Eurasian origin) is described in detail in rationale 1A, as are the problems associated with invasion by these species with respect to habitat suitability for grassland-dependent birds, native biodiversity, and overall functional integrity of remnant prairie areas.

Therefore, the frequency of occurrence of exotic cool-season grasses and the overall acreage of invasive plant species will be reduced on selected tracts of native prairie, over the next 15 years.

Refuge complex staff proposes a relatively small reduction in frequency of occurrence (i.e., 5 percent) of exotic grasses because recent data on vegetative response to management on lands in the refuge complex (Gregg Knutsen, Service, unpubl. data) indicate that proposing a more substantial reduction over the same timeframe is likely unrealistic, given several factors, including:

- the refuge complex's management limitations (e.g., staff, weather-related problems, lack of ability to reliably conduct certain management practices);
- the degree of invasion (i.e., certain sites may have passed an "invasion threshold" beyond which management actions have little or no positive impact on the native plant community);
- climatic conditions (e.g., prolonged wet conditions that enhance the competitive abilities of exotic grass species);
- a lack of understanding of how to properly manage against exotic grass species (Brome Summit, Jamestown, ND, March 2006, unpubl. data), and;
- the aggressive nature of these invasive exotic grass species.

Changes in frequency of occurrence will be incremental, but positive, keeping in mind that the native prairie goal is long-term (>15 years) in nature. A reduction in the frequency of occurrence of these exotic grass species should theoretically result in an increased competitive ability of native grass and, therefore, an increased frequency of occurrence of cool- and warm-season native grasses. Changes in frequency of occurrence will be measured according to the methodology outlined in rationale 1A (Grant et al. 2004a).

The refuge complex also plans to reduce the overall acreage of invasive plants over a 15-year period. Similar to the proposed reduction rate for exotic cool-season grasses, refuge complex staff proposes what some may view a conservative reduction in the acreage of invasive plants. A possibly conservative—but likely realistic and achievable—reduction value is most appropriate for invasive plants. The refuge complex's management and associated monitoring of invasive plant infestations and other habitat components will be adaptive in nature. Fifteen years is a short period of time with respect to altering the floral community of upland environments in the northern Great Plains. The refuge complex staff intends to apply certain management practices, at certain rates and according to certain timing, with the understanding that if future data indicates that a change in strategy would be beneficial with respect to reducing the abundance of problem plant species, its management can be adaptive (Walters 1986). Therefore, the refuge complex's proposed rate of reduction can be adjusted for future planning efforts, with an increased knowledge of vegetative response to various management practices, and continued consideration of all other extraneous variables.

Because of certain perceived limitations of the belt transect methodology (Grant et al. 2004a) with respect to accurately measuring change in abundance of invasive plant species, refuge complex staff decided to measure invasive plant changes using a different methodology. Refuge complex staff generally manages for a reduction of problem grass species (e.g., smooth brome) by applying a management practice (e.g., prescribed fire) to a broad area, such as an entire WPA, refuge management unit, or "field."

Conversely, refuge complex staff often controls invasive plants (e.g., leafy spurge) at specific, isolated sites within a field, WPA, or refuge management unit, using spot-management techniques like chemical application, mowing, or biological control agents. Therefore, it can be expected that if the treated infestations do not lie on one of the permanent belt transects, rate of change cannot be accurately determined. For example, several, small patches of Canada thistle could be present on multiple belt transects; however, because these patches may be considerably smaller than adjacent patches that do not lie on belt transects, they may not be deemed priority and may not receive treatment. Consequently, although the extent of the Canada thistle patches that were treated (off transects) were greatly reduced or even eliminated, this reduction would not be reflected when belt transects were resurveyed. Therefore, refuge complex staff has determined that a more appropriate approach to measuring changes is to measure an actual change in overall acreage, using data collected on all lands in the refuge complex between 2003 and 2006 as a starting point and recollecting data on select sites in an identical fashion, 15 years from the completion of this CCP.

Strategy 1B:

- Manage tracts, or portions of tracts, with prescribed fire, grazing, or a combination of both.
- Manage tracts with select chemical herbicides (i.e., Imazapic-based, Glyphosate-based).
- Interseed (no till) a mix of cool- and warm-season native grass seed.
- Monitor change over time by collecting and evaluating belt transect data.
- Collect baseline data when transects are initially established (within 1 year of the

completion of this CCP); Objective 1A will serve as a starting point for measuring changes in the frequency of occurrence of various habitat associations.

Strategy 1C:

- Chemically treat infested areas.
- Mow or hay infested areas.
- Graze infested areas.
- Burn infested areas to prepare the site for other control practices (e.g., biological control agents, chemical control).
- Release biological control agents (e.g., leaf spurge flea beetles).
- Use various combinations of the above treatments.
- Monitor change over time by collecting RLGIS cover-type data for the three principle invasive plant species, in a manner identical to how it was collected on Service-owned lands from 2003 to 2006 (see appendix M).

Objective 1D: On 50 percent of all native portions of refuges, manage for a frequency of occurrence of native, low shrubs (i.e., western snowberry, silverberry) of 30 percent, over a 15-year period.

Objective 1E: On 50 percent of all native portions of WPAs, manage for a frequency of occurrence of native, low shrubs (i.e., western snowberry, silverberry) of 50 percent, over a 15-year period.

Rationales 1D and 1E:

In addition to the negative effects on the biodiversity of native prairie caused by the invasion of exotic grasses (e.g., Kentucky bluegrass) and forbs (e.g., absinth wormwood), expansion of native woody vegetation (e.g., western snowberry, silverberry) has occurred over time since European settlement and the subsequent loss or misapplication of historical ecological disturbance regimes (e.g., fire, herbivory). Extirpation of bison (Campbell et al. 1994) and wildfire suppression are factors that have been tied to expansion of woody vegetation in the northern mixed-grass prairie (Grant et al. 2004b). According to Murphy (2005), invasion of native prairie by shrub species like western snowberry and silverberry is a principle threat to native plant diversity in North Dakota.

According to Igl and Johnson (1997), grassland-dependent bird populations in the state have declined over the last 25 years, whereas bird species associated with woody vegetation have increased. Grant et al. (2004b) determined that frequencies of occurrence of several bird species endemic to the Great Plains (e.g., chestnut-collared longspur), as well as mixed-grass prairie species of conservation concern (Igl and Johnson 1997; grasshopper sparrow, western meadowlark, bobolink, upland sandpiper) declined as the extent of woody vegetation increased in grassland areas. Occurrence of the most woodland-sensitive species declined rapidly as woody vegetation increased as little as 5–25 percent. Several grassland-nesting species, including the grasshopper sparrow and chestnut-collared longspur, had reduced densities in shrubby versus nonshrubby North Dakota study plots (Arnold and Higgins 1986). Additionally, Scheiman et al. (2003) found that grasshopper sparrow nest success was inversely related to shrub coverage in the eastern part of the state.

Multiple other studies have documented the negative affects of shrubby and woody cover to multiple target bird species, including the bobolink (Johnson and Temple 1986, Sample 1989, Bollinger and Gavin 1992, Helzer 1986, Madden 1996), chestnut-collared longspur (Schneider 1998), grasshopper sparrow (Johnson and Odum 1956, Smith 1963,Bent 1968, Wiens 1969, Wiens 1970, Kahl et al. 1985), marbled godwit (Renken and Dinsmore 1987), upland sandpiper (Buss and Hawkins 1939, Rotenberry and Wiens 1980, Renken 1983, Skinner et al. 1984, Sample 1989, Kantrud and Higgins 1992, Hull et al. 1996), and western meadowlark (Sample 1989, George and McEwen 1991, Kimmel et al. 1992, Anstey et al. 1995, Hull et al. 1996, Madden 1996).

Additionally, Arnold and Higgins (1986) found that brown-headed cowbirds, which are obligate nest parasites (Johnsgard 1979), were one of the two most abundant species on shrubby study sites. Davis and Sealy (2000) also documented increased brown-headed cowbird abundance on sites bordered by western snowberry.

Long Lake NWR, Florence Lake NWR, and Slade NWR were established as breeding grounds and sanctuaries for migratory birds; therefore, common sense dictates that the refuge complex manage its lands for the benefit of the bird species that are of the greatest concern in the PPR—grassland-nesting birds. The aforementioned scientific data clearly illustrate the negative impacts of woody cover to a multitude of grassland birds, therefore, refuge complex staff must limit the amount of this vegetative component on Service lands.

Arnold and Higgins (1986) considered “shrubby” sites in the Missouri Coteau of the state as those sites with 30 percent coverage of western snowberry and silverberry. Similarly, Murphy (2005) recommended a frequency of occurrence of native low shrubs of 30 percent as a component of "high-quality" native prairie in the state. Further, Grant et al. (2004b) recommend that restoration efforts on northern prairie grasslands target 20 percent woody encroachment. A more conservative—and likely realistic—target (30 percent) has been chosen for this initial restoration objective.

The purpose of district is to ensure the long-term viability of the breeding waterfowl population and production through the acquisition and management of WPAs, while considering the needs of other migratory birds, threatened and endangered species and other wildlife (Service, June 2004 unpubl. report). Therefore, despite what is known about the negative affects of native, low shrub encroachment on many grassland bird species, management of WPAs must, first and foremost, provide habitat conditions preferred by waterfowl, based on their establishing principles.

Several studies indicate that western snowberry-dominated communities are attractive early season nest sites for several duck species (Leitch 1951, Dzubin and Gollop 1972, Hines and Mitchell 1983, Cowardin et al. 1985, Duebbert et al. 1986, Kruse and Bowen 1996). Therefore, the refuge complex will allow a greater extent of low shrub coverage in the district, than on its refuges, which were established for "migratory birds" in general. In addition to upland nesting ducks, extensive coverage of native, low shrubs is preferred as nest site vegetation by other grassland bird species, including the northern harrier (Sutherland 1987, Messmer 1990, Kantrud and Higgins 1992, Murphy 1993, Sedivec 1994) and to a slightly lesser degree the sharp-tailed grouse (Heart et al. 1950, Christenson 1970, Pepper 1972, Kohn 1976, Hillman and Jackson 1973, Sisson 1976, Giesen 1987, Meints 1991), which are target species in the refuge complex. Further, scattered shrubs are often used as elevated singing perches for grassland-dependent species (e.g., chestnut-collared longspur; Harris 1944, Fairfield 1968, Creighton 1974, Creighton and Baldwin 1974). On WPAs the low shrub objective level is set at a maximum of 50 percent frequency of occurrence in order to provide quality duck nesting habitats, while not allowing these upland habitats to become so overrun with woody cover that use by certain target species (e.g., grasshopper sparrow, upland sandpiper) is precluded.

Strategies 1D and 1E:

- Manage tracts or portions of tracts with prescribed fire, grazing, and a combination of both.
- Concentrate cattle in shrub patches with salt licks during grazing operations.
- Manage tracts with appropriate herbicides (McCarty 1967).
- Mow shrub patches (Corns and Schraa 1965).
- Monitor change over time by collecting and evaluating belt transect data. Baseline data collected when transects are initially established (within 1 year of the completion of this CCP; Objective 1A) will serve as a starting point for measuring changes in the frequency of occurrence of various habitat associations.
- Manage shrub component on WPAs and NWRs in an appropriate condition and composition to provide quality nesting cover (i.e., between 0 and 50% on WPAs, between 0 and 30% on NWRs).

Objective 2A: On refuges in the refuge complex, maintain a minimum of 35 percent of all native prairie upland acres in a high visual obstruction reading (VOR) category (>8 inches [20 centimeters] ; Robel et al. 1970), a minimum of 25 percent in a medium VOR category (4–8 inches [10–20 centimeters]), and a minimum of 10 percent in a low VOR category (<4 inches [10 centimeters]).

Objective 2B: On WPAs in the refuge complex, maintain a minimum of 40 percent of all native prairie upland acres in a high VOR category (>8 inches [20 centimeters]; Robel et al. 1970), a minimum of 25 percent in a medium VOR category (4–8 inches [10–20 centimeters]), and a minimum of 5 percent in a low VOR category (<4 inches [10 centimeters]).

Rationales 2A and 2B:

Vegetative structure is an important component of grassland habitats in the northern Great Plains. According to Robel et al. (1970), vegetative species composition alone does not typically provide all of the information necessary to appraise the habitat potential of a grassland. Further, Emlen (1977) suggested that vegetative density and screening efficiency were at least as important as species composition in describing avian habitats. This is particularly true for birds that are vegetative species generalists, such as upland nesting ducks

(Mark Sherfy, USGS, unpubl. data), and several of the refuge complex's target upland species, including the bobolink (Johnson et al. 2004), grasshopper sparrow (Kendeigh 1941, Birkenholz 1973, Whitmore 1979, Sample 1989, Wilson and Belcher 1989, Madden 1996), sedge wren (Mousley 1934, Meanley 1952, Birkenholz 1973, Cink 1973, Crawford 1977, Knapton 1979, Johnsgard 1980, Faanes 1981, Burns 1982, Higgins et al. 1984, Skinner et al. 1984, Renken and Dinsmore 1987, Manci and Rusch 1988, Frawley 1989, Sample 1989, Bryan and Best 1991, Frawley and Best 1991, Volkert 1992, Johnson and Schwartz 1993a, Dhol et al. 1994, Hartley 1994, Johnson and Igl 1995, King and Savidge 1995, Helzer 1996, Patterson and Best 1996, Best et al. 1997, Delisle and Savidge 1997, Helzer and Jelinski 1999, Horn and Koford 2000), sharp-tailed grouse (Hanson 1953, Sisson 1976, Baydack 1988, Saab and Marks 1992), and northern harrier (Stewart and Kantrud 1965, Stewart 1975, Linner 1980, Evans 1982, Apfelbaum and Seelbach 1983, Faanes 1983, Kantrud and Higgins 1992, Dhol et al. 1994, Prescott et al. 1995, MacWhirter and Bildstein 1996, Prescott 1997). For the above grassland species and many others, vegetative structure is a more important factor than species composition.

Laubhan et al. (2006) summarized numerous scientific data that quantified structural habitat preferences of multiple upland birds, including all 10 of the refuge complex's target upland species. VOR (height-density) preferences for all are listed in table 6.

VOR measurements are strongly correlated ($P<0.01$) with the amount of vegetation present in a given area and can constitute a reliable index if certain measurement standards are followed (Robel et al. 1970). Based on the mean preferred VORs of these 10 species (Laubhan et al. 2006), they can be separated into three distinct categories: 1) low cover (<4 inches [10 centimeters]); 2) medium cover (4–8 inches [10–20 centimeters]), and; 3) high cover (>8 inches [20 centimeters]). Marbled godwits, chestnut-collared longspurs, and upland sandpipers prefer vegetation in the low-structural category; western meadowlarks, grasshopper sparrows, bobolinks, and sharp-tailed grouse prefer vegetation in the medium-structural category; and sedge wrens, mallards, and northern harriers prefer vegetation in the high-structural category.

Because structural habitat preferences (e.g., VORs) of both the target and secondary species vary widely, it is assumed that the needs of all species will not be met on a single tract or management unit, but rather the needs of the these species groups will be met by providing a mosaic of vegetative structures (i.e., high, medium, low) across many tracts of land in the refuge complex. Prairies generally need frequent, carefully timed defoliation by various means (i.e., fire, grazing) to maintain vegetative diversity (species richness and structure; Grant et al. 2004b). Refuge complex staff anticipates that periodic disturbance to portions of refuges and WPAs will not only maintain or enhance native plant diversity, but will also serve to provide a host of vegetative structures across the Service-owned landscape of the refuge complex.

Table 6. Preferred visual obstruction reading (VOR) range and mean for 10 target upland bird species (Laubhan et al. 2006)

Species	*VOR Range inches (cm)*	*VOR Mean inches (cm)*
Bobolink	12–21 (30–53)	17.8 (45.2)
Chestnut-collared longspur	N/A	7.5 (19.1)
Grasshopper sparrow	11–20 (28–51)	15.1 (38.4)
Mallard	14.5–45 (36.8–114)	28.7 (72.9)
Marbled godwit	0–10 (0–25.4)	5.5 (14)
Northern harrier	10 (25.4)	37.7 (96)
Sedge wren	N/A	23.5 (59.7)
Sharp-tailed grouse	13–30 (33–76.2)	19.4 (49.3)
Upland sandpiper	5–20 (12.7–50.8)	9.2 (23.4)
Western meadowlark	12.5–20 (31.8-50.8)	13.6 (34.5)

Postburn vegetative monitoring efforts across the northern Great Plains indicate that after defoliating a site, it takes multiple years (e.g., 2–3) for structural conditions to resemble preburn conditions (Launchbaugh 1972). Rates of vegetative return (i.e., VOR profile) vary among treatment type (e.g, fire, grazing; Kruse and Bowen 1996). For example, 1 year after a spring grazing event in the northwestern portion of the state, vegetative structure was similar to that of control fields (Kruse and Bowen 1996). However, from immediately after a spring burn until one year postburn, the percentage of short, sparse vegetation (<2 inches [5 centimeters]) increased, but by 2 years postburn it had decreased to a percentage similar to that in control fields. Therefore, conducting defoliation activities at variable intervals (e.g., every 3–5 years), across portions of numerous WPAs and refuges, will theoretically create a mosaic of vegetative structures across both temporal and geographical gradients.

Management recommendations for several upland target species, including the northern harrier (Johnson et al. 2004), sedge wren, grasshopper sparrow, bobolink, western meadowlark, and upland sandpiper (Johnson et al. 2004), all stress the need for land managers to maintain a mosaic of grassland conditions.

Defoliating different portions of Service-owned tracts in different years ensures that a variety of successional stages exist to not only meet the needs of a variety of nesting birds, but also to meet foraging (Schramm et al. 1986, Volkert 1992, Zimmerman 1993), loafing, and brood-rearing needs (Johnson et al. 2004) of various bird species. In addition to prescribed fire, rotational grazing is commonly recommended as a beneficial defoliation tool for the aforementioned target species and also for the remaining three target species (mallard, chestnut-collared longspur, marbled godwit; Cowan 1982, Messmer 1990, Sedivec 1994). Suggested defoliation intervals for the aforementioned target species ranged from 2–5 years (Johnson et al. 2004).

Therefore, in general, a defoliation return interval of approximately 3–5 years will be used, with the understanding that this return interval will apply only to priority lands, because of staff and budgetary limitations. This return interval may be decidedly shorter (e.g., 1 year, <1 year) if it is determined that more frequent treatments are needed to most effectively manage against the invasion of cool-season exotic grasses on a particular tract.


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Prescribed fire is used to manage tracts of refuge land.

If management is applied approximately at this interval (3–5 years), lands in the refuge complex should provide the percentages of vegetative structure categories outlined in objectives 2A and 2B. Thirty percent of the upland acreage in the refuge complex will not be targeted for a specific structural category, in order to allow for various uncontrollables (e.g., climatic extremes).

Refuge complex staff established different structural class target percentages for refuges and WPAs. Because WPAs are "waterfowl first" lands, it was decided that it is appropriate to manage for an increased percentage of high-VOR acres (40 percent; compared to 35 percent on refuges) and decreased percentage of low-VOR acres (5 percent; compared to 10 percent on refuges). In addition to mallards, several other upland nesting duck species (i.e., northern shoveler, gadwall, northern pintail, blue-winged teal) prefer VORs in the medium (4–8 inches [10–20 centimeters]) and high (>8 inches [20 centimeters]) categories (Laubhan et al. 2006). Additionally, it should be noted that VORs in the low category (<4 inches [10 centimeters]) are abundant within Long Lake WMD, in the form of privately owned pasture land that is commonly subject to intensive grazing pressure on an annual basis (Van Ningen, Service, pers. commun.).

In order to determine if objectives 2A and 2B are achieved, refuge complex staff will monitor VORs annually for 15 years on a sample of 20 WPAs and refuge management units that are deemed high-management priority, 10 WPAs and refuge management units that are deemed medium-management priority, and five WPAs and refuge management units that are deemed low management priority. This will allow refuge complex staff to capture VOR data not only on those tracts that receive regular management attention (i.e., high, and to a lesser degree medium priority; managed every 3–5 years), but also on low priority units that are managed at much greater intervals (i.e., managed no more than once every 7 years).

All high and moderate priority sample sites will contain a minimum of 25 native prairie acres, whereas low-priority sample sites will only have a minimum of 10 native prairie acres. To ensure collection of meaningful data, refuge complex staff will define a seasonal measurement window (e.g., mid-June to mid-July) during which all structural data will be collected each year.

Strategies 2A and 2B:

- Manage tracts or portions of tracts with prescribed fire, grazing, or a combination of both.
- Manage tracts with select chemical herbicides (i.e., Imazapic-based, Glyphosate-based).
- Measure VOR using a methodology modified from Robel et al. (1970) at approximately 19.5-foot (5.9 meter) intervals along permanent belt transects, excluding the start and end points (i.e., three measurement locations per 82-foot [25-meter] transect).
- Measure VOR annually, for a period of 15 years, at a sample of native prairie management areas (e.g., refuge management units, WPAs).

Objective 3: Within 3 years of the completion of this plan, determine the sod history (native versus previously cultivated) of all fee-title lands in the refuge complex. Record sod history data as a layer in the refuge complex's GIS.

Rationale 3:

Determining the sod history of certain Service-owned lands or portions thereof is often relatively straightforward, although it can also be difficult and exhaustive on some tracts. While some lands in the refuge complex were farmed within the last 10–20 years, some old crop fields were seeded back to grass cover shortly after the Service acquired the land (e.g., the 1930s on Long Lake NWR), and others were farmed for only a few years between the 1900s and 1930s and were actually acquired in perennial grass cover. Still other lands may have been broken (cultivated) in the early 1900s, but never cropped. Such areas may have been readily reinvaded by native plants and might currently support native vegetation and other biological communities equivalent to some of the most pristine native prairie tracts in the refuge complex (Grant, Service, pers. commun.).

A comprehensive and definitive determination of the sod history of all upland acres managed by the refuge complex had not been attempted prior to 2006. Knowledge of a tract's sod history is important because the suite of management tools available to refuge complex staff is dependent upon whether that tract is native prairie (never cultivated) or an old cropfield (previously cultivated). Specifically, the Service restricts any cultivation of native prairie, regardless of its apparent condition (i.e., whether dominant vegetative cover is native or exotic and invasive), to preserve various components (e.g., soil structure) of this increasingly rare habitat type. On the other hand, sites that have previously been cultivated and are now in perennial grass cover can again be cultivated (i.e., part of a multiyear prescription for eventual reseeding to a native grass mix) if it is determined that such an action is appropriate.

The degraded condition of much of the Service-owned native prairie in the refuge complex was discussed in detail in the background section of the native prairie habitat type. The problems associated with degraded native prairie (e.g., reduced use by breeding grassland-dependent birds) was discussed in rationales 1A, 1B, and 1C.

Based on systematic and nonsystematic evaluations of vegetative response to various grassland management practices on lands in the refuge complex, it is generally accepted that, in most cases, obtaining a desired grass diversity (i.e., a dominance of native species) on a severely degraded piece of land is most easily achieved by cultivating the tract and eventually reseeding it to a native grass mix (Knutsen and Van Ningen, Service, pers. commun.). Therefore, if refuge complex staff determines that a tract of land has a history of previous cultivation, it can use this management strategy to achieve a desired grass diversity. Conversely, if it is determined that the tract is native sod, staff must use other methods to improve the vegetative diversity of that particular tract.

For those tracts in which a definitive determination of sod history is especially difficult, multiple site visits and use of various historical data and possibly non-Service biological expertise may be necessary to accomplish this objective.

Strategy 3

- Check tracts in question for evidence of plow furrows or other linear disturbances caused by implements (e.g., plows disks, seed drills).
- Examine acquisition records, old refuge narratives, aerial photographs from multiple years, and U.S. Soil Conservation Service records for tracts in question.
- Use soil experts from the U.S. Natural Resources Conservation Service of the USDA or another agency or organization to examine the soil A-horizon for evidence of

disturbance due to cultivation for tracts in question.

- Create a comprehensive, attributed RLGIS layer using either GPS or "heads-up" digitize boundaries of areas identified as old crop fields.
- Consider other indicators of old cropland (when evaluating questionable tracts) including: 1) rock piles or rocks strewn linearly along fence lines or what appears to be a field edge; 2) distinct field edges; 3) nearly monotypic stands of smooth brome, with some Kentucky bluegrass, but little native plant community (frequent native re-invaders include pasture sage, common yarrow, several goldenrod species, and silverleaf scurfpea); 4) no partially buried rocks covered with profuse lichens; 5) especially deep furrows or linear piles of windborne topsoil along preexisting fence lines, and; 6) an absence of clubmoss and cryptogamic crust.

Objective 4A: Over a 15-year period, secure protected status on 80,000 grassland acres, with efforts focused on two priority area types: 1) areas of undisturbed grass (55 acres), located in areas that support 25 breeding duck pairs per square mile; 2) areas of contiguous undisturbed grass (640 acres), with 30 percent of their area being comprised of semipermanent or permanent wetlands.

Rationale 4A:

The central grasslands were once North America's most extensive ecosystem (Johnson and Igl 2001). Grasslands and wetlands are the two major habitat components in the PPR that influence the productivity of waterfowl (Dixon and Hollevoet 2005), as well as many other bird species that depend on both wetland and grassland areas during various parts of their life cycle (e.g., marbled godwit, Wilson's phalarope).

In the late 1800s, the first wave of farmers or "sodbusters" settled in the PPR. The central and eastern portions of the Dakotas were highly attractive to these settlers because of homesteading and agricultural opportunities. With settlement came agricultural, rural, and urban development, and a corresponding change in the face of the prairie landscape. Grassland losses in the mixed-grass prairie portion of the state are estimated at 70 percent compared to presettlement times (Sampson and Knopf 1994, Sampson et al. 1998, Conner et al. 2001). Associated with the large-scale conversion of native prairie has been a related change in grassland-dependent birds and other wildlife (e.g., Richardson's ground squirrel) communities (Johnson and Igl 2001). The rich abundances of prairie wildlife that are described in historical accounts (e.g., Dinsmore 1994) can now only be imagined. It was not until the 1960s that widespread and systematic surveys of most bird species were initiated, in the form of the North American Breeding Bird Survey (BBS; Robins et al. 1986). Therefore, quantitative evidence of grassland bird species population changes exist for only the past ~35 years, long after most grassland losses occurred. BBS data indicates that populations of many grassland bird species have been in decline over that brief time period alone. From 1967–1993, several bird species, including the chestnut-collared longspur and western meadowlark declined by 39 percent in the state (Johnson and Igl 2001). Bobolinks and many other species also showed noteworthy, but less dramatic, declines. Grassland-nesting birds have shown more consistent population declines during this period of time than any other group of birds in North America (Sauer et al. 2001).

Although the prairie potholes of the Dakotas support a wide diversity of birdlife, they are most well-known for their role in waterfowl production. Although the PPR occupies only 10 percent of North America's waterfowl breeding range, it produces approximately 50 percent of the continent's waterfowl population (Kantrud 1983). Many species of waterfowl (e.g., mallard, northern pintail, gadwall, blue-winged teal, northern shoveler) commonly nest in the grassed uplands that surround wetland basins; therefore, grassland losses equate to reduced productivity for these species. Converting native prairie areas of the PPR to cropland has directly impacted waterfowl, by increasing habitat fragmentation and reducing the overall area of breeding cover for grassland-nesting species (Sugden and Beyersbergen 1984, Batt et al. 1989). Greenwood et al. (1995) determined that duck nest success in the PPR increases as the amount of grassland in the landscape increases. Furthermore, it has been determined that increased grassland cover increases the daily survival rate for multiple duck species (Reynolds et al. 2001). Specifically, according to Reynolds (Service, pers. commun.), for every one percent decline of "priority" grassland in the PPR, there will be 25,000 fewer ducks in the fall.

Presently, unprotected grassland areas in cropland-dominated landscapes are typically converted to cropland, and associated wetlands are drained or converted to other uses (Dixon and Hollevoet 2005). Striving to protect what remains of the presettlement prairie landscape is an integral part of the Service's wildlife conservation efforts.

Despite the extensive loss of grasslands that has already occurred throughout the state, there is ample opportunity for the Service, and more specifically for the refuge complex, to protect a large percentage of the area's remaining grasslands through the establishment of perpetual and long-term easements and the purchase of WPAs and refuges. Societal transformations that have been most evident in the state in the last half century (i.e., urban growth, out-migration of young people) may actually increase opportunities for acquiring and protecting critical wildlife habitats that are currently in private ownership (Dixon and Hollevoet 2005). Presently, there is a strong public interest in protecting wildlife habitats, and a disproportionately large amount of private land that includes grassland habitat, as compared to the funding available to acquire easements and WPAs; therefore, the refuge complex staff's decisions can benefit from science-driven predictive habitat models. HAPET has developed a model which shows the distribution of priority grassland patches (55 acres) in relation to breeding duck pairs (25 per square mile; figure 15). Model outputs denote priority grassland patches, primarily with respect to upland nesting ducks; however, the protection of these sometimes small grassland areas will also benefit a wide variety of grassland-nesting birds that are not area-dependent (e.g., western meadowlark; Johnson and Igl 2001). Funds directed primarily toward waterfowl conservation (i.e., NAWCA) should be targeted towards grassland areas that this model deems priority. This acquisition strategy has been adopted by the Service's DWG for grassland easement acquisition, which is ultimately directed at increasing waterfowl productivity. If, over a 15-year period, 80,000 acres of additional grassland habitat can be protected, this will prevent the loss of habitat for a cumulative minimum of 139,080 ducks, based on relationships between grasslands and breeding duck populations (circa 1995-1998; Loesch, Service, unpublished data).

Another HAPET model identifies priority grassland areas with respect to area-dependent grassland-nesting birds (e.g., northern harrier, upland sandpiper, grasshopper sparrow, bobolink, sharp-tailed grouse; Johnson and Igl 2001). It shows the distribution of contiguous areas of grass cover that are 640 acres, with 30 percent of their area being comprised of semipermanent or permanent wetlands (figure 16). These areas, known as grassland bird conservation areas (type I) are based on the assumption that the protection of large, contiguous blocks of grass within a larger, grassland-dominated landscape provide adequate habitat for a wide range of grassland-dependent bird species (Mike Estey, Service, unpubl. report). The model was developed largely on the judgments and recommendations of numerous Midwestern grassland-bird experts. Funds directed at bird groups other than waterfowl (e.g., LWCF) should be focused on grassland areas that this model deems priority. HAPET compared the grassland bird conservation areas with empirical models developed with BBS data and found strong correlation between the two (Niemuth et al. 2005).

Prioritization for purchase of easements and fee-title lands can be done by giving preference to those currently unprotected grassland patches that are deemed priority by one of the above HAPET models and are located in close proximity to already protected tracts of grassland. Prioritizing for land protection in this manner ultimately leads to large protected areas that theoretically suffer reduced negative effects of fragmentation. According to Johnson and Igl (2001) habitat fragmentation is one of the main factors contributing to the present decline of numerous grassland bird populations.

Strategy 4A:

- Use an acquisition strategy developed by the Service's DWG from HAPET model results, which identifies priority grasslands (both native prairie and old cropfields) for upland nesting ducks, to determine the amount and approximate location of priority grassland acquisition areas for protection with NAWCA and donated partner (i.e., Ducks Unlimited) funds.
- Use a model developed by HAPET (grassland bird conservation areas; type I) to identify priority grasslands (both native prairie and old cropland) for grassland-dependent and area-sensitive birds, to determine the amount and approximate location of priority grassland acquisition areas for protection with LWCF and other funds.
- Purchase land through fee-title acquisition (i.e., WPAs, refuges).
- Establish perpetual easements on existing privately owned grasslands (both native prairie and old crop fields). Seek additional funding through the LWCF, partners, and/or other sources.

Objective 4B: Through active enforcement, protect from cultivation all grassland areas under perpetual Service easement over a 15-year period.

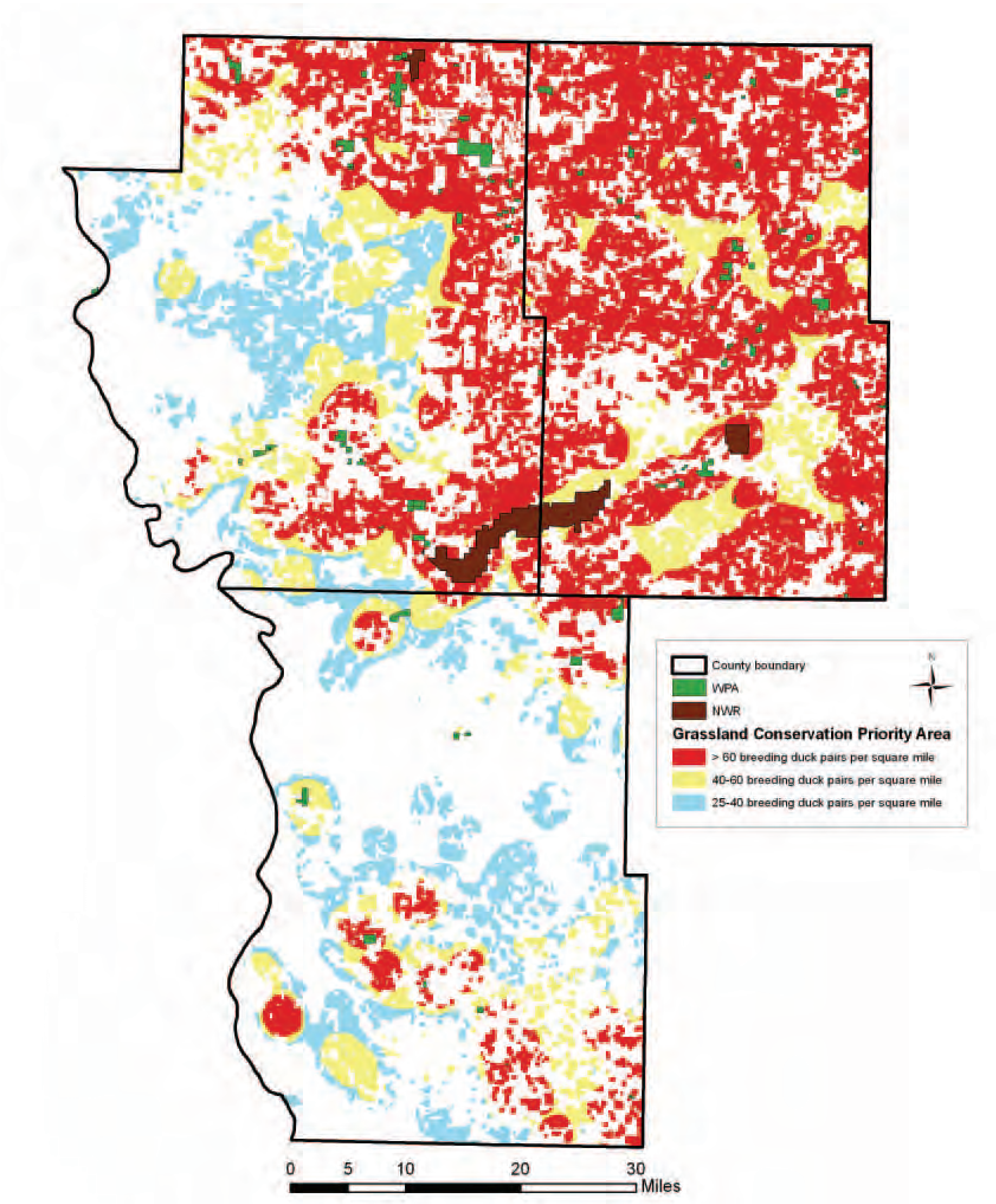

Figure 15. Distribution of 55-acre sections, which contain priority grasslands for conservation, relative to the number of breeding ducks per square mile

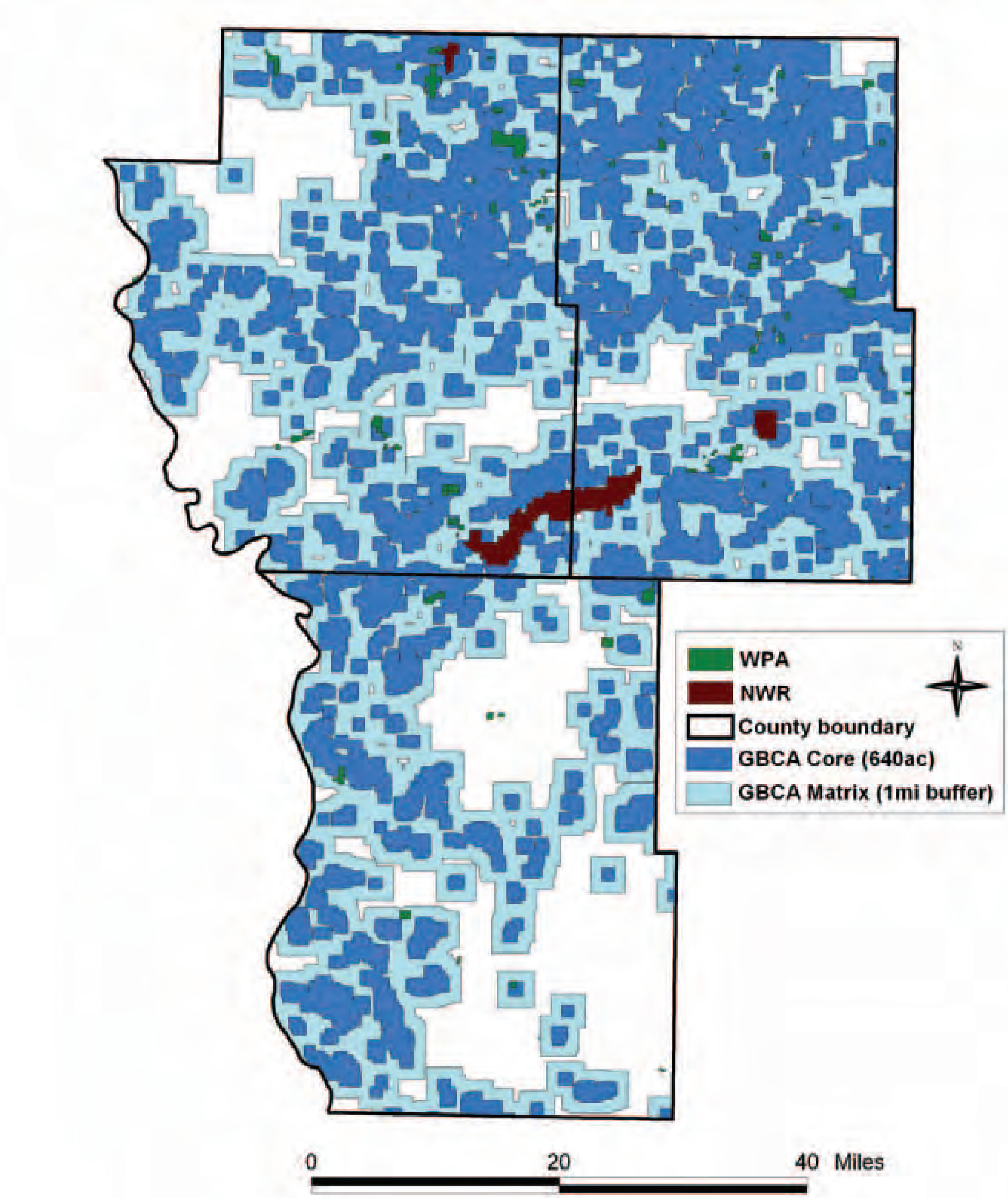

Figure 16. Grassland Bird Conservation Areas (type 1) and their associated 1-mile buffer areas in Long Lake Wetland Management District

Rationale 4B:
The Service's SWAP was authorized by Congress in 1958 as an amendment to the Duck Stamp Act (Service 2005b). Since the program began in the early 1960s, more than 2,000,000 acres of both wetland and grassland habitats have been protected through the easement program in the Dakotas, Montana, and Minnesota (Service 2005b). As of 2005, 41,181 grassland acres were protected under perpetual Service easements in the refuge complex.

Service grassland easements are perpetual in nature. The Service issues the landowner a one-time payment in order to acquire and maintain grass cover. This prevents landowners from ever cultivating protected grassland areas, or haying these areas prior to July 15 of each year. There are additional restrictions on development and mining of these protected areas.

The purpose of the easements is to protect the landscape for waterfowl production, as well as to secure the needs of other breeding grassland-dependent birds (e.g., marbled godwit, bobolink, grasshopper sparrow) while minimally affecting the farming and ranching community (Service 2005b). However, because of the history of periodic violations throughout North Dakota and other states, easement-compliance work is vitally important to the continued success of the program (Service 2005b). Based on current easements in the refuge complex, which are predominantly native prairie, the major regulatory enforcement issue concerns cultivation, since native prairie is rarely used as hayland. In the future, however, as the refuge complex acquires tamegrass (previously farmed) tracts that are used as hayland by landowners, the potential will increase for violation of the pre-July 15th haying restriction. The refuge complex will evaluate the need for additional enforcement strategies (e.g., aerial flights on, or shortly after, July 15) as easements are acquired on tamegrass tracts in the refuge complex. It is generally accepted that if easement compliance is not enforced annually through surveillance and necessary landowner contacts, violation rates in the state will increase (Van Ningen, Service, pers. commun.).

In addition to the reactionary measure of surveying the integrity of easement wetlands each year, the refuge complex also takes a proactive approach to easement enforcement by annually informing new landowners of existing Service easements on their property (since perpetual easements stay with the land, regardless of who owns it), as well as the associated regulations.

Through both proactive and reactive measures, the refuge complex can assure a high rate of landowner compliance within the district, which in-turn assures that more than 41,000 acres of privately owned grassland habitat in Burleigh, Emmons, and Kidder counties will be protected in perpetuity and will, therefore, be available to a wide variety of grassland-nesting birds.

Strategy 4B:

- Send letters to new landowners informing them of existing easements on their property, along with the associated regulations.
- Annually conduct aerial easement enforcement surveys of all existing easements (survey two-thirds of the district in the fall and the remaining one-third in the spring, rotating counties each year).
- Follow protocols within the Service's easement manual to handle all potential violations.
- Initiate annual aerial enforcement surveys of new tamegrass easements, timed to determine if haying restrictions are violated. Conduct these surveys on, or shortly after, July 15.

Old Cropland Sub-Goal:
Restore native floristic diversity to old cropland, as well as provide a mosaic of vegetative structure to satisfy the habitat needs of grassland-dependent bird species.

Background:
Approximately 9,600 acres (~ 48 percent) of the Service-owned upland acres in the refuge complex were previously cultivated. For the purpose of this CCP, they will hereafter be referred to as "old cropland." Nearly all of these old cropland areas are presently in perennial grass cover, but many of them are in poor condition with respect to vegetative diversity. These fields are often dominated by only 2–3 exotic cool-season grass species (e.g., smooth brome, Kentucky bluegrass, crested wheatgrass), and a few low-quality native forb (e.g., goldenrods; The Northern Great Plains Floristic Quality Assessment Panel 2001) and nonnative forb (e.g., absinth wormwood) species. These vegetative monocultures typically support a reduced diversity of grassland-nesting birds (Johnson and Igl 2001) and possess altered pools and flows of energy and nutrients, as compared to intact native prairie sites (Christian and Wilson 1999).

The refuge complex hopes to reclaim these lands and vegetate them with a diversity of native flora, creating systems that, with modest management, are relatively resistant to invasion by cool-season exotic grasses and invasive plants. Ideally, these areas will become a functional part of several extensive and relatively contiguous blocks of grass. One of the primary obstacles, which must be overcome, concerns the paucity of information on reestablishment of native grasses and, to a greater extent, forbs, on previously cultivated sod in the northern Great Plains.

Meeting the old cropland goal will require that extensive reclamation-level management is conducted to restore the native vegetation. Ideally, old cropland in the refuge complex will consist of large expanses of contiguous grassland habitat that provide a diversity of native flora and a mosaic of vegetative structure across a broad landscape.

The Service has selected 10 bird species to serve as "target" or "indicator" upland species, which as a group reflect quality of upland habitats on Service lands within the refuge complex. These species are the bobolink, chestnut-collared longspur, grasshopper sparrow, mallard, marbled godwit, northern harrier, sedge wren, sharp-tailed grouse, upland sandpiper, and western meadowlark. They were selected for a variety of reasons (see table 5), including that:

- All 10 species regularly nest on lands in the refuge complex;
- two species are endemic to the Great Plains and five others are secondary endemic species (Mengel 1970);
- eight are Noth Dakota Species of Conservation Priority (Hagen et al. 2005);
- six species are Birds of Conservation Concern (Service 2002)
- seven are Service Focal Species (Service 2005a);
- two are Stewardship Species under the North American Landbird Conservation Plan (Rich et al. 2004);
- two are Species of Concern under the United States Shorebird Conservation Plan (Skagen and Thompson 2003).

Upland habitat objectives in this CCP are geared toward the provision of quality habitats for these species. In addition to the target species, upland habitats found on Service lands within the refuge complex should benefit a much broader group of "secondary" bird species (see appendix L), as well as a variety of other nonavian wildlife.

Because structural habitat preferences (e.g., vegetative height-density) of both the target and secondary species vary widely, it is assumed that the needs of all species will not be met on a single tract of Service land (e.g., WPA), but rather the needs of the target and secondary species groups will be met by providing a mosaic of vegetative structures (e.g., tall, dense cover; short, sparse cover) across many tracts of Service land in the refuge complex.

Objective 1A: Over a 15-year period, annually seed 150 acres of old cropland to a native grass mix.

Objective 1B: Introduce a mix of native forbs on 100 acres of "established" native seedings within 15 years of the completion of this CCP.

Rationales 1A and 1B:
Grassland scientists in the northern Great Plains often speculate that some mixed-grass prairie areas become so heavily invaded by exotic cool-season grasses, that they pass a biological threshold beyond which even the most timely and appropriate management efforts will not restore any semblance of native plant diversity (Brome Summit, Jamestown, ND, March 2006, unpubl. data). The vegetative monocultures that exist on many old cropfield tracts are an example of sites where certain biological thresholds may have been surpassed. Considerable past effort has been directed at planting old cropfields to a DNC mix. DNC is generally a mix of sweetclover, alfalfa, and introduced wheatgrass species (e.g., intermediate, tall) that is planted primarily to provide quality upland nesting duck habitat (Duebbert 1969; Duebbert and Lokemoen 1976).

Although properly maintained DNC serves as quality nesting habitat for a variety of upland nesting ducks, staff in the refuge complex proposes to reseed all old cropland portions of Service-owned lands to a native grass mix, over a substantial period of time (i.e., >15 years), for multiple reasons. First, DNC is not likely as self-sustaining a vegetative community over the long-term as native grass seedings (Meyer 1987). Frequently, 10–15 years after establishment of DNC, its vegetative species composition changes (e.g., a reduction in the alfalfa component) due to a condition commonly described as "sod-bound" that is related to nitrogen deficiency (Canode 1965). Therefore, radical management strategies (e.g., light cultivation) are required to rejuvenate degraded DNC stands (Meyer 1987, Duebbert 1981, Van Ningen, Service, pers. commun.)

Conversely, it is thought that the establishment of native-dominated perennial herbaceous cover will, with modest management (i.e., periodic fire or grazing), better resist invasion by exotic cool-season grasses (Meyer 1987, Grant, Service, pers. commun.). Native vegetation is also preferred over nonnative vegetation by a number of the refuge complex's target upland species, including the chestnut-collared longspur, marbled godwit, upland sandpiper, and western meadowlark (Lindmeier 1960, Fairfield 1968, Owens and Myres 1973, Maher 1974, Stewart 1975, Kaiser 1979, Ryan 1982, Faanes 1983, White 1983, Ryan et al. 1984, Wilson and belcher 1989, Kantrud and Higgins 1992, Dhol et al. 1994, Anstey et al. 1995, Skeel et al. 1995, Prescott and Murphy 1996, Davis and Duncan 1999).

With respect to ducks, Mark Sherfy (USGS, unpubl. data) found that ducks nesting in Conservation Reserve Program (CRP) fields in the North Dakota and South Dakota showed no significant preference for tamegrass-seeded (e.g., DNC) fields over native-seeded fields. Also, nest success was actually slightly higher in native seedings than tamegrass seedings. According to Klett et al. (1984), nest initiation rates for mallards, gadwalls, and blue-winged teal in the Dakotas were as high or higher in native-seeded fields than in seeded fields that lacked natives. Nest success also was not significantly different in native-seeded versus tamegrass-seeded study fields (Klett et al. 1984).

The refuge complex will, therefore, seed old cropfields to a mix of cool- and warm-season native grasses over time. Duebbert et al. (1981) and Meyer (1987) suggest that quality grass habitat can be successfully established on previously cultivated lands. Many important considerations exist in planning for native seedings, including the mixture of species to be seeded. Duebbert et al. (1981) suggested several native species that can be seeded successfully in central part of the state, including green needlegrass, prairie junegrass, needle-and-thread, western wheatgrass, little bluestem, blue grama, prairie sandreed, and big bluestem. Refuge complex staff has used many of these species in past seed mixes.The number of species in refuge complex seed mixes is in part dependent on annual budgets; however, more important seed mix considerations concern the ratio of cool-season to warm-season species.

The refuge complex is part of an historically cool-season grass (C3) dominated ecosystem, which is supplemented with multiple warm-season (C4) grasses. The refuge complex staff strives for a cool-season to warm-season grass ratio close to 1:1. The early emergence of cool-season grasses are an important component of quality nesting cover, especially for early nesting ducks (i.e., mallard, northern pintail; Reynolds, Service, pers. commun.).

Other important variables in the actual seeding effort include, but are not limited to: 1) timing; 2) planting method (i.e., drilling, broadcasting depth; 3) seed source; 4) seeding rate (i.e., pounds of pure live seed per acre), and; 5) landform and topography (e.g., location in the landscape, such as aspect and slope).

The site—and more specifically seedbed preparation—are, however, also especially important in the establishment of native seedings (Duebbert et al.1981). A prescription that has been successful within the refuge complex in the past includes multiple years of cropping (i.e., small grains), followed by no less than one season of chemical fallowing using glyphosate-based herbicide. This is followed by seeding of natives during the appropriate timeframe. Bakker et al. (2003) found that competition from exotic cool-season grasses (i.e., crested wheatgrass) was significantly and consistently reduced through an annual application of a glyphosate-based herbicide. This strategy increased establishment, survivorship, and diversity of native seedings in Saskatchewan. Despite the native seeding establishment success derived in part from 4 years of generalist herbicide applications in Saskatchewan, exotic cool-season grasses persisted at these sites (Bakker 2003).

A final, important consideration when planning native seedings is uncontrollable climatic variability. Adequate precipitation is important for germination of native seeds; however, it also favors the competitive abilities of exotic cool-season grasses which are generally less drought-resistant than their native counterparts (Knutsen and Euliss 2001, Bakker 2003). Bakker (2003) recommended that management focus on establishing native vegetation during wet years and controlling exotic grasses during dry years.

Management subsequent to seeding should target the reduction of perennial nontarget plant species (e.g., smooth brome) and to a lesser extent annual nontarget plant species (e.g., green foxtail) through a variety of methods. Duebbert et al. (1981) indicated that seeded native grass will typically out-compete annual plants by the second or third year postseeding.

Native grass reseeding efforts over the next 15 years will be based on a priority hierarchy established in this CCP for lands in the refuge complex (appendix F). As with many management actions, but even more importantly for native reseeding activities, budgets need to be considered when determining annual seeding efforts.

Certain "established" native grass seedings may lack a diversity of native forbs (e.g., prairie coneflower, prairie smoke, dotted blazing star), perhaps due to cultivation and herbicide use. However, forbs are an important habitat component for nesting grassland birds (Buss and Hawkins 1939, Rotenberry and Wiens 1980, Renken 1983, Skinner et al. 1984, Sample 1989, Kantrud and Higgins 1992, Kimmel et al. 1992, Anstey et al. 1995, Hull et al. 1996, Madden 1996), as well as other prairie-obligate wildlife species (i.e., Dakota skipper; Marrone 1992, Murphy 2005).

Over a 15-year period, it is important to gain an improved understanding of the native forb communities that naturally revegetate after establishment of a native grass seeding, as well as learn more about the methods of interseeding of native forbs into "established" native grass stands.

Currently, there is a paucity of scientific literature related to the mechanics of interseeding forbs in the mixed-grass prairie of the northern Great Plains. However, based on limited, unpublished information, refuge complex staff suspects that adequate seed to soil contact is an important factor in native forb establishment; therefore, various defoliation measures may need to be applied (Glass, USFS, pers. commun.; Koerner, Service, pers. commun.; Kleiman, TNC, pers. commun.).

Defoliation prior to seeding also potentially creates openings for forbs to grow. Application of forb seed through broadcasting, rather than drilling, is preferred, according to several sources (Glass, USFS; Koerner, Service; Kleiman, TNC). A late fall or winter seeding timing (with or without snow cover) is generally preferred so that the freeze-thaw cycle draws forb seed into the ground (Glass, USFS, commun.; Koerner, Service, pers. commun); Kleiman, TNC, pers. commun.; Kleiman TNC, pers. commun.). Also recommended is harrowing seed into the soil. Koerner (Service, pers. commun.) suggested a postseeding graze, because cattle help to "plant" seed as they trail through an area. Koerner (Service, pers. commun.) also recommended multiple applications of forb seed over multiple years, coupled with multiple iterations of postseeding management (e.g., prescribed fire). Finally, Koerner (Service, pers. commun.) cautions as to the extended amount of time (i.e., >10 years) necessary for some forb species to express themselves in a seeded field.

Prior to any forb seeding, a limited forb diversity survey should be conducted at a sample of established native seedings to determine an actual need for interseeding forbs.

Strategy 1A:

- Drill or broadcast a native grass seed mix.
- Prepare seeding sites (i.e., old cropfields) using multiple years of cropping, followed by multiple years of chemical fallowing (using a glyphosate-based herbicide).
- Ensure seed mix has nearly equal cool- and warm-season components.
- Include a variety of tools in postseeding management, including clipping, prescribed fire, and prescription grazing.

Strategy 1B:

- Conduct a forb diversity inventory on "established" native grass seedings to select sites for limited interseeding of forbs. Potentially survey along existing belt transects, but incorporate floristic quality index methodology to obtain both qualitative (Swink and Wilhelm 1994, The Northern Great Plains Floristic Quality Assessment Panel 2001) and quantitative (Grant et al. 2004a) data on the existing forb communities at various sites.
- Conduct a fall prescribed burn to prepare seedbed (Glass, USDA Forest Service, pers. commun.; Koerner, Service, pers. commun.; Kleiman, TNC, pers. commun.). Broadcast forb seed during late fall or winter (Glass, USDA Forest Service, pers. commun.; Koerner, Service, pers. commun.; Kleiman, TNC, pers. commun.)

Objective 2A: Establish permanent vegetation monitoring transects and collect baseline floristic composition data on all native seedings that are classified as "established" (i.e., floristic composition is estimated to be 50 percent native grass, with both cool- and warm-season species represented), within 3 years of classification.

Objective 2B: Ten years after being classified as an "established" native seeding, a frequency of occurrence of 65 percent native grass (including both cool- and warm-season species) will exist on 75 percent of all "established" native seedings.

Rationales 2A and 2B:

Some native seedings on the refuges and WPAs have achieved a floristic composition that is 50 percent native grass within 2 years of being seeded (in most cases seedings take 3 years to achieve this level of native composition). Although the species richness of native graminoids is often relatively low in this early stage of restoration, at least one cool-season and one warm-season grass are generally present. Based on the timing of a management treatment (e.g., late spring burn), the vegetative expression at a particular seeding may be skewed towards either cool- or warm-season species. However, the Service intends to manage for a near 1:1 ratio of cool- and warm-season grasses. For management purposes, native seedings that have a dominance of native grass, represented by both cool- and warm-season species, should be considered "established" and subsequently be managed and monitored. Permanent belt transects should be established on all native seeded tracts that are considered "established" within 3 years of that classification. Detailed information on monitoring methodology is present in rationale 1A in the native prairie habitat section.

Through properly timed and executed management activities (i.e., fire, grazing), native grass composition should increase to at least 15 percent above the minimum threshold for a native seeding to be considered "established" (50 percent). These seedings should become sites that, with modest management, resist invasion by exotic cool-season grasses and invasive plants. Ideally, native seedings in the refuge complex should become a functional part of the large, contiguous grassland blocks that support a variety of grassland-dependent birds. Permanent belt transects (Grant et al. 2004a) will be used to determine vegetative change over time and refuge complex-imposed minimum success thresholds (e.g., a frequency of occurrence of native grasses 65 percent).

Strategy 2A:

- Establish one permanent 82-foot (25 meter) belt transect for every 10 acres of upland on tracts with >25 total upland acres.
- Collect baseline plant species composition data at transects.
- Determine upland acreage of sites and employ systematic-random transect placement using the Service's RLGIS extension and associated data layers.
- Estimate percent native grass composition (e.g., 50 percent) through ocular estimation.

USFWS

Many strategies including grazing will be used to control invasive plant species.

Document native grass species (at least one cool-season and one warm-season grass) presence during a nonsystematic survey, conducted only after it is determined that native grass composition is 50 percent.

Strategy 2B:

- Determine native grass percent composition through the collection and evaluation of belt transect data 10 years after a native seeding is designated as "established."

Objective 3A: Over a 15-year period, continue to maintain perennial grass cover (i.e., DNC, tamegrass) on tracts that have not yet been seeded to native grass or begun the seedbank preparation process (e.g., multiple years of row cropping) for eventual reseeding.

Objective 3B: At 5-year intervals, actively manage 300 acres of North Dakota State Listed Noxious Weeds (e.g., leafy spurge, Canada thistle, absinth wormwood; Lym 2004) on old cropland portions of refuges and WPAs.

Rationales 3A and 3B:

Old cropfield tracts that have not yet entered into their seedbed preparation process will be maintained in an idle state, which generally consists of a predominance of exotic cool-season grass species. Prior to initiating seedbed preparation management for eventual seeding to native grass, these sites are of relatively low priority. Management efforts can be better directed toward higher priority upland areas (i.e., native prairie, tracts already reseeded to native grass, tracts being actively prepared for native reseeding). Despite their sometimes substantial degree of degradation from a floristic diversity standpoint, the presence of perennial grass cover will likely support multiple plant species and generalist birds, including upland nesting ducks

(Mark Sherfy, USGS, unpubl. data), northern harriers and sedge wrens (Johnson et al. 2004).

The presence of invasive plant species in old cropfields can, however, lead to additional infestations in new locations, as well as future invasive plant problems once native grasses are reseeded. Further, a total lack of effort to control invasive plants on even the lowest priority sites sends a negative message to area landowners and the visiting public (e.g., birdwatchers, hunters). The various problems associated with invasion by invasive plant species is discussed in detail in rationales 3A, 3B, and 3C of the undeveloped wetlands habitat section.

It is important, therefore, to address public complaints about invasive plants on Service-owned lands in the refuge complex and also to target active invasive plant management on a minimum acreage of old cropfields. A predetermined target treatment acreage will exist for a 5-year time span.

Strategies 3A and 3B:

- Chemically treat infested areas.
- Mow or hay infested areas.
- Graze infested areas.
- Burn infested areas to prepare the site for other control practices (e.g., biological control agents, chemical control).
- Release biological control agents (e.g., leaf spurge flea beetles).
- Use various combinations of the above treatments. Idle old cropland until native seeding site preparation activities (e.g., cropping, chemical fallowing) are initiated.
- Determine infestations that will receive treatment based on: 1) landowner or other public complaints; 2) RLGIS cover-type data (circa 2003–2006), and; 3) anecdotal observations of invasive plant infestations made by refuge complex staff, while conducting other work activities afield.

Planted and Exotic Woody Vegetation Sub-Goal: Reduce fragmentation of grasslands, caused by planted and exotic woody vegetation, and thereby increase the extent of contiguous grassland habitat, for the benefit of grassland-dependent bird species.

Background:
Tree and shrub plantings presently occur on 31 WPAs and all three refuges in the refuge complex.

USFWS

Western meadowlark, an "indicator" upland species

Some of these plantings existed prior to Service ownership of these lands, whereas, some were established after the acquisition of these lands. Although some planted tree and shrub species are native to North America (e.g., green ash, cottonwood, buffaloberry), many others are nonnative (e.g., caragana, Russian olive, Siberian elm). Nonetheless, woody vegetation that was planted in any fashion (i.e., single trees, rows, blocks) on Service lands within the refuge complex is considered an unnatural component of the historical habitat. Additionally, certain exotic species of woody vegetation (e.g., Russian olive, Siberian elm) are invasive and readily spread from plantings into new areas. Similarly, any exotic trees and shrubs that have colonized portions of WPAs and refuges are considered an unnatural component of the historical habitat.

Historically, the south-central portion of the state was part of a grassland-dominated system, where fire and grazing restricted natural tree growth to limited areas (e.g., wooded draws, leeward wetland edges, riparian floodplains; Higgins 1986). Naturally occurring native trees and shrubs presently exist in limited acreage on several WPAs and refuges.

Meeting the planted and exotic woody vegetation goal will require the removal of planted and exotic woody vegetation from Service lands. Ideally, upland habitats in the refuge complex will, over time, consist of large expanses of contiguous grassland habitat that provide a diversity of native flora and a mosaic of vegetative structure across a broad landscape.

The Service has selected ten bird species to serve as "target" or "indicator" upland species, which as a group reflect quality upland habitats on Service lands within the refuge complex. These species are the bobolink, chestnut-collared longspur, grasshopper sparrow, mallard, marbled godwit, northern harrier, sedge wren, sharp-tailed grouse, upland sandpiper, and western meadowlark. They were selected for a variety of reasons (see table 5), including that:

- all 10 species regularly nest on lands in the refuge complex;
- two species are endemic to the Great Plains and five others are secondary endemic species (Mengel 1970);
- eight are North Dakota Species of Conservation Priority (Hagen et al. 2005)
- six species are Birds of Conservation Concern (Service 2002)
- seven are Service Focal Species (Service 2005a)
- two are Stewardship Species under the North American Landbird Conservation Plan (Rich et al. 2004)
- two are Species of Concern under the United States Shorebird Conservation Plan (Skagen and Thompson 2003).

Upland habitat objectives in this CCP are geared toward the provision of quality habitats for these species. In addition to the target species, upland habitats found on Service lands within the refuge complex should benefit a much broader group of "secondary" bird species (appendix L), as well as a variety of other nonavian wildlife.
Because structural habitat preferences (e.g., vegetative high-density) of both the target and secondary species vary widely, it is assumed that the needs of all species will not be met on a single tract of Service land (e.g., WPA), but rather the needs of the target and secondary species groups will be met by providing a mosaic of vegetative structures (e.g., tall, dense cover; short, sparse cover) across many tracts of Service land in the refuge complex.

Objective 1A: Over a 15-year period, remove 15–30 acres (1–2 acres per year) of planted and other exotic woody vegetation from WPAs and refuges. During the first 10 years, target removal efforts will target individual trees and shrubs, fields invaded by exotic saplings, and single- to few-rowed linear plantings. During years 10–15, expand the removal efforts to target many-rowed linear plantings and "block" plantings, based on the results of prior systematic wildlife surveys (see objective 1B).

Objective 1B: Between years 5 and 10 after completion of this CCP, complete two separate systematic wildlife surveys (one during summer, one during the following winter) in at least 2 of the 5 years, at three extensive planted woody vegetation areas (i.e., many-rowed linear plantings, "block" plantings).

Rationales 1A and 1B:

Prior to European settlement, scattered patches and corridors of native trees and shrubs were the only woodland features in the prairie landscape of the northern Great Plains (Rumble et al. 1998). Today, although numerous patches of native woodlands still exist in the northern Great Plains, once large expanses of nearly treeless prairie are now intermixed with cropland and scattered small (<5 acres) linear and block-shaped tree plantings (also commonly referred to as windbreaks, shelterbelts, and tree belts). Baer (1989) estimated that these plantings cover three percent of the land area in South Dakota. In Emmons County, North Dakota, alone, local county conservation districts and the Natural Resources Conservation Service annually plant more than 130,000 trees (Jacobs, Natural Resources Conservation Service, pers. commun.). Tree plantings are designed to reduce soil erosion from croplands (Baer 1989) 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, Winter et al. 2000, Ribic and Sample 2001).

Additionally, the suppression of ecological processes, such as fire, has allowed an increase in woody encroachment into grassland habitats (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 (Sampson and Knopf 1994, Herkert 1995). An extensive body of literature indicates that planted and/or exotic trees in prairie landscapes are often negatively associated with a variety of avian taxa (Bakker 2003).

Several studies have documented a reduced probability of occurrence of grassland passerines in areas rich in woody vegetation and at limited distances from woody vegetation. Bakker et al. (2002) determined that in eastern South Dakota grasslands, the sedge wren, grasshopper sparrow, and western meadowlark, among other species, exhibited a decreased probability of occurrence as the amount of woody perimeter increased. Further, Bakker (2000) suggested that bobolinks, grasshopper sparrows, and western meadowlarks were all negatively associated with increased proportions of woodland habitat in the eastern South Dakota landscape.

In Oklahoma, most grassland birds, including the western meadowlark and grasshopper sparrow, exhibited population declines related to the invasion of woody species (Coppedge et al. 2001). Areas with the least amount of woody vegetation retained core area characteristics suitable for several area-dependent species. Stauffer and Best (1980) found that in Iowa, western meadowlarks preferred pastures and haylands over woody areas. Western meadowlark nest density was negatively correlated with sapling/tree richness. In New York, bobolink abundance was significantly lower in fields with approximately 25 percent woody cover than in old hayfields with <25 percent woody cover (Bollinger and Gavin 1992). Habitats with >25 percent woody cover were determined to be unsuitable for bobolinks.

In southern Wisconsin, no western meadowlark territories contained trees, and only 10 percent of grasshopper sparrow territories contained trees (Wiens 1969). Kahl et al. (1985) characterized typical grasshopper sparrow habitat in Missouri as having no woody vegetation >3.3 feet (1 meter) tall. In Illinois, numbers of singing males of five species, including the grasshopper sparrow and bobolink, increased in fields of similar size with progressively less planted tree belt acreage (O'Leary and Nyberg 2000). In Georgia, grasshopper sparrows were found in fields with 10 percent shrub cover and were absent from fields containing 35 percent shrub cover (Johnston and Odum 1956). Similarly, in West Virginia, grasshopper sparrow territories had lower shrub cover (mean 0.7 percent) than nonterritories (mean 31.1 percent; Whitmore 1981).

Helzer (1996) found that in Nebraska, grasshopper sparrow abundance increased significantly when >246 feet (75 meters) from wooded edges. Also, in Nebraska, none of the ten recorded grasshopper sparrow nests were within 164 feet (50 meters) of edge habitat (e.g., wooded draws; Delisle and Savidge 1996). In western Minnesota, the probability of grasshopper sparrow and western meadowlark nest occurrence was lower in habitats <148 feet (45 meters) from forest edges (Johnson and Temple 1990a). Similarly, in southwestern Wisconsin, total nest density for grasshopper sparrows and bobolinks increased linearly with distance from woody edge (Renfrew 2002).

This documentation demonstrates that planted tree belts and invaded exotic trees and shrubs likely have a negative impact on grassland passerine use of Service lands in the refuge complex. The refuge complex staff is working with the University of Montana and other refuges and districts in North Dakota and South Dakota to evaluate the effects of tree belts on grassland birds. In 2005, staff evaluated bird use at varying distances from planted tree belts (66–722 feet [20–220 meters]) on three WPAs and one refuge in the refuge complex. In the winter of 2005–06, refuge complex staff removed the treebelts on two of these sites, in order to evaluate before-and-after bird use at these sites through continued surveys in 2006. Preliminary data from Service study sites, as well as others in the eastern Dakotas, suggested increasing densities of both bobolinks and sedge wrens (as well as other passernine species) at increasing distances from treebelts and in open (treeless) grassland control sites (figure 17; Quamen, University of Montana, unpublished data) Further, at four sites in eastern South Dakota where before-and-after tree removal bird surveys were conducted in 2004 and 2005, data indicated that although grassland birds may avoid trees, they may also redistribute to areas they previously avoided, after trees have been removed (Quamen, University of Montana, pers. commun.).

Regarding predation rates and associated nest-success rates, Bergin et al. (1997) suggested that wooded areas in Iowa provide cover for mammalian predators and elevated perches for avian predators. Additionally, certain predators (e.g., raccoons) have an affinity for wooded habitats and use them for travel and foraging. In Missouri, artificial nests located <197 feet (60 meters) from woody cover were less successful than those located >197 feet from woody cover (predation rates of 28.7 percent versus 7.9 percent). Distance to woody cover also explained twice as much variation in predation rates as did grassland patch size. Similarly, in western Minnesota, nest predation rates were lower for five species, including the grasshopper sparrow, bobolink, and western meadowlark, in nests located 148 feet (45 meters) from woody vegetation (Johnson and Temple 1990a,b). Further, in West Virginia, woodlots surrounding a 103-acre (41 hectare) reclaimed grass site concentrated predators and resulted in low-nesting success for grasshopper sparrows, according to Wray et al. (1982). Additionally, several studies examined the effect that woody vegetation had on brown-headed cowbird nest parasitism rates and abundance. Davis and Sealy (2000) found that female cowbirds were more abundant, and nests of other birds were more frequently parasitized, on a shrub-bordered study site in southwestern Manitoba. Increased cowbird activity was attributed in part to the increased availability of perches at this site, as compared to other study sites. Gates and Gysel (1978) also determined that brown-headed cowbird parasitism was higher near field-forest edges. In western Minnesota, nest parasitism was lower for nests 148

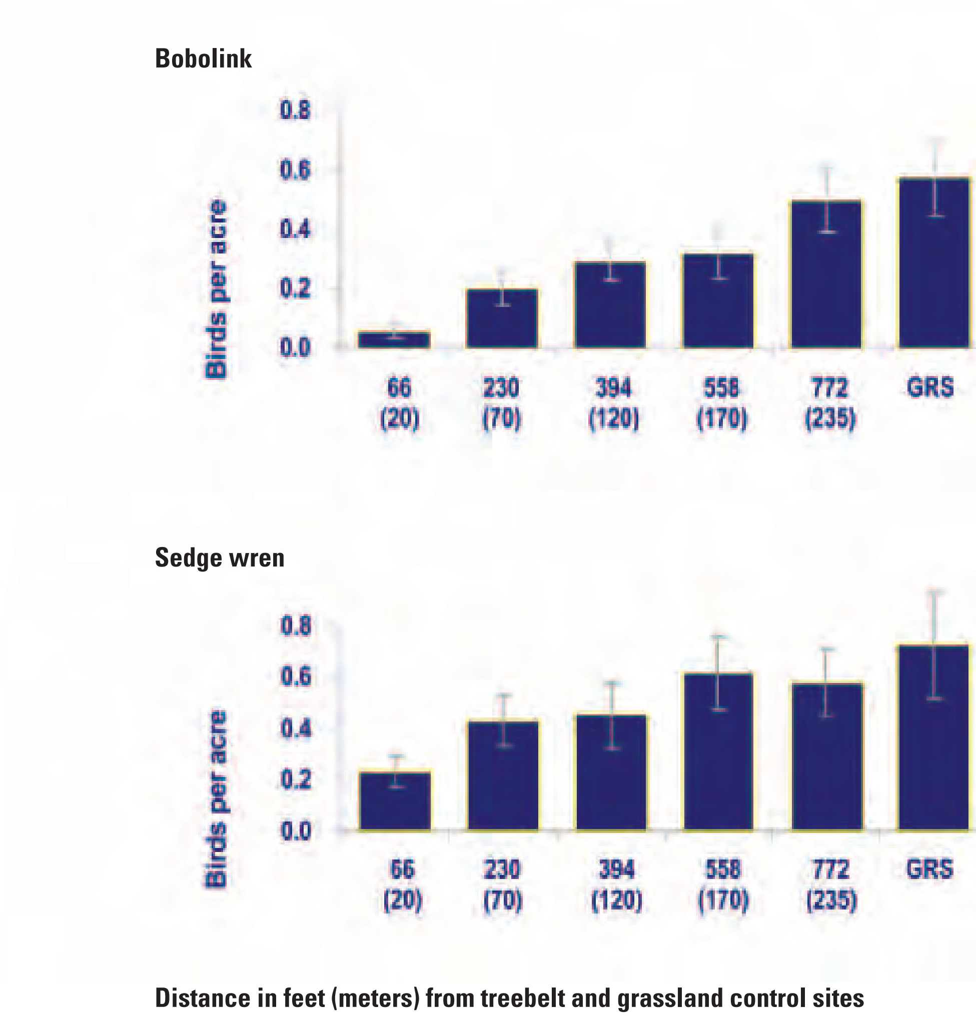

Figure 17. Densities of bobolinks and sedge wrens at increasing distances from treebelts and in open grassland control sites (GRS) in North Dakota and South Dakota during 2005 (n = 48; Frank Quamen, University of Montana, unpublished data).

feet from wooded edges for five species, including the grasshopper sparrow, bobolink, and western meadowlark (Johnson and Temple 1990b).

Concerning upland-nesting ducks, a study of South Dakota stock ponds found that mallard brood use was negatively associated with the proportion of shoreline with trees (Rumble and Flake 1983). In Idaho, duck nest success was 6.8 percent where Russian olive abundance was high, 19.8 percent where it was moderate, and 42.9 percent where it was low (Gazda et al. 2002). Artificial nest survival increased with distance from the nearest Russian-olive trees.

Several studies have examined use of planted cover by gallinaceous birds, such as sharp-tailed grouse and ring-necked pheasants. In Manitoba, sharp-tailed grouse were found to abandon leks once woody vegetation exceeded a certain percent coverage (Berger and Baydack 1992). Similarly, in Minnesota, Hanowski et al. (2000) determined that sharp-tailed grouse were sensitive to even small increases (1–2 percent) in the amount of woody vegetation. Active sharp-tailed grouse leks had significantly lower proportions of upland forest and brush cover types and higher proportions of native grasses within 1,640 feet and 3,281 feet of the site, than inactive leks.

Despite the fact that trees and shrubs are often planted to provide winter habitat for ring-necked pheasants, a number of studies suggest that these plantings may have some negative affect on this species. During typical South Dakota winters and during the early part of a severe winter (one every 10–15 years), cattail-choked wetlands, tall grass cover (>29.5 inches), and food-plot habitats were used to the greatest extent by females (Gabbert et al. 1999). Woodland and farmstead habitats were only preferred during the late stages of the severe winter. Authors concluded that cattail-choked wetlands, grassland habitat, and food plots are crucial for winter ring-necked pheasant survival. During severe winters, dense woody cover may prevent substantial ring-necked pheasant losses.

According to Larsen et al. (1994), in South Dakota the presence of wetland and grassland cover in the landscape were the most important variables determining food plot use. Tree cover appeared to be negatively associated with winter food plot use, primarily due to the negative relationship between trees and herbaceous winter cover. Tree plantings may also serve as a reproductive "sink" for ring-necked pheasants during the breeding season. Hanson and Progulske (1973) found that between June and October ring-necked pheasants in South Dakota used shelterbelts only intermittently. Nest success of ring-necked pheasants in that study ranged from a high of 34.1 percent in idle farmland (tamegrass cover), to 13.6 percent along roadsides and in small grain fields, to only 9.1 percent in shelterbelts (Olson and Flake 1975).

Similarly, Trautman et al. (1959) documented that in South Dakota the heaviest predation rates on ring-necked pheasant nests were in roadside, fencerow, and shelterbelt habitats. In Colorado, ring-necked pheasant nest predation was greater (33 percent) on or near (<0.37 miles [0.60 kilometers]) an area with extensive tree plantings than at more distant locations (14 percent) (Snyder 1984). In areas near extensive tree plantings both avian and mammalian predators decreased nest success, whereas mammals were the major source of predation farther (>0.37 miles [0.60 kilometers]) from the tree plantings. In Oklahoma, the ring-necked pheasant exhibited population declines related to the invasion of woody species (Coppedge et al. 2001).

Based on the above scientific findings, planted and invaded exotic woody vegetation will be removed from WPAs and refuges, as time, staffing constraints, and funding allow, with an initial emphasis being placed on: 1) individual trees and shrubs; 2) fields invaded by exotic saplings, and; 3) single- to few-rowed linear plantings. Removal actions will be conducted to meet the established planted and exotic woody vegetation goal. The Service anticipates that these areas of "limited" woody vegetation will offer more practical removal efforts than many-rowed linear plantings and "block" plantings. Additionally, from a habitat standpoint, these "limited" woody vegetation areas offer less to wildlife than their more extensive counterparts (i.e., many-rowed linear plantings, "block" plantings).

Because evidence suggests that extensive areas of dense woody vegetation provide important winter cover for resident bird species (e.g., sharp-tailed grouse, ring-necked pheasant; Parker 1970, Hillman and Jackson 1973, Sisson 1976, Berg 1990, Meints 1991, Gabbert et al. 1999) and they receive a certain degree of use from a variety of migratory woodland-bird species (e.g., yellow-rumped warbler, red-headed woodpecker, loggerhead shrike) and other wildlife (e.g., white-tailed deer), refuge complex staff proposes to evaluate the overall wildlife importance of these habitats on lands in the refuge complex through a series of systematic wildlife surveys, prior to determining their fate (e.g., removal).

Strategy 1A:

- Cut standing trees and shrubs and remove below-ground woody material (i.e., stumps, roots) using chainsaws and a variety of heavy equipment.
- Apply herbicides in situations where suckering occurs or is anticipated.
- Pile and burn downed woody material.

Strategy 1B:

- Use modified area-search methodology (Ralph et al. 1993) or other methodologies (e.g., Emlen 1977) to evaluate seasonal wildlife use.

Objective 2: Restore bare areas that result from woody vegetation removal to perennial grass cover within 6 years of the removal action.

Rationale 2:

Bare areas that occur as a result of tree and shrub removal will be prone to invasion by a variety of invasive forbs, some of which are North Dakota State Listed Noxious Weeds (e.g., absinth wormwood, Canada thistle; Lym 2004). Absinth wormwood and Canada thistle both readily colonize sites that have been disturbed, or are undergoing manipulative restoration management (Hutchinson 1992, Sedivec and Barker 1998, Liu et al. 2000). Both of these plant species are aggressive alien invaders that are capable of crowding out and replacing native grasses and forbs (Wrage and Kinch 1981, Hutchison 1992). Where they become established, they can alter the natural vegetative structure and species composition. New infestations, resulting from tree- or shrub-removal disturbance, could potentially serve as a seed source for invasion into surrounding grassland areas. To reduce this risk, refuge complex staff will informally survey these bare areas annually for invasive plant occurrence. New infestations will be treated with herbicides and/or other appropriate management practices (e.g., mowing). To reduce the overall likelihood of removal-site invasive plant infestations, refuge complex staff will attempt to reseed these areas to perennial grass cover within 6 years of woody vegetation removal. In some cases broadcast spot seeding will be used (i.e., areas where a small number of trees or shrubs were removed), but in most cases the field (e.g., management unit) associated with the removed trees (generally old cropland) will be targeted for immediate native-restoration site preparation.

Strategy 2:

- Spray appropriate herbicides for invasive plant invasions (e.g., wormwood), as needed, prior to native grass reseeding.
- Prepare a seedbed through 2–3 years of cropping, followed by 1–2 years of chemical fallowing.
- Reseed to a cool- and warm-season native grass mix.

Priority Population Issues Sub-Goal:
Improve protection and quality habitat for federally threatened, endangered, and candidate species that may occur on lands in the refuge complex.

Objective 1A: Over a 15-year period, annually place nest exclosures over piping plover nests found within the Long Lake WMD and monitor fate of caged nests, to the extent possible with existing staff.

Rationale 1A:

The northern Great Plains population of piping plovers is listed as threatened in the United States (Service 1985) due to a poorly understood decline in abundance. Mabee and Estelle (2000) suggested that nest predation is a major problem limiting piping plover nest success throughout their range. However, according to Murphy et al. (2003), predators can successfully be deterred from depredating eggs of piping plovers by placing large(10-foot [3 meter] diameter) mesh exclosures (cages) over individual nests. Recruitment has improved through the use of these cages in the northern Great Plains (Murphy et al. 2003). The refuge complex staff plans to erect these exclosures over piping plover nests that are encountered within the boundaries of the refuge complex; not limited to Service lands, when permission is granted on private property. However, the ability of the refuge complex staff to cage and monitor all documented piping plover nests in a given year will depend upon multiple factors, including staff and budget constraints, as well as the number of piping plover nests found. For example, despite the fact that a relatively small number of piping plover pairs and or nests (e.g., <five) have been documented on survey wetlands in the district in recent years, 107 pairs of piping plovers were recorded on eight wetlands surveyed during the International Piping Plover Census in 2006.

Exclosures placed after one egg has been laid in the nest bowl have resulted in <two percent nest abandonment on an operational basis in the

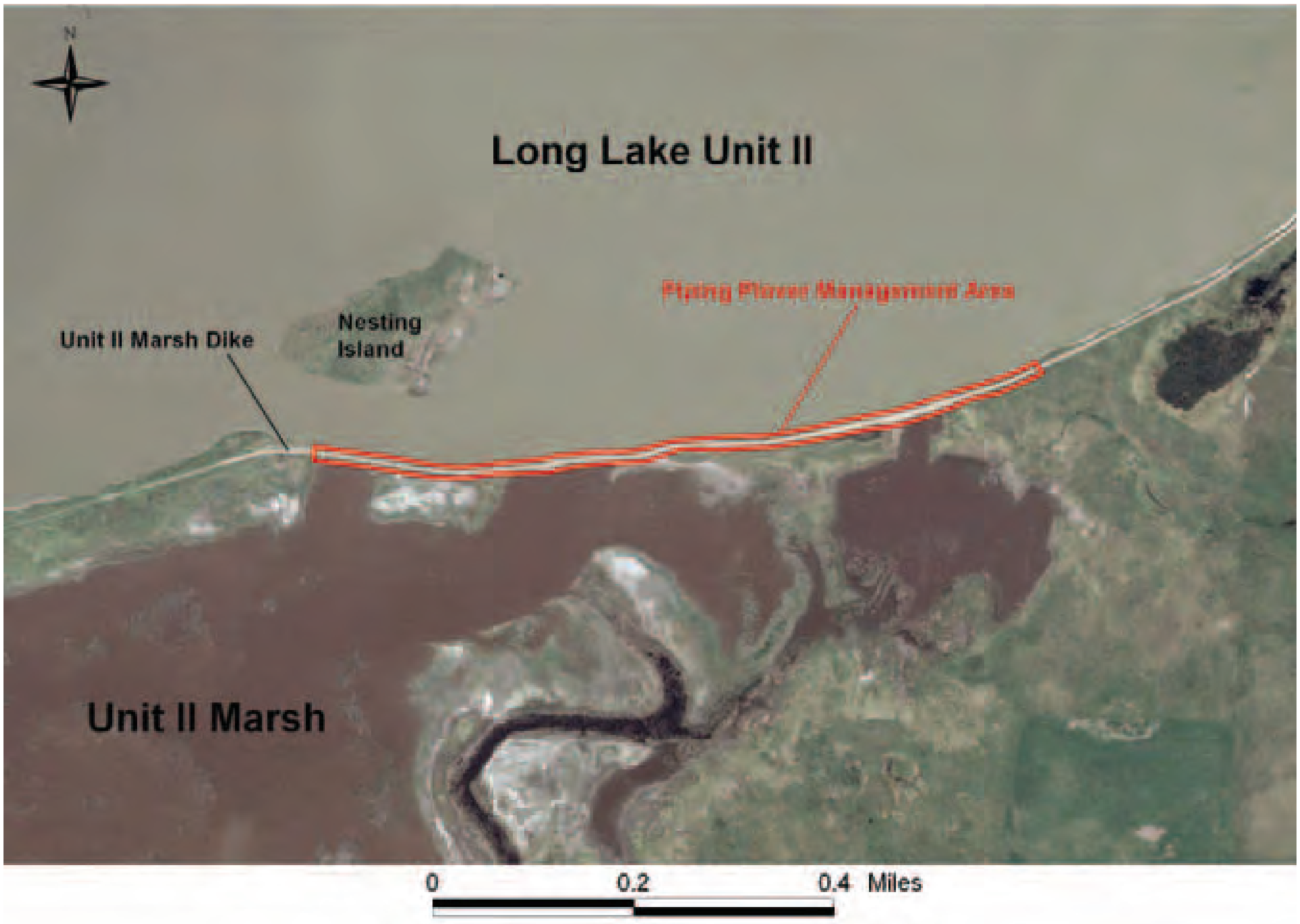

Figure 18. Unit II marsh dike piping plover management area (0.7 mile).

Rationale 2:
The whooping crane is one of the most endangered birds in North America. Presently, the only naturally occurring wild, migratory population in the world numbers fewer than 215 individuals (Tom Stehn, Service, per. commun.). Each fall, a number of whooping cranes use wetlands and agricultural fields in North Dakota as migratory stopover areas en-route to their wintering grounds in Texas. In particular, Long Lake NWR is one of the most frequently used stopover areas in the state (Beyersbergen et al. 2004). In addition to occasional whooping cranes, several thousand sandhill cranes stage in the central portion of the state each fall, where they are a relatively popular game species. Due to the large number of sandhill cranes that stage at Long Lake NWR each fall (between 10,000 and 25,000 during most years) and the refuge's proximity to Bismarck, it is one of the state's most popular destinations for sandhill crane hunters. Because of the often close interaction between sandhill and whooping cranes and their use of similar habitats, potential exists for a whooping crane to be accidentally mistaken for a sandhill crane and shot. In 2004, two whooping cranes were shot and killed near Quivera NWR in south-central Kansas by sandhill crane hunters who mistook them for the huntable species. Since 1968, there have been several other shooting incidents involving the whooping crane, four in Texas and one in Saskatchewan, Canada (Richard Hinton, Bismarck Tribune, pers commun. 2003). The Service hopes that by informing and educating area hunters about the whooping crane's use of the refuge, it can greatly reduce any risk of an accidental shooting. The Service will consult the Whooping Crane Contingency Plan (Service 2001) for appropriate actions when dealing with fall migrant whooping cranes that show potential for remaining in a particular portion of the refuge complex for multiple days.

Strategy 2:

- Post warning signs in the area being used by whooping cranes.
- Contact local media (e.g., radio, television, newspapers) upon confirming fall observations, where it appears that

northwestern portion of the state and northeastern Montana (Ryba, Service, pers. commun.).

Strategy 1A:

- Erect wire mesh cages with netted tops over piping plover nests.
- Monitor fate of caged nests by searching for "pick chips" in or near the nest bowl and/or timing nest visits based on known (or suspected) nest initiation date, laying rate, and mean incubation period.

Objective 1B: Over a 15-year period, use a variety of vegetation control methods to restrict annually vegetation on a 0.7-mile section of unit II marsh dike to 5 percent coverage. Control methods will not be conducted between May 15 and August 7 (Stewart 1975) or any time that piping plovers are present in the unit II marsh area.

Rationale 1B:

Piping plovers do not generally nest in areas of evenly distributed vegetation (Prindville Gains and Ryan 1988). Additionally, Espie et al. (1996) found that in Saskatchewan, depredated piping plover nests were closer to vegetation than successful nests. The portion of Long Lake NWR where the greatest extent of piping plover nesting activity has occurred in recent years (2001–2005) is atop the central portion of unit II marsh dike. This dike was resurfaced by Ducks Unlimited from 1999–2000, after high-water events in the mid-1990s severely damaged the embankment. Substrate used to repair the dike consisted of a substantial seed bank of various weedy upland plants (e.g., field pennycress). Therefore, although this substrate has shown to be of suitable composition for piping plovers, it also readily re-vegetates each year. Without intervention (mechanical disturbance) vegetation expands to become the predominant cover type on the dike. Refuge complex staff plans to annually remove as much of this vegetation as possible along a 0.7-mile portion of this dike (figure 18), through a variety of means, prior to and following the piping plover nesting season, to continue to provide quality piping plover breeding habitat at this location.

Strategy 1B:

- Determine percent coverage of vegetation by ocular estimation.
- Apply herbicides and mechanical disturbance (i.e., grading) to remove upland vegetation.

Objective 1C: Within 10 years of the completion of this CCP, complete a single survey for the presence of piping plovers on 50 percent of the wetland basins in the refuge complex identified by a HAPET-developed predictive model as having habitat potentially suitable for breeding piping plovers.

Wetlands on which breeding piping plovers have already been documented will be excluded.

Rationale 1C:

Beginning in 1991, biologists from throughout North America collaborated in a monumental effort known as the International Piping Plover Census (Haig and Plissner 1993). Both breeding and wintering habitats were censused in an effort to: 1) establish benchmark population levels for all known piping plover sites; 2) survey additional potential breeding and wintering sites, and; 3) assess the current status of the species relative to past population estimates. Since 1991, the International Piping Plover Census has been conducted at 5-year intervals (1996, 2001, 2006) at sites censused in 1991 and a very limited number of new sites (Plissner and Haig 2000). Refuge complex staff has participated in each of these survey efforts.

In an attempt to identify additional sites that have habitat potentially suitable for piping plovers, HAPET developed a predictive model through use of satellite imagery and data from the national wetlands inventory. This model identifies individual wetlands based on the presence of suitable habitat (i.e., alkaline gravel substrate lacking upland or wetland vegetation). In addition to resurveying sites of known piping plover activity to determine population trends at 5-year intervals, refuge complex staff additionally plans to survey new sites predicted by HAPET's model (figure 19). This effort will allow staff to develop a better understanding of the role Service and private lands in Burleigh, Kidder, and Emmons counties play in the recovery of piping plovers, as well as determine wetlands in need of protection through acquisition (i.e., fee title, wetland easement) or Piping Plover Critical Habitat designation.

Strategy 1C:

- Survey wetlands for piping plovers by the most appropriate means (e.g., boat, walk shoreline, view from vehicle with spotting scope).
- Surveys will be conducted between early and mid-June.

Objective 2: Over a 15-year period, inform the hunting public of fall, migrant whooping cranes using lands in the refuge complex, in an effort to reduce the risk of an accidental shooting.

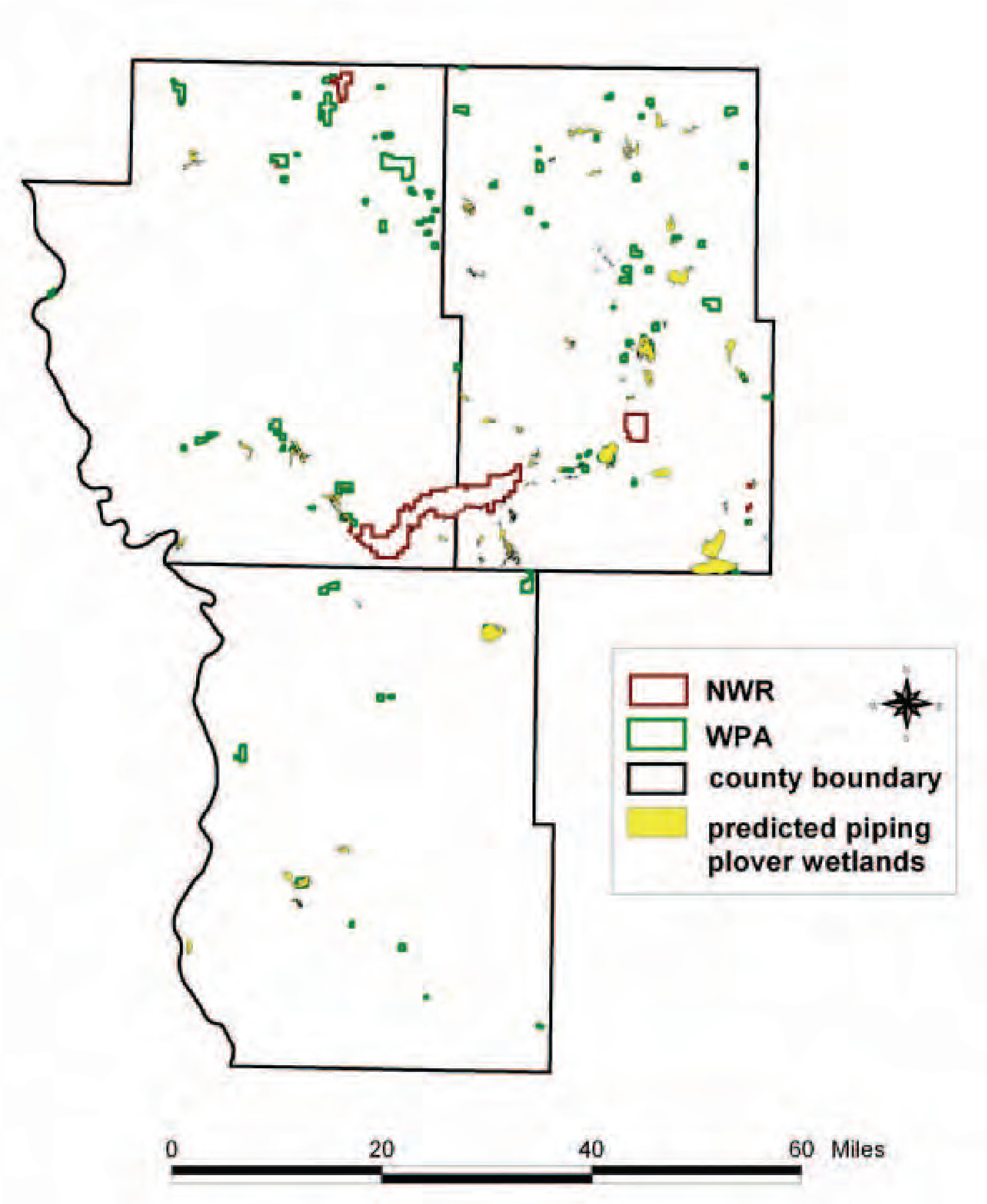

Figure 19. Predicted piping plover breeding wetlands

whooping cranes will stay in the area for multiple days and where hunting activity exists or is likely.

- Actively patrol areas being used by whooping cranes to periodically monitor their whereabouts and inform hunters of their presence.
- On a case-by-case basis (i.e., individual occurrence of a whooping crane[s]), consider the merits of a possible voluntary hunting closure on private lands where whooping crane use is occurring regularly. If it is deemed appropriate, contact the necessary landowner(s) to discuss a possible voluntary closure in accordance with the current Whooping Crane Contingency Plan (Service 2001).

Objective 3: At 5-year intervals, native prairie portions of refuges and WPAs >80 acres in size will be reevaluated as to their suitability as Dakota skipper habitat, based on new vegetative species composition data. Sites deemed suitable for the Dakota skippers (Tier II; Murphy 2005) will be managed in accordance with their habitat needs and will be surveyed 1 time to document Dakota skipper presence or absence, within 5 years of classification.

Rationale 3:

In 2005, refuge complex staff classified the degree of Dakota skipper habitat potential that existed on Service lands within the refuge complex, according to guidelines in a Service Conservation Strategy for Dakota Skippers in North Dakota and South Dakota (Murphy 2005). It was determined that only a portion of a single tract of land (Schiermeister WPA) presently has habitat characteristics (i.e., size, vegetative species composition) that indicate possible Dakota skipper occurrence (Tier II; appendix J). Upland habitat management of this WPA unit will follow guidelines presented in the Service Conservation Strategy (Murphy 2005). Additionally, any Service lands in the refuge complex that have habitat capable of supporting Dakota skippers need to be systematically surveyed in an attempt to document the presence or absence of this species. Further, periodic reevaluation (i.e., every 5 years) of native prairie tracts must be completed to capture changes in vegetative species composition that occurs over time as a result of Service management, climatic changes, or other factors (e.g., new invasion by exotic plant species). During the summer of 2006, a University of North Dakota professor conducted surveys for Dakota skippers on native portions of Braun and Schiermeister WPAs and Florence Lake NWR. No Dakota skippers were collected or documented; however, skippers (Family Hesperiidae) were seen at all three sites, but could not be captured for more specific identification. According to Goodwin (University of North Dakota, pers. commun.), relying on vegetative survey data may be a more appropriate means of determining Dakota skipper presence, compared to actual butterfly surveys, based on the rarity of the species and the short flight period.

Strategy 3:

- Use new belt transect (Grant et al. 2004) data to re-evaluate vegetative species composition.
- Systematically survey for Dakota skippers using either the “checklist” or “Pollard Walk” methods (Royer et al. 1998).
- Contract survey work to qualified lepidopterists.

Predator Management Sub-Goal:
Through management efforts, support upland duck nesting success sufficient to achieve recruitment rates, at or above, maintenance level (0.49).

Objective 1: Over a 15-year period, reduce indirect effects of heightened predation rates through the removal of artificial microhabitats (e.g., rock piles, abandoned buildings, downed fences, and miscellaneous junk) on ≥10 WPAs or refuge management units.

Rationale 1:

Abandoned buildings are often used by raccoons as winter shelter, den sites, and resting areas. These areas also provide year-round cover, and often a source of food (e.g., seeds, grains, rodents; Sovada et al. 2004). According to Larivière et al. (1999), skunks often winter, rest, and raise their young in rock piles and under abandoned structures. Removing unnatural microhabitats (e.g., rockpiles, abandoned buildings) from Service lands may reduce the attractiveness of these areas to several waterfowl predators (Dixon and Hollevoet 2005); however individual predators will simply relocate to nearby suitable habitats.

Removing abandoned structures and rock piles is a costly endeavor that likely will not single handedly result in improved nest success for waterfowl (Sovada et al 2004). Therefore, refuge complex staff plans this removal effort to be a part of a multifacetted strategy aimed at meeting the predation management goal. Removal of planted and exotic woody vegetation should also benefit upland duck nesting recruitment. However, the goal, objectives, rationale, and strategies for this effort are covered in detail under the planted and exotic woody vegetation section of this CCP.

Strategy 1:

- Focus initial efforts in areas of highest breeding duck pair density (i.e., 80 pairs per square mile).
- Bury or remove rock piles. Remove other "junk" (e.g., old equipment bodies, old, nonfunctional culverts) and downed fences. Demolish and burn abandoned buildings.

Objective 2: Within 10 years of the completion of this CCP, initiate predator removal activities at no less than one 36 square-mile site within the refuge complex, in order to support mean upland duck nest success rates ≥20 percent, over a ≥3-year period.

Rationale 2:

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 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 (e.g., northern harrier, short-eared owl), and upland gamebirds (Martin 1988, Martin 1995, Helmers and Gratto-Trevor 1996).

Several studies support the hypothesis that predator (e.g., striped skunk, raccoon, red fox) removal increases waterfowl nest success (Mense 1996, Garrettson et al. 1996, Zimmer 1996, Hoff 1999, Garrettson and Rohwer 2001), productivity (Sovada et al. 2001), and brood production (Balsar et al. 1968, Duebbert and Lokemoen 1980, Sargeant et al. 1995, Garrettson et al. 1996). 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 be comprised of 40 percent grass cover 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 (e.g., climatic conditions) that influence waterfowl recruitment. Additionally, Sargeant et al. (1995) and Garrettson et al. (2001) both concluded that predator control on large blocks is more efficacious than on smaller areas.

Past surveys of upland duck nest success on lands in the refuge complex indicate that in some years duck nests suffer predation at levels which suppress nest success to a point below a minimum maintenance threshold (15–20 percent). For example, in 2002, nest success was determined to be three percent, based on 79 duck nests at Long Lake NWR. Additionally, several studies have shown that the nest success for ducks on refuges and WPAs throughout much of the PPR is often less than the recommended minimum nest success values of 15–20 percent (Cowardin et al. 1985, Greenwood 1986, Klett et al. 1988, Greenwood et al. 1990). Furthermore, Klett et al. (1988) suggested that while conservation programs may curb grassland and wetland losses, a minimal increase in duck nest success will occur unless mammalian predation is reduced. Based on the above information, professional trapper(s) will be hired to reduce mammalian predator populations on large township-sized blocks (approximately 36 square miles) over a period of 3 years.

The refuge complex staff developed a Predator Management Plan in 1993. This plan authorized predator control, performed by personnel and their authorized agents, outside the normal trapping season. It authorized public trapping on refuges administered under the refuge complex, through issuance of a special use permit (SUP) to permittees for trapping during the state trapping season. Trapping targets predator management and infrastructure maintenance objectives.

Recreational trapping is available on all WPAs in the district, in accordance with NDGF trapping regulations.

A decision matrix developed by HAPET (figure 20) will allow the assessment of the wetland density, breeding duck pair density, and grassland cover in an area to aid in the decision making process for focusing predator management activities. The refuge complex staff will focus its efforts only on what it determines to be the highest priority areas, with respect to this management technique: 1) 60 duck pairs per square mile and 2) 20–40 percent grassland cover (Dixon and Hollevoet 2005).

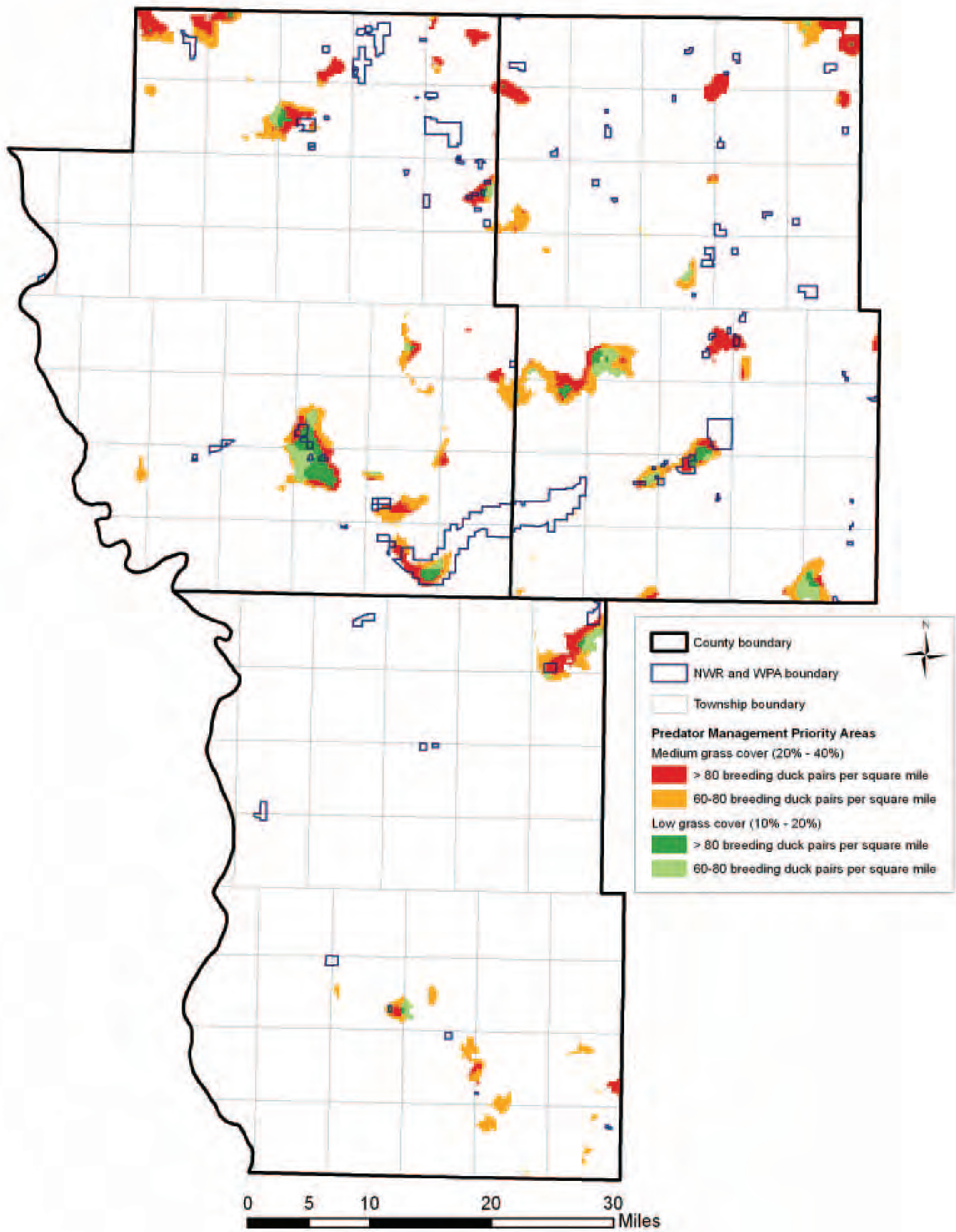

Figure 20. Priority areas for large-block predator management, relative to the percent grass cover on the landscape and the number of breeding duck pairs per square mile.

An evaluation of upland duck nesting success on a sample of study sites within the predator removal area will be conducted during each year of predator removal to determine if a mean nest success rate of 20 percent or greater was achieved (Mayfield 1961).

Strategy 2:

- Contract the services of a professional trapper to remove mammalian duck nest predators within a selected township-sized block of land (approximately 6 miles x 6 miles).
- Remove predators for a four-month period between March 15 and July 15 (Dixon and Hollevoet 2005).
- Obtain permission to trap across 80 percent of a selected predator removal block, including both public and private lands (Dixon and Hollevoet 2005).
- Annually determine upland duck nest success rates, on five 80-acre sites chosen through systematic-random selection, using chain drag methodology (Klett et al. 1986). Alternatively, refuge complex staff may use other new or developing methods to determine the effectiveness of predator management activities. For example, scientists with Delta are experimenting with the use of brood count indices as a measure of predator management success (Dixon, Service, pers. commun.)

Objective 3: Within 10 years of the completion of this CCP, initiate annual predator removal activities at no less than three priority islands on Service lands within the refuge complex to support mean upland duck nest success rates ≥40 percent.

Rationale 3:

Naturally occurring and created islands (includes peninsula cut-offs) are present on various WPAs and refuges throughout the refuge complex, as well as throughout the PPR of North Dakota and South Dakota. Research has shown that islands in the Dakotas have higher waterfowl nest densities and higher nest success than in surrounding upland areas (Lokemoen and Woodward 1992). Duck species that show the greatest affinity for islands are mallards, gadwall, and lesser scaup; however, Canada geese, shorebirds (e.g., Wilson's phalarope), and colonial waterbirds (e.g., common tern, California gull) also readily nest on islands (Lokemoen and Woodward 1992).

Nest success is usually higher on islands than on surrounding uplands, because access by mammalian predators is limited (Giroux 1981, Williams and Crawford 1989). Therefore, Duebbert et al. (1983) concluded that predator removal efforts on islands, prior to, and during, the nesting season, result in high nest success rates with relatively little effort. Lokemoen et al. (1987) found that when predators were removed from nine islands in the Devils Lake area, total nests increased by 799 (n=851) and nest success increased by 71 percent (87 percent), as compared to one year prior to predator removal.

Based on knowledge of waterfowl nesting dynamics on natural and created islands in the PPR and knowledge regarding the success of predator removal efforts on upland duck nesting success (discussed in detail in rationale 2 above), the refuge complex staff proposes to initiate predator removal efforts on selected Service-owned islands within the refuge complex, in an attempt to make these predator-limited microhabitats predator-free, or nearly so. Because research suggests that duck nest success on islands is generally higher than on surrounding uplands without any supplemental management, objective 3 aims for a greater mean nest success (40 percent) than does objective 2 (township-sized block predator removal effort).

Strategy 3:

- Remove mammalian duck nest predators on selected islands. Work will be done by either the refuge complex staff or a contracted professional trapper.
- Remove predators for approximately a 4-month period between March 15 and July 15 (Dixon and Hollevoet 2005).
- Determine upland duck nest success rates on all islands where predator removal activities occur, once every 2 years.
- Use current aerial photography to identify all manageable (i.e., predator removal) islands on refuges and WPAs in the refuge complex.

Objective 4: Oversee the placement of hen houses on priority WPAs and refuge wetlands through a partnership with Delta Waterfowl, Inc. Delta will erect new hen houses at a rate that will increase the total number that existed on lands in the refuge complex in 2005 (n=23) by 10 percent a year, over a 15-year period. Delta will annually determine duck use, nest, success, and maintenance needs. It will replace nesting material at all existing hen houses.

Rationale 4:

Artificial duck nesting structures provide secure nest sites for ducks because they put the nests out of reach of most mammalian predators (Sovada et al. 2004). Both Artmann et al. (2001) and Chouinard (2003) reported >80 percent nest success by mallards using artificial structures. Nest success by ducks using these structures (largely mallards) is generally high (Dixon and Hollevoet 2005).

Eskowich et al. (1998) suggest that because mallards are highly philopatric, use of nest structures has potential to increase local production and ultimately local populations. Comparison of several mallard nesting structure designs has shown that flax straw-woven tunnel designs (hereafter hen houses) appear to be the most effective (Eskowich et al. 1998). Using a RLGIS model developed by HAPET, refuge complex staff plans to select semipermanent and permanent wetlands in areas that contain <40 percent grassland and >10 mallard pairs per square mile (Dixon and Hollevoet 2005) for placement of new hen houses.

Strategy 4:

- Prioritize hen house placement on WPAs and refuges utilizing a model generated by HAPET.
- Delta members will erect hen houses in ice-covered wetlands between the months of December and March.
- Refuge complex staff will provide various types of support (e.g., materials, special access provisions, maps and aerial photos, priority placement locations) for this effort.

Wildlife Disease Sub-Goal:
Manage habitats and wildlife populations to minimize or avoid wildlife disease outbreaks, whenever possible. Respond to outbreaks in accordance with established protocols that promote safe and effective Service actions.

Objective 1A: Complete a refuge complex avian disease contingency plan within 1 year of the completion of this CCP to address all existing avian diseases (e.g., botulism) and those that are now emerging (e.g., avian influenza).

Rationale 1A:

Because of emerging disease threats, refuge complex staff can no longer rely on past informal disease protocols. Avian disease response will be a readily evolving process. Prior to 2006 and the present threat level regarding highly pathogenic avian influenza (HPAI) in North American migratory birds, the refuge complex dealt primarily with two principal diseases in its avian communities: botulism and more recently, West Nile virus. Although safe handling practices (e.g., rubber gloves) have always been employed, human health threats are relatively minor with respect to the handling of birds with botulism (Friend and Franson 1999) and West Nile virus (USGS 2006c). However, the highly pathogenic H5N1 strain of avian influenza (HPAI) presents refuge complex staff and other wildlife resource personnel with a wide range of unknowns, including possibly serious human health threats.

HPAI (bird flu) is a disease caused by a virus that infects both wild birds (e.g., shorebirds, waterfowl) and domestic poultry. Each year, there is a bird flu season just as there is a flu season for humans and, as with people, some forms of the flu are worse than others (USGS 2006a). Recently, the H5N1 strain of HPAI has been found in an increasing number of countries in Europe, Asia, and Africa. Currently, this strain is not present in the United States, but it is likely to spread to this country (Roffe, Service pers. commun.). There are a number of ways that the H5N1 strain could potentially reach the United States, including: 1) wild bird migration; 2) illegal smuggling of birds or poultry products; 3) travel by infected people or people traveling with virus-contaminated articles from regions where H5N1 already exists (USGS 2006b).

The Service is taking a proactive approach to HPAI, both with respect to monitoring and to employee safety. In the near future, the refuge complex will conduct all avian disease surveillance, reporting, response, and handling activities under the auspices of a refuge complex avian disease contingency plan.

Objective 1B: Over a 15-year period, follow monitoring and response protocols outlined in the CWD Plan for Service Lands in the Dakotas (Service 2004).

Rationale 1B:

CWD is a disease of the nervous system in deer and elk that results in distinctive brain lesions. Presently, CWD has not been detected in either wild or captive white-tailed deer, mule deer, or elk in the state (Fecske, NDGF, pers. commun.). The NDGF has conducted surveillance for this disease since 2002 and tested tissue samples from more than 5,600 deer heads (mostly hunter-harvested) in the process. Through 2004, all samples were negative, but results of some 2005 samples are still pending as of this writing (Fecske, NDGF, pers. commun.).

CWD, however, has been documented in surrounding states and Canadian provinces (captive cervids in Minnesota, Montana, and Saskatchewan; captive and wild cervids in South Dakota; USGS 2006b) and potential does exist for it to currently be present, but undetected, or eventually infect cervids in the state. Refuge complex staff assisted with NDGF CWD surveillance efforts in 2003 and 2004 by establishing drop-off sites for white-tailed deer (heads) harvested on Long Lake NWR during the state's firearms deer season (2003 and 2004) and by assisting with tissue sample processing in 2003. Refuge complex staff plans to adhere to protocols within the CWD Plan for Service Lands in the Dakotas (Service 2004) for all future CWD-related work. This plan acknowledges the NDGF as the lead in all CWD efforts in the state and describes the Service's role as a supporting partner.

Strategies 1A and 1B:

- Follow the monitoring and response protocols outlined in various disease contingency plans.

Objective 1C: Over a 15-year period, follow monitoring and response protocols outlined in the CWD Plan for Service Lands in the Dakotas (Service 2004).

Objective 2: Within 1 year of the completion of this CCP, eliminate all winter feeding operations on lands in the refuge complex.

Rationale 2:

For a number of years, refuge complex staff provided supplemental food, in the form of feed bales and loose grain in constructed feeders, to wildlife on Long Lake NWR and certain WPAs (e.g., Schiermeister) during the winter. The intent of this activity was to provide a reliable food source to resident gallinaceous birds (primarily ring-necked pheasants) during periods of especially harsh winter weather. In addition to attracting concentrations of ring-necked pheasants and other birds, these concentrations of food also typically attract large groups of white-tailed deer. Artificial concentrations of wildlife increase their susceptibility to diseases and other types of mortality (e.g., vehicle collisions). Supplemental feeding overrides the natural tendencies of wildlife, like deer, to disperse themselves across the landscape. Unnatural concentrations of wildlife are known to promote disease outbreaks (Williamson 2000). One of the diseases that is associated with artificial feeding is CWD (Williamson 2000). CWD is passed from animal to animal; therefore, any unnatural concentration of wildlife caused by supplemental feeding can increase potential for its spread (Williamson 2000). In addition to CWD, unnatural concentrations of white-tailed deer can increase their susceptibility to bacterial diseases like tuberculosis (Williamson 2000).

In many cases resident wildlife abundance reflects weather patterns. During especially harsh winters, resident wildlife populations, including both white-tailed deer and ring-necked pheasants, will be reduced by nature's stronghold. Conversely, during moderate and mild winters, little natural mortality will occur, allowing for population growth. These climatic fluctuations are natural and a constant influence on wildlife abundance and distribution (Williamson 2000).

Despite popular belief, ring-necked pheasants seldom succumb to starvation, even during extended periods of deep snow and extreme cold (NDGF 1992). Rather, most winter mortality of ring-necked pheasants is a result of exposure during blizzard events. When pheasants are caught away from adequate winter cover during a blizzard, they frequently die from suffocation and freezing. The critical factor for ring-necked pheasant winter survival is quality habitat (i.e., marshes; NDGF 1992). Winter feeding programs for ring-necked pheasants in North Dakota and other Midwestern states are generally considered to be very expensive and ultimately provide few tangible results (NDGF 1992). The refuge complex will, therefore, terminate this practice of winter food supplementation and remove existing wooden feed bunkers from WPAs and refuges.

Strategy 2:

- Cease distribution of winter feed (including bales) for white-tailed deer and gallinaceous birds.
- Destroy wooden feed bunkers that currently exist on refuges and WPAs.

Objective 3: Between 2–15 years after the completion of this CCP, complete a multiyear scientific evaluation of the Service's botulism cleanup procedures, including a determination of avian carcass fate and the relationship of detection rates to: 1) botulism surveillance intensity; 2) carcass size; 3) abundance of emergent vegetation, and; 4) other lake characteristics.

Rationale 3:

As discussed in rationale 2 under the developed wetlands section, botulism is a disease that can cause substantial mortality of waterfowl, shorebirds, and other waterbirds. Long Lake's varied history of botulism, including its frequency of occurrence and severity, was also discussed in that section.

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) C. 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, and; 4) toxicity leads to death, producing additional carcasses and perpetuating the cycle. Because of the botulism 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). However, substantial time, expense, and effort are expended by refuge complex staff annually in surveillance activities, based on little scientific data regarding the effectiveness of this management on progression of the disease or survival of migratory birds. Despite the lack of scientifically valid supporting data, the USGS National Wildlife Health Center continues to recommend carcass pickup for botulism control (Sohn, USGS, pers. commun.)

Recently, the significance of carcass removal to waterfowl survival during botulism outbreaks has been challenged (Evelsizer 2002). Evelsizer (2002) and Bollinger et al. (2003) suggested that carcass removal did not appear to be an effective technique for managing botulism in prairie Canada. The apparent failure of this management was attributed to the inefficiency of carcass removal on large wetlands. Under ideal conditions, no more than 30 percent of carcasses present were found and collected. What level of carcass pickup efficiency, if any, would have been effective is unknown. Nonetheless, these data have been used to defend the cessation of botulism cleanup efforts in Canada (Delta 2003). Carcass detection and pickup are likely biased toward detection of large, intact carcasses in unvegetated areas, potentially underestimating carcass presence and density for shorebirds and secretive marsh birds. However, no credible data exist regarding efficiency of Service carcass cleanup crews on PPR lakes and wetlands.

Reed and Rocke (1992) found that mortality in penned mallards was 4.5 times higher in pens with carcasses compared to pens without carcasses. In addition, T. Rocke (USGS, pers commun.) found that when mortality did occur in penned mallards from causes unrelated to botulism, botulism developed only in those pens where carcasses were not removed. These data reinforce that effective carcass pickup might be effective at increasing waterfowl survival.

In addition to the refuge complex, Service lands throughout the PPR are especially impacted by botulism, with no less than 13 field stations having historically managed botulism outbreaks in North Dakota and South Dakota alone. Many of these stations must deal with outbreaks on multiple WPAs, refuges, and privately owned lakes and wetlands. As Evelsizer (2002) provides the only available field research on carcass pickup effectiveness, attempts should be made to replicate the findings in the PPR of the United States, where habitats, lake size, and search methods differ from those at Evelsizer's (2002) Canadian study sites.

The ultimate question of interest with regard to carcass pickup is whether these efforts curtail progression of the disease and/or improve survival of affected species. A scientifically valid answer to this question would require an expensive, long-term project that is likely not feasible with respect to the refuge complex's resource availability. As an alternative, refuge complex staff proposes to (over a 3-year period), measure effectiveness of carcass retrieval crews in operational settings to determine the conditions under which carcass retrieval rates are maximized. This information will allow targeting of cleanup activities and will serve as a foundation for future research. Furthermore, information gathered during this initial 3-year study (e.g., under given habitat conditions, Service pickup crews can expect to recover a given percentage of shorebird carcasses) will provide a better foundation and reduce the overall workload for eventual research attempting to answer this fundamental question. Because carcass removal is logistically difficult and very expensive, it is critical that the effectiveness of these management activities are evaluated.

The study will be conducted in conjunction with operational botulism surveillance and carcass pickup on no less than three districts (i.e., Long Lake, Northeast Montana, Kulm) in the PPR of North Dakota and Montana. Additional areas, potentially including portions of the PPR in South Dakota, will be sought as the study develops.

Objective 3 states that this research will be conducted sometime between 2–15 years after the completion of this CCP. The refuge complex will not attempt to initiate this study immediately (i.e., from the completion of the CCP until 2 years after the completion of the CCP) because of unknowns related to HPAI. All indications are that the H5N1 strain of HPAI will surface in the United States, with the biggest unknown being "when" (Roffe, Service, pers. commun.). The incidence of HPAI anywhere in the United States will likely cause dramatic changes in how all Service staff are required to handle dead birds they encounter, no matter what is the suspected mortality agent. Therefore, the refuge complex will temporarily shelve plans for botulism-related research until it becomes clear how HPAI might affect the completion of certain aspects of the study (i.e., handling dead birds of unknown origin).

Strategy 3:

- Initiate a 3-year scientific study in cooperation with the NPWRC and the USGS and no less than two other districts (i.e., Kulm, northeast Montana).

Research, Inventory, and Monitoring Goal:

Use data from inventory, monitoring, and applied research to advance the understanding of the natural resources and their management on lands within the refuge complex.

Objective 1: Within 10 years of the completion of this CCP, develop and complete a new inventory and monitoring plan for the refuge complex.

Objective 2: Within 7 years of the completion of this CCP, develop and complete a new habitat management plan for the refuge complex.

Objective 3: Over a 15-year period, focus priority inventory, monitoring, and research efforts on related information needs outlined in the biological objectives within the refuge complex's CCP.

Objective 4: Within 1 year of the completion of this CCP, establish a secondary priority needs list of research, inventory, and monitoring information needs for the refuge complex.

Rationales 1, 2, 3, and 4:

Because the CCP is intended as a broad umbrella plan that provides general concepts and specific management and operational objectives for the refuge complex, it is imperative that step-down plans, such as inventory and monitoring and habitat management plans are produced. The purpose of step-down plans is to provide greater detail and clearer direction to Service managers and other employees who will carry out the strategies described herein. Specifically, the habitat management plan will provide staff with detailed information relating to the various proposed management practices (e.g., timing of prescribed fire, timing and intensity of grazing, timing, application rate, pesticide-type for chemical applications). The inventory and monitoring plan will outline all proposed activities (e.g., wildlife, habitat, abiotic) and provide detailed information on methodology and analysis.

Knowledge gaps, regarding natural resources that the refuge complex has been entrusted with managing and protecting, are many and varied. The information needs that refuge complex staff has determined to be of the highest priority are included in this CCP's biological objectives. These objectives are listed below by habitat types or category. Additional details concerning these objectives can be found earlier in this chapter.

Developed Wetlands
See objectives 1A, 1B, and 2.

Undeveloped Wetlands
See objectives 1A, 1B, 1C, and 2.

Native Prairie
See objectives 1A, 1B, 1C, 1D, 1E, 2A, 2B, and 3.

Old Cropland
See objectives 1 and 2.

Priority Population Issues
See objectives 1A, 1B, and 2.

Predator Management
See objectives 1 and 2.

Wildlife Disease
See objective 1.

All inventory, monitoring, and research activities that are not identified above need to be evaluated as to their importance, due to the inevitable fact that Service resources (e.g., staff, funding, equipment) are always limited and oftentimes insufficient.

Therefore, refuge complex staff will identify biological activities, in addition to those addressed in the CCP's biological objectives, which are deemed as important and accomplishable. This group of biological activities will be considered as a secondary priority.

Strategies 1 and 2:

- Complete detailed and accurate plans within the allowed timeframes.

Strategy 3:

- Direct the principal thrust of the refuge complex's biological efforts towards the information needs outlined in its CCP's biological objectives.

Strategy 4:

- Evaluate the refuge complex's biological information needs not addressed in the CCP's biological objectives to determine which deserve consideration as secondary priority needs.

Socio-economic Sub-Goal

Objective 1: Develop a demographic profile of wildlife-dependent recreational users (users within a 6-hour commuting radius) within 5 years of CCP approval to determine the long-term direction of refuge complex management and to provide quality public use opportunities.

Objective 2: Develop a demographic, attitudes, and expectations profile of wildlife-dependent recreational users (users throughout the Nation and overseas) within 10 years of CCP approval, to determine a long-term direction and to provide quality, public use opportunities for people who travel from outside the state to visit the refuge complex. Establish mechanisms to work collaboratively with USGS's BRD economists, area universities (i.e., departments of agriculture and resource economics) as well as with other U.S. governmental agencies, national and worldwide travel agencies, and nongovernmental organizations (NGO) to obtain the necessary data to ascertain travel trends concerning the refuge complex. Work with USGS's BRD economists and area universities, as well as with Region 6's Education and Visitor Services division to develop user-friendly, easily distributed questionnaires to obtain information from local, national, and international refuge complex visitors.

Objective 3: Develop an economic impact analysis within 5 years of CCP approval, to determine and

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The refuge plans to partner with local environmental education groups in the future.

describe how the refuge complex's management activities affect the local and state economies.

Rationales 1, 2, and 3:

Because of its size and rural location, the refuge complex has limited information concerning what the public wants and expects from the refuge complex. The Service will analyze this data to make decisions about future public use program developments and facilities.

Finally, this data will supplement existing data on economic benefits generated for the local and state economies where the refuge complex lies.

Strategy 1:

- Develop partnerships with local fishing and hunting groups, as well as birders and other wildlife enthusiasts to learn about: 1) fishing, hunting, and wildlife observation and photography use in the area; 2) access needs, and; 3) sport fishery and hunting goals.
- Work with NDGF and other refuges in North Dakota and South Dakota to determine what they offer and whom they serve.
- Work with local environmental education groups and other wildlife enthusiast groups to determine what they offer and whom they serve.
- Determine environmental education needs and student numbers within a 2-hour travel radius through collaboration with local schools and universities.

- Obtain information on wildlife-dependent recreational users visiting the area, in coordination with NDGF, local and state travel boards and chambers of commerce.
- Establish mechanisms to work collaboratively with the USGS's Biological Resource Division (BRD) economists and area universities (i.e., departments of agriculture and resource economics) to find ways to obtain or generate data on wildlife-dependent recreational expenditures in the area of the refuge complex.

Public Use Goal

Provide a safe environment for visitors of all abilities to enjoy wildlife-compatible recreation while increasing their knowledge and appreciation of the mixed-grass prairie ecosystem and the mission of the Refuge System.

Fishing Sub-Goal:
Provide quality fishing opportunities and access points to meet visitor needs. Support the Improvement Act's focus on fishing—one of the six priority public uses.

Objective 1: Within 10 years after CCP approval, survey all permanent wetlands on Long Lake NWR, Slade NWR, and Florence Lake NWR to gain a baseline of their fishery resource. Within 15 years of CCP approval, provide fishery programs and access where compatible.
Rationale 1:
Objective 1 capitalizes on existing fisheries only, and proposes programs where fish currently exist; therefore, programs can be offered in a compatible manner. Introducing fish to new areas is not planned as fish compete for aquatic invertebrate resources associated with migratory bird objectives. Fish have been recognized as competitors for aquatic resources with migratory birds (e.g., ducks; Cox et. al., 1998).

Sport fishing is one of the priority public uses of the Refuge System. Where compatible, this public use should be considered. Most permanent wetlands in the district have not been surveyed to document the presence or absence of fish. Certain wetlands on both Long Lake NWR and Slade NWR have marginal sport fish populations and thus have potential to provide limited fishing opportunity during PPR wet cycles. A limited sport fishing program already exists at Long Lake NWR.

Due to relatively shallow water levels during moderate and low water cycles, most permanent wetlands on lands in the refuge complex are shallow enough that winterkill erases or substantially reduces fish populations. During periods of marginal conditions (low oxygen and shallow depths) gamefish (e.g., northern pike) tend to succumb first leaving only nongame fish (i.e., rough fish) which are less desirable to fishermen. Because of higher survival in poor conditions and lack of removal by fishermen, the fish biomass quickly skews toward undesirable rough fish (e.g., common carp, bullhead). Rough fish contribute to increased turbidity and lower aquatic productivity. They result in a marginal sport fishery with high rough fish biomass, which perpetuates and exacerbates conflicts between accomplishing public use objectives and wildlife and habitat objectives (e.g., maintaining quality habitat for migratory birds).

Lead sinkers and spent lead birdshot are known contributors of lead to the aquatic environment. While restrictions can be placed on the use of lead sinkers for sport fishing in a manner similar to nontoxic shot regulations on WPAs and refuges, the availability of nonlead fishing sinkers is less universal than nontoxic shotshells. Primarily due to the comparatively large size of lead sinkers used for fishing, they present fewer problems for migratory birds, as suitability for ingestion is limited primarily to larger species (i.e., tundra swans, large races of Canada geese), whereas due to its small size, lead shot is available to a diversity of migratory birds for ingestion across the size spectrum. Consequently, if lead sinker use in refuge fishing programs poses a significant threat for certain larger-bodied migratory bird species in areas where fishing is allowed, restrictions should be placed on the use of lead sinkers in these areas.

Enforcement patrols would need to be substantially increased to assure compliance if fishing programs were expanded significantly; however, this plan only focuses efforts on providing access to fisheries where they may exist (refuge complex staff expects to discover few additional existing fisheries) and not in developing new fisheries due to biological conflicts between fish and migratory birds. Due to marginal fish resources on refuges in the refuge complex and relatively low expected fishing activity over the long-term, lead sinker issues are not believed to be significant in the limited areas where fishing occurs.

By identifying and collecting data on fisheries in the refuge complex, it may be possible to develop additional compatible fishing programs and provide information about these fishing opportunities (i.e., fishery location maps for the public). This will enable the refuge complex to capitalize on existing fisheries, to increase fishing opportunities for the public where compatible, and potentially to maintain those programs through stocking efforts to augment fisheries where they currently exist if and when necessary. Survey information will determine whether areas support fish, and further evaluation will determine whether areas can be opened for fishing in a compatible manner (e.g., ice fishing, seasonally restricted or limited access due to migratory bird breeding and nesting activities).

Additional programs and facilities will require additional operations, law enforcement, and maintenance costs which need to be addressed through funding, partnerships, and/or interagency commitments. The refuge complex may be able to administer and provide some of the proposed opportunities without the need for additional resources.

Strategy 1:

- Coordinate with the Service's Bismarck Missouri River Fish and Wildlife Management Assistance Office and NDGF fisheries division staff to sample permanent wetlands with fisheries potential.
- No new fisheries will be developed through introduction of fish.
- Where current fisheries exist, fish populations will be augmented with stocking, provided that fish are not collected from sites that could lead to accidental species introductions (e.g., invasive plant introductions) or the spread of disease (e.g., iridovirus [tiger salamanders], various fish diseases).
- Identify types of fishing use which are potentially compatible (e.g., ice fishing only, shore fishing only, seasonal restrictions to avoid conflicts with migratory bird objectives, primitive or developed access and facilities) and develop fishery programs using restrictions to maintain compatibility where appropriate.
- Identify needs for an enhanced public fishing program (i.e., patrol for law enforcement, facility needs, maintenance needs) and identify potential sources (e.g., NDGF, additional staff/funds through the Service's budget, other partnerships) to facilitate the additional opportunities.
- Identify fishing restrictions necessary to maintain compatibility of the fishing program with objectives for migratory birds and impose site-specific restrictions (e.g., lead sinkers, ice fishing only, seasonal restrictions) as warranted.
- Develop a Long Lake NWR or refuge complex tear sheet or fishing pamphlet to communicate fishing program specifics to the public.

Objective 2: Within 10 years after CCP approval, survey all permanent wetlands on WPAs to gain a baseline of the existing fisheries and within 15 years provide fishery programs and access where compatible.

Rationale 2:

The objective capitalizes on existing fisheries only, and proposes programs where fish currently exist and programs that can be offered in a compatible manner. Introducing fish to new areas is not planned as fish compete for aquatic resources associated with migratory bird objectives (Cox et al. 1998).

By identifying and collecting data on WPA fisheries, refuge complex staff may be able to develop additional compatible fishing programs and provide information about these fishing opportunities (i.e., fishery locations maps for the public). This will enable the district to capitalize on existing fisheries to increase fishing opportunities for the public where compatible, and potentially to maintain those programs through stocking efforts to augment fisheries where they currently exist if and when

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A youth fishing event will be conducted annually.

necessary. Survey information will determine whether certain WPAs support fish, and further evaluation will determine whether areas can be opened for fishing in a compatible manner (e.g., ice fishing, seasonally restricted or limited access due to migratory bird breeding and nesting activities, etc.).

Additional programs and facilities will require additional operations, law enforcement and maintenance costs which need to be addressed through funding, partnerships, and/or interagency commitments. It is possible that the refuge complex may be able to administer and provide some of the proposed opportunities without the need for additional resources.

Strategy 2:

- Coordinate with the Service's Bismarck Fisheries Assistance Office and NDGF fisheries division staff to sample permanent wetlands with fisheries potential. (Target those wetlands associated with WPAs with depths ≥ 10 feet and surface acreage of > 200 acres).
- No fisheries will be developed through the introduction of fish.
- Where current fisheries exist, fish populations could be augmented with stocking.
- Identify types of fishing use which are compatible (i.e. ice fishing only, shore fishing only, seasonal restrictions to avoid migratory bird objectives, primitive or developed access and facilities) and develop fishery programs where appropriate.
- Identify needs for an enhanced program (i.e., patrol for law enforcement, facility needs, maintenance needs) and identify potential sources (e.g., NDGF, additional staff/funds through the Service's budget, other partnerships) to facilitate the additional opportunities.
- Identify fishing restrictions necessary to maintain compatibility of the fishing program with objectives for migratory birds and impose site-specific restrictions (e.g., lead sinkers, ice fishing only, seasonal restrictions) as warranted.
- Develop tear sheet or fishing pamphlet to communicate fishing program specifics to the public.
- Use volunteers to collect and analyze data.

Objective 3: Annually conduct a youth fishing event (currently "Lines for Little Ones").

Strategy 3:

- Annually conduct a youth fishing event.
- Recruit volunteers to assist with and help fund the event.

Objective 4: Upon CCP approval, continue to provide year-round access to designated fishing areas on Long Lake NWR.

Strategy 4:

- Provide current information at the fishing area kiosk and visitor center.
- Update current fishing brochure as necessary.

Hunting Sub-Goal:
Provide quality hunting opportunities and access points to meet visitor needs. Support the Improvement Act's focus on one of the six priority public uses.

Objective 1: Within 5 years after CCP approval, explore additional hunting opportunities on three fee-title refuges within the refuge complex, where compatible. Within 10 years, provide hunting programs and access where compatible and where management constraints allow them.

Rationale 1:

Late season upland gamebird hunting has been allowed on Long Lake NWR since 1989 and has existed in a compatible manner. This recreational opportunity can be expanded to Slade NWR and Florence Lake NWR.

Deer hunting is allowed on Long Lake NWR and Slade NWR and has been provided in a compatible manner. This recreational opportunity can be expanded to Florence Lake NWR.

Although hunting predators during early and mid-winter months may have more limited potential for reducing predation on ground-nesting birds, as compared to predator removal between March 15 and July 15 (Dixon and Hollevoet 2005), those animals removed in late winter (e.g., late February–early March) may assist in reducing predation affects on ground-nesting birds. Localized depredation problems have been experienced by refuge neighbors, requiring removal of predators (e.g., coyotes) from the refuges by USDA, the Animal and Plant Health Inspection Service, and Wildlife Services personnel. These problems could likely be somewhat mitigated by providing a

Additional hunting opportunities will be explored.

compatible recreational predator hunting program on refuges administered by the refuge complex.

Access to harvestable populations of migratory birds during open seasons is becoming more restricted to hunters as lands adjacent to the refuges in the refuge complex are increasingly becoming leased, posted, or otherwise off-limits. Because of the large size and attributes of these refuges, there may be potential to provide hunting access for migratory birds in a compatible manner without adversely affecting refuge objectives for migratory birds.

Additional programs and facilities will require additional operations, law enforcement, and maintenance costs, which need to be addressed through funding, partnerships, and/or interagency commitments. The refuge complex may be able to administer and provide some of the proposed opportunities without the need for additional resources.

Strategy 1:

- In partnership with the NDGF, identify areas at Florence NWR, Slade NWR, and Long Lake NWR with potential to provide additional hunting opportunities.
- Evaluate the potential for a late-season (potentially December through March) predator hunting program targeting coyote and fox.
- Evaluate the potential for expanding late-season upland gamebird hunting programs on Slade NWR and Florence Lake NWR.
- Provide a predator hunting program in appropriate areas.
- Evaluate the potential for a deer hunting program on Florence Lake NWR. Provide this hunting program if deemed appropriate.
- Evaluate the potential for limited migratory bird hunting on Long Lake NWR. Provide this hunting program in specific areas if deemed appropriate.
- Identify needs for enhanced hunting programs (i.e., patrol for law enforcement, facility needs, maintenance needs) and identify potential sources (NDGF, additional staff/funds through the Service's budget, other partnerships) to facilitate the additional opportunities.
- Determine program restrictions necessary to maintain compatibility and regulate the programs (e.g., open areas, timing of seasons, access).
- Develop tear sheets or hunting program pamphlets to communicate hunting program specifics to the public.

Trapping Sub-Goal:
Manage furbearing species that have potentially negative impacts on certain other wildlife populations and Service infrastructure.

Objective 1: Maintain the existing management-directed trapping program on refuges administered by the refuge complex.

Rationale 1:

Permit trappers are an essential resource to management, as they provide information for assessing populations of various furbearing mammals.

Permit trappers serve another important function. in targeting the furbearing mammals that damage refuge infrastructure (e.g., muskrats) and prey on neighboring livestock (e.g., coyotes).

Trappers, who continue to remove mammals that predate ground-nesting birds late in the winter or early spring, may assist management in reducing the effects of nest predators on ground-nesting birds

The use of management-directed trappers is a cost effective way to obtain information regarding targeted mammal groups and reduce surplus mammals that present specific management issues, while providing a biologically sound recreational and economic activity.

Strategy 1:

Continue to administer the trapping program on the refuges by issuing SUPs to qualified trappers who serve as agents of management to:

- monitor mammal populations.
- remove portions of the annual surplus of furbearing mammals.
- reduce mammals that cause damage to refuge infrastructure and/or present localized predation and/or depredation issues for management.

Objective 2: Continue to provide recreational trapping on WPAs administered by the refuge complex.

Rationale 2:

On WPAs, recreational trapping is an activity that was approved by legislation.

Limits on means of access that are normally used on private lands to support trapping (e.g., snowmobiles, ATVs) are necessary to maintain compatibility. Therefore, although trapping is allowed on WPAs, the use of motorized vehicles is restricted to designated roads and trails.

Strategy 2:

- Allow trapping on WPAs within the framework of state seasons and regulations as prescribed by law.
- Continue to monitor and enforce trapping with regard to access and use to maintain compatibility with other WPA objectives.

Environmental Education and Interpretation Sub-Goal: Provide and actively support opportunities for compatible wildlife-dependent environmental education and interpretation in support of one of the six priority public uses outlined in the Improvement Act.

Facilities at Slade NWR will be upgraded to meet accessibility standards. Adjustments in facilities at Lake Isabel Recreation Area will be made to augment wildlife-dependent activities and reduce or eliminate nonpriority public uses. Upgrades will include accessible trails and tables. Signage at the refuge will be reduced by installing a centralized kiosk, which will include rules and regulations, wildlife information, and an interpretive panel about the history of the refuge.

The expansion of environmental education and interpretation opportunities will also include Small WPA. The existing nature trail at this WPA will be made accessible, and include wildlife interpretation information, either in the form of a pamphlet or a panel. This WPA has the potential to see an increasing amount of public use, because it is located only 6 miles from the city of Bismarck.

Objective 1: Within 5 years of the approval of the CCP, expand the quantity and quality of on-site wildlife-oriented interpretive events and programs.

Strategy 1:

- Conduct two theme-related events, one in the spring and one in the fall to interpret the migration of birds. Advertise in local newspapers and recruit guest speakers for events.
- Continue to promote recreational fishing by holding one annual event associated with national fishing week (currently "Lines for Little Ones").
- Continue to promote hunting and other wildlife-dependent recreation activities by holding one annual event associated with national wildlife refuge week (currently Juniors Acquiring Knowledge, Ethics, and Sportsmanship [JAKES] Day).
- Construct an observation tower at Long Lake NWR, along with an accessible observation deck, overlooking unit II marsh and unit II (near the Ducks Unlimited nesting island). The tower/deck will include interpretive panels containing information about the area wildlife.
- Develop a trail at Long Lake NWR from the stone buildings to the observation tower. Develop a pamphlet to interpret the sights and sounds along the trail. At Long Lake NWR, develop an auto tour using existing roads around Long Lake NWR, along with a pamphlet and signs to interpret popular wildlife viewing locations.
- Through partnerships, secure funding and design and develop accessible facilities and a trail.
- Upgrade facilities at Slade NWR to meet compatibility and accessibility standards. Upgrades will include accessible trails and tables.
- Install a centralized kiosk at Slade NWR, which will include rules and regulations, wildlife information, and an interpretive panel about the history of the refuge.

- Redesign and remove nonwildlife-oriented visitor use facilities at Slade NWR. Secure funding to improve facilities and identify potential partners to support the renovation.
- Enhance the existing nature trail at Small WPA to make it accessible, and include wildlife interpretation information either in the form of a pamphlet or a panel. Work with NGOs to secure funding, then design and construct trail upgrades.

Objective 2: Within 5 years of the approval of this CCP, expand the quantity and quality of the on-site wildlife-oriented environmental education programs offered by the refuge complex.

Rationale 2:

Environmental education and interpretation are two of the priority public uses established by the Improvement Act. Where compatible and contingent upon funding limits provided by the Service and its partners, these uses should be considered. Tremendous opportunities exist for educating and informing the local communities and visitors about refuge resources.

It is valuable to expend energy realizing these objectives for a variety of reasons, including: 1) Long Lake NWR lies in close proximity to Bismarck (the state capitol), which has a metropolitan population of nearly 100,000 people and a number of schools in the immediate commutable area; 2) the area attracts large numbers of tourists due to its central location in the state; 3) existing historical stone buildings could be developed into an environmental education center, and; 4) the availability and diversity of wildlife, especially migratory birds.

Strategy 2:

- Continue to conduct a minimum of one teacher's workshop annually (teachers currently obtain one credit through accreditation by Minot State University).
- Explore specific habitat types as themes for the workshop. Coordinate themes with potential on-site self-guided environmental education tours and activities targeting a menu of specific lesson themes for school groups.
- Promote self-guided tours, led by educators, targeting on-site environmental education for school-age children.
- Develop an educator's guide to self-guided refuge tours, which provides a menu


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The refuge complex provides excellent opportunities for wildlife observation.

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.

- Develop an on-site shorebird tour/activity as one potential theme, and develop others for educators and school groups who visit Long Lake NWR. Work with the refuge biologist to obtain information to support interpretive messages.
- Rehabilitate the historic stone buildings into an environmental education/interpretive center to provide an on-site classroom.
- Secure funding to reuse the stone facilities and make them accessible.
- Coordinate with the regional historic preservation officer. Design exhibits and educational programs.
- Construct an observation tower, along with an accessible observation deck, overlooking unit II marsh and unit II. The tower/deck will include interpretive panels containing information about the area wildlife.

Objective 3: Within 10 years of the approval of the CCP, expand the quality and quantity of the off-site wildlife-dependent environmental education program offered by the refuge complex.

Strategy 3:

- Develop an environmental outreach program to focus on specific themes (e.g., shorebird habitat).

- Visit science classes at two schools annually.
- Work with the biologist in the refuge complex to obtain information to support interpretive messages.
- Promote the program at local schools and make contact with teachers to generate interest.
- Continue to provide educational trunks (e.g., shorebird, wetland, prairie, endangered species) for off-site classroom reservations for area schools.

Objective 4: Increase visibility of the refuge complex by having signage installed on Interstate 94 and other local roads and highways. Accomplish this within 5 years of this CCP's approval.
Strategy 4:

- Coordinate with the State Highway Department, Department of Transportation, and/or the Department of Tourism to develop directional signs for tourist notification on major routes.

Wildlife Observation and Photography Sub-Goal:
Provide increased opportunities for wildlife observation and photography that enhance the visitor experience in support of the complex's purpose and in support of the Improvement Act's focus on the priority public uses.

Objective 1: Upon completion of the CCP, increase the opportunities for wildlife observation and photography by increasing the number of nonpermanent blinds on Long Lake NWR.

Rationale 1:

Presently, opportunities for wildlife observation and photography are limited in some areas due to lack of facilities, lack of access, and a limited availability of nonconsumptive wildlife-dependent recreational opportunities during periods that do not conflict with wildlife resource needs (e.g., breeding and nesting seasons of migratory birds) and/or consumptive wildlife recreation (e.g., hunting). Additional viewing blinds on the refuge will provide an increased opportunity for nonconsumptive public recreation.

Strategy 1:

- Identify areas that support exceptional wildlife viewing opportunities, and offer viewing opportunities through the placement of portable blinds as enhanced recreational opportunities.
- Designate potential areas, determine appropriate timing of activities (e.g., sharp-tailed grouse dancing), and construct new blinds.
- Inform the public of new and existing opportunities through various media outlets.

Cultural Resources Sub-Goal:
Identify, value, and preserve the cultural resources and history of the refuge complex and connect refuge complex staff, visitors, and the community to the area's past.

Objective 1: Avoid, or when necessary mitigate, adverse effects to significant cultural resources in compliance with Section 106, at all times.

Strategy 1:

- Continue cultural resource review of projects in the refuge complex to identify concerns.

Objective 2: Successfully integrate the Section 106 process into all applicable refuge complex projects by notifying the Service's cultural resource staff early in the planning process and, whenever possible, complete the review without delay to the project.

Strategy 2:

- Incorporate the Section 106 review into the project design as early as possible and complete process as applicable.
- Complete a Programmatic Agreement with the state Historic Preservation Office to expedite project review.

Objective 3: Create a site sensitivity model for the three refuges within 5 years of implementation of the CCP. Survey and document 20 percent of the high-sensitivity areas within 10 years.

Strategy 3:

- Use the Service's cultural resource staff to create the model and to conduct the survey.
- Partner with universities to conduct surveys of high-potential areas.

Objective 4: Within 5 years of implementation of the CCP, complete a structural assessment of the headquarters built by the Works Progress Administration (stone house complex) including recommendations for adaptive reuse.

Strategy 4:

- Find an architectural student to do the project as a thesis or independent study.
- Apply for grants to fund assessment surveys.

Objective 5: Within 5 years of the implementation of this CCP, write a report examining educational opportunities on the refuge complex. If feasible, carry out recommendations within 10 years.

Rationale 5:

The protection and interpretation of cultural resources is important to the public. Federal laws and policies mandate the consideration and often the protection of significant cultural resources.

Strategy 5:

- Research educational opportunities concerning cultural resources and the history of the region.
- Produce a brochure concerning the Works Progress Administration/Civilian Conservation Corps activities at Long Lake and the surrounding refuges.

Partnerships Sub-Goal:
Join a wide range of partners to support research and management, promote awareness of the Refuge System, and foster an appreciation of the mixed-grass prairie pothole ecosystem.

Objective 1: Upon approval of the CCP, the refuge complex will continue to participate in partnerships that promote sound wildlife management or contribute to the missions of the Service, the Refuge System, or the refuge complex.

Strategy 1:

- Continue to partner with Driscoll Wildlife Club, Delta, the National Wild Turkey Federation, and various contributing partners to hold educational and recreational events.
- Continue to partner with various groups (e.g., Bismarck/Mandan Birding Club, Delta, Ducks Unlimited) to accomplish wildlife censuses and surveys, habitat development, and habitat maintenance projects that further the accomplishment of refuge complex goals and objectives.
- Continue to partner with local county commissions, weed boards, soil conservation districts, and others to accomplish localized and broad scale conservation projects, including invasive plant control, recreation area maintenance, conservation education, etc.
- Explore opportunities for new, nontraditional partnerships that further the accomplishment of the goals and objectives of the refuge complex (e.g., Hazelton-Moffit-Bradock Long Lake Creek watershed water quality monitoring, Boy Scouts of America eagle badge projects, 4-H Club projects)

Objective 2: Within 5 years of CCP approval, develop a Long Lake NWR "friends group" to support and advocate for the refuge's programs and needs.

Strategy 2:

- Identify and recruit a core group of individuals from the surrounding communities to develop and promote the refuge.z
- Develop a charter and obtain nonprofit status.
- Write a grant to acquire "soft" monies to create the group.

Objective 3: Upon approval of the CCP, continue to participate in partnerships that promote a broad group of wildlife species and address resource needs at the refuge complex.

Rationale 3:

Partners are essential in fully implementing the CCP for the refuge complex. They require extensive staff time to coordinate, develop, and maintain. Long-term commitments, including funding and staff time are needed to maintain a strong and lasting relationship with partners. Without appropriate staffing, the refuge complex runs the risk of losing its current partners and not developing new partners. Several of the objectives in the CCP depend on partner support and funding. Many of the refuge complex's wildlife, habitat, and public use programs will not continue without the additional funding and support from partners. Without partners, many of the habitat protection, restoration, and enhancement projects will go unfunded. Over time, the diversity of wildlife species will begin to decline as habitat became degraded.

The refuge complex spans the entire three-county landscape with wetland and grassland easement programs and other activities that occur on lands administered by the refuge complex. They have the potential to affect neighbors and the surrounding communities. Communication through various outlets as well as on an individual basis, and staff participation in local events, meetings, and activities builds and maintains support for the refuge complex's programs. Partnerships are vital to accomplishing the Service mission. By establishing and maintaining partnerships it will foster communication between local communities, stakeholders, and others interested in the welfare of the refuge complex.

Refuge complex staff will continue to seek out new opportunities and foster existing relationships to assist with achieving mutually beneficial goals and objectives.

Strategy 3:

- Attend local NGO meetings to exchange information.
- Hold open houses, appreciation day or other similar events annually for the refuge complex's neighbors and friends.

STEP-DOWN MANAGEMENT PLANS

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

Under the CCP, refuge complex staff will revise or develop several step-down plans for the refuge complex. Step-down plans to be revised include:

- public use plan
- water management plan
- upland management plan
- fisheries management plan
- fire management plan
- habitat and wildlife monitoring plans

MONITORING AND EVALUATION

Adaptive management is a flexible approach to long-term management of natural resources that is directed over time by the results of ongoing monitoring activities and other information. Habitat, wildlife, and public use management techniques and specific objectives will be regularly evaluated as results of the monitoring program and other new technology and information become available. These periodic evaluations will be used over time to adapt both the management objectives and techniques to achieve management goals. Monitoring is an essential component of the CCP. Monitoring strategies have been integrated into many of the goals and objectives. Specific details including monitoring strategies, methods, techniques, and locations will be outlined in a step-down monitoring plan for the refuge complex. In this CCP, habitat monitoring receives the primary emphasis. Many of the wildlife species in the refuge complex are migratory birds. Migratory birds are impacted by a variety of factors (e.g., drought, disease, pollution, habitat destruction) on their wintering and nesting grounds and all along their migration pathways.

Determining whether a habitat manipulation on a Service-owned field or wetland is partly or wholly responsible for an associated migratory bird population change is difficult. Managers can strive to gather current information about the critical habitat needs for targeted species and then design habitat management plans and strategies to meet these needs. Habitats can then be monitored to determine if the management strategies are providing the critical habitat elements for a wildlife species. For example, if one of the critical habitat elements for bobolinks is vegetative structure at a specific height-density, managers can manipulate vegetation to achieve this structure and density. If a change in bobolink use occurs on a manipulated field, it may or may not be directly tied to manipulation. Monitoring bobolink populations in the manipulated field over the long-term can provide some general local population trend information and document bird use. Managers must then carefully evaluate the bird use data to try and determine if a direct correlation exists to the habitat manipulation.

The majority of habitat management activities will be monitored to assess whether the desired effect on wildlife and habitat components has been achieved. Baseline surveys will be conducted for wildlife species for which existing or historical numbers and occurrence is not well known. It is also important to conduct studies to monitor wildlife responses to increased public use including fishing, hunting, wildlife observation, and environmental education.

When stringent protocols or complex data analysis is needed, monitoring should be designed and developed in cooperation with universities and/or government research divisions (e.g., NPWRC, University of North Dakota). Applied research can help to answer habitat, wildlife, and public use management questions. Refuge complex staff will work with researchers to ensure that the research is applicable and compatible with refuge complex objectives.

This CCP is designed to be effective for a 15-year period. Periodic review of the CCP will be required to ensure that established goals and objectives are being met and strategies are being implemented. Ongoing monitoring and evaluation will be an important part of this process. Key monitoring needs are identified throughout the CCP. A step-down monitoring plan will incorporate and describe how, when, and who will conduct the monitoring on Service lands within the refuge complex.