4 Management Direction

Dave Menke/USFWS

Northern pintail.

This chapter describes the management direction the Service designed—with public and partner coordination—to achieve the vision for the Souris River basin refuges as described in chapter 2. The chapter includes the following sections:

- overview
- management direction
- step-down management plans
- staffing and funding
- partnership opportunities
- monitoring and evaluation

The pages specified below contain the management direction—designed to achieve the vision (in chapter 2) for the Souris River basin refuges—for each of the three refuges:

Des Lacs NWR, pages 70–88

J. Clark Salyer NWR, pages 88–111

Upper Souris NWR, pages 111–133

NOTE: Although a number of needs were identified during the planning process, there are no assurances that projects identified in this CCP will be fully or even partially funded. However, within every planning effort, there are opportunities to examine current funding and resources and to determine the best available uses based on a comprehensive evaluation of critical needs. If this were never completed, issues could go unresolved due to a lack of public and administrative understanding and support.

Overview

The CCP for the Souris River basin refuges emphasizes restoration of ecological processes important in the evolution and maintenance of native plant communities and wildlife populations in the northern Great Plains. The Service will carry out the CCP with assistance from existing and new partner agencies and organizations and the public.

The Service has developed objectives in support of goals identified in "Chapter 2, The Refuges" for management of the Souris River basin refuges. Strategies to achieve objectives are suggested. Rationale is included that supports goals, objectives, and strategies. Assumptions are discussed.

Goals and Objectives— *Biological Resources*

Biological goals and objectives emphasize management of plant communities as habitat for wildlife, especially migratory birds. The goals and objectives are organized by major habitat types represented at the three refuges.

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

The Service will assess biological, economic, and political feasibilities associated with habitat restoration. Specific criteria and objectives identify areas for restoration, with high-priority areas more likely restored than those more degraded. In recognition of inadequate resources to manage all wildlife habitats and populations occurring at the Souris River basin refuges, evaluation will require careful and deliberate consideration of management priorities (especially allocation of funding and staffing) relative to expected ecological resource benefits. The Service will adjust management efforts equal to changes in staff and funding.

Management practices such as grazing, haying, and farming are compatible with the mission of the Service as applied at the Souris River basin refuges (see appendixes O–Q). In addition, appendix R describes the fire management program for the refuges.

Goals and Objectives— *Cultural Resources, Visitor Services, Research and Science, Refuge Operations*

The Service developed goals, objectives, and strategies for cultural resources, visitor services, research and science, and refuge operations. Cultural resources will be protected when found. Some visitor services will likely decrease as some staff and funding shift to habitat restoration, while others will remain at current levels. Research and science will support habitat restoration.

Des Lacs NWR Management Direction

The following goals, objectives, and strategies for Des Lacs NWR outline the actions needed to achieve the vision of the Souris River basin refuges. The Service intends to meet these objectives during the next 15 years.

Drift Prairie Goal

Restore and maintain extensive examples of plant communities dominated by native flora characteristic of the mid-1800s drift prairie. Create the temporally and spatially dynamic habitat conditions that will attract most breeding bird species and other vertebrate fauna characteristic of that era.

Drift Prairie Objective 1

By 1 year after CCP approval, use current vegetation inventory data and landscape considerations to characterize each habitat management unit with ≥40 acres of drift prairie as either high or low management priority. Reevaluate prioritization 15 years after CCP approval.

Strategy

— Apply multiple selection criteria.

CRITERIA FOR HIGH-PRIORITY UNITS

Floristic Composition. Vegetation is characterized by ≥20% mean frequency (percentage occurrence) of pristine, native herbaceous types (plant groups 41–43 and 46–48 [Grant et al. 2004b]; see appendix G) plus native herbaceous-dominated vegetation with Kentucky bluegrass as the main subdominant (plant group 53).

Floristic Potential. Vegetation is characterized by <20% mean frequency of smooth brome-dominated types (plant groups 61 and 62).

Landscape Context. The unit is contiguous with the best examples of prairie slope habitat (largest slopes with the most intact native plant composition or greatest availability to the public, or both).

or

is adjacent to other high-priority, drift prairie units or tracts of native prairie adjacent to the refuge under non-

Service ownership (especially important if the unit has relatively little drift prairie area, <40 acres).

CRITERIA FOR LOW-PRIORITY UNITS

Floristic Composition. Vegetation is characterized by <20% mean frequency of pristine, native herbaceous types (plant groups 41–43 and 46–48 [Grant et al. 2004b]) plus native herbaceous-dominated vegetation with Kentucky bluegrass as the main subdominant (plant group 53).

Floristic Potential. Vegetation is characterized by ≥20% mean frequency of smooth brome-dominated types (plant groups 61 and 62).

Landscape Context. The unit is neither contiguous with significant prairie slope habitat, nor adjacent to high-priority drift prairie units or tracts of native prairie adjacent to the refuge.

Rationale and Assumptions

Most northern mixed-grass prairie has been destroyed. Losses have been particularly severe in the Drift Plain physiographic region, such that drift prairie could be considered an endangered resource. Key roles of the Refuge System include contribution to ecosystem integrity and conservation of biological diversity. The Souris River basin refuges should contribute to the conservation of native prairie communities unique to the Drift Plain region. However, the native mixed-grass drift prairie at the refuges is badly deteriorated, mainly through extensive invasion by introduced cool-season grasses.

Recent inventory data indicate that occurrences of relatively intact, native herbaceous flora are rare (<5% frequency) on most drift prairie management units at Des Lacs NWR. Native warm-season grasses are nearly absent. Under appropriate management, warm-season grasses can outcompete introduced cool-season grasses if the former are sufficiently abundant (>20% frequency).

Most drift prairie at Des Lacs NWR likely has already passed a threshold, such that restoration of a modestly diverse, native herbaceous flora is an unrealistic and impractical goal. However, restoration may be possible on some tracts where native grasses, sedges, and forbs are more common and widespread. Such tracts need to be identified by objective criteria that focus on (1) diversity and prevalence of existing native plants, and (2) landscape area and connectivity, which underlie the quality of nesting habitat for grassland birds, a species group of significant conservation concern (see appendix I) in North America.

This approach will shift investment to manage more intensively (than under current management) select units. This will improve the chances of restoring at least some drift prairie.

Drift Prairie Objective 2

On high-priority drift prairie units, use frequent and precisely timed disturbances (principally fire and grazing) to restore vegetation to the following standards within 15 years of CCP approval. This will provide habitat for most wildlife species that were characteristic of North Dakota's eastern mixed-grass prairie but that currently are rare or absent at the refuge (burrowing owl, horned lark, Baird's sparrow, Sprague's pipit, chestnut-collared longspur, northern pintail, and Richardson's ground squirrel).

- Composition on each unit includes (1) >40% pristine native and native-dominated/ bluegrass-subdominant vegetation (plant groups 41–43, 46–48, and 53), (2) <20% smooth brome-dominated vegetation (plant groups 61 and 62), and (3) <20% low shrub-dominated vegetation (plant groups 11–17); based on percentage frequency of occurrence on belt transects (Grant et al. 2004b).
- Native trees and tall shrubs are absent or nearly so, comprising <0.1% land cover on each unit, and no nonnative or planted native woody vegetation exists.
- Leafy spurge frequency is decreased by >50% on each unit, to <1% frequency (frequencies per belt transects; most high-priority units currently have little to no spurge); absinth wormwood is actively controlled; and yellow toadflax and other newly appearing species of noxious weed that pose a threat to the drift prairie are eliminated within 5 years of initial detection.

Strategies

— Disturb the vegetation, typically by livestock grazing or fire, at least 2 of every 3 years. An ideal management sequence over 5 years might be BGGGR (B=prescribe burn the first year; G=graze in each of years 2, 3, and 4; then R=rest), then reinitiate the sequence. The area covered by trees, tall shrubs, and low shrubs will be incrementally reduced with this burning frequency.

— Primarily use prescribed fire when smooth brome plants are at least in the 4- to 5-leaf stage, but not yet showing an inflorescence; this generally occurs during a narrow mid-May through early June "window." A less preferred option is to burn in fall in anticipation of a negative, winter drought effect on smooth brome and Kentucky bluegrass.

— Graze mainly during late May through August or September via a rotation approach with many

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Restored tracts of drift prairie will provide nesting habitat for Baird's sparrow, which has a declining population.

(7–10) relatively small (40–60 acres) grazing cells per unit and short grazing periods (4–7 days) per cell. Adjust stocking rates to facilitate regrazing of individual smooth brome plants at least once within a grazing period, but move livestock to the next cell before native plants are regrazed (be sure to note grazing of native upland sedges, an important forage base in some management units).

— Annually survey for noxious weeds. Continue widespread use of biological control by monitoring local areas for *Apthona* spp. beetles and by redistributing beetles among leafy spurge patches as needed. Use herbicides as needed along boundaries with private lands.

— Reseed adjoining old cropland units into native vegetation dominated by warm-season grasses (see objectives for old cropland). Manage these intensively, in concert with the high-priority drift prairie units they adjoin, to sustain a native-dominated flora and to reduce sources of invasion by introduced cool-season grasses and noxious weeds (see objectives and strategies for old cropland).

— Experiment on low-priority tracts with new or high-risk restoration methods for use on high-priority tracts.

— Experiment with specialized control of dense silverberry patches. Cutting tends to stimulate resprouting in silverberry, as does burning. Therefore, foliar applications of glyphosate, which have been used to control other species of the genus *Elaeagnus*, may achieve the best possible control. Application must be done in ways that does not harm native, understory, herbaceous vegetation (for example, use a wick applicator). One approach may be to chemically treat silverberry and achieve a kill, and then apply prescribed fire.

— Experiment with horses as alternative grazing tools; horses may have greater impact than cattle on woody vegetation, especially silverberry. Since horses may founder (succumb to hoof inflammation) on rich, green vegetation, an appropriate approach in a 3-year grazing cycle may be to use cattle during the first 2 years, then horses the third year.

— Experiment with control of introduced cool-season grasses and release of native plants on a small, localized scale with selective herbicide treatment.

— Experiment with seeding of native warm-season grass mixes in brome monotypes on unit edges. Apply prescribed fire followed by multiple herbicide treatments over 2 years for site preparation. Use similar approaches on brome-dominated edges of adjoining, low-priority units.

NOTE: Service policy regarding refuge management implicitly promotes seeding to reestablish native plants in native sod where such plants have become rare or absent ("National Wildlife Refuge System Biological Integrity, Diversity, and Environmental Health," 601 FW 3, 2001).

— Experiment with "interseeding" of native plants, principally warm-season species, into brome monotypes within units. Apply prescribed fire or repeated intensive grazing, and then use a wick applicator to apply herbicide to emerging smooth brome and Kentucky bluegrass. Follow by seeding via drill.

— Experiment with localized hand plantings and husbandry (such as weed control and herbivore exclusion) of select native forbs such as milkvetches (*Astragalus* spp.) to increase plant species diversity and structural diversity.

— Transplant and release Richardson's ground squirrels on areas of low-stature vegetation within high-priority units, wherever an adjacent source for colonization appears unavailable.

— Remove local, human disturbances and artifacts of twentieth-century origin (including the refuge era). This includes prominent plow furrows, old road grades, rock piles, and impoundment dams on intermittent drainages (except on those essential as livestock water sources). Restore such sites as close as possible to their original condition.

Rationale and Assumptions

This objective focuses on restoration of floristic composition. Smooth brome and Kentucky bluegrass are widespread and common on the Drift Plain at Des Lacs NWR. Kentucky bluegrass tends to increase under prolonged rest or with grazing, but decreases with fire especially when burning occurs during stem elongation or in dry years. Smooth brome also increases under rest but, in contrast to

Kentucky bluegrass, appears sensitive to repeated grazing but unaffected or variably affected by prescribed fire. A strategy to improve competitive abilities of native herbaceous plants should match the types, timing, and frequencies of disturbances under which these plants evolved. Meanwhile, a strategy to decrease competitive abilities of bluegrass and brome on the relatively rich loam soils of the Drift Plain should focus on combined use of fire and grazing.

Smooth brome-dominated types are twice as prevalent as Kentucky bluegrass-dominated types on the drift prairie of Des Lacs NWR, indicating that smooth brome may be more competitive than Kentucky bluegrass in the relatively rich loam soils. Of the two introduced species, smooth brome generally seems more difficult to control and more significantly alters the quality and structure of northern prairie habitats. Therefore, restoration management should focus more on strategies to reduce brome.

The contemporary breeding bird community on the drift prairie of Des Lacs NWR is characterized by three to four species that tolerate introduced cool-season grasses and relatively dense, rank, oftentimes brushy cover. Grassland bird species that are uncommon to absent generally require shorter, sparser, more herbaceous prairie vegetation than that available in the refuge's drift prairie. These species also are of much greater conservation concern due mainly to declining population trends (for example, Sprague's pipit and chestnut-collared longspur). Thus, habitat for a broader array of northern prairie birds—including several endemic species and other species characteristic of the historical mixed-grass prairie community—can be significantly increased by providing frequent disturbance and the resulting increases in early successional stages.

In the historical setting, Richardson's ground squirrels were characteristically widespread and contributed to the maintenance of early seral stages, and their burrows provided unique microhabitats. The ground squirrel should be a component of the restored prairie community.

Historically, the drift prairie was treeless. Trees and tall shrubs can diminish the survival of nests of grassland birds by harboring potential nest predators. They also provide perches from which brown-headed cowbirds can find other species' nests in which to lay eggs. Furthermore, recent data from the Souris River basin refuges indicate that relatively small areas of tall woody vegetation can effectively fragment grassland habitats and cause many grassland bird species to avoid entire landscapes. Elimination of tall woody cover is a logical strategy for restoration of landscape structure and plant community makeup, as well as to improve the attractiveness and security of the habitat for a variety of grassland-breeding bird species.

Drift Prairie Objective 3

On low-priority drift prairie units, apply disturbance (principally fire) every 5–8 years to remove plant litter, restore plant vigor, reverse woody plant expansion, and provide a mix of structural types that include (1) relatively short/sparse vegetation for species such as killdeer, horned lark, and Brewer's blackbird, (2) moderately short vegetation for species such as blue-winged teal and upland sandpiper, and (3) tall/dense vegetation for species such as mallard, short-eared owl, Le Conte's sparrow, and bobolink. Vegetation should present the below characteristics within 15 years of CCP approval.

NOTE: There is almost no monitoring of vegetation on these units except for routine, cursory surveillance for noxious weeds. Knowledge of relationships between fire frequency and resulting, postfire vegetation structure is adequate to predict habitat conditions described below.

One-fourth of the area in 0- to 1-year postdisturbance, one-fourth in 2–3 years postdisturbance, and one-half in 4–6+ years postdisturbance—corresponding roughly to a structure of <2 inches VOR, 2–3.9 inches VOR, and >3.9 inches VOR (mean VORs in early spring, per Robel et al. 1970).

Native trees and tall shrubs compose <0.2% land cover on each unit above the prairie slope, and all nonnative woody vegetation and planted, native woody vegetation is eliminated from at least half of the units.

Leafy spurge is maintained at <2% frequency, absinth wormwood is actively controlled, and yellow toadflax and other newly appearing species of noxious weed that pose a threat to the drift prairie are eliminated within 5 years of initial detection.

Strategies

— Apply prescribed fire on each unit at least every 5–8 years, increasing burn frequency during dry years when possible to reduce more effectively reduce tall shrubs and trees. Rotate burns among units. Burn opportunistically, at any time, mainly to remove litter and control tall shrubs and trees.

— To increase structural diversity, occasionally introduce livestock grazing—with wide latitude on timing, intensity, and duration—when doing so will not detract from management of high-priority units. Experiment with seeding and "interseeding" of native, warm-season grass mixes in smooth brome monotypes, mainly to

help develop effective restoration approaches for high-priority units.

— Periodically survey for noxious weeds. Continue widespread use of biological control by monitoring local areas for *Apthona* spp. beetles and redistributing beetles among leafy spurge patches as needed. Use herbicides as needed along boundaries with private lands.

Rationale and Assumptions

This objective focuses on providing vegetation structural diversity. Most drift prairie at Des Lacs NWR has almost no intact native herbaceous vegetation. From a practical standpoint, most of the drift prairie probably cannot be restored to a state where native herbaceous vegetation is a widely noticeable or otherwise common vegetation component. However, with modest effort, the prevalent, introduced cool-season grasses and scattered low shrubs can be managed to provide a mix of postdisturbance structural types attractive to a broad array of native, grassland bird species.

The most appropriate management of these units is to provide structural variety and use the units as a basis for creating extensive areas of grassland (including off-refuge lands) to satisfy needs of several area-sensitive, native, grassland bird species. This will also reduce predation and nest (brood) parasitism associated with edge-dominated, highly fragmented grassland. The rationale for reducing tall shrubs and trees is similar to that for high-priority drift prairie (objective 2 above).

Drift Prairie Objective 4

Improve or help maintain the habitat quality and the economic sustainability of nonfederally owned, native prairie remnants adjacent to drift prairie units within 15 years of CCP approval. Extend protection and stewardship to most other grassland that adjoins drift prairie units. Seek opportunities to expand the total grassland area and create broad, contiguous blocks of open grassland, principally as habitat for breeding grassland birds.

Strategy

— Use grassland easements and extension agreements, for example, for specialized livestock grazing systems on native prairie, or native grass establishment and management, or to remove "hostile" cover such as trees and tall shrubs that could harbor nest (brood) parasites and nest predators. Certain grazing systems can improve livestock carrying capacity and the condition of annually grazed prairie, to enhance the economic viability of native prairie and reduce chances of conversion to other land uses, especially cultivation.

Rationale and Assumptions

The quality of prairie as breeding habitat for grassland birds (in terms of average annual nest success and relative contribution to population recruitment) is directly related to its extent or, conversely, indirectly related to the degree of its fragmentation.

Native prairie on the Drift Plain could be considered an endangered resource and little of it remains in the Des Lacs River valley. Conserving remnant tracts adjacent to the refuge, by whatever means possible, should be among the highest priorities for landscape conservation.

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Drift prairie tracts with moderate amounts of native grasses and forbs will be considered high priority for restoration.

Prairie Slope Goal

Restore representative examples of prairie slopes to preserve some of the most pristine plant communities that remain in the Souris River basin and promote appreciation and stewardship of prairie resources.

Prairie Slope Objective 1

By 1 year after CCP approval, use vegetation inventory data and topographic considerations to characterize management units with significant prairie slope resources as high-priority units. Reevaluate prioritization 15 years after CCP approval.

Strategy

PHYSICAL CHARACTERISTICS

— Apply multiple selection criteria.

CRITERIA FOR HIGH-PRIORITY UNITS

Floristic Composition. Vegetation is characterized by >60% mean frequency of pristine, native herbaceous types (plant groups 41–43 and 46–48 [Grant et al. 2004b]) plus native low shrub with a native plant understory (plant groups 11, 12, and 15)

Physical Characteristics. Unit aspect is principally south- to west-facing; slope is 25–60%; and elevation gain is >100 feet from slope bottom to top.

Rationale and Assumptions

Native flora is relatively intact along much of the east side of the Des Lacs River valley, in particular, areas with the longest southwest-facing slopes on Des Lacs NWR. Conservation and appreciation of native plant communities needs special consideration.

Some of these high-priority prairie slopes may adjoin high-priority drift prairie and can be managed in conjunction with the drift prairie. However, some of the best-quality slopes may adjoin low-priority drift prairie. These latter slopes need to be identified and managed more intensively than the drift prairie they adjoin, to retain or improve their native plant diversity. Much of this high-quality prairie occurs along a major roadway (Old Lake Road, recently designated as a scenic byway), and has much exposure to the public along with access.

Prairie Slope Objective 2

On high-priority prairie slope units, apply disturbance (principally fire and grazing) every 5–6 years to restore vegetation to the following standards within 15 years after CCP approval.

- Composition on the slope in each unit includes (1) >65% pristine, native herbaceous types (plant groups 41–43 and 46–48), (2) <10% smooth brome-dominated types (plant groups 61 and 62), and (3) <20% low shrub-dominated types (plant groups 11–17); based on percentage frequency of occurrence on belt transects located from top to bottom of slope.
- Native trees and tall shrubs are few, comprising <1% of all cover on the prairie slope of each unit, and no nonnative or planted native woody vegetation exists.
- Leafy spurge frequency is decreased by >50% on slope of each unit to <1% frequency, absinth wormwood is actively controlled, and yellow toadflax and other newly appearing species of noxious weeds that pose a threat to the prairie slope are eliminated within 5 years of initial detection.

Strategies

— Use fire and generally follow historical fire patterns with which native plants evolved. Burn about every 5–6 years, alternating the timing of burning among late spring (mid-May through early June), summer (mid-July through early September), and fall (late September through late October) seasons. Late May and early June burns should be particularly effective restoration strategies on slopes, allowing the unusually prevalent warm-season grasses to outcompete smooth brome and Kentucky bluegrass. Avoid early spring burning, which generally will promote introduced cool-season grasses and woody species that resprout vigorously.

— Use livestock grazing, generally following grazing strategies for high-priority drift prairie units, but with lighter (50–75% lower) initial stocking rates. Use grazing mainly for smooth brome control. Have livestock regraze individual brome plants at least once within a grazing period, but move cattle to the next cell just before native plants are regrazed. Avoid early spring grazing, which may reduce the competitiveness of native cool-season grasses.

Rationale and Assumptions

The contemporary prairie-slope plant community is dominated by a balance of native warm- and cool-season grasses and forbs, especially on mid- and upper slopes (for example, sideoats grama and porcupine grass are unusually prevalent). Native plants are highly competitive on the relatively arid, thin soils of these sites and, compared to their counterparts on drift prairie, need less frequent and less intensive management for restoration. However, on drainages and subirrigated sites scattered along the slopes and on the more mesic

lower slopes, smooth brome, Kentucky bluegrass, and western snowberry generally are codominant, along with big bluestem. Scattered tall shrubs and trees also are often conspicuous in these sites and leafy spurge infestations on slopes are distributed here. Thus, restoration management should target these mesic areas of slopes. The management approach is similar to that on high-priority drift prairie units, but is more flexible and less frequent and intensive—disturbs the vegetation, typically by livestock grazing or fire, about every other year, on average. A management sequence over 5 years might be BRGGR or BRGRR.

Prairie slope is not extensive but supports some of the most pristine native flora in the Souris River basin, making this a highly valued resource worthy of careful stewardship. Prairie slopes probably offer the most accessible, best examples of native prairie heritage to the public.

Old Cropland Goal

On high-priority old cropland areas, establish native-dominated, perennial herbaceous cover that, with modest management, resists invasion by introduced cool-season grasses and noxious weeds. This seeded cover will help form extensive, contiguous blocks of structurally diverse, open grassland for grassland-dependent, breeding bird species.

Old Cropland Objective 1

By 10 years after CCP approval, locate and determine boundaries of old cropland areas and record these in the refuge's geographic information system (GIS) database.

Strategies

- Identify old cropland areas, including those considered DNC, that were seeded to introduced grasses and forbs and/or native grasses since the mid-1970s.
- Identify other old cropland areas, as evidenced by
  - distinct field edges, especially deep furrows and linear piles of wind-borne topsoil that had been deposited along preexisting fence lines and subsequently vegetated;
  - rock piles or rocks strewn linearly along what appears to be a field edge (although rock sometimes was cleared for native hay harvests);
  - nearly monotypic stands of smooth brome, typically with some Kentucky bluegrass but with little native sedge in the understory (several native plant species such as western snowberry, Wood's rose, white sage, western yarrow, several goldenrod species, and silver scurfpea often reinvade these stands);
  - no partly buried rocks with profuse lichens;
  - no clubmoss or cryptogamic crust.
- Use acquisition records, old refuge narratives, 1938–39 aerial photographs, and U.S. Soil Conservation Service records for ancillary support.
- Flag the probable boundaries of areas verified as old cropland, record via GPS, and upload into the refuge's GIS database.

Rationale and Assumptions

Furrows and other linear disturbances caused by implements (for example, plows, disks, and seed drills) are much more evident after an area is treated with prescribed fire or heavily grazed. They are also more readily detected from horseback. Evidence of soil A-horizon disturbance due to cultivation may be determined by NRCS staff. Some areas with signs of farming disturbance (for example, furrows) may have been cropped only for a few years circa 1900–30 or may have been broken during this period yet never cropped. Such areas often are successfully reinvaded by native plants, and may currently support native vegetation at levels approaching the most pristine areas on similar site types at the refuge that are considered native sod.

Old Cropland Objective 2

Within 15 years after CCP approval, convert DNC on at least eight old cropland units to vegetation dominated by several species of native warm-season grasses that vary in stature and growth form and that include several species of native forbs wherever possible. Give priority to units with stands of vegetation that have become decadent and overrun by undesirable, introduced cool-season grasses, especially where such units are adjacent to or within high-priority drift prairie units or high-priority prairie slope units.

Strategies

- Following multiple applications of a broad-spectrum herbicide, seed a native plant mixture that mainly consists of 80–90% warm-season grass species especially big bluestem, little bluestem, switchgrass, and sideoats grama.
- During the first 3–4 years after seeding, annually mow the stand with a hay conditioner and harvest the hay. Substitute grazing or prescribed fire treatments in the subsequent 3–4 years. Use herbicide spot spraying or "interseeding" where necessary.

Rationale and Assumptions

Although initially expensive, native warm-season grasses are economically and ecologically superior to seeded stands of introduced plants in old croplands because

- permanent, perennial cover eliminates regular (every 12–14 years) replacement of seeded, introduced species cover via a farming cycle and thus nearly eliminates potential for soil erosion;
- native grasses reduce local habitat fragmentation and eliminate "edge" associated with the farming cycle;
- a warm-season growth strategy for plants vastly improves the capacity for an assemblage of plants to outcompete smooth brome—by which seeded stands of introduced grasses and forbs are most typically degraded—mainly by affording broader and more effectively timed management opportunities;
- there is improved opportunity for use of prescribed fire in late spring compared to high-priority drift prairie units because the warm-season-dominated cover has relatively high fuel value through early June, versus mostly green vegetation on cool season–dominated cover on the drift prairie by late May;
- there is a broader "window" (later in summer) for harvest of hay that still has forage value;
- native grasses are in compliance with policy that discourages planting of introduced species on Service lands and encourages planting of native species ("National Wildlife Refuge System Biological Integrity, Diversity, and Environmental Health," 601 FW 3, 2001);
- native grasses reduce "source sites" from which introduced and weedy plants invade adjoining native prairie;
- native grasses have improved and longer lasting structural diversity within stands.

Old Cropland Objective 3

By 10 years after CCP approval, identify other old cropland areas (those not known to have been seeded since the mid-1970s) that are high management priority (areas most important to convert to native warm-season grasses). Develop a detailed plan to convert these during the subsequent 10–15 years to vegetation dominated by several species of native warm-season grasses that vary in stature and growth form and that include several species of native forbs wherever possible.

NOTE: There are no goals and objectives for remaining old cropland areas in uplands. They are low priority and will be managed with adjoining habitats.

Strategy

— Apply multiple selection criteria.

CRITERIA FOR HIGH MANAGEMENT PRIORITY OLD CROPLAND IN UPLANDS (excluding DNC and other old cropland known to have been seeded since the mid-1970s)

Floristic Composition. Vegetation is characterized by <20% mean frequency of pristine, native herbaceous types (plant groups 41–43 and 46–48 [Grant et al. 2004b]) plus native herbaceous-dominated vegetation with Kentucky bluegrass as the main subdominant (plant group 53).

Floristic Potential. Vegetation is characterized by >20% mean frequency of smooth brome-dominated types (plant groups 54, 61, and 62).

Landscape Context. The unit has no size criterion
and
bears clear evidence of a farming history
and
is contiguous with high-priority drift prairie, prairie slope units, or tracts of native prairie adjacent to the refuge under non-Service ownership.

Rationale and Assumptions

Native grass and forb seed is very costly, as is the time and expense of materials needed to prepare seedbeds, plant seed, and annually manage newly seeded areas (see strategies and rationale under objective 2).

Old cropland that adjoins high-priority drift prairie or prairie slope and supports little, native, herbaceous vegetation likely is a source of invasion by undesirable, introduced grasses and weedy forbs. Without attempts to establish native vegetation through seeding, such areas are unpromising candidates for restoration to grassland in which native herbaceous plants are evident, much less an important codominant component of the plant community.

Old cropland areas with a more prominent native plant component—such as areas farmed for 5–10 years before refuge establishment, presumably before smooth brome and Kentucky bluegrass were widely distributed—may have been reinvaded by native herbaceous plants. These areas may have

restoration potential that at least equals that of adjoining, high-quality drift prairie or prairie slope.

Old Cropland Objective 4

After seeding and establishing native warm-season plants in an old cropland unit, maintain native plants as the most dominant vegetation cover, per qualitative estimation.

NOTE: There are no goals and objectives for other old cropland units (those not yet converted to warm-season-dominated communities); they are low priority.

Strategies

— Seeded warm-season stands of herbaceous plants should be well established 5–8 years after seeding; manage these by a disturbance treatment about every 2–3 years. They probably can be disturbed more flexibly with regard to phenology, mainly to discourage smooth brome invasion.

— Use grazing as an alternate management treatment and take advantage of the wide, spring-grazing "window" afforded by the warm-season-dominated community.

— Integrate management with that of surrounding drift prairie while focusing on treatment approaches that promote native warm-season plant species.

— In the interim between prescribed burns, possibly harvest hay every 2–3 years from old cropland units, alternating among July, August, and September to favor warm-season grasses.

— If and where occasionally needed along unit boundaries, use herbicides to reduce encroaching, introduced cool-season grasses and release native warm-season plants. Use integrated pest management to treat local infestations of noxious weeds as needed.

Rationale and Assumptions

The warm-season growth strategy for plants vastly improves the capacity for an assemblage of grassland plants to outcompete smooth brome—by which seeded stands of introduced grasses and forbs are most typically degraded—mainly by affording broader and more effectively timed management opportunities.

Old Cropland Objective 5

Within 15 years of CCP approval, eliminate planted tall shrubs and trees and any naturalized, nonnative woody vegetation that occurs within or adjacent to high-priority old cropland areas as they are being restored to native-dominated vegetation.

Strategies

— Remove tree-shrub plantings by mechanical means (for example, cutting ash trees by hand; shearing caragana shrubs with a tractor blade or bucket during winter). Follow with herbicide treatment of stumps, or follow with broadly applied herbicide, rotary mowing, and/or prescribed burning of resprouting vegetation wherever necessary.

Rationale and Assumptions

Trees and tall shrubs can diminish the survival of nests of grassland birds by harboring potential nest predators. They also provide perches from which brown-headed cowbirds can find other species' nests in which to lay eggs. Recent data from the Souris River basin refuges indicate that relatively small areas of tall woody vegetation can effectively fragment grassland habitats and cause many grassland bird species to avoid entire landscapes. Elimination of tall woody cover is a logical strategy for restoration of landscape structure and plant community makeup and improvement of the attractiveness and security of the habitat for a variety of grassland-breeding bird species.

Coulee Woodland and Coulee Woodland Edge Goal

Acknowledge a nearly irreversible, localized establishment of mature, contiguous woodland and minimally manage these areas as breeding and migration habitat principally for forest-interior, migratory bird species such as veery and ovenbird. Strive to eliminate remaining, noncontiguous, edge-dominated tree and tall shrub cover, particularly near high-priority drift prairie and the largest, most contiguous grassland tracts.

Coulee Woodland and Edge Objective 1

By 1 year after CCP approval, use GIS vegetation data and topographic considerations to classify management units with significant (>20% cover) tree and tall shrub cover as either "coulee woodland units" or "coulee woodland edge units."

Strategies

— Use these criteria for identifying units with significant tree and tall shrub cover as coulee woodland units: the uppermost vegetation strata of a unit comprises >50% tree cover with some tall shrub, forming woodland patches that generally are contiguous (minimum woodland width × length = 330 × 660 feet, about 5 acres).

— Use these criteria for identifying units with significant tree and tall shrub cover as coulee woodland edge units: the uppermost vegetation strata of a unit comprise 5–50% tree and tall

shrub cover, generally occurring in narrow bands and are not contiguous.

Rationale and Assumptions

It is critical to the refuge's vision and restoration approach to distinguish management units with considerable woodland cover versus those with much woodland edge. Coulee woodland at Des Lacs NWR is difficult to restore back to prairie, mainly because understory and ground fuels are too limited to carry fires of sufficient extent and intensity to kill overstory trees. Such areas probably do not have native prairie, grass-forb seed banks. However, coulee woodland could continue to provide modest habitat for forest-interior bird species such as veery and ovenbird without slowing widespread improvement in grassland bird habitat elsewhere at the refuge.

S. Maslowski/USFWS

The ovenbird finds desirable habitat in coulee woodland.

In contrast, coulee woodland edge is a widespread habitat type that, in the absence of fire, will continue to fragment drift prairie and some prairie slope. None of the breeding bird species that are common in this edge habitat is of management concern. However, 11 grassland bird species that occur or used to occur at Des Lacs NWR are species of concern.

Conversion of woodland edge habitat to open prairie at the refuge could be achieved through repeated use of prescribed fire. This conversion will insignificantly influence continental population trends of woodland bird species, while helping reverse population declines of grassland bird species. Reduction of woodland edge may also reduce cowbird parasitism rates on grassland bird nests.

Coulee Woodland and Edge Objective 2

Minimally manage several tracts of green ash-dominated, contiguous coulee woodland that cover about 800 acres and present the following characteristics within 15 years:

- There are 260–350 trees per acre and 55–60% canopy cover (roughly same as current condition, based on 1995 random plot data in Nenneman et al. 2003).
- Chokecherry, serviceberry, and green ash saplings are principle understory shrubs with ≥75% frequency each (current condition, based on 1995 data from random plots [Nenneman and Murphy, unpublished]).
- Noxious weeds are controlled within woodland (common buckthorn, leafy spurge, common burdock, and other noxious weed species are each reduced to <3% frequency and newly discovered species of noxious weeds eliminated) and elsewhere on each woodland unit (buckthorn and other introduced species of tall shrubs or trees are eliminated and leafy spurge is reduced by >50%, to <5% frequency). Infestations of other, newly appearing species of noxious weed are detected and eliminated.

Strategies

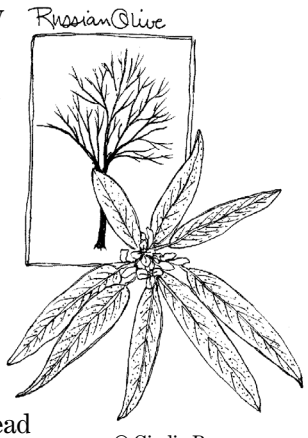
— Except for active control of noxious weeds, rely mainly on passive management—do almost nothing. Contiguous woodland cover at Des Lacs NWR probably is nearing its maximum extent, apparently limited by local site potential (Grant and Murphy 2005). American elm formerly was codominant with green ash but by the late 1990s was widely decimated at the refuge by Dutch elm disease, with little recent evidence of recruitment (3% shrub frequency).

— In open areas around woodland, continue to reduce leafy spurge by occasional redistribution of *Apthona* spp. beetles, plus limited use of herbicides at refuge boundaries if necessary. Leafy spurge occurs uncommonly in woodland (<3% frequency, 1996 data).

— Within woodland, control common buckthorn by combinations of mechanical (hand cutting) and chemical means (herbicides applied on stumps freshly exposed by cutting). Common buckthorn was common (25% frequency) on random woodland plots in 1996. The shrub appears to be steadily increasing, especially in HB14 (south half) and HB18. Without prompt, concerted, control efforts, buckthorn likely will dominate forest understories at Des Lacs NWR within 15 years and significantly diminish habitat values for forest-interior bird species such as

veery and ovenbird in addition to having other undesirable effects. Buckthorn is readily identified in late fall because it retains green leaves long after leaf-fall of other deciduous trees and tall shrubs. Seeds of the shrub are readily disseminated by many bird species and extended control must include regular vigilance.

— Remove or aggressively destroy, wherever opportunity allows, other introduced woody plants (Russian olive, honeysuckle, and Siberian pea). These plants seldom occur in woodland (<3% frequency, 1996 data), but occur outside woodland in the same and other units (for example, Russian olive is particularly widespread near refuge headquarters).



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Rationale and Assumptions

The area covered by coulee woodland increased significantly through the late 1960s but appears to have reached its potential extent. Most areas covered by coulee woodland at Des Lacs NWR may be difficult to restore back to prairie but probably could continue to provide modest habitat for forest-interior bird species without hindering widespread improvement in grassland bird habitat elsewhere at the refuge.

Coulee Woodland and Edge Objective 3

On each coulee woodland edge unit, apply disturbance (principally fire) every 5–6 years to restore the vegetation to the following standards within 15 years:

- Tree and tall shrub cover are reduced by >50% (measured via remote imagery).
- Plant litter is removed and herbaceous plant vigor and structural diversity are restored by management treatment applied every 5–6 years (these responses will be unmeasured and instead will be assumed to coincide with disturbance events).
- At any given time, about one-fourth of the area of all woodland edge units is in 0–1 year postdisturbance, one-fourth is in 2–3 years postdisturbance, and one-half is in 4–6+ years postdisturbance. This corresponds roughly to VOR height-density classes of 0–2.0 inches, 2.0–3.9 inches, and 3.9–5.9 inches respectively, to contribute to the variety of grassland structural types across the landscape.
- Noxious weeds are controlled: (1) buckthorn, caragana, and other introduced species of tall shrubs or trees are nearly eliminated; (2) leafy spurge is reduced by >50%, to <5% frequency; (3) absinth wormwood and Canada thistle are actively controlled at the refuge boundary; and (4) infestations of yellow toadflax and any other, newly appearing species of noxious weed are detected and eliminated.

Strategies

— Apply prescribed fire every 5–6 years, varying the timing of burns within a given unit. Concede to continued invasion by introduced cool-season grasses, especially smooth brome, over much of these units, although upper slope areas may continue to support small patches (0.1–2.0 acres) of relatively diverse, native plant communities with a prominent warm-season grass component (somewhat similar to southwest-facing prairie slopes).

— So long as critical needs of priority management units (especially high-priority drift prairie) are not compromised, seek opportunities for occasional grazing by livestock during years between prescribed burns to improve structural heterogeneity and slow litter accumulation. Grazing prescriptions can be very flexible, even allowing occasional, relatively severe defoliations, although such events may result in local increases in weeds such as Canada thistle and yellow sweetclover.

Rationale and Assumptions

Coulee woodland edge is a widespread habitat type at Des Lacs NWR that, in the absence of fire, will continue to fragment drift prairie and some prairie slope. None of the breeding bird species that are common in this edge habitat is of management concern, whereas 11 grassland bird species that occur or used to occur at the refuge are considered species of concern. Conversion of woodland edge habitat to open prairie, through repeated prescribed fire, will negligibly influence continental population trends of woodland bird species while helping reverse population declines of grassland bird species. Reduction of woodland edge may also help reduce cowbird parasitism rates on grassland bird nests.

Meadow Goal

Restore and maintain extensive examples of plant communities dominated by native flora characteristic of seasonally flooded meadows within the Souris River floodplain to attract grassland- and wetland-dependent bird species and other wildlife.

Meadow Objective 1

Manage meadows to present a mosaic of short-sparse herbaceous cover to tall-dense herbaceous cover and limit tall woody vegetation to <1% of the overall plant cover.

Strategy

— Manage meadows with the broader habitats that they adjoin or in which they are embedded (marsh units, prairie slope), using periodic prescribed fire and grazing where possible.

Rationale and Assumptions

Meadow is limited in area at Des Lacs NWR, occurring in small, isolated, often long, narrow patches (<40 acres). Meadows occur at the mouths of major coulees or on the periphery of marsh units along the southern one-third of the refuge. Although these areas contribute to plant and wildlife diversity (for example, the Baltic rush-saltgrass-sedge community includes several unique species of sedge, along with sedge wren and Nelson's sharp-tailed sparrow), it generally is impractical to exclusively target these areas in management planning.

Combinations of prescribed burning and grazing are appropriate management. However, grazing without recurrent fire treatments could increase occurrences of grazing-tolerant species such as foxtail barley and curly-cup gumweed. Local invasion by two introduced, rhizomatous grasses, reed canarygrass and quackgrass, might be exacerbated by grazing without recurrent fire. Fire also will maintain the current low occurrence of willow and meadowsweet, plus that of western snowberry in the relatively high, less moist sites within meadows.

Wetland Goal

Manage riverine wetlands, including marshes and lakes, to sustain the long-term capacity of riverine wetlands to support diverse plant and wildlife communities. Restore ecological processes that sustain long-term productivity of wetlands.

Wetland Objective 1

Within 5 years of CCP approval, synthesize available information on the effects of physical alterations, altered hydrology and hydroperiod, increased sedimentation, and changes in water quality of the riverine system, past and present: (1) develop a report to describe consequences of these alterations on long-term viability of riverine marshes, (2) determine biological potentials and constraints for each wetland impoundment, and (3) develop criteria to prioritize refuge impoundments with the greatest potential for sustained productivity.

Strategies

— Use past narratives, aerial photographs, unpublished refuge files, and scientific literature to evaluate the biological potential of wetland impoundments and prioritize units for management.

— Map physical areas within each impoundment that are expected to respond to management.

— Develop and prioritize a list of knowledge gaps and research needs.

— In cooperation with USGS's Northern Prairie Wildlife Research Center, complete a sediment accretion study and contaminants studies.

— Monitor groundwater and soil moisture levels in impoundments and within the adjacent meadow zone.

Rationale and Assumptions

This objective focuses on compilation of past and current data about development and management of the Des Lacs River wetlands. Although riverine wetlands form one of the most extensive and important habitats at the refuge, site-specific information is limited about effects of habitat management (especially water level management) on vegetation structure and composition, species diversity and density of aquatic invertebrates, and wetland-dependent bird species. Models for managing northern prairie wetlands exist but their utility is limited for managing riverine marshes at the Souris River basin refuges, primarily because impoundments include flow-through of the rivers, which limits wetland management capabilities.

This objective requires compilation of existing wetland management records along with a clear, succinct treatment of threats and management opportunities and limitations for riverine wetlands. Laubhan and others (2003) completed a biological assessment of wetland conditions for the Souris River basin refuges; this report provides a start in meeting this objective and those that follow.

Wetland Objective 2

Within 15 years of CCP approval, evaluate and comprehend crucial ecological processes that maintain long-term wetland productivity. Develop a range of biological indicators (for example, sago pondweed biomass, decline of important invertebrate species, and shifts in extent and juxtaposition of aquatic emergent vegetation) useful as references or benchmarks for implementing management strategies such as water level management and prescribed fire to maintain wetland productivity over the long term.

Strategies

- Complete development of a USGS computer application that uses long-term flow data from gauging stations to assess effects associated with long-term alterations in river hydrology and hydroperiod on wetland plants, wildlife, and ultimately the potential to sustain long-term wetland productivity.
- In cooperation with USGS's Northern Prairie Wildlife Research Center, complete a sediment accretion study and determine effects of sedimentation for long-term management of riverine marshes.
- In cooperation with USGS and others, assess available contour maps for wetlands; where inadequate, develop detailed contour maps of marsh bottoms for all impoundments to help construct models that predict vegetation response to water level management.
- In the absence of full restoration of the natural hydrograph and hydroperiod of the Des Lacs River, continue to study the economic, physical, and biological feasibility of constructing a major bypass channel to expand management opportunities at all impoundments.
- Develop a method to inventory contemporary vegetation communities in managed wetlands. Expand use of remote imagery (1) to monitor sago pondweed biomass, which is positively correlated with invertebrate diversity and density at the refuge (Euliss et al. 2003), and (2) to develop methods for long-term monitoring of other wetland vegetation.
- In cooperation with USGS and others, use information derived above to develop models that predict effects of water management (especially hydroperiod) on wetland plants, invertebrates, and migratory birds. Revise objective 1 accordingly.

Dan Severson/USFWS

Unit 2 at Des Lacs NWR.

Rationale and Assumptions

This objective focuses on synthesizing existing scientific research on wetland function and cycles in northern prairie wetlands and impounded riverine wetlands. It also prompts site-specific inventory, monitoring, and research to support management of riverine marshes.

A biological assessment of wetland conditions for the Souris River basin refuges was completed recently (Laubhan et al. 2003). This report provides context for the original construction and subsequent physical and operational modifications to the managed wetland system at the Souris River basin refuges. Additionally, long-term threats to the system are discussed. However, past management of riverine wetlands has been based more on "gut feeling," an irregular local climate, and politics, than on sound science. Site-specific data are lacking regarding effects of wetland management on vegetation structure and composition, aquatic invertebrate densities, and wetland-dependent wildlife species.

Relative to upland habitats, managers have less effective control over wetland systems, due in part to the following:

- misunderstandings about the biological significance of drought and of complete drawdown, dating back to the original construction of wetland impoundments;
- limited knowledge of long-term impacts of low-head dams on rivers in the northern Great Plains;
- significant physical limitations of constructed impoundments, especially inability to manipulate water levels of adjacent impoundments independently;
- inherent difficulties in conducting basic inventory, long-term monitoring, or applied research in wetlands relative to upland sites.

Wetland Objective 3

During the 15 years after CCP approval, develop and implement a new management philosophy that emphasizes long-term wetland productivity over older models based on "oasis" management, where wet acres are maximized (especially during extreme drought) or years of "hemi-marsh" conditions are maximized. In high-priority impoundments, use periodic disturbance to provide the full spectrum of wetland conditions—for example, (1) dry marsh, (2) densely vegetated marsh (regenerative phase), (3) hemi-marsh, (4) open marsh (degenerative phase), and (5) open water—to benefit wetland-dependent migratory birds.

Strategies

— Re-create, where possible, the natural hydrology and hydroperiod of the Des Lacs River. In most areas, physical disruptions such as rights-of-way, dikes, and control structures compromise the degree to which this strategy could be carried out. Focus management on the lower refuge impoundments (units 4–7), which probably have the greatest potential for sustained productivity (from objective 1).

— Use natural climatic fluctuations to increase wetland management opportunities. Periodic drought may hasten full or partial drawdowns in some units. Although such drawdowns maximize the long-term viability of wetlands, the availability of wetlands with water is reduced during drought. In contrast, previous management emphasized retaining as much water as possible to offset landscape-level drought effects on migratory birds at the expense of long-term capacity to sustain wetland productivity in refuge impoundments.

— Use periodic, growing-season drawdown over multiple seasons if required to (1) stimulate production of seed-bearing annual plants, (2) increase invertebrate biomass, and (3) stimulate establishment and expansion of emergent and submergent plant species.

— During the drawdown phase, use additional disturbances, especially prescribed fire, mechanical soil treatment (for example, disking and farming), and defoliation (haying or grazing) to boost vegetation and invertebrate response during the regenerative phase and control robust emergent vegetation. Refer to appendixes O, P, and Q for compatibility determinations for grazing, haying, and farming, respectively.

— Use periodic inundation to reduce robust emergent vegetation, especially cattail and common reed.

— Use aerially applied herbicides when needed to reduce the extent of monotypic, robust stands of emergent vegetation in portions of impoundments that, historically, do not respond to water level management (cannot hold >3 feet of water during the growing season).

— Obtain remaining water rights through North Dakota State Water Commission. Buy additional water rights.

— Detect and eliminate purple loosestrife and salt cedar.

— Maintain carp-free status.

Rationale and Assumptions

This objective focuses on implementation and management, using the best available science. Past management goals and objectives rarely addressed or incorporated unforeseen impacts related to the physical disruptions of the river (for example, original construction of dikes and dams), or changes in habitat (biotic and abiotic) resulting from these events. Inevitable decreases in water quality and in marsh management capabilities—especially because of accretion of sediments—are assumed, based on current knowledge of such trends on this and similar impounded riverine marshes in the northern Great Plains.

Productivity of northern prairie wetlands was historically maintained by periodic wet and dry cycles. Productivity is particularly enhanced during reflooding following natural drought or drawdown (in managed wetlands). Riverine marshes have an inherent reduced capacity to be dewatered during the growing season because the river flows through each impoundment. Departures from a natural hydroperiod can render prescriptive drawdowns ineffective because marsh sediments never dry sufficiently to (1) oxidize soils, (2) establish annual wetland plants (important waterfowl foods and a substrate for invertebrate production), or (3) establish perennial emergent and submergent vegetation (food cover and invertebrate substrate). Furthermore, control of robust emergent plants (cattail, reed, and bulrush) becomes difficult because of continued anoxic (absence of oxygen) conditions, with little reduction in organic material in marsh soils. Consequently, wetlands often cycle rapidly between open water and a dense-vegetated marsh phase, both of which are less productive than intervening stages. A periodic dry marsh phase is rarely achieved. Instead, under this objective, wetland management will become more opportunistic. Periodic drawdowns will be emphasized, typically working in conjunction with wet-to-dry cycles to achieve management objectives.

Wetland Objective 4

Over the course of the CCP, introduce efforts on a watershed level that reduce sedimentation and nonpoint source pollution and/or their effects on riverine marshes.

Strategies

— Develop models similar to the “mallard model” developed by the HAPET that target areas within the watershed (for example, adjacent to major tributaries or drainage systems) that have the highest potential for sediment transport, especially during extreme rainfall or snowmelt events.

— Use models to target areas for conversion from cropland to grassland via USDA’s CRP, Wetland Reserve Program, or other USDA conservation initiatives. Identify drained wetlands within targeted areas for restoration. Initiate and develop additional conservation

measures that reduce or mitigate impacts from sedimentation and pollution.

— Work with the NRCS to ensure compliance with "Sodbuster," "Swampbuster," and other provisions in the Farm Bill (current and future) that reduce soil erosion.

— Explore construction of sediment traps at the refuge to reduce sediment inputs. Where management capability has already been reduced, explore the feasibility of dredging to reduce accumulated sediment in certain impoundments.

— Protect native prairie and prairie wetlands within target areas or adjacent to the refuge, using perpetual easements.

— In cooperation with the USGS and the state of North Dakota, monitor and document sediment loads and water quality associated with various flows. Consider trying to pass flows with high sediment loads or that significantly reduce water quality.

Rationale and Assumptions

Initial samples collected at the Souris River basin refuges document only slightly elevated levels of sediment accretion for most impoundments. However, over many decades, sedimentation is expected to continue to the point where storage capacity (water depth) of pools will decline. This will result in reduced capability to manage wetland vegetation, especially robust emergent plants, using water level manipulations. Results from an ongoing sedimentation study at the Souris River basin refuges are expected to confirm this assumption.

Sedimentation and pollution mainly originate within the watershed, but outside refuge boundaries. Sediment is transported mainly via agricultural runoff carried in major tributaries and wetland drainage projects. Flows that contain high sediment loads or that significantly reduce water quality appear associated with floods originating from heavy winter snowmelt or significant rainfall events.

Island Goal

Manage islands to attract waterfowl and increase nest survival, especially during drought years when wetland habitat outside of the Souris River basin refuges is limited.

Island Objective 1

By 1 year after CCP approval, prioritize nesting islands based on past waterfowl use, nest survival, and maintenance feasibility.

Strategies

— Use data from nest studies (1990s) to evaluate each nesting island for waterfowl production.

— Emphasize islands far from shore with a large, surrounding, open-water barrier and islands with extensive, relatively dense, tall, nesting cover (for example, VOR >5.9 inches).

— Identify and maintain islands that (1) have value for migratory bird species of management concern as secure nesting habitat, and (2) require almost no maintenance (for example, erosion control and occasional predator removal; less than $250 average annual expenditures per island).

— Allow islands that are poorly designed and unproductive for nesting waterfowl to deteriorate.

Donna Dewhurst/USFWS

Canvasback.

Rationale and Assumptions

Island management will be lower priority than restoration of other, more extensive, habitat types. Therefore, limited resources expended on island management should target islands with the greatest potential to produce waterfowl. Data on waterbird nesting and nest success were collected during the 1990s on islands available for nesting by waterfowl and other migratory birds. Data on presence of mammalian predators also were collected, based on annual trapping records. Anecdotal, incidental notes have been gathered on use of islands for nesting and roosting by a variety of migratory bird species.

Island Objective 2

Remove nesting islands with a history of low waterfowl nest densities and/or low nest survival. Burn some islands with low nest survival in late April or May to discourage waterfowl nesting.

Strategies

— Allow islands to deteriorate slowly through erosion.

— Level islands by bulldozing during drought or drawdown periods.

Rationale and Assumptions

Islands that consistently support low levels of waterfowl nest success detract from species population goals.

Island Objective 3

During drought conditions, remove mammalian predators from islands selected as high priority for management and discourage nesting by gulls.

Strategies

— Trap predators such as skunk, raccoon, and mink soon after ice-out in the spring, during drought years or when resources allow. The spring "window" for effectively capturing mink is narrow; capture is unlikely once nesting has begun.

— Except for poisoning (currently not an approved strategy), the best control for mink is attained by limiting winter muskrat populations that maintain survival of mink during winter months.

— Partial winter drawdowns can be used to control muskrat populations.

— Discourage gull nesting by maintaining tall, dense vegetation.

Rationale and Assumptions

Islands can potentially support high levels of waterfowl nest density and nest success, but only if free from predators. Island objectives remain secondary to marsh management objectives that maintain long-term wetland productivity.

Cultural Resource Goal

Discover and protect cultural resources and interpret sites when the interpretation does not adversely affect habitat management.

Cultural Resource Objective 1

Within 15 years of CCP approval, identify and protect cultural resources present at the refuge.

Strategies

— Complete cultural resource surveys as needed for management purposes.

— Identify and store known cultural resource sites on a secure GIS database layer that can be used during management planning.

— Secure funding to survey the entire refuge for cultural resource sites.

— Protect known sites with refuge law enforcement, barriers, signing, and special use permits.

Rationale and Assumptions

There are limited resources (funding and staff) that will be allocated yearly to the refuge. The priority for these funding and staffing resources is to protect and manage upland and wetland habitats for wildlife. Protection of cultural resources is an integral part of the purpose. All cultural resource laws and policies will be complied with to prevent the destruction of known and unknown sites.

Cultural Resource Objective 2

Within 10 years of CCP approval, develop a cultural resource interpretive program that will convey the cultural history of the Des Lacs River valley to refuge visitors.

Strategy

— Develop a self-guided interpretive route at the Munch's Coulee National Recreation Trail that details life on the prairie in the 18th century, using replicated cultural resource sites.

Rationale and Assumptions

The interpretation of cultural resources is encouraged if sufficient funding and staff are available (so that habitat management will not be negatively affected). Interpretation of the Souris River basin culture will enhance visitors' appreciation and knowledge of the role of refuges to protect native habitats and wildlife. In addition, visitors will be taught to respect, value, and protect cultural resources.

Creating replicas of cultural resource sites will convey the message that is learned from cultural resource sites without risking damage to actual sites.

Replicas will allow many types of sites to be viewed in a limited area, reducing impacts to important habitats.

Visitor Service Goal

Provide wildlife-dependent recreational opportunities to a diverse audience when the administration of these programs does not adversely affect wildlife and habitat management.

Visitor Service Objective 1—Hunting

Within 5 years of CCP approval, provide hunting opportunities for 500 visitors when resources needed to administer these programs do not adversely affect the refuge's ability to implement habitat management. Continue to provide hunters with safe, reasonable harvest opportunities; uncrowded conditions; minimal conflicts with other users; and satisfaction with their overall experiences.

Strategies

— Annually determine whether resources (funding and staff) will be available to provide hunting opportunities at the current level.

— When compatible, add other designated game animals to the list of species open for hunting.

— Provide hunting opportunities and access for hunters with disabilities, on request, when determined to be compatible.

— Continue to work with the NDGF to provide quality hunting opportunities where possible.

— Continue providing the public with information on refuge hunting opportunities by news releases, updated hunting brochures, signs, and the refuge website, as needed.

— Continue to regulate hunting with refuge law enforcement.

Rationale and Assumptions

"Hunting is clearly an important activity with visitors making multiple trips to the refuge to do so. These visitors feel that hunting at the refuge provides a unique experience they cannot find elsewhere," (Sexton et al. 2005). However, there are limited resources (funding and staff) that will be allocated yearly to the refuge. The priority for these resources is to protect and manage upland and wetland habitats. Hunting programs will be allowed if resources needed to administer hunting will not materially detract from habitat management. The Service intends to keep the present level of programs, unless funding or staffing shortfalls increase. The greatest expenses for the hunting program are for law enforcement, sign development and maintenance, development and printing of hunting brochures, answering questions, and updating the refuge website.

The compatibility determination for recreational hunting is in appendix S.

Visitor Service Objective 2—Wildlife Observation and Photography

Within 5 years of CCP approval, provide wildlife observation and photography opportunities for no less than 8,000 visitors annually as a result of improved tour routes and habitat and wildlife diversity.

Strategies

— Continue efforts to improve the Scenic Backway auto tour route (asphalt surfacing on the south section and improved gravel surfacing on the north section).

— Develop partnerships with wildlife groups and organizations to market available birding and wildlife opportunities at the refuge.

Robert Murphy/USFWS

Scenic byway at Des Lacs NWR.

Rationale and Assumptions

Visitors drawn to the refuge for nonconsumptive activities found birding, wildlife observation, the auto tour route, and walking interpretive trails to be the most important activities. Visitors tend to observe and photograph wildlife collaterally at the same time they participate in other wildlife-dependent activities. The auto tour route gives visitors excellent opportunities to view birds and other wildlife. Although there are no plans to expand these existing facilities, they can be enhanced. Habitat management improvements will provide a greater diversity of wildlife available for observation and photography.

The compatibility determination for wildlife observation and photography is in appendix T.

Visitor Service Objective 3—Environmental Education and Interpretation

Within 5 years of CCP approval, provide environmental education programming to no less than 100 students per year. Provide interpretive exhibits that will be viewed by 15% of visitors per year. Emphasize learning about natural plant and animal communities, ecological processes, refuge management, and restoration of upland and wetland.

Strategies

— Develop educational partnerships with schools and other government entities to efficiently tell the refuge story.

— Complete the redesign of visitor center exhibits to tell the story of the refuge and the Refuge System, and to emphasize the importance of the prairie grassland ecosystem.

— Maintain existing interpretation panels at the Scenic Backway and overlooks.

— Complete the interpretation of Munch's Coulee National Recreation Trail.

— In cooperation with partners, participate in at least one special event annually to increase visitors' knowledge and understanding of wildlife conservation and related issues.

Rationale and Assumptions

There are limited opportunities to educate a large number of people about the refuge and the Refuge System in the rural communities surrounding the refuge. Most visitors and users of the refuge are local. There are opportunities to educate local youth about wildlife and habitat; most of these youth will leave the state when they graduate and take the message elsewhere.

Unfortunately, the Des Lacs NWR does not have educational facilities or staff to provide this valuable service. The refuge's priority is to protect and manage upland and wetland habitats to prevent degradation. Existing educational programs will be continued, but less frequently, and will rely on volunteers and other groups to contribute more time.

The compatibility determination for environmental education and interpretation is in appendix T.

Non-wildlife-dependent Public Use

Objectives and strategies are not developed for non-wildlife-dependent public use activities. Examples of these activities are canoeing, boating, berry picking, horseback riding, walking, hiking, bicycling, cross-country skiing, snowshoeing, four wheeling, swimming, water skiing, sailing, and snowmobiling.

These types of activities may be compatible when associated with wildlife-dependent public use. For example, berry picking along a trail might be allowed as a compatible activity incidental to the wildlife-dependent public use of wildlife observation. Compatibility of activities will be determined on an individual basis by the refuge manager as needed in the future.

Research and Science Goal

Conduct innovative natural resource management using sound science and applied research to advance the understanding of natural resource function and management within the northern Great Plains.

Research and Science Objective 1

During the 15 years following CCP approval, identify and prioritize research needs required to meet the refuge's goals and objectives; promote investigations that reliably address these needs.

Strategies

— Conduct vegetation and wildlife inventories of all plant communities within major habitats identified in chapter 3. Use initial inventories as baseline data to assess past and future changes in plant and animal community composition.

— Use periodic surveys (for example, every 5 years) to assess vegetation composition and structure of high-priority refuge habitats.

— Focus wildlife population research on assessments of species-habitat relationships. Develop models that predict wildlife response to habitat management or restoration.

— Design and conduct issue-driven research unlikely to be reliably addressed using long-term monitoring. Develop predictive models of habitat management and restoration.

— Promote refuge research and science priorities within the broader scientific community. Ensure that cooperative research focuses on meeting information needs identified in habitat management goals and objectives.

Cory Rubin/USFWS

Refuge staff member measures vegetation.

Rationale and Assumptions

Habitat-based goals and objectives form the basis for setting research and monitoring priorities for Des Lacs NWR. Investigations must be sufficiently designed, funded, and carried out to reliably address proposed hypotheses or questions.

Partnerships are integral to meeting the research and science goal and objectives. Cooperative efforts are supported with shared funding, lodging, vehicles, equipment, knowledge, and expertise.

Operations Goal

Efficiently use funding and staffing for the benefit of all natural and cultural resources, the National Wildlife Refuge System, and present and future generations. Effectively manage visitor service programs that complement habitat management.

Operations Objective 1

Within 15 years of CCP approval, hire three additional personnel to restore native prairie habitat

and manage wetland resources on 100% of high-priority habitat units and 50% of moderate-priority habitat units.

Strategies

— Hire a full-time refuge manager with duties to plan and carry out intensive habitat restoration efforts on the highest priority habitats and units.

— Hire a full-time wildlife biologist to monitor wildlife and habitat responses to habitat protection, management, and restoration efforts.

— Hire a full-time tractor operator to carry out the habitat restoration work.

Rationale and Assumptions

There are limited resources (funds and staff) allocated yearly to the refuge. The priority for these resources is to manage upland and wetland habitats. If the target (minimum) staffing level and funding are not reached or only partially reached, fewer accomplishments will be achieved.

Operations Objective 2

Within 15 years of CCP approval, secure additional funding necessary to complete habitat restoration on 100% of high-priority habitat units and 50% of moderate-priority habitat units. Include restoration with (1) native prairie reseeding, and (2) intensive management of existing native prairie including woody plant reduction, invasive species control, and increased prescribed fire and grazing activities.

Strategies

— Use additional funding to purchase native grass and forb seeds for reseeding former cropland and planted cover.

— Use additional funding to purchase herbicides to control invasive species and remove/control woody plant expansion.

— Continue to use maintenance management funding to maintain or replace equipment and facilities, as needed, to Service standards.

— Secure additional funding to construct an equipment storage building to protect existing equipment and implements to extend their useful life. Equipment is necessary for habitat protection and restoration and maintenance of existing facilities.

— Maintain existing facilities and equipment to Service standards, including necessary roads, dikes, water control structures, buildings, and fences (all of which are critical in habitat management and protection).

Rationale and Assumptions

There are limited resources (funds and staff) allocated yearly to the refuge. The priority for these resources is to protect and manage upland and wetland habitats for wildlife. Operational funding will be targeted to work on the highest priority habitats and habitat units at the refuge. Management intensity will be increased on those habitats and units and will require additional personnel and funding to restore native prairie.

J. Clark Salyer NWR Management Direction

The following goals, objectives, and strategies for J. Clark Salyer NWR outline the actions needed to achieve the vision of the Souris River basin refuges. The Service intends to meet these objectives during the next 15 years.

Drift Prairie Goal

Restore and maintain extensive examples of plant communities dominated by native flora characteristic of the mid-1800s drift prairie. Create the temporally and spatially dynamic habitat conditions that will attract most breeding bird species and other vertebrate fauna characteristic of that era.

Prairie Slope Goal

Restore representative examples of prairie slopes to preserve some of the most pristine plant communities that remain in the Souris River basin and promote appreciation and stewardship of prairie resources.

NOTE: The limited prairie slope habitat at J. Clark Salyer NWR will be managed in conjunction with the refuge's drift prairie, through application of the following drift prairie objectives.

Drift Prairie Objective 1

By 1 year after CCP approval, use current vegetation inventory data and landscape considerations to characterize each habitat management unit with ≥40 acres of drift prairie as either high or low management priority. Reevaluate prioritization 15 years after CCP approval.

Strategy

— Apply multiple selection criteria.

Criteria for High-priority Units

Floristic Composition. Vegetation is characterized by >10% mean frequency

of pristine, native herbaceous types (plant groups 41–43 and 46–48 [Grant et al. 2004b]; see appendix G), plus native herbaceous-dominated vegetation with Kentucky bluegrass as the main subdominant (plant group 53).

Floristic Potential. Vegetation is characterized by <30% mean frequency of smooth brome-dominated vegetation (plant groups 61 and 62).

Landscape Context. The unit is contiguous with the best examples of prairie slope habitat (largest prairie slopes with the most intact native plant composition).

or

is adjacent to other high-priority, drift prairie units and/or tracts of native prairie adjacent to the refuge under non-Service ownership (especially important if the unit has relatively little drift prairie area, i.e., <40 acres).

CRITERIA FOR LOW-PRIORITY UNITS

Floristic Composition. Vegetation is characterized by <10% mean frequency of pristine, native herbaceous types (plant groups 41–43 and 46–48 [Grant et al. 2004b]) plus native herbaceous-dominated vegetation with Kentucky bluegrass as the main subdominant (plant group 53).

Floristic Potential. Vegetation is characterized by >30% mean frequency of smooth brome-dominated vegetation (plant groups 61 and 62).

Landscape context. The unit is small (<100 acres) and not contiguous with significant prairie slope habitat, nor adjacent to high-priority drift prairie units and/or tracts of native prairie adjacent to the refuge.

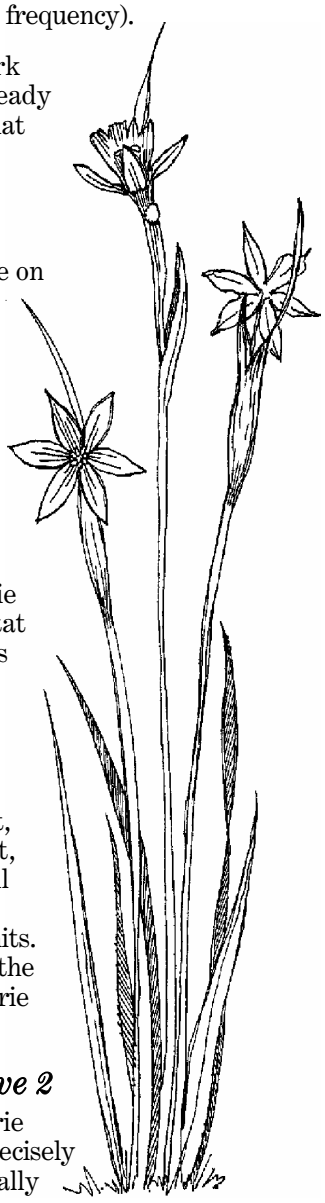
Rationale and Assumptions

Most northern mixed-grass prairie has been destroyed. Losses have been particularly severe in the Drift Plain physiographic region, such that drift prairie could be considered an endangered resource. Key roles of the Refuge System include contribution to ecosystem integrity and the conservation of biological diversity. The Souris River basin refuges should contribute to the conservation of native prairie communities unique to the Drift Plain region. However, the native mixed-grass drift prairie at the refuges is badly deteriorated, mainly through extensive invasion by introduced cool-season grasses.

Recent inventory data indicate that occurrences of relatively intact, native herbaceous flora are rare (<5% frequency) on most drift prairie management units of J. Clark Salyer NWR. Native warm-season grasses are nearly absent. Under appropriate management, warm-season grasses can outcompete introduced cool-season grasses if the former are sufficiently abundant (>20% frequency).

Most drift prairie at J. Clark Salyer NWR likely has already passed a threshold, such that restoration of a modestly diverse, native herbaceous flora is an unrealistic and impractical goal. However, restoration may be possible on some tracts where native grasses, sedges, and forbs are more common and widespread. Such tracts need to be identified by objective criteria that focus on (1) diversity and prevalence of existing native plants, and (2) landscape area and connectivity, which underlie the quality of nesting habitat for grassland birds, a species group of significant conservation concern (see appendix I) in North America.

A major assumption is that, under current management, native herbaceous flora will continue to decline and disappear on drift prairie units. This approach will improve the chances that some drift prairie will be restored.



Blue-eyed grass.
© Cindie Brunner

Drift Prairie Objective 2

On high-priority drift prairie units, apply frequent and precisely timed disturbance (principally fire and grazing) to restore vegetation to the following standards within 15 years of CCP approval. This will provide habitat for most wildlife species that were characteristic of North Dakota's eastern mixed-grass prairie but that currently are rare or absent at the refuge (burrowing owl, horned lark, Baird's sparrow, Sprague's pipit, chestnut-collared longspur, northern pintail, and Richardson's ground squirrel).

- Composition on each unit includes (1) >40% pristine native and native-dominated/ bluegrass-subdominant vegetation (plant groups 41–43, 46–48, and 53), (2) <20% smooth brome-dominated vegetation (plant groups 61 and 62), and (3) <20%

low shrub-dominated vegetation (plant groups 11–17); based on percentage frequency of occurrence on belt transects (Grant et al. 2004b).

- Native trees and tall shrubs are absent or nearly so, comprising <0.1% land cover on each unit, and no nonnative or planted native woody vegetation exists.
- Leafy spurge is decreased by >50% on each unit, to <1% frequency (frequencies per belt transects; most high-priority units currently have little to no spurge), absinth wormwood is actively controlled, and yellow toadflax and other newly appearing species of noxious weed that pose a threat to the drift prairie are eliminated within 5 years of initial detection.

Strategies

— Disturb the vegetation, typically by livestock grazing or fire, at least 2 of every 3 years. An ideal management sequence over 5 years might be BGGGR (B=prescribe burn the first year; G=graze in each of years 2, 3, and 4; R=rest), and then reinitiate the sequence. The area covered by trees, tall shrubs, and low shrubs will be incrementally reduced with this burning frequency.

— Primarily use prescribed fire when smooth brome plants are at least in the 4- to 5-leaf stage, but not yet showing an inflorescence; this generally occurs during a narrow mid-May through early June "window." A less preferred option is to burn in fall in anticipation of a negative, winter drought effect on smooth brome and Kentucky bluegrass.

— Graze mainly during May through August or September, via a rotation approach with many (7–10) relatively small (40–60 acres) grazing cells per unit and short grazing periods (4–7 days) per cell. Adjust stocking rates to facilitate regrazing of individual smooth brome plants at least once within a grazing period, but move livestock to the next cell before native plants are regrazed (be sure to note grazing of native upland sedges, an important forage base in some management units).

— Annually survey for noxious weeds. Continue widespread use of biological control by monitoring local areas for *Apthona* spp. beetles and by redistributing beetles among leafy spurge patches as needed. Use herbicides as needed along boundaries with private lands.

— Reseed adjoining old cropland units into native vegetation dominated by warm-season grasses (see objectives for old cropland). Manage these intensively, in concert with the high-priority drift prairie units they adjoin, to sustain a native-dominated flora and to reduce sources of invasion by introduced cool-season grasses and noxious weeds (see objectives and strategies for old cropland).

— Experiment on low-priority tracts with new or high-risk restoration methods for use on high-priority tracts.

— Experiment with horses as alternative grazing tools; horses may have greater impact than cattle on woody vegetation, especially silverberry. Since horses may founder (succumb to hoof inflammation) on rich, green vegetation, an appropriate approach in a 3-year grazing cycle may be to use cattle during the first 2 years, then horses the third year.

— Experiment with control of introduced cool-season grasses and release of native plants on a small, localized scale with selective herbicide treatment.

— Experiment with seeding of native warm-season grass mixes in brome monotypes on unit edges. Apply prescribed fire followed by multiple herbicide treatments over 2 years for site preparation. Use similar approaches on brome-dominated edges of adjoining, low-priority units.

NOTE: Service policy regarding refuge management implicitly promotes seeding to reestablish native plants in native sod where such plants have become rare or absent ("National Wildlife Refuge System Biological Integrity, Diversity, and Environmental Health," 601 FW 3, 2001).

— Experiment with "interseeding" of native plants, principally warm-season species, into brome monotypes within units. Apply prescribed fire or repeated intensive grazing, and then use a wick applicator to apply herbicide to emerging smooth brome and Kentucky bluegrass. Follow by seeding via drill.

— Experiment with localized hand plantings and husbandry (such as weed control and herbivore exclusion) of select native forbs such as milkvetches (*Astragalus* spp.) to increase plant species diversity and structural diversity.

— Transplant and release Richardson's ground squirrels on areas of low-stature vegetation within high-priority units wherever an adjacent source for colonization appears unavailable.

— Remove local, human disturbances and artifacts of twentieth-century origin (including the refuge era). This includes prominent plow furrows, old road grades, rock piles, and impoundment dams on intermittent drainages (except on those essential as livestock water sources). Restore such sites as close as possible to their original condition.

Rationale and Assumptions

This objective focuses on restoration of floristic composition. Smooth brome and Kentucky bluegrass are widespread and common on the Drift Plain at J. Clark Salyer NWR. Kentucky bluegrass tends to

increase under prolonged rest or with grazing, but decreases with fire especially when burning occurs during stem elongation or in dry years. Smooth brome also increases under rest but, in contrast to Kentucky bluegrass, appears sensitive to repeated grazing but unaffected or variably affected by prescribed fire. A strategy to improve competitive abilities of native herbaceous plants should match the types, timing, and frequencies of disturbances under which these plants evolved. Meanwhile, a strategy to decrease competitive abilities of bluegrass and brome on the relatively rich loam soils of the Drift Plain should focus on combined use of fire and grazing.

Smooth brome-dominated types are twice as prevalent as Kentucky bluegrass-dominated types on the drift prairie of J. Clark Salyer NWR, indicating that smooth brome may be more competitive than Kentucky bluegrass in the relatively rich loam soils. Of the two introduced species, smooth brome generally seems more difficult to control and more significantly alters the quality and structure of northern prairie habitats. Therefore, restoration management should focus more on strategies to reduce brome.

The contemporary breeding bird community on the drift prairie at J. Clark Salyer NWR is characterized by three to four species that tolerate introduced cool-season grasses and relatively dense, rank, oftentimes brushy cover. Grassland bird species that are uncommon to absent generally require shorter, sparser, more herbaceous, prairie vegetation than that available in the refuge's drift prairie. These species also are of much greater conservation concern due mainly to declining population trends (for example, Sprague's pipit and chestnut-collared longspur). Thus, habitat for a broader array of northern prairie birds (including species characteristic of the historical mixed-grass prairie community) can be significantly increased by providing frequent disturbance and the resulting increases in early successional stages.

In the historical setting, Richardson's ground squirrels were characteristically widespread and contributed to the maintenance of early seral stages, and their burrows provided unique microhabitats. The ground squirrel should be a component of the restored prairie community.

Historically, the drift prairie was a treeless landscape. Trees and tall shrubs can diminish the survival of nests of grassland birds by harboring potential nest predators. They also provide perches from which brown-headed cowbirds can find other species' nests in which to lay eggs. Furthermore, recent data from the Souris River basin refuges indicate that relatively small areas of tall woody vegetation can effectively fragment grassland habitats and cause many grassland bird species to avoid entire landscapes. Elimination of tall woody

Gary Eslinger/USFWS

Highbush cranberry at J. Clark Salyer NWR.

cover is a logical strategy for restoration of landscape structure and plant community makeup, and to improve the attractiveness and security of the habitat for a variety of grassland-breeding bird species.

In restorations, vegetation composition is considered along a habitat continuum, where plant communities can be separated by degree of invasion by undesirable plants. A continuum for drift prairie (least desirable vegetation to the left) follows: woodland←tall shrub land←leafy spurge←smooth brome←low shrub←Kentucky bluegrass←native herbaceous vegetation. With management, less desirable plant species are replaced by more desirable plant groups. For example, it is acceptable in the short term to increase Kentucky bluegrass in areas where leafy spurge is reduced. Conversely, replacement of Kentucky bluegrass by smooth brome is undesirable.

Drift Prairie Objective 3

On low-priority drift prairie units, apply disturbance (principally fire) every 5–8 years to remove plant litter, restore plant vigor, reverse woody plant expansion, and provide a mix of structural types that include (1) relatively short/sparse vegetation for species such as killdeer, horned lark, and Brewer's blackbird, (2) moderately short vegetation for species such as blue-winged teal and upland sandpiper, and (3) tall/dense vegetation for species such as mallard, short-eared owl, Le Conte's sparrow, and bobolink. Vegetation should present the below characteristics within 15 years of CCP approval.

NOTE: There is almost no monitoring of vegetation on these units except routine, cursory surveillance for noxious weeds. Knowledge of relationships between fire frequency and resulting, postfire, vegetation structure is adequate to predict habitat conditions described below.

One-fourth of the area in 0- to 1-year postdisturbance, one-fourth in 2–3 years postdisturbance, and one-half in 4–6+ years postdisturbance—corresponding roughly to a structure of <2 inches VOR, 2–3.9 inches VOR, and >3.9 inches VOR (mean VORs in early spring, per Robel et al. 1970).

Native trees and tall shrubs compose <0.2% land cover on each unit above the prairie slope, and all nonnative woody vegetation and planted, native woody vegetation is eliminated from at least half of the units.

Leafy spurge frequency is maintained at <2% frequency, absinth wormwood is actively controlled, and yellow toadflax and other newly appearing species of noxious weed that pose a threat to the drift prairie are eliminated within 5 years of initial detection.

Strategies

— Apply prescribed fire on each unit at least every 5–8 years, increasing burn frequency during dry years when possible to more effectively reduce tall shrubs and trees. Rotate burns among units. Burn opportunistically, at any time, mainly to remove litter and control tall shrubs and trees.

— To increase structural diversity, occasionally introduce livestock grazing—with wide latitude on timing, intensity, and duration, if doing so will not detract from management of high-priority units. Experiment with seeding and "interseeding" of native, warm-season grass mixes in smooth brome monotypes, mainly to help develop effective restoration approaches for high-priority units.

— Periodically survey for noxious weeds. Continue widespread use of biological control by monitoring local areas for *Apthona* spp. beetles and redistributing beetles among leafy spurge patches as needed. Use herbicides as needed along boundaries with private lands.

Rationale and Assumptions

This objective focuses on providing vegetation structural diversity. Most drift prairie at J. Clark Salyer NWR has almost no intact, native, herbaceous vegetation. From a practical standpoint, low-priority drift prairie probably cannot be restored to a state where native herbaceous vegetation is a widely noticeable or otherwise common vegetation component. However, with modest effort, the prevalent, introduced cool-season grasses and scattered low shrubs can be managed to provide a mix of postdisturbance structural types attractive to a broad array of native, grassland bird species.

The most appropriate management of these units is to provide structural variety and use the units as a basis for creating extensive areas of grassland (including off-refuge lands) to satisfy needs of several area-sensitive, native, grassland bird species. This will also reduce predation and nest (brood) parasitism associated with edge-dominated, highly fragmented grassland. The rationale for reducing tall shrubs and trees is similar to that for high-priority drift prairie (objective 2).

Drift Prairie Objective 4

Improve or help maintain the habitat quality and the economic sustainability of nonfederally owned, native prairie remnants adjacent to drift prairie units within 15 years of CCP approval. Extend protection and stewardship to most other grassland that adjoins drift prairie units. Seek opportunities to expand the total grassland area and create broad, contiguous blocks of open grassland, principally as habitat for breeding grassland birds.

Strategy

— Use grassland easements and extension agreements, for example, for specialized livestock grazing systems on native prairie, or native grass establishment and management, or to remove "hostile" cover such as trees and tall shrubs that could harbor nest predators and parasitic brown-headed cowbirds. Certain grazing systems can improve livestock carrying capacity and the condition of annually grazed prairie to enhance the economic viability of native prairie and reduce chances of conversion to other land uses, especially cultivation.

Rationale and Assumptions

The quality of prairie as breeding habitat for grassland birds (in terms of average annual nest success and relative contribution to population recruitment) is directly related to its extent or, conversely, indirectly related to the degree of its fragmentation.

Native prairie on the Drift Plain could be considered an endangered resource and little of it remains in the Souris River valley. Conservation of remnant tracts adjacent to the refuge, by whatever means possible, should be among the highest priorities for landscape conservation.

Prairie Parkland Goal

Restore and maintain extensive examples of plant communities characteristic of the mid-1800s prairie parkland. Create the temporally and spatially dynamic habitat conditions that will attract most breeding bird species and other vertebrate fauna characteristic of that era.

Prairie Parkland Objective 1

By 1 year after CCP approval, use the on-site vegetation inventory data, recent satellite imagery, and landscape considerations to characterize each management unit within the prairie parkland as high, moderate, or low management priority. Reevaluate prioritization 15 years after CCP approval.

Strategy

— Apply multiple selection criteria.

CRITERIA FOR HIGH-PRIORITY UNITS

Contemporary woodland coverage. A unit is characterized by <30% total cover of trees and tall shrubs (mainly aspen-oak woodland and chokecherry shrub land).

Floristic potential. Vegetation (excluding woodland) is characterized by >30% mean frequency of pristine, native herbaceous types (plant groups 41–43 and 46–48 [Grant et al. 2004b]) plus native herbaceous-dominated vegetation with Kentucky bluegrass as the main subdominant (plant group 53).

Degree of connectivity to treeless grassland. The unit is adjacent to treeless refuge grassland or private grassland, especially native prairie.

CRITERIA FOR MODERATE-PRIORITY UNITS

Contemporary woodland coverage. A unit is characterized by 30–70% total cover of trees and tall shrubs (mainly aspen-oak woodland and chokecherry shrub land); many tracts may be medium to large grasslands (40–600 acres) that are mostly surrounded by aspen-oak woodland.

Floristic potential. Vegetation (excluding woodland) is characterized by >40% mean frequency of pristine, native herbaceous types (plant groups 41–43 and 46–48 [Grant et al. 2004b]) plus native herbaceous-dominated vegetation with Kentucky bluegrass as main subdominant (plant group 53).

Degree of connectivity to treeless grassland. By default, moderate-priority units are isolated from other treeless grasslands.

CRITERIA FOR LOW-PRIORITY UNITS

Contemporary woodland coverage. A unit is characterized by >70% total cover of trees and tall shrubs (mainly aspen-oak woodland and chokecherry shrub land).

Floristic potential. Extensive woodland cover makes restoration of grassland patches unlikely, regardless of floristic composition.

Size and degree of connectivity to treeless grassland. Remaining grassland patches (<30% cover) are isolated by surrounding woodland from other higher priority grasslands, making restoration impractical.

Rationale and Assumptions

Criteria used to prioritize management units reflect three important issues affecting ecological integrity of the prairie parkland: (1) trees and tall shrubs compromise the integrity of native prairie; (2) woody plants are detrimental to grassland birds as an ecological group; and (3) intact native-dominated plant communities are more likely to be restored than units invaded by woody and introduced plants.

Prairie Parkland Objective 2

On high-priority prairie parkland units, apply periodic disturbance (principally fire and grazing) to restore vegetation to the following standards within 15 years of CCP approval, to provide habitat for most indigenous bird species, especially Baird's sparrow, Sprague's pipit, vesper sparrow, chestnut-collared longspur, western meadowlark, and upland sandpiper.

- Aspen woodland on a unit has <10% coverage by 15 years after CCP approval.
- Vegetation composition is >40% pristine native and native-dominated/bluegrass subdominant (plant groups 41–43, 46–48, and 53 [Grant et al. 2004b]).

Strategies

— Use high-intensity spring fires (late March to April, prior to leaf-out) to initially kill mature aspen trees; within 4 years, again use fire during the dormant season (spring or fall) to reduce viability of aspen clones, especially dense aspen suckers. Continue control of trees and tall shrubs with periodic fire (every 3–6 years) applied from March to November. As woodland cover is reduced, frequency and timing of fire can change to facilitate control of other invasive species, especially Kentucky bluegrass.

— Between prescribed fire intervals, use grazing to periodically reduce shading and seed production of yellow sweetclover. Where smooth brome occurs, use season-long (light to moderate stocking rates) or rotation grazing (begin mid- to late April) to reduce cover of smooth brome.

Tracts with brome may be grazed in consecutive years, allowing 1 year of rest to accumulate sufficient fuels for burning.

— Experiment with "interseeding" of native warm-season grasses into brome monotypes or on unit edges, using fire followed by multiple herbicide treatments over 2 years for site preparation.

— In winter (over frozen ground), use mechanical treatment (bulldozer) to create islands of dead fuel within large or fire-resistant aspen woodland. Use a drum chopper or hydro ax to reduce dead standing timber and willows near hazards such as prescribed fire unit boundaries and reduce aspen and willow sprouting in patches resistant to fire.

— Experiment with control of leafy spurge using Plateau® herbicide. Release flea beetles (*Apthona* spp.) in patches of leafy spurge growing on various microsites. If flea beetles become locally adapted to survive on sandy sites, then begin wide-scale releases to control leafy spurge.

Rationale and Assumptions

This objective focuses on restoration of open, treeless grasslands. Trees, tall shrubs, and introduced cool-season plants, especially Kentucky bluegrass and leafy spurge, compromise the integrity of native prairie.

Dan Severson/USFWS

The aboveground growth of these aspen trees has been killed by fire and is being replaced by grasses and forbs to improve the landscape for birds that depend on open grassland for nesting.

Since 1850, the extent of aspen woodland has more than doubled in prairie parkland units, due primarily to fire suppression and elimination of large herds of bison and elk. Reducing trees and tall shrubs will benefit 10–15 grassland-dependent bird species including three species endemic to the northern Great Plains (Baird's sparrow, chestnut-collared longspur, and Sprague's pipit). Prairie parkland becomes largely unsuitable for these species when woodland cover (within a quarter-section) exceeds 25–30%. Trees and tall shrubs can diminish the survival of nests of grassland birds by harboring potential nest predators. Trees and shrubs provide perches from which brown-headed cowbirds can find other species' nests in which to lay eggs.

The quality of prairie parkland units is further diminished by introduced plants and by loss of important ecological processes such as fire and grazing that historically maintained these areas as predominantly grassland. Introduced grasses decrease the suitability of prairies for some bird species such as Sprague's pipit, chestnut-collared longspur, and horned lark.

Based on recent inventory data, parkland prairies are degraded mainly by Kentucky bluegrass and, to a lesser extent, by leafy spurge and smooth brome. Kentucky bluegrass increases under prolonged rest or with grazing, but decreases with fire. Smooth brome also increases under rest but, in contrast to Kentucky bluegrass, appears sensitive to repeated grazing and may be unaffected by fire (see drift prairie for more detail on controlling Kentucky bluegrass and smooth brome).

Leafy spurge remains a serious long-term threat to the integrity of prairie parkland. Use of flea beetles has been ineffective for spurge that grows on sandy soils. Chemical control also is limited—many sites are inaccessible and use of certain chemicals (such as Tordon®) is prohibited because of concerns about groundwater contamination.

In restorations, vegetation composition is considered along a habitat continuum, where plant communities are separated by degree of invasion by undesirable plants. A continuum for prairie parkland (least desirable vegetation to the left) follows: mature woodland←early successional woodland/tall shrub land←leafy spurge←smooth brome←low shrub ←Kentucky bluegrass←native herbaceous vegetation. With management, less desirable plant species are replaced by plants that are more desirable. For example, it is acceptable in the short term to increase Kentucky bluegrass cover in areas where aspen woodland has been reduced. Conversely, replacement of Kentucky bluegrass due to expansion of leafy spurge is undesirable.

Prairie Parkland Objective 3

On moderate-priority units, within 15 years after CCP approval, eliminate aspen groves on prairie interiors and maintain current patch size by minimizing woodland encroachment along grassland-woodland edges. These grasslands attract Sprague's pipit, vesper sparrow, horned lark, and clay-colored sparrow. Additionally, restore prairies to the following standards.

■ Plant composition includes >50% pristine native and native dominant/bluegrass subdominant

groups (plant groups 41–43, 46–48, and 53 [Grant et al. 2004a]).

- Leafy spurge is reduced to <2% composition and smooth brome (plant groups 61 and 62) compose <4% cover.

Strategies

— Use fire every 5–10 years to (1) eliminate aspen groves within the interior of moderate-priority units, (2) control invasion of woodland edge into the prairie patches, and (3) reduce cover of Kentucky bluegrass.

— Use mechanical treatments (drum chopper) in cases where fire is impractical for removing trees and tall shrubs.

— Use herbicides for spot control of minor invasions of leafy spurge and smooth brome.

— Experiment with control of leafy spurge using Plateau® herbicide. Release flea beetles (*Apthona* spp.) in patches of leafy spurge growing on various microsites. If flea beetles become locally adapted to survive on sandy sites, then begin wide-scale releases to control leafy spurge.

Rationale and Assumptions

This objective focuses on restoration of high-quality prairie plant communities. Most moderate-priority units are prairie patches that are mostly surrounded by aspen woodland (the extent of open, treeless grasslands is less than that on high-priority units).

Many of the most floristically intact prairie communities occur in moderate-priority units where woodland cover currently exceeds 30%. Moderate-priority units are attractive to several grassland bird species of regional or national management concern such as vesper sparrow, Sprague's pipit, clay-colored sparrow, and grasshopper sparrow.

Rationale for controlling introduced cool-season plants is the same as for objective 2.

Prairie Parkland Objective 4

In low-priority units, opportunistically rejuvenate 100–200 acres of mature (>60 years old) aspen woodland to provide structural diversity (various age classes) important for woodland birds.

Strategies

— Under certain circumstances (once every 15–25 years), expand prescribed fire in moderate- or high-priority prairie parkland units to include adjacent low-priority units that are extensively wooded; some mature (>60 years old) aspen-oak woodland can be periodically regenerated using prescribed fire.

— Use mechanical treatment (winter shearing with a bulldozer) or commercial timber removal to periodically rejuvenate small patches (<10 acres) within large aspen-oak woodlands. Retain mature bur oak and shade-tolerant tree species such as green ash.

Rationale and Assumptions

This objective recognizes that most low-priority units are former grasslands that have been mostly replaced by aspen-oak woodland. Large contiguous patches of woodland are a significant component of contemporary prairie parkland. However, restoration of these (former) grasslands is unlikely. Within low-priority units, woodland patches will continue to expand and further displace small, scattered prairies.

Aspen woodland is an early successional forest type maintained by periodic disturbance, usually fire. Large woodlands provide important habitat for area-sensitive, forest-interior bird species (such as veery, ovenbird, hairy woodpecker, rose-breasted grosbeak, and ruffed grouse), many of which have shown steep regional or continental population declines. Ideally, large woodlands include several age classes of aspen and oak. Some bird species (for example, ruffed grouse) rely on many age classes during their lifecycle. Other species such as yellow warbler and willow flycatcher breed mainly in young (<20 years) aspen woodland. Many species (for example, ovenbird, veery, and hairy woodpecker) nest only in mature aspen-oak woodland.

Prairie Parkland Objective 5

Opportunistically protect extensive native prairie remnants adjacent to high- and moderate-priority prairie parkland units.

Strategy

— Use grassland easements and extension agreements, for example, for specialized livestock grazing systems on native prairie, or native grass establishment and management, or to remove "hostile" cover such as trees and tall shrubs that could harbor nest (brood) parasites and nest predators. Certain grazing systems can improve livestock carrying capacity and the condition of annually grazed prairie to enhance the economic viability of native prairie and reduce chances of conversion to other land uses, especially cultivation.

Rationale and Assumptions

Northern mixed-grass prairie has declined by >70% from its historical extent. More than 1,560 square miles of native rangeland have been converted for agricultural production in North Dakota, South Dakota, and Montana since 1985.

Grassland in McHenry County, including J. Clark Salyer NWR, comprises one of the largest, most

contiguous patches of northern mixed-grass prairie remaining in North America. Large prairie patches are more valuable than smaller prairie patches to grassland-dependent wildlife, especially grassland birds (for example, sharp-tailed grouse, upland sandpiper, marbled godwit, and Baird's sparrow). In addition, large prairie patches have less edge and, therefore, less potential for invasion by introduced cool-season plants such as smooth brome. Protecting adjacent prairie from conversion to agricultural production is critical to preserving the integrity of refuge tracts and meeting the goal and objectives for prairie parkland habitat.

Sandhills Goal

Restore and maintain plant communities characteristic of the mid-1800s sandhills within the prairie parkland landscape.

Sandhills Objective 1

By 1 year after CCP approval, use on-site vegetation inventory data, data from satellite imagery, and landscape considerations to characterize the sandhills, which are embedded within more extensive prairie parkland, as either high or low management priority. Reevaluate prioritization 15 years after CCP approval.

Strategy

— Apply multiple selection criteria.

CRITERIA FOR HIGH-PRIORITY UNITS

Contemporary woodland coverage. A unit is characterized by <30% total cover by trees and tall shrubs (mainly aspen-oak woodland and chokecherry shrub land).

Floristic potential. Vegetation (excluding woodland area) is characterized by >35% mean frequency of pristine, native herbaceous types (plant groups 41–43 and 46–48 [Grant et al. 2004b]) and <10% leafy spurge.

Degree of connectivity to treeless grasslands. The unit is embedded within high-priority prairie parkland units.

NOTE: The remaining sandhills are low priority for management; they are mainly dominated by woody plants or leafy spurge or both.

Rationale and Assumptions

Criteria used to prioritize management units reflect three important issues affecting ecological integrity of sandhills: (1) trees and tall shrubs compromise integrity of native prairie; (2) woody plants are detrimental to grassland birds as an ecological group; and (3) more intact, native-dominated plant communities are more likely to be restored than sandhills invaded by woody and introduced plants.

Sandhills Objective 2

On high-priority units, by 15 years after CCP approval, restore two representative examples of sandhills to the following standard: (1) reduce aspen woodland to <10% coverage while retaining all oak savanna; (2) reduce leafy spurge to <5% composition, contingent on finding an effective, widely applicable method to control leafy spurge; and (3) contingent on *(2)*, apply leafy spurge control to low-priority sandhills.

Strategies

— Use high-intensity spring fires (late March to April, prior to leaf-out) to initially kill mature aspen trees. Within 4 years, again use fire during the dormant season (spring or fall) to reduce viability of aspen clones, especially dense aspen suckers. Continue control of trees and tall shrubs with periodic fire (every 6–10 years) applied from March to November.

— Where access allows, experiment with control of leafy spurge using Plateau® herbicide. Release flea beetles (*Apthona* spp.) in patches of leafy spurge growing on various microsites. If flea beetles become locally adapted to survive on sandy sites, begin wide-scale releases to control leafy spurge.

— Until leafy spurge can be controlled, exclude livestock grazing from the sandhills. Soil disturbance associated with grazing hastens the spread of leafy spurge.

Rationale and Assumptions

This objective extends restoration objectives for the prairie parkland to the high-priority sandhills.

The sandhills are embedded within the more extensive prairie parkland and, like prairie parkland, the sandhills prairie has been degraded by trees and tall shrubs. Most oak-savanna characteristic of the 1850s has been converted to closed canopy aspen-oak woodland. Oak savanna is maintained by periodic fires that reduces the cover of aspen, chokecherry, and other woody plants. Oak savanna is important habitat for lark sparrow, black-and-white warbler, orange-crowned warbler, pocket gopher, and American badger.

The most pristine native plant assemblages at J. Clark Salyer NWR occur within the sandhills where soils and topography limit invasion by introduced cool-season plants. Leafy spurge and, to a lesser extent, Kentucky bluegrass threaten the sandhills prairie. Periodic fire reduces Kentucky bluegrass on harsh sites in the sandhills. In contrast, leafy spurge is adapted to sandy soils and thrives

within the varied slope and aspects characteristic of the sandhills. Based on recent inventories, leafy spurge composes 17% of contemporary cover in the sandhills. Biological control efforts have been ineffective on similar sandy sites throughout North Dakota. Furthermore, the sandhills are mostly inaccessible, which limits chemical control options. It may take a decade or more to find an effective biological control for leafy spurge growing in the sandhills.

Old Cropland Goal

On high-priority old cropland areas, establish native-dominated, perennial herbaceous cover that, with modest management, resists invasion by introduced cool-season grasses and noxious weeds. This seeded cover will help form extensive, contiguous blocks of structurally diverse, open grassland for grassland-dependent, breeding bird species.

Old Cropland Objective 1

By 10 years after CCP approval, locate and determine boundaries of old cropland areas and record these in the refuge's GIS database.

Strategies

- Identify old cropland areas, including those considered DNC, that were seeded to introduced grasses and forbs and/or native grasses since the mid-1970s.
- Identify other old cropland areas, as evidenced by
  - distinct field edges, especially deep furrows and linear piles of wind-borne topsoil that had been deposited along preexisting fence lines and subsequently vegetated;
  - rock piles or rocks strewn linearly along what appears to be a field edge (although rock sometimes was cleared for native hay harvests);
  - nearly monotypic stands of smooth brome, typically with some Kentucky bluegrass but with little native sedge in the understory (several native plant species often reinvade these stands, such as western snowberry, Wood's rose, white sage, western yarrow, several goldenrod species, and silver scurfpea);
  - no partly buried rocks with profuse lichens;
  - no clubmoss or cryptogamic crust.
- Use acquisition records, old refuge narratives, 1938–39 aerial photographs, and U.S. Soil Conservation Service records for ancillary support.
- Flag the probable boundaries of areas verified as old cropland, record via GPS, and upload into the refuge's GIS database.

Rationale and Assumptions

Furrows and other linear disturbances caused by implements (for example, plows, disks, and seed drills) are much more evident after an area is treated with prescribed fire or heavily grazed. They are also more readily detected from horseback. NRCS staff may determine evidence of A-horizon soil disturbance due to cultivation. Some areas with signs of farming disturbance (for example, furrows) may have been cropped only for a few years circa 1900–30 or may have been broken during this period yet never cropped. Such areas often are successfully reinvaded by native plants and may currently support native vegetation at levels approaching the most pristine areas on similar site types at the refuge that are considered native sod.

Old Cropland Objective 2

Within 15 years after CCP approval, convert at least 10 old cropland units to vegetation dominated by several species of native warm-season grasses that vary in stature and growth form and that include several species of native forbs, wherever possible. Give priority to units with stands of vegetation that have become decadent and overrun by undesirable, introduced cool-season grasses, especially where such units are adjacent to or within high-priority drift prairie units or high-priority prairie slope units.

Strategies

- Following multiple applications of a broad-spectrum herbicide, seed a native plant mixture that mainly consists of 80–90% warm-season grass species especially big bluestem, little bluestem, switchgrass, and sideoats grama.
- During the first 3–4 years after seeding, annually mow the stand with a hay conditioner and harvest the hay. Substitute grazing or prescribed fire treatments in the subsequent 3–4 years. Use herbicide spot spraying or "interseeding" where necessary.

Rationale and Assumptions

Although initially expensive, native warm-season grasses are economically and ecologically superior to seeded stands of introduced plants in old croplands because

- permanent, perennial cover eliminates regular (every 12–14 years) replacement of seeded, introduced species cover via a farming cycle and, thus, nearly eliminates potential for soil erosion;
- native grasses reduce local habitat fragmentation and eliminate "edge" associated with the farming cycle;

- a warm-season growth strategy for plants vastly improves the capacity for an assemblage of plants to outcompete smooth brome, mainly by affording broader and more effectively timed management opportunities;
- there is improved opportunity for prescribed burning in late spring compared to high-priority drift prairie units because the warm season–dominated cover has relatively high fuel value through early June (versus mostly green vegetation on cool season–dominated cover on the drift prairie by late May);
- there is a broader "window" (later in summer) for harvest of hay that still has forage value;
- native grasses are in compliance with policy that discourages planting of introduced species on Service lands and encourages planting of native species ("National Wildlife Refuge System Biological Integrity, Diversity, and Environmental Health," 601 FW 3, 2001);
- native grasses reduce "source sites" from which introduced and weedy plants invade adjoining native prairie;
- native grasses have improved and longer lasting structural diversity within stands.

Old Cropland Objective 3

By 10 years after CCP approval, identify other old cropland areas (those not known to have been seeded since the mid-1970s) that are high management priority (areas most important to convert to native warm-season grasses). Develop a detailed plan to convert these during the subsequent 10–15 years to vegetation dominated by several species of native warm-season grasses that vary in stature and growth form and that include several species of native forbs wherever possible.

NOTE: There are no goals and objectives for remaining old cropland areas in uplands. They are low priority and will be managed with adjoining habitats.

Strategy

— Apply multiple selection criteria.

CRITERIA FOR HIGH MANAGEMENT PRIORITY OLD CROPLAND IN UPLANDS (excluding DNC and other old cropland known to have been seeded since the mid-1970s)

Floristic composition. Vegetation is characterized by <20% mean frequency of pristine, native herbaceous types (plant groups 41–43 and 46–48 [Grant et al. 2004b]), plus native herbaceous-dominated vegetation with Kentucky bluegrass as the main subdominant (plant group 53).

Floristic Potential. Vegetation is characterized by >20% mean frequency of smooth brome-dominated types (plant groups 54, 61, and 62).

Landscape Context. The unit has no size criterion
and
bears clear evidence of a farming history
and
is contiguous with high-priority drift prairie, prairie slope units, or tracts of native prairie adjacent to the refuge under non-Service ownership.

Rationale and Assumptions

Native grass and forb seed is very costly, as is the time and expense of materials needed to prepare seedbeds, plant seed, and annually manage newly seeded areas, per strategies and rationale listed under objective 2.

Old cropland that adjoins high-priority drift prairie or prairie parkland and supports little native herbaceous vegetation likely is a source of invasion by undesirable, introduced grasses and weedy forbs. Without attempts to establish native vegetation through seeding, such areas are unpromising candidates for restoration to grassland in which native herbaceous plants are evident, much less an important codominant component. This includes areas that were farmed for 5–10 years before refuge establishment (presumably, before smooth brome and Kentucky bluegrass were widely distributed) that may have been reinvaded by native plants. These areas may have restoration potential that at least equals that of adjoining, high-quality, drift prairie or prairie parkland.

Old Cropland Objective 4

After seeding and establishing native warm-season plants in an old cropland unit, maintain native plants as the most dominant vegetation cover, per qualitative estimation.

NOTE: There are no goals and objectives for other old cropland units (those not yet converted to warm-season-dominated communities); they are low priority.

Strategies

— Seeded warm-season stands of herbaceous plants should be well established 5–8 years after seeding; manage these by a disturbance treatment about every 2–3 years. They probably

can be disturbed more flexibly with regard to phenology, mainly to discourage smooth brome invasion.

— Use grazing as an alternate management treatment and take advantage of the wide, spring-grazing "window" afforded by the warm-season-dominated community.

— Integrate management with that of surrounding drift prairie while focusing on treatment approaches that promote native warm-season plant species.

— In the interim between prescribed burns, possibly harvest hay every 2–3 years from old cropland units, alternating among July, August, and September to favor warm-season grasses.

— If occasionally needed along unit boundaries, use herbicides to reduce encroaching, introduced cool-season grasses and release native warm-season plants. Use integrated pest management to treat local infestations of noxious weeds as needed.

Rationale and Assumptions

The warm-season growth strategy for plants vastly improves the capacity for an assemblage of grassland plants to outcompete smooth brome—by which seeded islands of introduced grasses and forbs are most typically degraded—mainly by affording broader and more effectively timed management opportunities.

Old Cropland Objective 5

Within 15 years of CCP approval, eliminate planted tall shrubs and trees and any naturalized, nonnative woody vegetation that occurs within or adjacent to high-priority old cropland areas as they are being restored to native-dominated vegetation.

Strategy

— Remove tree-shrub plantings by mechanical means (for example, cutting ash trees by hand, shearing caragana shrubs with a tractor blade or bucket during winter); follow by herbicide treatment of stumps or by broadly applied herbicide, rotary mowing, and/or prescribed burning of resprouting vegetation wherever necessary.

Rationale and Assumptions

Trees and tall shrubs can diminish the survival of nests of grassland birds by harboring potential nest predators. They also provide perches from which brown-headed cowbirds can find other species' nests in which to lay eggs. Furthermore, recent data from the Souris River basin refuges indicate that relatively small areas of tall woody vegetation can effectively fragment grassland habitats and cause many grassland bird species to avoid entire landscapes. Elimination of tall woody cover is a logical strategy for restoration of landscape structure and plant community makeup and to improve the attractiveness and security of the habitat for a variety of grassland-breeding bird species.

Old Cropland Objective 6

By 2 years after CCP approval, develop and implement an effective, practical comprehensive plan for integrated control of noxious weeds in DNC and other old cropland areas in the riparian zone. In these areas, continue to maintain perennial herbaceous cover comprised of introduced species and native plant species, or both, and the vegetation should present the following characteristics.

- About one-half of the area in 0- to 1-year postdisturbance and one-half in 2–3 years postdisturbance; corresponds roughly to a structure of 0–3.9 inches VOR and >3.9 inches VOR, respectively (mean VORs in early spring, per Robel et al. 1970).
- Native trees and tall shrubs compose <0.2% land cover on each old cropland area.
- Leafy spurge frequency is maintained at <2% frequency, absinth wormwood is actively controlled, and yellow toadflax and other newly appearing species of noxious weed that pose a threat to the drift prairie are eliminated within 5 years of initial detection. Canada thistle control is a low-priority weed control issue (mean frequency <25%).

Strategies

— Use hay harvest or fire at least every third year to maintain plant species vigor and vegetation structure and to control plant litter accumulation.

— Annually survey for noxious weeds. Continue widespread use of biological control by monitoring local areas for *Apthona* spp. beetles and redistributing beetles among leafy spurge patches as needed. Use herbicides as needed, especially along boundaries with private lands.

— Review and update the weed management plan, detailing specific methods and timetables for managing noxious weeds in old cropland areas of the riparian zone.

Rationale and Assumptions

Smooth brome, quackgrass, and Kentucky bluegrass dominate old cropland in riparian areas. These areas have relatively moist, deep, silty loams that are particularly suitable for these introduced grass species and allow them to outcompete nearly all native herbaceous species. There currently are no practical, sustainable avenues for conversion of these areas to more desirable stands of native

herbaceous vegetation. However, there are practical methods for simultaneously controlling most species of noxious weeds and providing vegetation structure that is attractive to grassland bird species native to the region. These birds prefer relatively dense, tall grassland vegetation and include mallard, northern harrier, Le Conte's sparrow, and bobolink.

In addition to removing litter, periodic prescribed fire will slow or reverse invasion by woody vegetation such as western snowberry and willow.

Canada thistle is a noxious weed that tends to pervade and persist in disturbed soils of the riparian zone at J. Clark Salyer NWR. This thistle is variably common across the region's cultivated lands, mainly due to its prolific production of highly mobile, wind-borne seed. This weed species cannot be controlled consistently by available means within most of the refuge's riparian zone. This is mainly because the soils typically are too damp in late spring and early summer to support wheeled vehicles used to apply herbicides at an appropriate time for effective control. Aerial application is possible in some areas, but tends to be more costly and controversial. Aerial application is more difficult to administer than ground spraying and adjacent areas of habitat or privately owned land may be subjected to overspray.

Regular monitoring and control of other noxious weed species such as leafy spurge and wormwood are more crucial than control of Canada thistle and are far more gratifying (in terms of available methods of biological and other nonchemical controls and overall costs versus benefits).

Riparian Woodland Goal

Maintain the approximate presettlement extent of green ash–American elm riparian woodland within the floodplain of the Souris River to benefit a broad suite of woodland-associated, breeding bird species.

Riparian Woodland Objective 1

By 10 years after CCP approval, complete a baseline floristic inventory of riparian woodland.

Strategy

— Use a modified James and Shugart (1970) method to inventory floristic composition and stand structure of all riparian woodland.

Rationale and Assumptions

Vegetation composition and structure of riparian woodland has not been inventoried, nor have breeding bird communities. Qualitative observations suggest that most American elm has been lost to Dutch elm disease.

Riparian Woodland Objective 2

Maintain in perpetuity the presettlement extent of riparian woodland. Explore methods that restore American elm as a codominant tree species of riparian woodland communities.

Strategies

— Use aerial photos and satellite imagery to periodically assess changes in the extent of riparian woodland.

— Assess methods to control Dutch elm disease including (1) biological control of the fungus or of native and introduced elm-bark beetles that spread the disease, and (2) development of disease-resistant cultivars of American elm adapted to survive severe North Dakota winters.

— Because ash-elm riparian woodland is fire intolerant, suppress and control fires. Since the potential long-term effects of alterations in the hydrology (especially hydroperiod) of the Souris River are unknown, carefully investigate even minor changes in woodland extent or composition.

Rationale and Assumptions

The extent of riparian woodland has changed little since the presettlement period. However, some meadow has been invaded by aspen–balsam poplar woodland and willow shrub land, which may succeed to ash-elm woodland and, thereby, expand riparian woodland cover.

Contemporary riparian woodland forms large, extensive patches of mature, closed-canopy woodland. These woodlands are important habitat for forest-interior migratory birds such as northern waterthrush, red-eyed vireo, and American redstart. Great blue heron and black-crowned night-heron colonies also are found in riparian woodland.

Meadow Goal

Restore and maintain extensive examples of plant communities dominated by native flora characteristic of seasonally flooded meadows within the Souris River floodplain to attract grassland- and wetland-dependent bird species and other wildlife.

Meadow Objective 1

By 1 year after CCP approval, use on-site vegetation inventory data, data from satellite imagery, and landscape considerations to characterize meadows as high, moderate, or low management priority. Reevaluate prioritization in 15 years after CCP approval.

Strategy

— Apply multiple selection criteria.

CRITERIA FOR HIGH-PRIORITY UNITS

Contemporary tree and tall shrub coverage. A unit is characterized by <15% total cover by trees and tall shrubs (mainly aspen–balsam poplar woodland and willow shrub land). Some meadows may have significant continuous woody cover around unit perimeters, but little willow or aspen in unit interiors.

Floristic potential. Vegetation (excluding woodland area) is characterized by >15% mean frequency of pristine, native herbaceous pristine types (low prairie and meadow types [plant groups 43 and 46, modified from Grant et al. 2004b] and less than 10% reed canarygrass [plant group 78]).

Degree of connectivity to treeless grasslands. A unit is adjacent to a large meadow, high-priority prairie parkland unit, or native grassland.

CRITERIA FOR MODERATE-PRIORITY UNITS

Contemporary tree and tall shrub coverage. A unit is characterized by ≤30% total cover by trees and tall shrubs (mainly aspen–balsam poplar woodland and willow shrub land). Some meadows may have significant continuous woody cover around unit perimeters, but little willow or aspen in unit interiors.

Floristic potential. Meadow may be degraded by introduced grasses, especially quackgrass, smooth brome, and reed canarygrass.

Degree of connectivity to treeless grasslands. The unit is either adjacent to a large meadow, high-priority prairie parkland unit, or native prairie grassland.

NOTE: The remaining low-priority meadows occur where willow and aspen have mostly replaced herbaceous plants; these units have little restoration potential.

Rationale and Assumptions

Criteria used to prioritize units recognize two issues that compromise grassland including meadow: (1) tall woodland plants are detrimental to grassland birds as an ecological group and to the ecological integrity of meadow; and (2) more intact native-dominated plant communities are more likely to be restored than meadows invaded by woody and introduced plant species.

Gary Eslinger/USFWS

Spiderwort in a meadow at J. Clark Salyer NWR.

Meadow Objective 2

Within 15 years of CCP approval, restore vegetation to the following standards on high-priority meadows, mainly as habitat for grassland- and wetland-dependent bird species. Meadow units include

- <10% cover of woody vegetation taller than 3 feet;
- >40% cover of low prairie and meadow types (plant groups 43 and 46).

Strategies

— Use cooperators to biannually clip (hay) meadow vegetation to control willows <3 feet tall. Use a drum chopper or hydro ax to remove taller woody vegetation. Meadows may be clipped every year (for several years) following extensive flooding.

— Reintroduce fire to control woody vegetation and litter.

— Locate and control leafy spurge. Experiment with control of leafy spurge using Plateau® herbicide. Release flea beetles (*Apthona* spp.) in patches of leafy spurge growing on various microsites, including meadow-woodland edges. Use fire or a combination of haying and raking to reduce litter on sites for flea beetle releases. Once flea beetles become locally adapted to meadow sites, begin wide-scale releases to control leafy spurge.

— Experiment with the timing of fire to reduce cool-season quackgrass and increase warm-season prairie cordgrass.

— Experiment with methods (such as chemical, biological, and "interseeding" methods) to control isolated patches of Canada thistle and reed canarygrass.

Rationale and Assumptions

This objective—which focuses on restoration of open, treeless meadows and on increasing native plant diversity—addresses the two imminent threats to meadow habitat: (1) expansion of tall shrubs and trees; and (2) invasion of introduced plants, especially quackgrass, reed canarygrass, Canada thistle, and leafy spurge.

Since 1938, tall shrub and tree cover in meadow increased from 3% to 26%. Clipping at a frequency ≤2 years appears effective in controlling trees and shrubs. When the interval between clippings increases, willows cannot be controlled by haying. In these cases, mechanical treatment using a hydro ax or drum chopper is effective. Meadows with >10–20% shrub and tree cover are avoided by several grassland bird species such as bobolink, sedge wren, and Le Conte's sparrow.

Meadow is a transitional habitat at the Souris River basin refuges, supporting both wetland and upland prairie plants, depending on moisture cycles. Quackgrass, reed canarygrass, Canada thistle, and leafy spurge degrade native grass-sedge-rush communities. Meadow vegetation evolved with periodic disturbances including flooding, grazing by elk and bison, and fire. Strategies should favor native species (adapted to these disturbances) over introduced species.

In restorations, vegetation composition is considered along a habitat continuum, where plant communities are separated by degree of invasion by undesirable plants. A continuum for meadow (least desirable vegetation to the left) is mature woodland←willow shrub land←leafy spurge or Canada thistle←reed canarygrass←smooth brome or quackgrass←low shrubs←native herbaceous vegetation. With management, less desirable plant species are replaced by plants that are more desirable. For example, it is acceptable in the short term to increase quackgrass cover in areas where willow shrub land has been reduced. Conversely, it is undesirable to replace quackgrass with leafy spurge.

Meadow Objective 3

Manage large meadows composed variously of nonnative and native plants to provide a mosaic of relatively short-sparse and tall-dense herbaceous-dominated cover. By 15 years after CCP approval, reduce tall shrub and tree cover to <10% on moderate-priority units.

Strategies

— Use cooperators to biannually clip (hay) meadow vegetation to control willows <3 feet tall. Use a drum chopper or hydro ax to remove taller woody vegetation. Meadows may be clipped every year (for several years) following extensive flooding.

— Experiment with control of leafy spurge using Plateau® herbicide. Release flea beetles (*Apthona* spp.) in patches of leafy spurge growing on various microsites, including woodland edges. Once flea beetles become locally adapted to meadow sites, begin wide-scale releases to control leafy spurge.

Rationale and Assumptions

Moderate-priority meadows are extensively invaded by introduced herbaceous plants (especially quackgrass and reed canarygrass), such that full restoration of native plant assemblages is unlikely. This objective focuses on restoring open, treeless meadows. Reduction in tall woody plants should benefit grassland and wetland birds intolerant of woody plants (see objective 2). Meadows invaded by introduced grasses will benefit these species despite being floristically simple in composition. Such benefits have been noted for sites seeded to introduced grasses, most notably in the CRP (Johnson and Igl 1995).

Leafy spurge is actively controlled because infestations function as "source sites" for spurge invasion into adjacent meadow, prairie parkland, and sandhills habitats. Biological control of leafy spurge using flea beetles has not been tested in meadows, but holds promise as an effective control measure.

Meadow Objective 4

Minimally manage low-priority meadows that have mostly shifted from grassland to woodland–tall shrub communities. During the life of the plan, opportunistically rejuvenate 100 acres of willow shrub land to provide structural diversity in willow shrub land.

Strategies

— Under certain circumstances, fire or mechanical treatments may be used to rejuvenate willows in low-priority meadows adjacent to moderate- or high-priority meadows.

— Experiment with control of leafy spurge using Plateau® herbicide. Release flea beetles (*Apthona* spp.) in patches of leafy spurge growing on various microsites. Once flea beetles become locally adapted to meadow sites, begin wide-scale releases to control leafy spurge.

Rationale and Assumptions

Large patches of shrub land–woodland have irreparably replaced grass-sedge-rush communities such that restoration of these meadows is unlikely. Willow shrub land provides unique habitat for some species, especially willow flycatcher, yellow warbler, black-billed cuckoo, common yellowthroat, moose, and white-tailed deer.

Leafy spurge is commonly associated with aspen and willow patches that have invaded meadow sites. Many areas are inaccessible to vehicles and thus difficult to treat using herbicides. These infestations function as source sites for spurge invasion into adjacent meadow, prairie parkland, and sandhill habitats. Biological control of leafy spurge using flea beetles has not been tested in meadows, but holds promise as an effective control measure.

Wetland Goal

Manage riverine wetlands, including marshes and lakes, to sustain the long-term capacity of riverine wetlands to support diverse plant and wildlife communities. Restore ecological processes that sustain long-term productivity of wetlands.

Wetland Objective 1

Within 5 years of CCP approval, synthesize available information on the effects of physical alterations, altered hydrology and hydroperiod, increased sedimentation, and changes in water quality of the riverine system, past and present: (1) develop a report to describe consequences of these alterations on long-term viability of riverine marshes; (2) determine biological potentials and constraints for each wetland impoundment; and (3) develop criteria to prioritize impoundments with the greatest potential for sustained productivity.

Strategies

- Use past narratives, aerial photographs, unpublished refuge files, and scientific literature to evaluate the biological potential of wetland impoundments and prioritize units for management.
- Map physical areas within each impoundment that are expected to respond to management.
- Develop and prioritize a list of knowledge gaps and research needs.
- In cooperation with USGS's Northern Prairie Wildlife Research Center, complete sediment accretion and contaminants studies.
- Monitor groundwater and soil moisture levels in impoundments and within the adjacent meadow zone.

Rationale and Assumptions

This objective focuses on compiling past and current data regarding development and management of the Souris River wetlands. Although riverine wetlands form one of the most extensive and important habitats at J. Clark Salyer NWR, site-specific information is limited regarding effects of habitat management (especially water level management) on vegetation structure and composition, species diversity and density of aquatic invertebrates, and wetland-dependent bird species. Models for managing northern prairie wetlands exist, but their utility is limited for managing riverine marshes at the Souris River basin refuges, primarily because impoundments include flow-through of the Souris River (which limits wetland management capabilities).

This objective requires compilation of existing wetland management records along with a clear, succinct treatment of threats and management opportunities and limitations for riverine wetlands. Laubhan and others (2003) completed a biological assessment of wetland conditions for the Souris River basin refuges; this report provides a start in meeting this objective and those that follow.

Wetland Objective 2

Within 15 years of CCP approval, evaluate and comprehend crucial ecological processes that maintain long-term wetland productivity. Develop a range of biological indicators (for example, decline of important wetland plant or invertebrate species, shifts in extent and juxtaposition of emergent or submerged aquatic emergent vegetation) useful in the implementation of management strategies (for example, water level management and prescribed fire) intended to maintain long-term wetland productivity.

USFWS

Wetland objectives will help the refuge sustain its important migration habitat for shorebirds such as these black-bellied plovers.

Strategies

— Complete development of a USGS computer application that uses long-term flow data from gauging stations to assess effects associated with long-term alterations in river hydrology and hydroperiod on wetland plants, wildlife, and (ultimately) the potential to sustain long-term wetland productivity. Particularly important is monitoring flows that cross international boundaries. Additionally, monitor inflows at major tributaries as necessary.

— In cooperation with USGS's Northern Prairie Wildlife Research Center, complete a sediment accretion study and determine impacts of sedimentation for long-term management of riverine marshes.

— In cooperation with the USGS and others, develop detailed contour maps of marsh bottoms for all impoundments to help construct models that predict vegetation response to water level management.

— In the absence of full restoration of the natural hydrograph and hydroperiod of the Souris River, study the economic, physical, and biological feasibility of constructing a major bypass channel to improve management of (1) pools 320, 326, and 332, (2) the Benson subimpoundment, and (3) the Redhead Unit.

— Develop a method to inventory contemporary vegetation communities in managed wetlands. Develop methods for long-term monitoring of wetland vegetation.

— In cooperation with the USGS and others, use information derived above to develop predictive models that determine effects of water management (especially hydroperiod) on wetland plants, invertebrates, and migratory birds; redefine objective 1.

Rationale and Assumptions

This objective focuses on synthesizing existing scientific research on wetland function and cycles in northern prairie wetlands and impounded riverine wetlands. It also prompts site-specific inventory, monitoring, and research to support management of riverine marshes.

A biological assessment of wetland conditions for the Souris River basin refuges was recently completed (Laubhan et al. 2003). This report provides context for the original construction and subsequent physical and operational modifications to the managed wetland system at the Souris River basin refuges. Additionally, long-term threats to the system are discussed. However, past management of riverine wetlands has been based more on "gut feeling" and politics than on sound science. Site-specific data are lacking regarding effects of wetland management on vegetation structure and composition, aquatic invertebrate densities, and species of wetland-dependent wildlife.

Relative to upland habitats, managers have less effective control over wetland systems, due in part to the following:

- misunderstandings about the biological significance of drought and complete drawdown dating back to the original construction of wetland impoundments;
- significant physical limitations of constructed impoundments, especially the lack of independence among adjacent wetland units when manipulating water levels;
- inherent difficulties in conducting basic inventory, long-term monitoring, or applied research in wetlands relative to upland sites.

Wetland Objective 3

During the 15 years after CCP approval, develop and implement a new management philosophy that emphasizes long-term wetland productivity over older models based on (1) political management based on 5-year cycles, (2) "oasis" management, where wet acres are maximized especially during extreme drought, or (3) maximizing years of "hemi-marsh" conditions.

In high-priority impoundments, use periodic disturbance to provide the full spectrum of wetland conditions—for example, dry marsh, densely vegetated marsh (regenerative phase), hemi-marsh, open marsh (degenerative phase), and open water—to benefit wetland-dependent species of wildlife.

Strategies

— Re-create, where possible, the natural hydrology and hydroperiod of the Souris River. In most areas, physical disruptions and conflicts among water users compromise the degree to which this strategy can be carried out. Focus management on units that have the greatest potential for sustained productivity (from objective 1).

— Use natural climatic fluctuations to increase wetland management opportunities. Periodic drought may hasten full or partial drawdowns in some units. Although such drawdowns maximize the long-term viability of wetlands, the availability of wetlands with water is reduced during drought. In contrast, previous management emphasized retaining as much water as possible to offset landscape-level drought effects on migratory birds at the expense of long-term capacity to sustain wetland productivity in refuge impoundments.

— Confine major releases from upstream reservoirs to the period from September to May, reducing

extended inundation during the growing season when most wetland birds are nesting. Ideally, releases from Canada to the United States should occur according to the natural hydroperiod as identified in the international agreement for the Souris River basin (United States and Canadian Negotiating Delegation 1989).

— Use water stored in Lake Darling to supplement spring and summer flows at J. Clark Salyer NWR during extended or extreme drought, or during the regenerative marsh phase following drawdown of priority impoundments.

— Use periodic, growing-season drawdown over multiple seasons if required to stimulate production of seed-bearing annual plants, increase invertebrate biomass, and stimulate establishment and expansion of emergent and submergent plant species.

— During the drawdown phase, use additional disturbance, especially prescribed fire, mechanical soil treatment (for example, disking and sheep-foot packer), and defoliation (haying or grazing) to increase vegetation and invertebrate response during the regenerative phase and to control robust emergent vegetation.

— Use periodic water level management and muskrat herbivory to reduce robust emergent vegetation, especially cattail and common reed.

— Periodically use aerially applied herbicides to reduce the extent of monotypic emergent vegetation in portions of impoundments that, historically, do not respond (water levels >3 feet cannot be attained during the growing season).

— Obtain remaining prescriptive water rights through North Dakota State Water Commission. Buy additional water rights.

— Detect and eliminate purple loosestrife and salt cedar.

— Maintain the carp-free status.

— As the final water user in the United States portion of the Souris River, supply the North Dakota obligation of 20 cfs to Manitoba, Canada, from June 1 through October 31, unless certain drought conditions exist.

Rationale and Assumptions

This objective focuses on implementation and management using the best available science. Historically, conflicts in direction for wetland management have occurred among various water users of the Souris River. Past management goals and objectives rarely addressed or incorporated unforeseen impacts related to the physical disruptions of the river (original construction of dikes and dams), or changes in habitat (biotic and abiotic) resulting from these events. Inevitable decreases in water quality and in marsh management capabilities—especially because of accretion of sediments—are assumed, based on current knowledge of this and similar impounded riverine marshes in the northern Great Plains.

Productivity of northern prairie wetlands historically was maintained by periodic wet and dry cycles. Productivity is particularly enhanced during reflooding following natural drought or drawdown (in managed wetlands). Riverine marshes have an inherent reduced capacity to be dewatered during the growing season because the river flows through each impoundment. Departures from the normal hydroperiod, ill-timed upstream water releases, or significant summer rains can render prescriptive drawdowns ineffective because marsh sediments never dry sufficiently to (1) oxidize soils, (2) establish wetland plants (important waterfowl foods and a substrate for invertebrate production), or (3) establish perennial emergent and submergent vegetation (food cover and invertebrate substrate). Furthermore, control of robust emergent plants (cattail, common reed, and bulrush) becomes difficult because of continued anoxic (absence of oxygen) conditions resulting in little reduction in organic material in marsh soils. Consequently, wetlands often cycle rapidly between open water and a dense-vegetated marsh phase, both of which are less productive than intervening stages. Because attainment of the periodic dry marsh phase is a significant factor limiting long-term wetland function, periodic drawdowns are emphasized under this objective. By necessity, wetland management will become more opportunistic, often working in conjunction with wet and dry cycles to achieve management objectives.

Wetland Objective 4

Over the course of the CCP, introduce efforts on a watershed level that reduce sedimentation and nonpoint source pollution and/or their effects on riverine marshes.

Strategies

— Develop models similar to the “mallard model” developed by the HAPET that target areas within the watershed (for example, adjacent to major tributaries or drainage systems) that have the highest potential for sediment transport, especially during extreme rainfall or snowmelt events.

— Use models to target areas for conversion from cropland to grassland via USDA’s CRP, Wetland Reserve Program, or other USDA conservation initiatives. Identify drained wetlands within targeted areas for restoration. Initiate and develop additional conservation measures that reduce or mitigate impacts from sedimentation and pollution.

— Work with the NRCS to ensure compliance with "Sodbuster," "Swampbuster," and other provisions in the Farm Bill (current and future) that reduce soil erosion.
— Explore construction of sediment traps to reduce the extent of sediment accumulations. Where management capability has already been reduced, explore the feasibility of dredging to reduce accumulated sediment in certain impoundments.
— Protect native prairie and prairie wetlands within target areas or adjacent to the refuge, using perpetual easements.
— In cooperation with the USGS, the state of North Dakota, and the USACE, monitor and document sediment loads and water quality associated with various flows. Consider passing flows that contain high sediment loads or that significantly reduce water quality.

Rationale and Assumptions

Initial samples collected at the Souris River basin refuges document only slightly elevated levels of sediment accretion for most impoundments. However, over many decades, sedimentation is expected to continue to the point where storage capacity (water depth) of pools will decline. This will result in reduced capability to manage wetland vegetation, especially robust emergent plants, using water level manipulations. Results from an ongoing sedimentation study at the Souris River basin refuges are expected to confirm this assumption.

Sedimentation and pollution mainly originate within the watershed, but outside refuge boundaries. Sediment is transported via agricultural runoff carried in major tributaries and wetland drainage projects. Flows that contain high sediment loads or that significantly reduce water quality appear associated with runoff originating from heavy winter snowmelt or significant rainfall events.

Island Goal

Manage islands to attract waterfowl and increase nest survival, especially during drought years when wetland habitat outside of the Souris River basin refuges is limited.

Island Objective 1

By 1 year after CCP approval, prioritize nesting islands based on waterfowl nest densities, nest survival, and maintenance costs.

Strategies

— Use data from nest studies (1992–94) to evaluate nesting islands for waterfowl production. Prioritize management of islands far from shore (with a large open-water barrier surrounding the island) and islands with extensive cover of low shrubs.
— Identify islands that are high maintenance, especially those that are prone to extensive erosion.

Rationale and Assumptions

Island management will be lower priority for restoration than other, more extensive, habitat types. Therefore, limited resources expended on island management should target islands with the greatest potential to produce waterfowl. Use of nesting islands by waterfowl has been intensively studied at J. Clark Salyer NWR since 1950, and criteria useful in prioritizing islands are readily available.

Ryan Hagerty/USFWS

Canada goose.

Island Objective 2

During drought conditions, maintain 70% apparent nest survival on 20 islands most attractive to waterfowl. Within pools 320, 326, and 332, island objectives remain secondary to marsh management objectives that enhance long-term wetland productivity.

Strategies

— Manage islands for the following characteristics: (1) large open-water barrier surrounding an island; (2) open shoreline without tall emergent vegetation; (3) far from the mainland; and (4) cover dominated by shrubs, grasses, or tall forbs. Achieve this with the following strategies: (1) water level management; (2) h erbicide application to reduce emergent cover surrounding an island; and (3) cover manipulation using plantings and prescribed fire.
— Trap predators such as skunk, raccoon, and mink soon after ice-out in the spring, during drought years or when staff and funding are available. The spring "window" for effectively capturing mink is narrow; capture is unlikely once nesting has begun.

— Additionally, control mink populations by reducing muskrat populations (the major winter food source of mink). Use partial winter drawdowns to control muskrat populations.

— Remove nesting islands with a history of low nest densities and/or low nest survival. Some islands with low nest survival can be burned in late April or May to discourage waterfowl nesting.

Rationale and Assumptions

The J. Clark Salyer NWR has more than 50 nesting islands that vary in attractiveness to nesting waterfowl. Some islands can support densities of more than 400 nests per acre during drought years. Other islands are rarely used or have perpetually low nest survival; these islands should be removed when funding and winter access allows.

Island objectives remain secondary to marsh management objectives that maintain long-term wetland productivity. Periodic water management, for example, holding water level high to facilitate muskrat herbivory, may conflict with maintenance of predator-free nesting islands (mink numbers are mainly influenced by winter muskrat populations). Summer drawdowns limit the utility of nesting, especially during drought years.

Cultural Resource Goal

Discover and protect cultural resources and interpret sites when the interpretation does not adversely affect habitat management.

Cultural Resource Objective 1

Within 15 years of CCP approval, identify refuge cultural resources and protect them from degradation.

Strategies

— Complete a cultural resources survey as needed when new projects may disturb refuge lands.

— Protect known cultural resources by minimizing disturbances in sensitive areas.

— Compile historical records pertaining to cultural resources mainly by consolidating available files and photographs and by interviewing area residents.

— In support of the Archaeological Resources Protection Act, develop a plan for managing refuge archaeological resources.

Rationale and Assumptions

There are limited resources (funding and staff) that will be allocated yearly to the refuge. The priority for these funding and staffing resources is to protect and manage upland and wetland habitats for wildlife. Protection of cultural resources is an integral part of the purpose. All cultural resource laws and policies will be complied with to prevent the destruction of known and unknown sites.

Cultural Resource Objective 2

Within 10 years of CCP approval, promote interpretation and protection of cultural resources and their importance to refuge wildlife and habitat resources.

Strategies

— Enhance the understanding of the CCC Camp BF-4, Company 766 site, by establishing an interpretive area that describes the work of the CCC in early development of refuge infrastructures.

— Add an on-site kiosk and headquarters' brochures to identify the Woods End and the Steven's Ranch sites.

Rationale and Assumptions

Protection and interpretation of cultural resources at the refuge, especially those that relate to the wildlife and habitat found there, will help visitors understand some of the environmental changes that have taken place. Interpreting the work of the CCC in developing much of the early refuge infrastructure will allow visitors to understand the importance of habitat management and restoration. The Steven's Ranch will serve as an example of the role grazing—first by wildlife, then by livestock—had in maintaining and changing native prairie grasslands.

Visitor Service Goal

Provide wildlife-dependent recreational opportunities to a diverse audience when the administration of these programs does not adversely affect wildlife and habitat management.

Visitor Service Objective 1—Hunting

Within 5 years of CCP approval, provide hunting opportunities for 1,000 visitors when resources needed to administer these programs do not adversely affect the refuge's ability to implement habitat management. Provide hunters with safe, reasonable harvest opportunities, uncrowded conditions, minimal conflicts with other users, and satisfaction with their overall experiences.

Strategies

— Annually determine whether resources (funding and staff) will be available to provide hunting opportunities at the current level.

— When compatible, add other designated game animals to the list of species open for hunting.

— Continue to work with the NDGF to provide quality hunting opportunities.


USFWS

Hunting white-tailed deer at J.Clark Salyer NWR.

— When compatible, on request, provide special use permits for hunters with disabilities.
— Enhance public understanding of refuge hunting opportunities by regularly updating hunting brochures, signs, and the refuge website.
— Increase the visibility of refuge law enforcement to seek compliance with regulations to ensure ethical hunting.

Rationale and Assumptions

There are limited resources (funding and staff) allocated yearly to the refuge. The priority for these resources is to manage upland and wetland habitat. Hunting programs will be allowed if resources needed to administer hunting will not materially detract from habitat management. The Service intends to keep the present level of programs, unless funding or staffing shortfalls increase. The greatest expenses for the hunting program are for law enforcement and printing of hunting brochures.

The compatibility determination for recreational hunting is in appendix S.

Visitor Service Objective 2—Fishing

Within 5 years of CCP approval, provide fishing opportunities for 1,000 anglers when resources needed to administer the program do not adversely affect the refuge's ability to implement habitat management. Provide anglers with safe, reasonable harvest opportunities, minimal conflicts with others, and satisfaction with their overall experiences.

Strategies

— Annually determine whether resources (funding and staffing) will be available to provide fishing opportunities at the current level.
— Provide the current level of fishing opportunities to anglers with disabilities and explore ways to expand access.
— Continue to work with the NDGF to provide quality fishing opportunities.
— Enhance public understanding of refuge fishing opportunities by regularly updating fishing brochures, signs, and the refuge website.
— Increase the visibility of refuge law enforcement to seek compliance with regulations to ensure ethical fishing.
— Develop cost-effective partnerships to increase and improve shore-angler access to the water.

Rationale and Assumptions

There are limited resources (funding and staff) allocated yearly to the refuge. The priority for these resources is to manage upland and wetland habitat. Fishing programs will be allowed if resources needed to administer fishing do not materially detract from habitat management. Most fishing opportunities are at bank locations along public roads and along water control structures. Costs to administer this program are limited to law enforcement and brochure printing; no additional expenses are anticipated to occur.

The Service intends to keep the present level of fishing access, unless funding and staffing shortfalls require fishing access to be closed. Fishing opportunities likely will not be expanded. However, partnerships with local sporting groups could be used to enhance access for shore anglers.

The compatibility determination for recreational fishing is in appendix U.

Visitor Service Objective 3—Wildlife Observation and Photography

Within 5 years of CCP approval, provide wildlife observation and photography opportunities for no less than 6,000 visitors as a result of improved habitat and wildlife diversity.

Strategies

— Develop a short brochure describing opportunities.
— Develop partnerships with local groups to provide birding and other wildlife tours.
— Modify the refuge website to include a current list of wildlife sightings.

Rationale and Assumptions

In a 2003–2004 refuge visitor survey, wildlife observation was ranked the third-largest use by visitors, behind fishing and hunting. Visitors tend to observe and photograph wildlife collaterally at the same time they participate in other wildlife-dependent activities. For example, while fishing, anglers have many opportunities to see a wide diversity of waterbirds swimming or flying overhead.

The Scenic and Grassland trails, photo blinds to observe grouse dances, and viewing platforms near refuge headquarters are the only facilities developed for wildlife observation and photography. Wildlife observation and photography go hand-in-hand with interpretation and environmental education programs. Although the Service does not plan to expand these facilities, a greater diversity of wildlife will be available for observation and photography as the habitat improves.

The compatibility determination for wildlife observation and photography is in appendix T.

Visitor Service Objective 4—Environmental Education and Interpretation

Within 5 years of CCP approval, provide environmental education programming to no less than 100 students per year. Provide interpretive exhibits that will be viewed by 15 % of visitors per year. Emphasize learning about natural plant and animal communities, ecological processes, refuge management practices, and restoration of upland and wetland habitat.

Strategies

— Build an interactive website for education and interpretation.

— Write an education and interpretive plan that focuses on enhancing awareness of prairie and wetland ecology and management. Ensure the curriculum is fresh and dynamic and meets the needs of all students and adults.

— Develop strong educational partnerships with schools and other government entities to efficiently tell the refuge story.

— Complete two new kiosks with interpretive panels.

— Complete reconstruction of the Scenic and Grassland trails and development of interpretive panels by the Federal Highway Administration.

— Upgrade and replace interpretive and informational panels throughout the refuge and along the Canoe Trail so they are consistent with the refuge theme.

— Upgrade the audiovisual equipment and the refuge orientation slide show.

— In cooperation with partners, participate in at least two special events annually to increase visitors' knowledge and understanding of wildlife conservation and related issues.

Rationale and Assumptions

Within commuting distance of J. Clark Salyer NWR is a population exceeding 60,000. There are unlimited opportunities to educate youth about wildlife and habitat of the northern Great Plains and to carry that knowledge into adulthood. The results of a 2003–2004 visitor survey indicated satisfaction with the management of the refuge and a desire to learn more about the natural resources present and the methods used to manage it.

Unfortunately, the refuge does not have educational facilities or staff to provide this valuable service. The refuge's priority is to manage habitats to prevent degradation. Improving the habitat while keeping visitors informed of activities will create more environmental education opportunities for visitors to learn, appreciate, and support management efforts.

The compatibility determination for environmental education and interpretation is in appendix T.

Non-wildlife-dependent Public Use

Objectives and strategies are not developed for non-wildlife-dependent public use activities. Examples of these activities are canoeing, boating, berry picking, horseback riding, walking, hiking, bicycling, cross-country skiing, snowshoeing, four wheeling, swimming, water skiing, sailing, and snowmobiling.

These types of activities may be compatible when associated with wildlife-dependent public use. For example, berry picking along a trail might be allowed as a compatible activity incidental to the wildlife-dependent public use of wildlife observation. Compatibility of activities will be determined on an individual basis by the refuge manager as needed in the future.

Research and Science Goal

Conduct innovative natural resource management using sound science and applied research to advance the understanding of natural resource function and management within the northern Great Plains.

Research and Science Objective 1

During the 15 years following CCP approval, identify and prioritize research needs required to meet the refuge's goals and objectives; promote investigations that reliably address these needs.

Strategies

— Conduct vegetation and wildlife inventories of all plant communities within major habitats identified in chapter 3. Use initial inventories as baseline data to assess past and future changes in plant and animal community composition.

— Use periodic surveys (for example, every 5 years) to assess vegetation composition and structure of high-priority refuge habitats.

— Focus wildlife population research on assessments of species-habitat relationships. Develop models that predict wildlife response to habitat management or restoration.

— Design and conduct issue-driven research unlikely to be reliably addressed using long-term monitoring. Develop predictive models of habitat management and restoration.

— Promote refuge research and science priorities within the broader scientific community. Ensure that cooperative research focuses on meeting information needs identified in habitat management goals and objectives.

Rationale and Assumptions

Habitat-based goals and objectives form the basis for setting research and monitoring priorities for J. Clark Salyer NWR. Investigations must be sufficiently designed, funded, and carried out to reliably address proposed hypotheses or questions.

Partnerships are integral to meeting the research and science goal and objectives. Cooperative efforts are supported with shared funding, lodging, vehicles, equipment, knowledge, and expertise.

Operations Goal

Efficiently use funding and staffing for the benefit of all natural and cultural resources, the National Wildlife Refuge System, and present and future generations. Effectively manage visitor service programs that complement habitat management.

Operations Objective 1

Within 15 years of CCP approval, hire six additional personnel to protect current resources, assist with administrative duties, and assist the rest of the staff to restore native prairie habitat and manage wetland resources on 100% of high-priority habitat units and 50% of moderate-priority habitat units.

Strategies

— Hire two full-time refuge managers with duties to plan and carry out intensive habitat restoration efforts on the highest priority habitats and units.

— Hire a full-time wildlife biologist and resource specialist to monitor wildlife and habitat responses to habitat protection, management, and restoration efforts.

— Hire a full-time law enforcement officer to protect resources and manage the visiting public.

— Hire an administrative clerk to assist with additional administrative duties.

— Maintain 40% of equipment and facilities to Service standards within 5 years of CCP approval.

— Replace 25% of worn-out equipment within 5 years of CCP approval, as needed.

Rationale and Assumptions

There are limited resources (funds and staff) allocated yearly to the refuge. The priority for these resources is to manage upland and wetland habitats. If the target (minimum) staffing level and funding are not reached or only partially reached, fewer accomplishments will be achieved.

Operations Objective 2

Within 15 years of CCP approval, secure additional funding necessary to complete habitat restoration on 100% of high-priority habitat units and 50% of moderate-priority habitat units. Include restoration with (1) native prairie reseeding, and (2) intensive management of existing native prairie including woody plant reduction, invasive species control, and increased prescribed fire and grazing activities.

Strategies

— Use additional funding to purchase native grass and forb seeds for reseeding former cropland and planted cover.

— Use additional funding to purchase herbicides to control invasive species and remove/control woody plant expansion.

— Continue to use maintenance management funding to maintain or replace equipment and facilities, as needed, to Service standards.

— Secure additional funding to enhance streamflow monitoring and water management and develop new area-capacity data for refuge marshes.

— Maintain existing facilities and equipment to Service standards, including necessary roads, dikes, water control structures, buildings, and fences (all of which are critical in habitat management and protection).

Rationale and Assumptions

There are limited resources (funds and staff) allocated yearly to the refuge. The priority for these resources is to protect and manage upland and wetland habitats for wildlife. Operational funding will be targeted to work on the highest priority habitats and habitat units at the refuge. Management intensity will be increased on those habitats and units and will require additional personnel and funding to restore native prairie.

Upper Souris NWR Management Direction

The following goals, objectives, and strategies for Upper Souris NWR outline the actions needed to achieve the vision of the Souris River basin refuges. The Service intends to meet these objectives during the next 15 years.

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Upper Souris NWR.

Drift Prairie Goal

Restore and maintain extensive examples of plant communities dominated by native flora characteristic of the mid-1800s drift prairie. Create the temporally and spatially dynamic habitat conditions that will attract most breeding bird species and other vertebrate fauna characteristic of that era.

Prairie Slope Goal

Restore representative examples of prairie slopes to preserve some of the most pristine plant communities that remain in the Souris River basin and promote appreciation and stewardship of prairie resources.

NOTE: For Upper Souris NWR, drift prairie and prairie slope habitats will be concurrently managed with similar vegetation objectives in units that include both habitats. This is mainly because the contemporary vegetation composition is fairly similar between the two habitats, except that drift prairie has less pristine, native herbaceous plant life (mean frequency 4% versus 15% and 13% for southwest-facing and northwest- to southeast-facing slopes). In addition, most management units to be delineated that include drift prairie will also include adjoining prairie slope habitat.

Drift Prairie and Prairie Slope Objective 1

By 1 year after CCP approval, delineate management units on uplands.

Strategies

— Divide refuge uplands into landscape units based on

- ❑ borders of native-sod prairie wherever clearly evident;
- ❑ management history (for example, the area that consistently encompasses a general grazing rotation or a prescribed burn);
- ❑ obvious boundaries such as permanent fence lines;
- ❑ anticipated future management actions.

— Assign a logical sequence of identifiers for units (for example, sequential numbering or north to south).

Rationale and Assumptions

Designation of individual management units is essential for establishing management objectives and priorities for planning habitat treatments and for basic communication including that of management history on a detailed, local level. Designation of management units needs to be done by Service management staff who have several years of on-the-ground experience at the refuge and who are familiar with its management history.

Drift Prairie and Prairie Slope Objective 2

Use current vegetation inventory data and area and landscape considerations to characterize each habitat management unit with native sod prairie as either high or low management priority, upland prairie units. Reevaluate prioritization of 15 years after CCP approval.

Strategy

— Apply multiple selection criteria.

CRITERIA FOR HIGH-PRIORITY UNITS

Floristic composition. Vegetation is characterized by ≥20% mean frequency of pristine, native herbaceous types (plant groups 41–43 and 46–48 [Grant et al. 2004b]; see appendix G), plus native herbaceous-dominated vegetation with Kentucky bluegrass as the main subdominant (plant group 53).

Floristic potential. Vegetation is characterized by <20% mean frequency of smooth brome-dominated vegetation (plant groups 54, 61, and 62).

Size and landscape context. The unit has ≥40 acres of prairie that is clearly native sod
and
is contiguous with other high-priority, native prairie units or with tracts of native prairie adjacent to the refuge under non-Service ownership.

CRITERIA FOR LOW-PRIORITY UNITS

Floristic composition. Vegetation is characterized by <20% mean frequency of pristine, native herbaceous types (plant groups 41–43 and 46–48 [Grant et al. 2004b]), plus native herbaceous-dominated vegetation with Kentucky bluegrass as the main subdominant (plant group 53).

Floristic potential. Vegetation is characterized by >20% mean frequency of smooth brome-dominated vegetation (plant groups 54, 61, and 62).

Size and landscape context. The unit has <40 acres of native sod prairie
and
is neither contiguous with high-priority, native prairie units nor adjacent to tracts of native prairie under non-Service ownership.

Rationale and Assumptions

Drift prairie occurs as small, gently sloping, isolated patches at Upper Souris NWR. Vegetation dominated by Kentucky bluegrass occurs frequently (42%), but smooth brome-dominated vegetation occurs infrequently (13%). Of the two introduced grass species, smooth brome is a greater hindrance to restoration of both vegetation composition and vegetation structure in northern mixed-grass prairie. Brome generally seems more difficult to control and more significantly alters the quality and structure of northern prairie habitats.

Drift prairie at Upper Souris NWR probably has the greatest restoration potential of any such prairie on publicly-owned lands in the Drift Plain physiographic region in North Dakota. Restoration management should focus on strategies to increase the competitive ability of native herbaceous plants, especially warm-season grasses, while reducing the vigor Kentucky bluegrass and keeping smooth brome in check. When managed by strategies that incorporate carefully timed fire and grazing disturbances, Kentucky bluegrass can occur as a codominant or subdominant species and emulate native grasses in structure.

Prairie slope is three times more prevalent than drift prairie at the refuge (see figure 9 in chapter 3). Vegetation on the more potentially pristine, southwest-facing slopes is relatively degraded, however (mean frequency of vegetation dominated by Kentucky bluegrass and by smooth brome is 33% and 14%, respectively).

Management of upland native prairie should simultaneously and equally target drift prairie and prairie slope because

- drift prairie is relatively limited in area yet not significantly invaded by smooth brome;
- Kentucky bluegrass is prevalent on both drift prairie and prairie slope; management to reduce this introduced grass and increase native herbaceous vegetation will logically target both site types simultaneously where both occur within a management unit.

Drift Prairie and Prairie Slope Objective 3

On high-priority units of prairie slope or high-priority units of prairie slope and drift prairie, apply frequent and precisely timed disturbance (principally fire and grazing) to restore vegetation and provide habitat for most wildlife species, especially burrowing owl, horned lark, Baird's sparrow, Sprague's pipit, chestnut-collared longspur, northern pintail, and Richardson's ground squirrel. Vegetation should present the below characteristics within 15 years of CCP approval.

- Mean frequency composition on each unit includes (1) >40% pristine-native and native-dominated/bluegrass subdominant vegetation (plant groups 41–43, 46–48, and 53), (2) <10% smooth brome-dominated vegetation (plant groups 54, 61, and 62), and (3) <15% low shrub-dominated vegetation (plant groups 11–17); based on percentage frequency of occurrence on belt transects (Grant et al. 2004b).
- Native trees and tall shrubs are absent or nearly so, comprising ≤1% land cover on each unit and no nonnative or planted native woody vegetation exists.

- Leafy spurge frequency is decreased by at least 50% and is maintained at 1% frequency on each unit (frequencies per belt transects), absinth wormwood is actively controlled, and yellow toadflax and other newly appearing species of noxious weeds that pose a threat to the drift prairie are eliminated within 5 years of initial detection.

Strategies

— Disturb the vegetation, typically by livestock grazing or fire, at least 2 of every 3 years. An ideal management sequence over 5 years might be BGGGR (B=prescribe burn the first year; G=graze in each of years 2, 3, and 4; R=rest), and then reinitiate the sequence. The area covered by trees, tall shrubs, and low shrubs will be incrementally reduced with this burning frequency.

— Primarily use prescribed fire when smooth brome plants are at least in the 4- to 5-leaf stage, but not yet showing an inflorescence; this generally occurs during a narrow mid-May through early June "window." A less preferred option is to burn in fall in anticipation of a negative, winter drought impact on smooth brome and Kentucky bluegrass.

— Graze mainly during late May through August or September, via a rotation approach with many (7–10) relatively small (40–60 acres) grazing cells per unit and short grazing periods (4–7 days) per cell. Adjust stocking rates to facilitate regrazing of individual smooth brome plants at least once within a grazing period, but move livestock to the next cell before native plants are regrazed (be sure to note grazing of native upland sedges, an important forage base in some management units).

— Establish native vegetation dominated by warm-season grasses on adjoining, high-priority old cropland (see objectives for old cropland). Manage these intensively in concert with the high-priority prairie units they adjoin to sustain a native-dominated flora and to reduce sources of introduced cool-season grasses and noxious weeds.

— Experiment on old cropland areas within low-priority prairie units, with new or high-risk restoration methods that may have application for restoration of old cropland within high-priority prairie units. For example, attempt control of introduced cool-season grasses and release of native plants on a small, localized scale with selective herbicide treatment.

— Remove local, human disturbances and artifacts of twentieth-century origin (including the refuge era). This includes prominent plow furrows, old road grades, rock piles, and impoundment dams on intermittent drainages (except on those essential as livestock water sources). Restore such sites as close as possible to their original condition.

— Annually survey for noxious weeds. Continue widespread use of biological control by monitoring local areas for *Apthona* spp. beetles and redistributing beetles among leafy spurge patches as needed. Use herbicides as needed along boundaries with private lands.

Deb Parker/USFWS

Rationale and Assumptions

Kentucky bluegrass is common among all topographic site types of upland native prairie at Upper Souris NWR. This grass tends to increase under prolonged rest or grazing, but decreases with fire especially when burning occurs during stem elongation or in dry years. Smooth brome, a less common introduced grass in drift prairie and prairie slope, also increases under rest. In contrast to Kentucky bluegrass, smooth brome appears sensitive to repeated grazing.

The upland native prairie has been treated regularly and extensively by livestock grazing, mostly via various rotation strategies. Conversely, little or no prescribed fire has been used to manage areas of upland native prairie, and most fire was applied only recently (2000–2005). Restoration management needs to focus on reduction of Kentucky bluegrass while keeping smooth brome in check. This is a challenging

task because a reduction of one of these grass species often accompanies an increase in the other. Increased use of fire to better match the types, timing, and frequencies of disturbances under which native herbaceous plants evolved will improve the competitive abilities of native herbaceous plants in high-priority, upland prairie units. Use of fire needs to be carefully executed to simultaneously decrease competitive abilities of both bluegrass and brome.

Makeup of the contemporary breeding bird community on drift prairie and prairie slope at Upper Souris NWR is incompletely documented. However, bird species diversity may be greater than that on the drift prairie at Des Lacs NWR or at J. Clark Salyer NWR mainly because there is much less smooth brome and more topographic variation at Upper Souris NWR. The refuge's high-priority upland prairie probably can be improved for birds and other wildlife species that historically were characteristic of northern mixed-grass prairie by incorporating more prescribed fire disturbance. Thus, there will be increased area in early successional stages.

Trees and tall shrubs increased significantly in area at the refuge during the past century (see chapter 3). This tall woody cover can diminish the survival of nests of grassland birds by harboring nest predators. This cover also provides perches from which brown-headed cowbirds can find other species' nests in which to lay eggs.

Recent data from the Souris River basin refuges indicate that relatively small areas of tall woody vegetation can effectively fragment grassland habitats and cause many grassland bird species to avoid entire landscapes. Elimination of tall woody cover is a logical strategy for restoration of landscape structure and plant community makeup, and to improve the attractiveness and security of the habitat for a variety of grassland-breeding bird species.

Drift Prairie and Prairie Slope Objective 4

On low-priority units of prairie slope or prairie slope plus drift prairie, apply disturbance (principally fire) every 5–8 years to remove plant litter, restore plant vigor, and reverse or stall woody plant expansion. Provide a mix of structural types that include (1) relatively short/sparse vegetation for species such as killdeer, horned lark, and Brewer's blackbird, (2) moderately short vegetation for species such as blue-winged teal and upland sandpiper, and (3) tall/dense vegetation for species such as mallard, short-eared owl, Le Conte's sparrow, and bobolink. Vegetation should present the below characteristics within 15 years of CCP approval.

NOTE: There likely will be no monitoring of vegetation on these units except for routine, cursory surveillance for noxious weeds. Tree and tall shrub cover can be coarsely monitored over decades via remote imagery. Knowledge of relationships between fire frequency and resulting, postfire, vegetation structure is adequate to predict habitat conditions described below.

> *One-fourth of the area is 0–1 year post-disturbance, one-fourth is 2–3 years post-disturbance, and one-half is 4–6+ years post-disturbance (corresponding roughly to a structure of <2 inches VOR, 2–4 inches VOR, and >4 inches VOR, respectively [mean VORs in early spring, per Robel et al. 1970]).*
>
> *Native trees and tall shrubs comprise <4% land cover on each unit, and all nonnative woody vegetation and planted native woody vegetation is eliminated from at least one-half of the units.*
>
> *Leafy spurge is maintained at <2% frequency, absinth wormwood is actively controlled, and yellow toadflax and other newly appearing species of noxious weeds that pose a threat to the drift prairie are eliminated within 5 years of initial detection.*

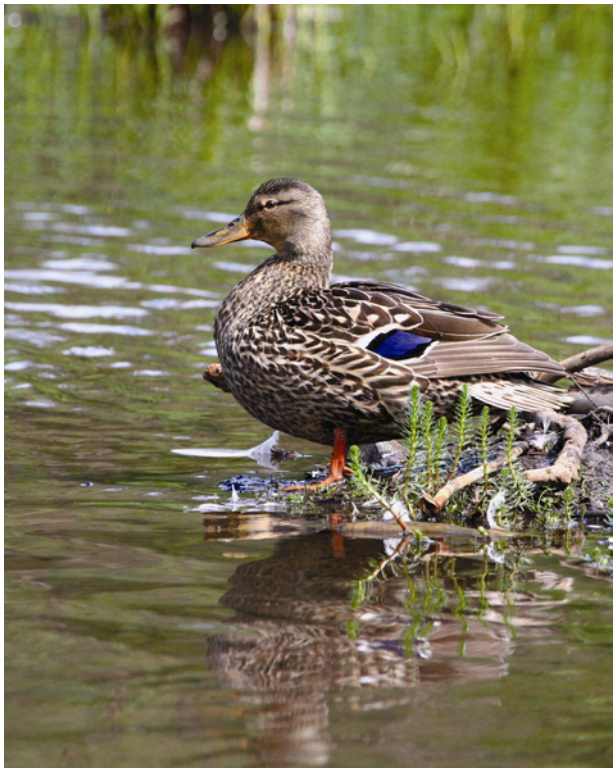
Strategies

- Apply prescribed fire on each unit at least every 5–8 years, increasing burn frequency during dry years when possible to more effectively reduce tall shrubs and trees. Rotate burns among units. Burn opportunistically, at any time, mainly to remove litter and control tall shrubs and trees.
- To increase structural diversity, occasionally introduce livestock grazing with wide latitude on timing, intensity, and duration, when doing so will not detract from management of high-priority units.
- Periodically survey for noxious weeds. Continue widespread use of biological control by monitoring local areas for *Apthona* spp. beetles and redistributing beetles among leafy spurge patches as needed. Use herbicides as needed along boundaries with private lands.

Rationale and Assumptions

Some upland prairie units at Upper Souris NWR have little intact, native herbaceous vegetation. From a practical standpoint, these areas probably cannot be restored to a state where such plants are a widely noticeable or an otherwise common vegetation component. However, with modest effort, the prevalent introduced cool-season grasses and scattered low shrubs can be managed to provide a mix of post-disturbance structural types attractive to a broad array of native grassland bird species.

The most appropriate management of these units is to provide structural variety and to use the units as



Donna Dewhurst/USFWS

Mallard hen.

a basis to create extensive areas of grassland that include off-refuge lands, to satisfy needs of several area-sensitive, native, grassland bird species. This could reduce predation and nest (brood) parasitism incidence associated with edge-dominated, highly fragmented grassland.

The rationale for reducing tall shrubs and trees is the same as that for high-priority prairie slope or prairie slope plus drift prairie (see objective 3).

Drift Prairie and Prairie Slope Objective 5

Help improve or maintain the habitat quality and economic sustainability of nonfederally owned, native prairie remnants adjacent to the refuge's drift prairie and slope prairie units within 15 years after CCP approval. Extend protection and stewardship to most other grasslands that adjoin these units. Seek opportunities to expand the total grassland area and create broad, contiguous blocks of open grassland, principally as habitat for breeding grassland birds.

Strategy

— Use grassland easements and extension agreements (for example, specialized livestock grazing systems on native prairie) for native grass establishment and management, or to remove "hostile" cover such as trees and tall shrubs that could harbor nest (brood) parasites and nest predators. Certain grazing systems can improve livestock carrying capacity and the condition of annually grazed prairie to enhance the economic viability of native prairie and reduce chances of conversion to other land uses, especially cultivation.

Rationale and Assumptions

The quality of prairie as breeding habitat for grassland birds (in terms of average annual nest success and relative contribution to population recruitment) is directly related to its extent or, conversely, indirectly to the degree of its fragmentation.

Native prairie on the Drift Plain could be considered an endangered resource and much of what remains of North Dakota's Drift Plain prairie occurs in the Souris River valley. Conserving remnant tracts adjacent to the refuge by whatever means possible should be among the highest priorities for landscape conservation.

Old Cropland Goal

On high-priority old cropland areas, establish native-dominated, perennial herbaceous cover that, with modest management, resists invasion by introduced cool-season grasses and noxious weeds. This seeded cover will help form extensive, contiguous blocks of structurally diverse, open grassland for grassland-dependent, breeding bird species.

Old Cropland Objective 1

By 10 years after CCP approval, locate and determine boundaries of old cropland areas and record these in the refuge's GIS database.

Strategies

— Identify old cropland (considered DNC) areas that were seeded to introduced grasses and forbs and/or native grasses since the mid-1970s.

— Identify other old cropland areas, as evidenced by

- distinct field edges, especially deep furrows and linear piles of wind-borne topsoil that had been deposited along preexisting fence lines and subsequently vegetated;
- rock piles or rocks strewn linearly along what appears to be a field edge (although rock sometimes was cleared for native hay harvests);
- nearly monotypic stands of smooth brome, typically with some Kentucky bluegrass but with little native sedge in the understory (several native plant species such as western snowberry, Wood's rose, white sage, western yarrow, several goldenrod species, and silver scurfpea often reinvade these stands);

  - ❑ no partly buried rocks with profuse lichens;
  - ❑ no clubmoss or cryptogamic crust.
- — Use acquisition records, old refuge narratives, 1938–39 aerial photographs, and U.S. Soil Conservation Service records for ancillary support.
- — Flag the probable boundaries of areas verified as old cropland, record via GPS and attribute, and upload into the refuge's GIS database.

Rationale and Assumptions

Furrows and other linear disturbances caused by implements (for example, plows, disks, and seed drills) are much more evident after an area is treated with prescribed fire or heavily grazed. They are also more readily detected from horseback. NRCS staff may determine evidence of A-horizon soil disturbance due to cultivation. Some areas with signs of farming disturbance (for example, furrows) may have been cropped only for a few years circa 1900–30 or may have been "broken" during this period yet never cropped. Such areas often are successfully reinvaded by native plants and may currently support native vegetation at levels approaching the most pristine areas on similar site types at the refuge that are considered native sod.

Old Cropland Objective 2

Within 15 years after CCP approval, convert DNC on at least 10 old cropland units to vegetation dominated by several species of native warm-season grasses that vary in stature and growth form and that include several species of native forbs, wherever possible. Give priority to units with stands of vegetation that have become decadent and overrun by undesirable, introduced cool-season grasses, especially where such units are adjacent to or within high-priority drift prairie units or high-priority prairie slope units.

Strategies

- — Following multiple applications of a broad-spectrum herbicide, seed a native plant mixture that mainly consists of 80–90% warm-season grass species especially big bluestem, little bluestem, switchgrass, and sideoats grama.
- — During the first 3–4 years after seeding, annually mow the stand with a hay conditioner and harvest the hay. Substitute grazing or prescribed fire treatments in the subsequent 3–4 years. Use herbicide spot spraying or "interseeding" where necessary.

Rationale and Assumptions

Although initially expensive, native warm-season grasses are economically and ecologically superior to seeded stands of introduced plants in old croplands because

- ❑ permanent, perennial cover eliminates regular (every 12–14 years) replacement of seeded, introduced species cover via a farming cycle and thus nearly eliminates potential for soil erosion;
- ❑ native grasses reduce local habitat fragmentation and eliminate "edge" associated with the farming cycle;
- ❑ a warm-season growth strategy for plants vastly improves the capacity for an assemblage of plants to outcompete smooth brome, mainly by affording broader and more effectively timed management opportunities;
- ❑ there is improved opportunity for prescribed burning in late spring compared to high-priority drift prairie units because the warm season–dominated cover has relatively high fuel value through early June (versus mostly green vegetation on cool season–dominated cover on the drift prairie by late May);
- ❑ there is a broader "window" (later in summer) for harvest of hay that still has forage value;
- ❑ native grasses are in compliance with policy that discourages planting of introduced species on Service lands and encourages planting of native species ("National Wildlife Refuge System Biological Integrity, Diversity, and Environmental Health," 601 FW 3, 2001);
- ❑ native grasses reduce "source sites" from which introduced and weedy plants invade adjoining native prairie;
- ❑ native grasses have improved and longer lasting structural diversity within stands.

Old Cropland Objective 3

By 10 years after CCP approval, identify other old cropland areas (those not known to have been seeded since the mid-1970s) that are high management priority (areas most important to convert to native warm-season grasses). Develop a detailed plan to convert these during the subsequent 10–15 years to vegetation dominated by several species of native warm-season grasses that vary in stature and growth form and that include several species of native forbs, wherever possible.

NOTE: There are no goals and objectives for remaining old cropland areas in uplands. They are low priority and will be managed with adjoining habitats.

Strategy

— Apply multiple selection criteria.

CRITERIA FOR HIGH MANAGEMENT PRIORITY OLD CROPLAND IN UPLANDS (excluding DNC and other old cropland known to have been seeded since the mid-1970s)

Floristic Composition. Vegetation is characterized by <20% mean frequency of pristine, native herbaceous types (plant groups 41–43 and 46–48 [Grant et al. 2004b]) plus native herbaceous-dominated vegetation with Kentucky bluegrass as the main subdominant (plant group 53).

Floristic Potential. Vegetation is characterized by >20% mean frequency of smooth brome-dominated types (plant groups 54, 61, and 62).

Landscape Context. The unit has no size criterion
and
bears clear evidence of a farming history
and
is contiguous with high-priority prairie units or tracts of native prairie adjacent to the refuge under non-Service ownership.

Rationale and Assumptions

Native grass and forb seed is very costly, as is the time and expense of materials needed to prepare seedbeds, plant seed, and annually manage newly seeded areas, per strategies and rationale listed under objective 2.

Old cropland that adjoins high-priority drift prairie or prairie slope and supports little native herbaceous vegetation likely is a source of invasion by undesirable, introduced grasses and weedy forbs. Without attempts to establish native vegetation through seeding, such areas are unpromising candidates for restoration to grassland in which native herbaceous plants are evident much less an important codominant component. This includes areas that were farmed for 5–10 years before refuge establishment—presumably before smooth brome and Kentucky bluegrass were widely distributed—that may have been reinvaded by native plants. These areas may have restoration potential that at least equals that of adjoining, high-quality drift prairie or prairie slope.

Darla Leslie/USFWS

Rainbow over Upper Souris NWR.

Old Cropland Objective 4

After seeding and establishing native warm-season plants in an old cropland unit, maintain dominance by native plants as the most dominant vegetation cover per qualitative estimation.

NOTE: There are no goals and objectives for other old cropland units (those not yet converted to warm season-dominated communities); they are low priority.

Strategies

— Disturb less frequently (every 2–3 years) the seeded warm-season stands, which should be well established 5–8 years after seeding. They probably can be disturbed more flexibly with regard to phenology, mainly to discourage smooth brome invasion.

— Use grazing as an alternate management treatment and take advantage of the wide, spring-grazing "window" afforded by the warm season–dominated community.

— Integrate management with that of surrounding prairie slope and drift prairie while focusing on treatment approaches that promote native warm-season plant species.

— In the interim between prescribed burns, possibly harvest hay every 2–3 years from old cropland units, alternating among July, August, and September to favor warm-season grasses.

— Where occasionally needed along unit boundaries, use herbicides to reduce encroaching, introduced cool-season grasses and release native warm-season plants. Use integrated pest management to treat local infestations of noxious weeds as needed.

Rationale and Assumptions

The warm-season growth strategy for plants vastly improves the capacity for an assemblage of grassland plants to outcompete smooth brome (which typically degrades seeded introduced stands), mainly by affording broader and more effectively timed management opportunities.

Old Cropland Objective 5

Within 25 years of CCP approval, eliminate planted tall shrubs and trees and any naturalized, nonnative, woody vegetation that occurs within or adjacent to

high-priority old cropland areas as they are being restored to native-dominated vegetation.

Strategy

— Remove tree-shrub plantings by mechanical means (for example, cutting ash trees by hand; shearing caragana shrubs with a tractor blade or bucket during winter); follow by herbicide treatment of stumps or by herbicide treatment, rotary mowing, and/or prescribed burning of resprouting vegetation wherever necessary.

Rationale and Assumptions

Trees and tall shrubs can diminish the survival of nests of grassland birds by harboring potential nest predators. They also provide perches from which brown-headed cowbirds can find other species' nests in which to lay eggs. Recent data from the Souris River basin refuges indicate that relatively small areas of tall woody vegetation can effectively fragment grassland habitats and cause many grassland bird species to avoid entire landscapes. Elimination of tall woody cover is a logical strategy for restoration of landscape structure and plant community makeup and to improve the attractiveness and security of the habitat for a variety of grassland-breeding bird species.

Old Cropland Objective 6

By 2 years after CCP approval, develop and implement an effective, practical, comprehensive plan for integrated control of noxious weeds in DNC and other old cropland areas in the riparian zone. In these areas, continue to maintain perennial herbaceous cover comprised of introduced species and native plant species or both, and the vegetation should present the following characteristics.

- About one-half of the area in 0- to 1-year postdisturbance and one-half in 2–3 years postdisturbance; corresponds roughly to a structure of 0–3.9 inches VOR and >3.9 inches VOR, respectively (mean VORs in early spring, per Robel et al. 1970).
- Native trees and tall shrubs compose <0.2% land cover on each old cropland area.
- Leafy spurge frequency is maintained at <2% frequency, absinth wormwood is actively controlled, and yellow toadflax and other newly appearing species of noxious weed that pose a threat to the drift prairie are eliminated within 5 years of initial detection. Canada thistle control is a low-priority weed control issue (mean frequency <25%).

Strategies

— Use hay harvest or fire at least every third year to maintain plant species vigor and vegetation structure and to control plant litter accumulation.

— Annually survey for noxious weeds. Continue widespread use of biological control by monitoring local areas for *Apthona* spp. beetles and redistributing beetles among leafy spurge patches as needed. Use herbicides as needed, especially along boundaries with private lands.

— Review and update the weed management plan, detailing specific methods and timetables for managing noxious weeds in old cropland areas of the riparian zone.

Rationale and Assumptions

Smooth brome, quackgrass, and Kentucky bluegrass dominate old cropland in riparian areas. These areas have relatively moist, deep, silty loams that are particularly suitable for these introduced grass species and allow them to outcompete nearly all native herbaceous species. There currently are no practical, sustainable avenues for conversion of these areas to more desirable stands of native herbaceous vegetation. However, there are practical methods for simultaneously controlling most species of noxious weeds and providing vegetation structure that is attractive to grassland bird species native to the region. These birds prefer relatively dense, tall, grassland vegetation and include mallard, northern harrier, Le Conte's sparrow, and bobolink.

S. Maslowski/USFWS

Bobolink.

In addition to removing litter, periodic prescribed fire will slow or reverse invasion by woody vegetation such as western snowberry and willow.

Canada thistle is a noxious weed that tends to pervade and persist in disturbed soils of the riparian zone at Upper Souris NWR. This thistle is variably common across the region's cultivated lands, mainly due to its prolific production of highly mobile, wind-borne seed. This weed species cannot be controlled consistently by available means within most of the refuge's riparian zone. This is mainly because the soils typically are too damp in late spring and early summer to support wheeled vehicles used to apply herbicides at an appropriate time for effective control. Aerial application is possible in some areas,

but tends to be more costly and controversial. Aerial application is more difficult to administer than ground spraying and adjacent areas of habitat or privately owned land may be subjected to overspray.

Regular monitoring and control of other noxious weed species such as leafy spurge and wormwood are more crucial than control of Canada thistle and are far more gratifying (in terms of available methods of biological and other nonchemical controls and overall costs versus benefits).

Coulee Woodland and Coulee Woodland Edge Goal

Acknowledge a nearly irreversible, localized establishment of mature, contiguous woodland and minimally manage these areas as breeding and migration habitat principally for forest-interior, migratory bird species such as veery and ovenbird. Strive to eliminate remaining, noncontiguous, edge-dominated tree and tall shrub cover, particularly near high-priority drift prairie and the largest, most contiguous grassland tracts.

Coulee Woodland and Edge Objective 1

By 2 years after CCP approval, use GIS vegetation data and topographic considerations to classify management units with significant (>20% cover) tree and tall shrub cover as either "coulee woodland units" or "coulee woodland edge units."

Strategies

— *Use these criteria for identifying units with significant tree and tall shrub cover as coulee woodland units:*
The uppermost vegetation strata of a unit comprises >50% tree cover with some tall shrub, forming woodland patches that generally are contiguous (minimum woodland width × length = 330 × 660 feet, about 5 acres).

— *Use these criteria for identifying units with significant tree and tall shrub cover as coulee woodland edge units:*
The uppermost vegetation strata of a unit comprise 5–50% tree and tall shrub cover, generally occurring in narrow bands and is not contiguous.

Rationale and Assumptions

Distinguishing between management units with considerable woodland cover versus those with much woodland edge is critical to the refuge's vision and to a prioritized management approach. Coulee woodland at Upper Souris NWR is difficult to restore back to prairie, mainly because understory and ground fuels are too few to carry fires of sufficient extent and intensity to kill overstory trees. Such areas probably do not have native prairie, grass-forb seed banks. However, coulee woodland could continue to provide modest habitat for forest-interior bird species, such as veery and ovenbird, without slowing widespread improvement in grassland bird habitat elsewhere at the refuge.

In contrast, coulee woodland edge is a widespread habitat type that in the absence of fire will continue to fragment drift prairie and prairie slope. None of the breeding bird species that are common in this edge habitat is of management concern. However, 11 grassland bird species that occur or used to occur at Upper Souris NWR are species of concern.

Conversion of woodland edge habitat to open prairie at the refuge could be achieved through repeated use of prescribed fire. This conversion will insignificantly influence continental population trends of woodland bird species, while helping reverse population declines of grassland bird species. Reduction of woodland edge may also reduce cowbird parasitism rates on grassland bird nests.

Coulee Woodland and Edge Objective 2

Within 5 years after CCP approval, analyze and summarize data that were collected during 2001–2003 on the composition and structure of a sample of coulee woodland at Upper Souris NWR.

Strategy

— Rank the summary and reporting of coulee woodland vegetation attributes among the highest priorities for a biologist who oversees the refuge's biological program.

Rationale and Assumptions

Available inventory data will provide critical insight on the status of American elm recruitment and the occurrence of noxious weed species. These data will provide a base for quantifying habitat relationships of bird species that breed in the refuge's woodland.

Coulee Woodland and Edge Objective 3

Minimally manage green ash–dominated, contiguous, coulee woodland that within 15 years of CCP approval covers a total of about 1,500 acres (slightly less than the current level of 1,600 acres) and in which noxious weeds are controlled as follows: (1) common buckthorn, leafy spurge, common burdock, and other noxious weed species are each reduced and maintained at <3% frequency; and (2) newly discovered species of noxious weeds are eliminated.

Strategies

— Apply prescribed fire to halt further expansion of coulee woodland within and adjacent to high-priority upland prairie areas. Use frequent (for

example, every 5 years) prescribed fire to reduce the area occupied by the smallest coulee woodlands that are adjacent to high-priority prairie areas.

— In open areas around woodland, continue to reduce leafy spurge by occasional redistribution of *Apthona* spp. beetles, plus limited use of herbicides at refuge boundaries if necessary.

— To assess the status of buckthorn and other noxious weeds in coulee woodland, complete the data summary and reporting in the previous objective 2 and, if necessary, seek ways to extend the sampling and help direct control efforts. Common buckthorn may be invading coulee woodland at Upper Souris NWR and, if so, will threaten habitat values for forest-interior bird species such as veery and ovenbird in addition to having other undesirable impacts.

Rationale and Assumptions

The area covered by coulee woodland at Upper Souris NWR has been increasing steadily during the past century (Grant and Murphy 2005). Coulee woodland continues to replace or indirectly diminish habitat values of the refuge's native upland prairie. Most areas covered by coulee woodland at the refuge may be difficult to restore back to prairie, but probably could continue to provide modest habitat for forest-interior bird species without hindering widespread improvement in grassland bird habitat elsewhere at the refuge.

Coulee Woodland and Edge Objective 4

On each coulee woodland edge unit, apply disturbance (principally fire) every 5–6 years to restore the vegetation to the following standards within 15 years:

- Tree and tall shrub cover are reduced by >50% (measured via remote imagery).
- Plant litter is removed and herbaceous plant vigor and structural diversity are restored by management treatment applied every 5–6 years (these responses will be unmeasured and instead will be assumed to coincide with disturbance events).
- At any given time, about one-fourth of the area of all woodland edge units is in 0–1 year postdisturbance, one-fourth is in 2–3 years postdisturbance, and one-half is in 4–6+ years postdisturbance. This corresponds roughly to VOR height-density classes of 0–2.0 inches, 2.0–3.9 inches, and 3.9–5.9 inches, respectively, to contribute to the variety of grassland structural types across the landscape.

  NOTE: There likely will be no monitoring of vegetation on nearly all of these units except for routine, cursory surveillance for noxious weeds. Tree and tall shrub cover could be coarsely monitored over decades via remote imagery. Knowledge of relationships between fire frequency and resulting, postfire vegetation structure is adequate to predict habitat conditions under this objective.

- Noxious weeds are controlled as follows: (1) buckthorn, caragana, and other introduced species of tall shrubs or trees are nearly eliminated; (2) leafy spurge is reduced by >50%, to <5% frequency; (3) absinth wormwood and Canada thistle are actively controlled at the refuge boundary; and (4) infestations of yellow toadflax and any other, newly appearing species of noxious weed are detected and eliminated.

Strategies

— Apply prescribed fire every 5–6 years, varying the timing of burns within a given unit to halt or reduce invasion by introduced cool-season grasses.

— So long as critical needs of priority management units (especially high-priority upland prairie) are not compromised, seek opportunities for occasional grazing by livestock during years between prescribed burns to improve structural heterogeneity and slow litter accumulation. Grazing prescriptions can be very flexible, even allowing occasional, relatively severe, defoliations, although such events may result in local increases in weeds such as Canada thistle and yellow sweetclover.

Rationale and Assumptions

Coulee woodland edge appears to be a widespread habitat type at Upper Souris NWR that in the absence of fire probably fragments significant areas of drift prairie and prairie slope. None of the breeding bird species that are common in this edge habitat are of management concern, whereas 11 grassland bird species that occur or used to occur at the refuge are considered species of concern. Conversion of woodland edge habitat to open prairie through repeated prescribed fire probably will negligibly influence continental population trends of woodland bird species while helping reverse population declines of grassland bird species.

Riparian Woodland Goal

Maintain the approximate presettlement extent of green ash–American elm riparian woodland within the floodplain of the Souris River to benefit a broad suite of woodland-associated, breeding bird species.

Riparian Woodland Objective 1

By 10 years after CCP approval, complete a baseline floristic inventory of riparian woodland.

Strategy

— Use a modified James and Shugart (1970) method to inventory floristic composition and stand structure of all riparian woodland.

Rationale and Assumptions

Vegetation composition and structure of some riparian woodland has been inventoried and breeding bird communities have also been inventoried. However, the data has not been analyzed and summarized. Qualitative observations suggest that most American elm has been lost to Dutch elm disease.

Riparian Woodland Objective 2

Maintain, in perpetuity, the riparian woodland present today. Explore methods that restore American elm as a codominant tree species of riparian woodland communities.

Strategies

— Use aerial photos and satellite imagery to periodically assess changes in the extent of riparian woodland.

— Assess methods to control Dutch elm disease including (1) biological control of the fungus or of native and introduced elm-bark beetles that spread the disease, and (2) development of disease-resistant cultivars (cultivated varieties of a plant) of American elm adapted to survive severe North Dakota winters.

— Because ash-elm riparian woodland is fire intolerant, suppress and control fires. Since the potential long-term effects of alterations in the hydrology (especially hydroperiod) of the Souris River are unknown, carefully investigate even minor changes in woodland.

Rationale and Assumptions

The extent of riparian woodland has changed little since the presettlement period. However, some meadows have been invaded by aspen woodland and willow woodland, which may succeed to ash-elm woodland.

Contemporary riparian woodland forms large, extensive patches of mature, closed-canopy woodland. These woodlands are important habitat for forest-interior migratory birds such as northern waterthrush, red-eyed vireo, and American redstart. Great blue heron and black-crowned night-heron colonies also are found in riparian woodland.

Meadow Goal

Restore and maintain extensive examples of plant communities dominated by native flora characteristic of seasonally flooded meadows within the Souris River floodplain to attract grassland- and wetland-dependent bird species and other wildlife.

Meadow Objective 1

Manage meadows composed variously of nonnative and native plants to provide a mosaic of relatively short-sparse and tall-dense herbaceous-dominated cover. By 15 years after CCP approval, reduce tall shrub and tree cover to <10%.

Strategies

— Use cooperators to periodically clip (hay) meadow vegetation to control trees, shrubs, and noxious weeds, especially Canada thistle. Meadows may be clipped every year (for several years) following extensive flooding.

— Experiment with control of leafy spurge using Plateau® herbicide. Release flea beetles (*Apthona* spp.) in patches of leafy spurge growing on various microsites. Once flea beetles become locally adapted to meadow sites, begin wide-scale releases to control leafy spurge.

Rationale and Assumptions

Meadow is a transitional habitat at the Souris River basin refuges, where it supports some hydrophilic (water-loving) plants and is sometimes temporarily flooded. Meadow also supports vegetation characteristic of mesic (relatively moist) uplands. Quackgrass, reed canarygrass, Canada thistle, and leafy spurge degrade native grass-sedgerush communities. Meadow vegetation evolved with periodic disturbances including flooding, grazing by elk and bison, and fire.

Meadows at Upper Souris NWR are mostly invaded by cool-season introduced plants (especially quackgrass and reed canarygrass), such that full restoration of native plant assemblages is unlikely. This objective focuses on maintenance of open, treeless meadows. Reduction in tall woody plants should benefit grassland and wetland birds intolerant of woody plants. Meadows invaded by introduced grasses will benefit these species despite being floristically simple in composition. Such benefits have been noted for sites seeded to introduced grasses, most notably in the CRP (Johnson and Igl 1995).

Wetland Goal

Manage riverine wetlands, including marshes and lakes, to sustain the long-term capacity of riverine wetlands to support diverse plant and wildlife communities. Restore ecological processes that sustain long-term productivity of wetlands.

Wetland Objective 1

Within 5 years of CCP approval, synthesize available information on the effects of physical

alterations, altered hydrology and hydroperiod, increased sedimentation, and changes in water quality of the riverine system, past and present: (1) develop a report to describe consequences of these alterations on long-term viability of riverine marshes; (2) determine biological potentials and constraints for each wetland impoundment; and (3) develop criteria to prioritize impoundments with the greatest potential for sustained productivity.

Strategies

- Use past narratives, aerial photographs, unpublished refuge files, and scientific literature to evaluate the biological potential of wetland impoundments and prioritize units for management.
- Map physical areas within each impoundment that are expected to respond to management.
- Develop and prioritize a list of knowledge gaps and research needs.
- In cooperation with USGS's Northern Prairie Wildlife Research Center, complete sediment accretion study and contaminants studies.
- Monitor groundwater and soil moisture levels in impoundments and within the adjacent meadow zone.

Rationale and Assumptions

This objective focuses on compilation of past and current data regarding development and management of the Souris River wetlands. Although riverine wetlands form one of the most extensive and important habitats at Upper Souris NWR, site-specific information is limited regarding effects of habitat management (especially water level management) on vegetation structure and composition, density of aquatic invertebrates, and wetland-dependent bird species. Models for managing northern prairie wetlands exist, but their utility is limited for management of riverine marshes at the Souris River basin refuges, primarily because three impoundments include flow-through of the Souris River (which limits wetland management capabilities).

This objective requires compilation of existing wetland management records along with a clear, succinct treatment of threats, management limitations, and management potentials for riverine wetlands. Laubhan and others (2003) recently completed a biological assessment of wetland conditions for the Souris River basin refuges; this report provides a start in meeting this objective and those that follow.

Existing models may be applicable to seven smaller impoundments that are physically located next to the Souris River, but are not totally affected by fluctuations in river flows. These impoundments have water supplies taken from the Souris River that are independent of the fluctuations in river flows. However, most of the impoundments can only be drained when the in-stream riverine marshes are drawn down, which is readily accomplished most years.

USFWS

Waterfowl congregate in a wetland at Upper Souris NWR.

Wetland Objective 2

Within 15 years of CCP approval, evaluate and comprehend crucial ecological processes that maintain long-term wetland productivity. Develop a range of biological indicators (for example, decline of important wetland plant or invertebrate species and shifts in extent and juxtaposition of emergent or submerged aquatic emergent vegetation) useful in the implementation of management strategies (for example, water level management, and prescribed fire) intended to maintain long-term wetland productivity.

Strategies

- Complete development of a USGS computer application that uses long-term flow data from gauging stations to assess effects associated with long-term alterations in river hydrology and hydroperiod on wetland plants, wildlife, and (ultimately) the potential to sustain long-term wetland productivity. Particularly important is monitoring flows that cross international boundaries. Additionally, monitor inflows at major tributaries as necessary.
- Through USGS's Northern Prairie Wildlife Research Center, complete a study of sediment accretion and its implications for long-term management of riverine marshes.
- In cooperation with USGS and others, assess available contour maps for wetlands; where inadequate; develop detailed contour maps of marsh bottoms for all impoundments to help construct models that predict vegetation response to water level management.
- Develop a method to inventory contemporary vegetation communities in managed wetlands. Develop methods for long-term monitoring of wetland vegetation.
- In cooperation with the USGS and others, use information derived above to develop predictive

models that determine effects of water management (especially hydroperiod) on wetland plants, invertebrates, and migratory birds.

— Since few on-site data are available, use relevant information from a broad spectrum of scientific publications and literature syntheses to address effects of Lake Darling water quality and water management. Reference documents may include, for example, a sediment accretion study completed through USGS's Northern Prairie Wildlife Research Center and an assessment of wetland conditions for the Souris River system by Laubhan et al. (2003).

Rationale and Assumptions

This objective focuses on synthesizing existing scientific research on wetland function and cycles in northern prairie wetlands and impounded riverine wetlands. It also prompts site-specific inventory, monitoring, and research to support management of riverine marshes.

A biological assessment of wetland conditions for the Souris River basin refuges was recently completed (Laubhan et al. 2003). This report provides context for the original construction and subsequent physical and operational modifications to the managed wetland system at the Souris River basin refuges. Additionally, long-term threats to the system are discussed. However, riverine wetlands have been managed mainly through opportunity, flood control objectives, and politics rather than sound science. Site-specific data are lacking regarding effects of wetland management on vegetation structure and composition, aquatic invertebrate densities, and wetland-dependent wildlife species.

Relative to upland habitats, managers have less effective control over wetland systems, due in part to the following:

- misunderstandings about the biological significance of drought and of complete drawdown dating back to the original construction of wetland impoundments;
- limited understanding of long-term impacts of low-head dams constructed in rivers in the northern Great Plains;
- significant physical limitations of constructed impoundments, especially the lack of independence among adjacent wetland units when manipulating water levels;
- inherent difficulties in conducting basic inventory, long-term monitoring, or applied research in wetlands relative to upland sites.

Wetland Objective 3

During the 15 years after CCP approval, develop and implement a new management philosophy that emphasizes long-term wetland productivity over older models based on (1) political management based on 5-year cycles, (2) "oasis" management, where wet acres are maximized especially during extreme drought, or (3) maximizing years of "hemi-marsh" conditions.

In high-priority impoundments, use periodic disturbance to provide the full spectrum of wetland conditions—for example, dry marsh, densely vegetated marsh (regenerative phase), hemi-marsh, open marsh (degenerative phase), and open water—to benefit wetland-dependent species of wildlife.

Strategies

— Re-create, where possible, the natural hydrology and hydroperiod of the Souris River. In most areas, physical disruptions and conflicts among water users compromise the degree to which this strategy can be carried out. Focus management on units that have the greatest potential for sustained productivity (from objective 1).

— Use natural climatic fluctuations to increase wetland management opportunities. Periodic drought may hasten full or partial drawdowns in some units. Although such drawdowns maximize the long-term viability of wetlands, the availability of wetlands with water is reduced during drought. In contrast, previous management emphasized retaining as much water as possible to offset landscape-level drought effects on migratory birds at the expense of long-term capacity to sustain wetland productivity in refuge impoundments.

— Use periodic, growing-season drawdown over multiple seasons if required to (1) stimulate production of seed-bearing annual plants, (2) increase invertebrate biomass, and (3) stimulate establishment and expansion of emergent and submergent plant species.

— During the drawdown phase, use additional disturbance, especially prescribed fire, mechanical soil treatment (for example, disking and sheep-foot packer), and defoliation (haying or grazing) to increase vegetation and invertebrate response during the regenerative phase and to control robust emergent vegetation.

— Use water level management and muskrat herbivory to reduce robust emergent vegetation, especially cattail and common reed.

— Periodically use aerially applied herbicides to reduce the extent of monotypic emergent

vegetation in portions of impoundments that, historically, do not respond to water level management (cannot hold >3 feet of water during the growing season).

— Confine major releases from upstream reservoirs to September through May, reducing extended inundation during the growing season when most wetland birds are nesting. Ideally, spring releases from Canada to the United States will occur according to the natural hydroperiod as identified in the international agreement for the Souris River basin (United States and Canadian Negotiating Delegation 1989).

— Use water stored in Lake Darling to supplement spring and summer flows at J. Clark Salyer NWR during extended or extreme drought, or during the regenerative marsh phase following drawdown of priority impoundments.

Rationale and Assumptions

This objective focuses on implementation and management, using the best available science. Since establishment of the refuge, conflicts in uses of Souris River water and in objectives for wetland management have occurred among various water users. Past management goals and objectives rarely addressed or incorporated unforeseen impacts related to the physical disruptions of the Souris River (original construction of dikes and dams), or changes in habitat (biotic and abiotic) resulting from these events. Inevitable decreases in water quality and in marsh management capabilities—especially because of accretion of sediments—are assumed, based on current knowledge of this and similar impounded riverine marshes in the northern Great Plains.

Productivity of northern prairie wetlands historically was maintained by periodic wet and dry cycles. Productivity is particularly enhanced during reflooding following natural drought or drawdown (in managed wetlands). Riverine marshes have an inherent reduced capacity to be dewatered during the growing season because the river flows through each impoundment. Departures from the normal hydroperiod, ill-timed upstream water releases, or significant summer rains can render prescriptive drawdowns ineffective because marsh sediments never dry sufficiently to (1) oxidize soils, (2) establish annual wetland plants (important waterfowl foods and a substrate for invertebrate production), or (3) establish perennial emergent and submergent vegetation (food cover and invertebrate substrate). Furthermore, control of robust emergent plants (cattail, common reed, and bulrush) becomes difficult because of continued anoxic (absence of oxygen) conditions that result in little reduction in organic material in marsh soils. Consequently, wetlands often cycle rapidly between open water and a dense-vegetated marsh phase, both of which are less productive than intervening stages. Because attainment of the periodic dry marsh phase is a significant factor that limits long-term wetland function, periodic drawdowns are emphasized under this objective. By necessity, wetland management will become more opportunistic, often working in conjunction with periodic wet-to-dry cycles to achieve management objectives.

Wetland Objective 4

Over the course of the CCP, introduce efforts on a watershed level that reduce sedimentation and nonpoint source pollution and/or their effects on riverine marshes.

Strategies

— Develop models similar to the "mallard model" developed by the HAPET that target areas within the watershed (for example, adjacent to major tributaries or drainage systems) that have the highest potential for sediment transport, especially during extreme rainfall or snowmelt events.

— Use models to target areas for conversion from cropland to grassland via USDA's Conservation Reserve Program, Wetland Reserve Program, or other USDA conservation initiatives. Identify drained wetlands within targeted areas for restoration. Initiate and develop additional conservation or legal measures, or both, that reduce or mitigate impacts from sedimentation and pollution.

— Work with the NRCS to ensure compliance with "Sodbuster," "Swampbuster," and other provisions in the Farm Bill (current and future) that reduce soil erosion.

— Explore construction of sediment traps to reduce the extent of sediment accumulations. Where management capability has already been reduced, explore the feasibility of dredging to reduce accumulated sediment in certain impoundments.

— Protect native prairie and prairie wetlands within target areas or adjacent to the refuge, using perpetual easements.

— In cooperation with the USGS, state of North Dakota, and USACE, monitor and document sediment loads and water quality associated with various flows. Consider passing flows that contain high sediment loads or that significantly reduce water quality.

Rationale and Assumptions

Initial samples collected at the Souris River basin refuges document only slightly elevated levels of sediment accretion. However, over many decades, sedimentation is expected to continue to the point where storage capacity (water depth) of pools will decline. This will result in reduced capability to

manage wetland vegetation, especially robust emergent plants, using water level manipulations. Results from an ongoing sedimentation study at the Souris River basin refuges are expected to confirm this assumption.

Darla Leslie/USFWS

Lake Darling from the fire lookout tower at Upper Souris NWR.

Sedimentation and pollution mainly originate within the watershed, but outside refuge boundaries. Sediment is transported via agricultural runoff carried in the Souris River and its tributaries. Flows that contain high sediment loads or that significantly reduce water quality above Lake Darling are associated with runoff originating from rapidly melting snow or significant rainfall events.

Wetland Objective 5

Annually review and adhere to refuge mandates and laws plus pertinent federal, state, and international legal obligations, agreements, and policies when managing or planning to manage water levels of the Lake Darling impoundment, or when attempting to prevent or reduce threats to the impoundment presented by water management practices elsewhere in the Souris River system.

Strategies

- By late summer each year, coordinate with the North Dakota State Water Commission, J. Clark Salyer NWR, and Saskatchewan Watershed Authority to determine a fall water release schedule for impoundments in the Souris River in Saskatchewan and Lake Darling.
- Annually reduce the water level in Lake Darling to 1,595.85 feet by October 15 and release no water thereafter.
- Annually reduce the water level in Lake Darling to 1,596.0 feet by February 1 for spring flood control purposes.
- By June 1 each year, store water in Lake Darling up to the interim summer level of 1,596.0 feet for refuge management purposes. This strategy is a proposal to alter the summer storage elevation from 1,597.0 to 1596.0 feet; implementation would require modification of the international agreement.
- During spring runoff or after unusually heavy summer rains, release water as needed to avoid exceeding an elevation of 1596.5 feet and to permit storage of an additional 5,000 acre-feet of water beyond that provided by the interim summer level.
- Release no more than 500 cubic feet per second (cfs), measured at Minot, North Dakota, after June 1.
- Communicate with the North Dakota State Water Commission when planning to release water from Lake Darling to benefit wildlife resources downstream at J. Clark Salyer NWR.
- Pass water from Saskatchewan through Lake Darling to senior water right holders whenever possible. Coordinate with the North Dakota State Water Commission and J. Clark Salyer NWR when releasing such water. Reserve no water stored in Lake Darling for later use by senior or junior water permit holders.
- Routinely scrutinize the USACE operation and maintenance of the Souris River Flood Control Project to verify that it is "operated and maintained in a manner compatible with the migratory waterfowl refuge purpose of the project," per section 21 of the Flood Control Act of 1965.
- Regularly communicate with the USACE, North Dakota State Water Commission, Saskatchewan Watershed Authority, and other agencies and downstream water users that have an interest in runoff releases. Coordination with the North Dakota State Water Commission and J. Clark Salyer NWR is prudent when discussing water management issues with the Saskatchewan Watershed Authority.
- Work with the USACE and North Dakota State Water Commission to protect Minot from 10-year flood events, per the operating plan of the international agreement for the Souris River basin (United States and Canadian Negotiating Delegation 1989). Alert the North Dakota State Water Commission and other members of the U.S. International Souris River Board when 10-year flood conditions do not occur: when runoff is less than a 10% event (1 in 10 years) and water allocated to the United States does not reach North Dakota to facilitate a natural hydrograph, as required in the international agreement. During such years, pass and/or store runoff water in Lake Darling according to the original intent of Upper Souris NWR as a refuge for migratory waterfowl.
- Publicize releases to describe their purpose and to stop users from removing water not allocated to them.

Rationale and Assumptions

This objective focuses on legal and policy mandates for management of Lake Darling. Lake Darling contributes to the long-term capacity of riverine wetlands to support diverse plant and wildlife communities within constraints of legal obligations. The main purpose of Lake Darling is to store a 2-year supply of water for managing downstream marshes at J. Clark Salyer NWR. This often has been incorrectly interpreted that Lake Darling should be kept as full as possible to maintain a lake-like character except during extreme drought periods. This interpretation drove a decision to raise the summer operating level from 1,596.0 feet to 1,597.0 feet after the Souris River Flood Control Project was completed. This increased elevation and newly constructed dams in Saskatchewan have reduced the ability to appropriately manage wetland habitats at Upper Souris NWR and J. Clark Salyer NWR.

There are two reasons to keep the water elevation below 1,596.0 feet: (1) shoreline erosion, the incidence of botulism, and upstream flooding of riparian woodland are reduced, and (2) water clarity, availability of shoreline for shorebirds and other wildlife, and the extent of wetland vegetation for waterfowl food and cover are improved. Additionally, this elevation limit provides better water level management capability for pool 41.

Relatively low water levels can occur on the Lake Darling impoundment in late summer due to evaporation, low precipitation levels, or water releases to J. Clark Salyer NWR. Low water levels can be ecologically beneficial and, on Lake Darling, can provide storage for unusually heavy summer rains, reducing the untimely flooding of downstream marshes. At times, water that enters Lake Darling may contribute downstream flows that are greater than the legally permitted levels. The impoundment's elevation during such periods may exceed 1,596.5 feet. Such runoff could be stored temporarily in the impoundment as long as the elevation does not exceed 1,598.0 feet. Beyond this level, water could be released at the rate of its flow into the reservoir. Water stored below 1,596.5 feet can either be released slowly over time or allowed to evaporate to an elevation of 1,596.0 feet by February 1. Releases are coordinated with the North Dakota State Water Commission to avoid negative downstream effects.

The 1965 legislative act that authorizes the Souris River Flood Control Project states that flood control is to be "operated and maintained in a manner compatible with the migratory waterfowl refuge purpose of the project."

The act requires the government of Saskatchewan, the U.S. Army, and the Service to appoint a contact person with whom states, provinces, and agencies may consult about project operations. Representatives of the U.S. Army, Saskatchewan Water Corporation (now Saskatchewan Watershed Authority), Service, and North Dakota State Engineer's office must regularly monitor the project plan.

For flood control purposes, each impoundment designated under the Souris River Flood Control Project must not exceed a stipulated water elevation by February 1. However, during some years, water still flows in the Souris River from Saskatchewan into North Dakota after October 15; water may still need to be released from Lake Darling to reach the impoundment's elevation goal for that date. When this occurs, much of the water may not reach Manitoba before freeze-up, making it difficult to manage downstream water at J. Clark Salyer NWR and in Manitoba. However, water releases up to 500 cfs at Minot during September 1–October 15 should allow the extra water to enter Manitoba by November.

Operating Lake Darling at a summer elevation of 1,596.0 feet will, under normal evaporation rates, allow some water released from Saskatchewan to be stored in Lake Darling (up to 1,595.85 feet). This may result in less water being passed through Lake Darling—water that otherwise might negatively affect the management of downstream resources. Saskatchewan must end releases by October to allow the Souris River to regain flows. For about 15 days after the flows end, excess water drains from river pools and bank storage until most water has passed into Lake Darling. This additional water must be passed through Lake Darling if the impoundment is to be staged at 1,595.85 feet for winter.

Water stored in Lake Darling can be released to supplement spring and summer flows at J. Clark Salyer NWR during extended or extreme drought, or during a regenerative marsh phase that follows drawdown of high-priority wetland impoundments. Water released from Lake Darling is legally owned by the Service and cannot be withdrawn without the agency's written permission. If unauthorized withdrawals are not prevented by the North Dakota State Water Commission, less water arrives at J. Clark Salyer NWR. According to past experience, only 50% of the water that is released into a nearly dry riverbed eventually is delivered to J. Clark Salyer NWR; the remainder replenishes bank storage and fills deep river holes.

The following excerpt from the international agreement describes when water should be released to North Dakota from reservoirs in Saskatchewan.

> *"Flow releases to the United States should occur (except in flood years) in the pattern which would have occurred in a state of nature. To the extent possible and in consideration of potential channel losses and operating efficiencies, releases from the Canadian dams will be scheduled to coincide with periods of beneficial use in*

North Dakota. Normally, the period of beneficial use in North Dakota coincides with the timing of the natural hydrograph, and that timing should be a guide to releases of the United States portion of the natural flows.

Water must be delivered in the spring according to the historical hydrograph to be beneficially used by water permit holders on the Souris River. Delaying the water release from Saskatchewan means that senior water right holders may not be able to benefit from the later release. Late releases can have detrimental effects on fish spawning, waterfowl marsh filling, fishing, and reproduction of over-water nesting migratory birds."

Island Goal

Manage islands to attract waterfowl and increase nest survival, especially during drought years when wetland habitat outside of the Souris River basin refuges is limited.

Island Objective 1

By 10 years after CCP approval, prioritize nesting islands based on waterfowl nest densities, nest survival, and maintenance costs.

Strategies

— Use data from nest studies conducted at other sites in North Dakota to evaluate nesting islands for waterfowl production.

— Identify islands that are high maintenance, especially those that are prone to extensive erosion.

— Map island locations and evaluate vegetation cover.

Rationale and Assumptions

Island management will be lower priority than restoration of other, more extensive, habitat types. Therefore, limited resources expended on island management should target islands with the greatest potential to produce waterfowl. Use of nesting islands by waterfowl has not been studied at Upper Souris NWR. Nesting islands have been sufficiently studied at other sites in North Dakota, particularly J. Clark Salyer NWR, to provide a basis for evaluations.

Island Objective 2

During drought conditions, maintain 70% apparent nest survival on priority islands. Within all pools below Lake Darling, island objectives remain secondary to marsh management objectives that enhance long-term wetland productivity.

Donna Dewhurst/USFWS

Northern shoveler.

Dave MenkeUSF WS

Muskrat.

Strategies

— Manage islands for the following characteristics: (1) large open-water barrier surrounding an island; (2) open shoreline without tall emergent vegetation; (3) far from the mainland; and (4) cover dominated by shrubs, grasses, or tall forbs. Achieve this with the following strategies: water level management, herbicide application to reduce emergent cover surrounding an island, and cover manipulation using plantings and prescribed fire.

— Trap predators such as skunk, raccoon, and mink soon after ice-out in the spring during drought years or when funding and staff are available. The spring "window" for effectively capturing mink is narrow; capture is unlikely once nesting has begun.

— Additionally, control mink populations by reducing muskrat populations (the major winter food source of mink). Use partial winter drawdowns to control muskrat populations.

— Remove nesting islands with a history of low nest densities and/or low nest survival. Some islands with low nest survival can be burned in late April or May to discourage waterfowl nesting.

Rationale and Assumptions

The Upper Souris NWR has approximately 28 nesting islands that probably vary in attractiveness to nesting waterfowl. The two largest islands are only 2 acres apiece; most of the islands are no more than 0.1 acre in size. These islands may be marginally attractive to nesting waterfowl. Many islands are in shallowly flooded pools, are spaced close together, are close to shore, or are surrounded by emergent vegetation.

Island objectives remain secondary to marsh management objectives that maintain long-term wetland productivity. Periodic water management, for example, holding water level high to facilitate muskrat herbivory, may conflict with maintenance of predator-free nesting islands (mink numbers are mainly influenced by winter muskrat populations). Summer drawdowns limit the utility of nesting, especially during drought years.

Cultural Resource Goal

Discover and protect cultural resources and interpret sites when the interpretation does not adversely affect habitat management.

Cultural Resource Objective 1

Within 15 years of CCP approval, identify refuge cultural resources and protect them from degradation.

Strategies

— Conduct government-to-government consultation with Native American nations—who lived, hunted, or used other resources in the Souris River basin—to identify which cultural or spiritually significant archaeological sites and traditional cultural properties are associated with them.

— Complete cultural resource surveys as needed for management purposes.

— Identify known cultural resource sites on a secure GIS database layer that can be used during management planning.

— Secure funding to survey the remainder of the refuge for cultural resource sites.

— Protect sites by using law enforcement patrol, special use permits, signing, and placement of physical barriers.

Rationale and Assumptions

There are limited resources (funding and staff) that will be allocated yearly to the refuge. The priority for these funding and staffing resources is to protect and manage upland and wetland habitats for wildlife. Protection of cultural resources is an integral part of the purpose. All cultural resource laws and policies will be complied with to prevent the destruction of known and unknown sites.

Cultural Resource Objective 2

Within 7 years of CCP approval, develop an interpretive program that will convey the cultural history of the Souris River valley to refuge visitors.

Strategies

— Develop an interpretive area within the headquarters building that gives a visitor an appreciation of the development of the Souris River valley and how it contributes to the visitor's quality of life.

— Develop an interpretive brochure depicting the cultural history of the Souris River valley.

— Develop an interpretive program that can be geared to several ages of visitors.

Rationale and Assumptions

The interpretation of cultural resources is encouraged if sufficient funding and staff are available (so that habitat management will not be negatively affected). Interpretation of the Souris River basin culture will enhance visitors' appreciation and knowledge of the role of refuges to protect native habitats and wildlife. In addition, visitors will be taught to respect, value, and protect cultural resources.

Visitor Service Goal

Provide wildlife-dependent recreational opportunities to a diverse audience when the administration of these programs does not adversely affect wildlife and habitat management.

Visitor Service Objective 1—Hunting

Within 5 years of CCP approval, provide hunting opportunities for 2,500 visitors when resources needed to administer these programs do not adversely affect the refuge's ability to implement habitat management. Continue to provide hunters with safe, reasonable harvest opportunities, uncrowded conditions, minimal conflicts with other users, and satisfaction with their overall experiences.

Strategies

— Annually determine whether resources (funding and staff) will be available to provide hunting opportunities at the current level.

— Add turkey, moose, or other species to the hunted list if compatible.

— Provide hunting opportunities and access for hunters with disabilities, on request, when determined to be compatible.

— Continue to work with the NDGF to provide quality hunting opportunities where possible.

— Continue to provide the public with information on refuge hunting opportunities by regularly updating hunting brochures, signs, and the refuge website, on an as-needed basis.
— Continue to provide visibility of refuge law enforcement officers to seek adherence to regulations.

Rationale and Assumptions

"Hunting is clearly an important activity with visitors making multiple trips to the refuge to do so. These visitors feel that hunting at the refuge provides a unique experience they cannot find elsewhere," (Sexton et al. 2005). However, there are limited resources (funding and staff) that will be allocated yearly to the refuge. The priority for these resources is to manage upland and wetland habitat. Hunting programs will be allowed if resources needed to administer hunting will not materially detract from habitat management. The Service intends to keep the present level of programs, unless funding or staffing shortfalls increase. The greatest expenses for the hunting program are for law enforcement, sign development and maintenance, development and printing of hunting brochures, answering questions, and update of the refuge website.

The compatibility determination for recreational hunting is in appendix S.

Visitor Service Objective 2—Fishing

Within 5 years of CCP approval, provide fishing opportunities for 50,000 to 75,000 anglers when resources needed to administer these programs do not adversely affect the refuge's ability to implement habitat management. Continue to provide anglers with safe, reasonable harvest opportunities, minimal conflicts with others, and satisfaction with their overall experiences.

Strategies

— Annually determine whether resources (funding and staffing) will be available and make adjustments as needed.
— Provide at least the current level of fishing opportunities to anglers with disabilities and elderly anglers and explore ways to expand access.
— Discuss enhancement of fishing opportunities with the NDGF.
— Continue to provide the public with information on refuge fishing opportunities by regularly updating fishing brochures, signs, and the refuge website, on an as-needed basis.
— Continue to provide visibility of refuge law enforcement to seek adherence to regulations.
— Develop cost-effective partnerships to increase and improve shore-angler access to the water.

USFWS

Fishing is popular at the refuge.

Rationale and Assumptions

The majority of visitors to the refuge are anglers. "Almost unanimously, fishing was identified as the most cited experience that would bring respondents back to the refuge. Angler visitors appear to be motivated to fish there simply for the enjoyment of the activity, being less concerned about catching large trophy fish. The majority of respondents who fish at the refuge would continue to do so even if they thought they would not catch any fish. This says much about the experience that the refuge provides for this activity, indicating they are likely gaining more from the experience than simple catching fish," (Sexton et al. 2005).

All boat ramps and fishing access piers were replaced with quality facilities in 2005 and should need only minimal maintenance during the next 15 years. A request for "additional fishing access" areas such as piers and docks was the most frequent comment when asked, "What would enhance your experience at Upper Souris National Wildlife Refuge?" Included in this request was access that accommodated handicapped or elderly anglers (Sexton et al. 2005). Partnerships with local sporting groups could be explored to expand access for shore anglers.

There are limited resources (funding and staff) allocated yearly to the refuge. The priority for these resources is to manage upland and wetland habitat. Fishing programs will be allowed if resources needed to administer them do not materially detract from habitat management. Program expenses include the following: (1) law enforcement; (2) brochure development and printing; (3) annual access and facility maintenance; (4) sign development and maintenance; (5) answering questions; and (6) website development and update. The Service does not intend to add additional areas for boat or shore fishing, or to increase the hours in a day that anglers can fish at the refuge. The Service intends to keep the present level of fishing access, unless funding and staffing shortfalls require fishing access to be reduced.

The compatibility determination for recreational fishing is in appendix U.

Visitor Service Objective 3—Wildlife Observation and Photography

Within 5 years of CCP approval, provide wildlife observation and photography opportunities for no less than 6,000 visitors as a result of improved habitat and wildlife diversity.

Strategies

— Develop a short brochure describing opportunities.

— Develop partnerships with wildlife groups and organizations to market available birding and wildlife opportunities at the refuge.

— Update the refuge website on a regular basis to provide details of current wildlife sightings.

Rationale and Assumptions

Nonconsumptive users most found wildlife observation, driving the Prairie-Marsh Scenic Drive, walking the interpretive trails, and photography to be important activities. Visitors ranked wildlife observation the third-largest use, behind fishing and hunting (Sexton et al. 2005). Visitors tend to observe and photograph wildlife collaterally at the same time they participate in other wildlife-dependent activities. There were 49–60% of the consumptive users that rated viewing waterbirds and other wildlife as important. Sixty-eight percent of nonconsumptive users rated photography important and approximately 76–93% of nonconsumptive users rated wildlife observation as important (Sexton et al. 2005).

Deb Parker/USFWS

Entry point to the Prairie-Marsh Scenic Drive.

The Prairie-Marsh Scenic Drive, nature trails, and photo blinds to observe grouse dances are the only facilities developed for wildlife observation and photography. However, every place that visitors walk or drive there is wildlife to be seen. Wildlife observation and photography go hand-in-hand with interpretation and environmental education programs. Although the Service does not plan to expand these facilities, a greater diversity of wildlife will be available for observation and photography as the habitat improves.

The compatibility determination for wildlife observation and photography is in appendix T.

Visitor Service Objective 4—Environmental Education and Interpretation

Within 5 years of CCP approval, provide environmental education programming to no less than 100 students per year. Provide interpretive exhibits that will be viewed by 15 % of visitors per year. Emphasize learning about natural plant and animal communities, ecological processes, refuge management, and restoration of upland and wetlands.

Strategies

— Build a learning center and hire an environmental education coordinator that will provide programs on and off the refuge to diverse citizens of all ages.

— Build an interactive education and interpretive website.

— Write an education and interpretation plan that focuses on enhancing awareness of prairie and wetland ecology and management. Ensure the curriculum is fresh and dynamic and meets the needs of all students and adults.

— Develop strong educational partnerships with schools and other government entities to efficiently tell the refuge story.

— Educate students and families of a transient Air Force workforce so they can advocate protection of fish and wildlife habitat and support refuges after they move.

— Complete two new kiosks and interpretive panels.

— Complete reconstruction of the Prairie-Marsh Scenic Drive and development of interpretive panels in conjunction with the Federal Highway Administration.

— Apply for Scenic Byway designation to attract visitors.

— Upgrade and replace interpretive and information panels that are consistent with the refuge theme.

— Build an elevated platform overlooking pools B and C to enhance the visitor's experience of marsh wildlife by interpreting the marsh ecosystem.

— Upgrade the audiovisual equipment and the refuge orientation slide show.

— In cooperation with partners, participate in at least two special events annually to increase visitors' knowledge and understanding of wildlife conservation and related issues.

— Construct additional interpreted hiking and walking trails or improve existing trails.

Rationale and Assumptions

Within commuting distance of Upper Souris NWR there is a population of at least 60,000 people, including Minot Air Force Base located 14 miles east. Survey results show that 93% of visitors reside within the state (Sexton et al. 2005). There are unlimited opportunities to educate youth about wildlife and habitat; most of these youth will leave the state when they graduate and take the message elsewhere.

During the public scoping meeting process, most participants asked for more environmental education opportunities at the refuge. Refuge visitor survey results (Sexton et al. 2005) indicate the following:

- kiosks or signs with information about the refuge and its wildlife and self-guided interpretive trails and auto tours are important or very important to approximately 64% of visitors
- environmental education programs, interpretive exhibits, and interpretive trails are important to 46–75% of visitors drawn to the refuge for nonconsumptive activities
- 56% of visitors stated that special events (environmental education, open houses, Migratory Bird Day) at the refuge are important to their decision to visit the refuge
- 33% of respondents indicated that having more education and interpretive programs would maximize their experience while visiting the refuge
- 76% of nonconsumptive users stated they would like to see more hiking and walking trails

Unfortunately, the Upper Souris NWR does not have educational facilities or staff to provide this valuable service. The refuge's priority is to manage upland and wetland habitats to prevent degradation. As the habitat improves and more is learned about refuge biology, there will likely be more ability to create increased environmental education opportunities for visitors to learn about, appreciate, and become supporters of refuge management efforts.

The compatibility determination for environmental education and interpretation is in appendix T.

Non-wildlife-dependent Public Use

Objectives and strategies are not developed for non-wildlife-dependent public use activities. Examples of these activities are canoeing, boating, berry picking, horseback riding, walking, hiking, bicycling, cross-country skiing, snowshoeing, four wheeling, swimming, water skiing, sailing, and snowmobiling.

These types of activities may be compatible when associated with wildlife-dependent public use. For example, berry picking along a trail might be allowed as a compatible activity incidental to the wildlife-dependent public use of wildlife observation. Compatibility of activities will be determined on an individual basis by the refuge manager, as needed in the future.

Research and Science Goal

Conduct innovative natural resource management using sound science and applied research to advance the understanding of natural resource function and management within the northern Great Plains.

Research and Science Objective 1

During the 15 years following CCP approval, identify and prioritize research needs required to meet the refuge's goals and objectives; promote investigations that reliably address these needs.

Strategies

— Conduct vegetation and wildlife inventories of all plant communities within major habitats identified in chapter 3. Use initial inventories as baseline data to assess past and future changes in plant and animal community composition.

— Use periodic surveys (for example, every 5 years) to assess vegetation composition and structure of high-priority refuge habitats.

— Focus wildlife population research on assessments of species-habitat relationships. Develop models that predict wildlife response to habitat management or restoration.

— Design and conduct issue-driven research unlikely to be reliably addressed using long-term monitoring. Develop predictive models of habitat management and restoration.

— Promote refuge research and science priorities within the broader scientific community. Ensure that cooperative research focuses on meeting information needs identified in habitat management goals and objectives.

Rationale and Assumptions

Habitat-based goals and objectives form the basis for setting research and monitoring priorities for Upper Souris NWR. Investigations must be sufficiently designed, funded, and carried out to reliably address proposed hypotheses or questions.

Partnerships are integral to meeting the research and science goal and objectives. Cooperative efforts are supported with shared funding, lodging, vehicles, equipment, knowledge, and expertise.

Operations Goal

Efficiently use funding and staffing for the benefit of all natural and cultural resources, the National Wildlife Refuge System, and present and future generations. Effectively manage visitor service programs that complement habitat management.

Operations Objective 1

Within 15 years of CCP approval, hire five additional personnel to protect current resources, assist with administrative duties, and assist the rest of the staff to properly handle public use and restore native prairie habitat and manage wetland resources on 100% of high-priority habitat units and 50% of moderate-priority habitat units.

Strategies

— Hire a public use specialist to plan and carry out an intensive public awareness program to educate the public about habitat restoration efforts.

— Hire one full-time wildlife biologist and two permanent-seasonal technicians to monitor wildlife and habitat responses to habitat protection, management, and restoration efforts.

— Hire a full-time fire management specialist to manage the fire program necessary for habitat restoration.

— Hire an administrative clerk to assist with additional administrative duties.

— Maintain 40% of equipment and facilities to Service standards within 5 years of CCP approval.

— Replace 25% of worn-out equipment within 5 years of CCP approval, as needed.

Rationale and Assumptions

There are limited resources (funds and staff) allocated yearly to the refuge. The priority for these resources is to manage upland and wetland habitats. If the target (minimum) staffing level and funding are not reached or only partially reached, fewer accomplishments will be achieved.

Operations Objective 2

Within 15 years of CCP approval, secure additional funding necessary to complete habitat restoration on 100% of high-priority habitat units and 50% of moderate-priority habitat units. Include restoration with (1) native prairie reseeding, and (2) intensive management of existing native prairie including woody plant reduction, invasive species control, and increased prescribed fire and grazing activities.

Strategies

— Use additional funding to purchase native grass and forb seeds for reseeding former cropland and planted cover.

— Use additional funding to purchase herbicides to control invasive species and remove/control woody plant expansion.

— Continue to use maintenance management funding to maintain or replace equipment and facilities, as needed, to Service standards.

— Secure additional funding to enhance streamflow monitoring and water management and develop new area-capacity data for refuge marshes.

— Use additional funding to purchase facilities to increase the environmental education program and expand outreach activities.
— Maintain existing facilities and equipment to Service standards; includes necessary roads, dikes, water control structures, buildings, and fences (all of which are critical in habitat management and protection).

Rationale and Assumptions

There are limited resources (funds and staff) allocated yearly to the refuge. The priority for these resources is to protect and manage upland and wetland habitats for wildlife. Operational funding will be targeted to work on the highest priority habitats and habitat units at the refuge. Management intensity will be increased on those habitats and units and will require additional personnel and funding to restore native prairie.

STEP-DOWN MANAGEMENT PLANS

The CCP for the Souris River basin refuges is intended to be a broad umbrella plan (1) that outlines general concepts and objectives for habitat, wildlife, visitor services, cultural resources, and partnerships, and (2) that guides refuge management for the next 15 years. Step-down management plans provide greater detail for carrying out specific actions authorized by the CCP. Tables 5–7 list step-down management plans for each refuge that are anticipated to be needed, along with their current status and next revision date.

Table 5. Step-down management plans for Des Lacs NWR, North Dakota.

Step-down Management Plan	*Completed Plan, Year Approved*	*New or Revised Plan, Completion Year*
Fire management plan	2003	2007
Habitat management plan	—	2010
Habitat management plan (annual)	2006	2007
Hunting plan	1993	2010
Integrated pest management plan	2005	2010
Law enforcement plan	—	2010
Predator management plan	1985	2010
Safety plan	1995	2007
Visitor service plan	1990	2010
Water management plan	2006	2007

Pasqueflower. *Shooting Star.* *Bluet.*

Line art © Cindie Brunner

Table 6. Step-down management plans for J. Clark Salyer NWR, North Dakota.

Step-down Management Plan	*Completed Plan, Year Approved*	*New or Revised Plan, Completion Year*
Cropland management plan	1997	2008
Development plan	1985 (obsolete)	2009
Duck viral enteritis contingency plan	1973 (obsolete)	2012
Fire management plan	2001	2006
Habitat management plan (annual)	2006	2006
Hunting and fishing plan	1986	1993
Integrated pest management plan	2005	2010
Law enforcement plan	—	2011
Predator management plan	1985	2012
Safety plan	1998	2008
Trapping plan	1968	2010
Visitor service plan	—	2014
Water management plan (annual)	2006	2006

Canada goose.

Table 7. Step-down management plans for Upper Souris NWR, North Dakota.

Step-down Management Plan	*Completed Plan, Year Approved*	*New or Revised Plan, Completion Year*
Fire management plan	1999	2007
Grassland management plan	1995	2008*
Habitat work plan (annual)	2006	2007
Hunting plan	1993	2009
Integrated pest management plan	2000	2006
Law enforcement plan	—	2006
Predator management plan	1985	2006
Safety plan	2005	2006
Sign plan	1986	2012*
Visitor service plan	—	2006
Water management plan (annual)	2006	2007
Water management plan (long-range)	1968	2010**

** Year is dependent on hiring a public use specialist.*
*** Year is dependent on hiring a biologist.*

STAFFING AND FUNDING

This section describes the human and monetary resources needed to carry out the CCP.

Staffing

Due to a reduced budget within the Service, a decision was made to change the administrative structure of the three refuges, two of which had been part of former refuge complexes (Des Lacs NWR Complex and J. Clark Salyer NWR Complex).

One project leader will now administer a larger unit called the Souris River Basin NWR Complex, which places all three Souris River basin refuges under one manager. This will provide a consistent message at international meetings concerning the Souris River and will allow consistent application of management practices that the Service developed for this CCP.

Tables 8–10 list current positions along with new positions that are needed for full implementation of this CCP. The proposed positions are also included in the database for the Refuge Operating Needs System (RONS) (see appendixes V–X).

Funding

Projects required to carry out the CCP are funded through two separate systems, as follows:

- The Service uses the RONS database to document requests to Congress for funding and staffing needed to carry out projects above the existing base budget.
- The Service uses the Service Asset Maintenance Management System (SAMMS) database to document the equipment, buildings, and other existing properties that require repair or replacement.

Lists of the RONS and SAMMS projects required to carry out this CCP (including maintenance of structures and equipment to a safe and productive standard for the 15 years of the CCP) are in the following appendixes: appendix V (Des Lacs NWR), appendix W (J. Clark Salyer NWR), and appendix X (Upper Souris NWR).

Table 8. Current and proposed staff for Des Lacs NWR, North Dakota.

Staff Group	*Current Positions*	*Additional Proposed Positions (Unfunded)*
Management	Wildlife refuge manager GS[1]-13	Wildlife refuge manager GS-11 Wildlife refuge manager GS-5/7/9
Biology	None	Wildlife biologist GS-12 Wildlife biologist GS-11 Biological science technician GS-11
Visitor services	None	None
Administration	Administrative support assistant GS-5	None
Maintenance	Engineering equipment operator WG[2]-10 Maintenance worker WG-8	None
Fire management*	Assistant fire management officer GS-11 Prescribed fire specialist GS-9 Range technician GS-5 Dispatcher/range technician GS-6	Range technician GS-6 Fire operations and fuels specialist GS-9
Law enforcement	None	None

[1]GS=general schedule position
[2]WG=wage grade position.
**All fire positions are not exclusive to the Souris River Basin NWR Complex, but are shared within the larger Western North Dakota Fire District that encompasses numerous refuges and wetland management districts in central and western North Dakota.*

Table 9. Current and proposed staff for J. Clark Salyer NWR, North Dakota.

Staff Group	*Current Positions*	*Additional Proposed Positions (Unfunded)*
Management	Wildlife refuge manager GS[1]-13 Wildlife refuge manager[2] GS-12 Wildlife refuge manager GS-5/7/9	Wildlife refuge manager GS-9/11 Wildlife refuge manager GS-9/11
Biology	Wildlife biologist GS-12 Private lands biologist[2] GS-11 Biological science technician[2] GS-8	Wildlife biologist GS-11 Resource specialist GS-11
Visitor services	None	Outdoor recreation planner GS-9
Administration	Administrative officer GS-9	Clerk GS-5
Maintenance	Auto mechanic WG[3]-10 Engineering equipment operator WG-8 Engineering equipment operator[2] WG-8	None
Fire management*	Prescribed fire specialist GS-9 Fire program technician GS-7 Range technician GS-5	None
Law enforcement	None	Law enforcement officer GS-9

[1]GS=general schedule position.
[2]Primary duties are at the J. Clark Salyer WMD.
[3]WG=wage grade position.
**All fire positions are not exclusive to the Souris River Basin NWR Complex, but are shared within the larger Western North Dakota Fire District that encompasses numerous refuges and wetland management districts in central and western North Dakota.*

Table 10. Current and proposed staff for Upper Souris NWR, North Dakota.

Staff Group	*Current Positions*	*Additional Proposed Positions (Unfunded)*
Management	Wildlife refuge manager GS[1]-12	Wildlife refuge manager GS-11
Biology	Wildlife biologist GS-11 Biological science technician GS-9	Biological science technician GS-9 (permanent, career-seasonal; 0.5 FTE[2])
Visitor services	None	Outdoor recreation planner GS-11
Administration	Administrative support assistant GS-7	Clerk GS-5 (permanent, career-seasonal; 0.5 FTE)
Maintenance	Maintenance worker WG[3]-8	None
Fire management*	Fire management officer GS-11 Supervisory range technician GS-6/7	None
Law enforcement	Park ranger GS-9	Park ranger GS-9 (permanent, career-seasonal; 0.5 FTE)

[1]GS=general schedule position.
[2]FTE=full-time equivalent; one or more job positions with tours of duty that, when combined, equate to one person employed for the standard government work-year.
[3]WG=wage grade position.
**All fire positions are not exclusive to the Souris River Basin NWR Complex, but are shared within the larger Western North Dakota Fire District that encompasses numerous refuges and wetland management districts in central and western North Dakota.*

Partnership Opportunities

Opportunities exist near the Souris River basin refuges to establish partnerships with sporting clubs, elementary and secondary schools, and community organizations. A strong partnership already exists between the Service and the NDGF.

At regional and state levels, partnerships might be established with organizations such as Ducks Unlimited, The Nature Conservancy, National Audubon Society, National Wild Turkey Federation, North Dakota Wildlife Federation, wildlife societies, Delta Waterfowl, and many others.

Monitoring and Evaluation

The step-down management plans (tables 5–7) will describe specific monitoring and evaluation activities.

Adaptive management is a flexible approach to long-term management of biotic resources.

Adaptive management is directed, over time, by the results of ongoing monitoring activities and other information. More specifically, adaptive management is a process by which projects are carried out within a framework of scientifically driven experiments to test the predictions and assumptions outlined within a CCP (figure 16).

To apply adaptive management, specific survey, inventory, and monitoring protocols will be adopted for the Souris River basin refuges. The habitat management strategies will be systematically evaluated to determine management effects on wildlife populations. This information will be used to refine approaches and determine how effectively the objectives are being accomplished. Evaluations will include participation by the HAPET, the ecosystem team, and other appropriate partners. If monitoring and evaluation indicate undesirable effects for target and nontarget species or communities, alterations to the management projects will be made. Subsequently, the CCP will be revised.

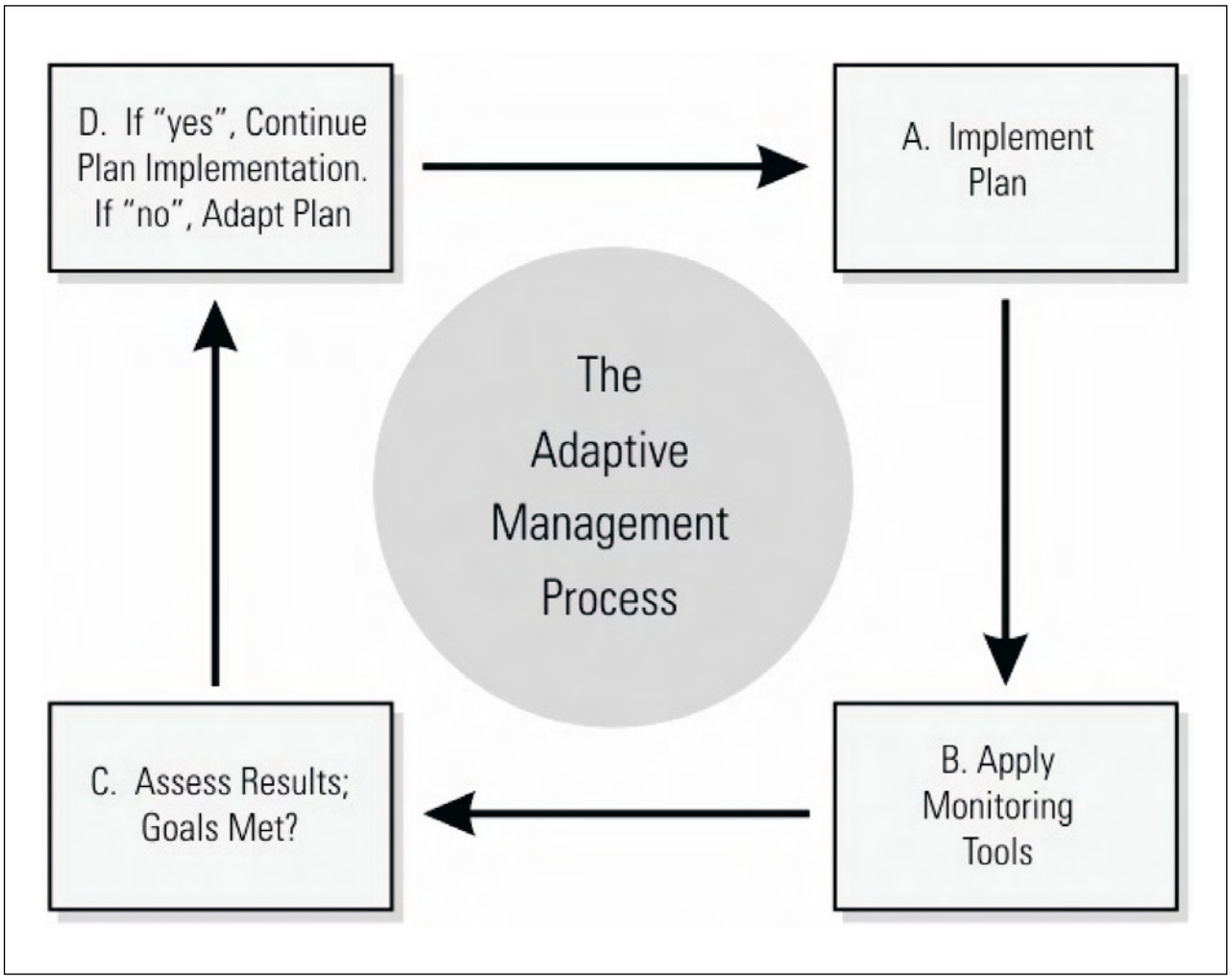


Figure 16. The adaptive management process.