4 Alternatives

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Pied-billed Grebe

A challenge for natural resource managers is to anticipate and resolve potential conflicts involving various aspects and levels of resource management and protection.

Each alternative in this EA meets the purposes and goals of the refuge. However, each has a unique set of objectives that involve different management strategies and form options for addressing ecosystem and resource needs and public use.

Three alternatives for management of the refuge are considered in this document. Current management is described in the no-action alternative (alternative 1). Alternative 2 would maximize the biological potential for grassland-nesting birds. The proposed action (alternative 3) describes the draft CCP for the refuge and takes an integrated approach that maximizes the biological potential for migratory birds and finds a balance with reducing cropland, while ensuring depredation is minimized.

This chapter provides the following information:

- Summary of alternatives
- Descriptions of alternatives 1–3
- Operations to carry out alternatives

The rationale for each objective includes background information, assumptions, and technical details used to formulate the objective. The rationale provides context to enhance comprehension and facilitate future evaluations. [Because alternative 1 describes current management (no action) with no specific changes to the way the refuge is currently managed, the text does not contain rationale for the objectives or discussion of the management strategies.]

Summary of Alternatives

Three management alternatives have been developed to meet the purposes, vision, and goals of the refuge. The goals are described in chapter 1. A goal is a descriptive, broad statement of *desired future conditions* that conveys a purpose, but does not define measurable units.

An objective is a concise statement of *what* is to be achieved, *how* much is to be achieved, *when* and *where* it is to be achieved, and *who* is responsible to achieve it. Strategies are ways to achieve an objective.

Table 2 displays how each alternative would meet the goals through its unique set of objectives.

Table 2. Summary of alternatives for the comprehensive conservation plan, Sand Lake National Wildlife Refuge, South Dakota

ALTERNATIVE 1 *Current management—no action*	***ALTERNATIVE 2*** *Maximize biological potential for grassland-nesting birds*	***ALTERNATIVE 3*** *Integrated management—proposed action*
Biological Diversity Goal. Promote the natural biological diversity of the area and, through management of refuge habitats, provide for the greatest number of native fauna and flora species within the capabilities of the Sand Lake National Wildlife Refuge.		
Threatened and Endangered Species Subgoal: Provide for the protection and welfare of any threatened or endangered plants and animals that may occur on the refuge.		
Threatened and Endangered Species Objective—Provide nesting and roosting habitat for bald eagles during the course of the year. Make special efforts to protect and provide for the well-being of any threatened or endangered species, such as the whooping crane, that is found to be present.	*Threatened and Endangered Species Objective*—Same as alternative 1.	*Threatened and Endangered Species Objective*—Same as alternative 1.
Waterfowl Resources Subgoal: Provide sufficient habitat (wetlands and grasslands) for the production and maintenance of waterfowl species.	**Waterfowl and Grassland-nesting Birds Subgoal:** Provide sufficient habitat (wetlands and grasslands) for the production and maintenance of waterfowl and grassland-nesting, nongame bird species.	
Waterfowl Objective—Provide quality breeding pair and nesting habitat for the annual production of 15,000 ducks. Manage islands and the headquarters exclosure to maximize waterfowl production.	*Waterfowl and Grassland-nesting Birds Objective*—Maintain or develop 8,000–12,000 acres of nesting habitat for waterfowl and grassland-nesting, nongame birds within 10 years of CCP approval, as conditions change due to dike breaching.	*Waterfowl and Grassland-nesting Birds Objective*—Maintain or develop a minimum of 8,000 acres of nesting habitat for waterfowl and grassland-nesting nongame birds within 10 years of CCP approval.
Colonial Birds Subgoal: Provide and manage wetland habitats as nesting areas for the tremendous variety of colonial bird species using the refuge.		
Colonial Birds Objective—Manage the emergent vegetative zones using water level manipulation to provide nesting and roosting habitat for the hundreds of thousands of colonial-nesting birds that use the refuge. Maintain 750 acres of emergent vegetation south of Highway 10 within the traditional nesting area.	*Colonial Birds Objective*—If natural flooding or high flows attract colonial-nesting birds, protect and provide for their well-being.	*Colonial Birds Objective*—Same as alternative 1.

Table 2. Summary of alternatives for the comprehensive conservation plan, Sand Lake National Wildlife Refuge, South Dakota

ALTERNATIVE 1 *Current management—no action*	*ALTERNATIVE 2* *Maximize biological potential for grassland-nesting birds*	*ALTERNATIVE 3* *Integrated management—proposed action*
Biological Diversity Goal. Promote the natural biological diversity of the area and, through management of refuge habitats, provide for the greatest number of native fauna and flora species within the capabilities of the Sand Lake National Wildlife Refuge.		
Resident Wildlife Subgoal: Contribute to habitat requirements for regional populations of resident wildlife including fish, reptiles, amphibians, mammals, and nonmigratory birds.		
Resident Wildlife Objective—Work with the South Dakota Cooperative Research Unit and the South Dakota Heritage Program on nongame wildlife issues.	*Resident Wildlife Objective*—Same as alternative 1.	*Resident Wildlife Objective*—Same as alternative 1.
Deer Management Objective—Continue working cooperatively with SDGFP to meet winter food requirements for white-tailed deer.	*Deer Management Objective*—Same as alternative 1.	*Deer Management Objective*—Same as alternative 1.
Grassland Habitat Subgoal: Restore, maintain, and provide quality habitat for the life requirements of a diversity of migratory birds and other wildlife species.		
Grassland Habitat Objective—Maintain 7,600 acres of grassland habitat.	*Grassland Habitat Objective*—Maintain or develop 8,000–12,000 acres of grassland habitat with a minimum of 80 percent of grassland habitat managed in blocks of at least 300 acres within 15 years of CCP approval.	*Grassland Habitat Objective*—Manage at least 8,000 acres of grassland habitat with a minimum of 80 percent of the grassland habitat managed in blocks of at least 160 acres within 15 years of CCP approval.
Vegetative Structure and Composition Objective—Keep native grasses and forbs, and tame grass stands, in a vigorous and diverse condition using upland management techniques. Vary treatments and frequency of treatments among fields, as determined by monitoring criteria.	*Vegetative Structure and Composition Objective*—Manage habitat blocks of DNC so that, in 7 out of 10 years, the habitat blocks would have a mean vegetative visual obstruction reading (VOR) of 11 inches, a litter depth of 0.5–2.5 inches, and a habitat composition of 50 percent forbs and 0 percent trees during late spring (May 25–June 15).	*Vegetative Structure and Composition Objective*—Same as alternative 2.

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ALTERNATIVE 1 *Current management—no action*	*ALTERNATIVE 2* *Maximize biological potential for grassland-nesting birds*	*ALTERNATIVE 3* *Integrated management—proposed action*
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Grassland Habitat Subgoal: Restore, maintain, and provide quality habitat for the life requirements of a diversity of migratory birds and other wildlife species.		
Introduced, Cool-season Grasses Objective—None.	*Introduced, Cool-season Grasses Objective*—Manage habitat blocks of introduced, cool-season grasses so that, in 7 out of 10 years, habitat blocks would have a mean vegetative VOR of 7 inches, a litter depth of 0.5–2.5 inches, and a habitat composition of 5 percent forbs and 0 percent trees during late spring (May 25–June 15).	*Introduced, Cool-season Grasses Objective*—Same as alternative 2.
Seeded Natives Objective—None.	*Seeded Natives Objective*—Manage habitat blocks of seeded native grasses so that, in 7 out of 10 years, habitat blocks would have a mean vegetative VOR of 11 inches, a litter depth of 0.5–2.5 inches, and a habitat composition of 10 percent forbs and 0 percent trees during late spring (May 25–June 15).	*Seeded Natives Objective*—Same as alternative 2.
Wetland Habitat Subgoal: Maintain a diversity of quality wetland habitat that meets the needs of wetland-dependent wildlife species.		
Impoundment Objective—Provide 750 acres of nesting and roosting habitat for colonial-nesting birds on Mud and Sand lakes and the five subimpoundments (flood control pool #1, flood control pool #2, Dry Run, Display Pool, and Columbia Marsh).	*Impoundment Objective*—Remove or breach the Mud Lake dike and water control structure and the Sand Lake dike and water control structure to reduce sedimentation within the boundaries of the refuge to an average of 0.08 inch or less per year within 10 years of CCP approval.	*Impoundment Objectives* —Manage the Mud Lake impoundment for 30–50 percent emergent vegetation within the area from Mud Lake dike to 2 miles north of the dike, with a mean vegetation height of 19.7 inches above water, a mean vegetative VOR of 11.8 inches, and a water depth of 7.9–19.7 inches. —Manage the Sand Lake impoundment to provide 30–60 percent emergent vegetation within the area from State Highway 10 to 2 miles south of the highway, with a mean vegetation height of 19.7 inches above water, a mean vegetative VOR of 11.8 inches, and a water depth of 7.9–19.7 inches.

Table 2. Summary of alternatives for the comprehensive conservation plan, Sand Lake National Wildlife Refuge, South Dakota

ALTERNATIVE 1 *Current management—no action*	*ALTERNATIVE 2* *Maximize biological potential for grassland-nesting birds*	*ALTERNATIVE 3* *Integrated management—proposed action*
Biological Diversity Goal. Promote the natural biological diversity of the area and, through management of refuge habitats, provide for the greatest number of native fauna and flora species within the capabilities of the Sand Lake National Wildlife Refuge.		
Wetland Habitat Subgoal: Maintain a diversity of quality wetland habitat that meets the needs of wetland-dependent wildlife species.		
Subimpoundment Objective—See previous impoundment objective.	*Subimpoundment Objective*—Manage the subimpoundments as dynamic wetland systems that cycle between drawdown and flood events, within 5 years of CCP approval, to provide quality habitat for waterfowl, shorebirds, and wading birds. During periods between drawdowns, manage the subimpoundments to provide 10–75 percent emergent vegetation and annuals, a mean water-column invertebrate biomass of 0.007 ounces per activity trap per 24-hour set during the June sampling period, and water depths of 0.4–9.8 inches over 50 percent of the flooded area for a portion of the time between April 1 and October 15.	*Subimpoundment Objective*—Same as alternative 2.
Wildlife-dependent Recreational Use Goal. Provide opportunities for quality, wildlife-dependent recreation for visitors to Sand Lake National Wildlife Refuge.		
Consumptive Use Subgoal: Provide wildlife-dependent, consumptive, recreational opportunities that are compatible with refuge purposes and contribute to a quality outdoor hunting or fishing experience.		
Hunting Objectives —Conduct an annual program to permit white-tailed deer and pheasant hunting. Vary the number and composition of the deer tags annually as necessary to meet management needs. —Provide and maintain hunting blinds, including one universally accessible blind, for waterfowl hunting until the blinds are deemed unnecessary. —Provide law enforcement during the waterfowl, deer, and pheasant hunting seasons to ensure that game laws are followed and visitors have a safe, quality hunting experience.	*Hunting Objective*—Allow annual, compatible, fall-hunting opportunities for deer, upland game birds, and waterfowl, consistent with applicable state regulations and principles of sound game management.	*Hunting Objective*—Same as alternative 2.

Table 2. Summary of alternatives for the comprehensive conservation plan, Sand Lake National Wildlife Refuge, South Dakota

ALTERNATIVE 1 *Current management—no action*	***ALTERNATIVE 2*** *Maximize biological potential for grassland-nesting birds*	***ALTERNATIVE 3*** *Integrated management—proposed action*
Wildlife-dependent Recreational Use Goal. Provide opportunities for quality, wildlife-dependent recreation for visitors to Sand Lake National Wildlife Refuge.		
Consumptive Use Subgoal: Provide wildlife-dependent, consumptive, recreational opportunities that are compatible with refuge purposes and contribute to a quality outdoor hunting or fishing experience.		
Fishing Objective—When available and accessible, allow open water and ice fishing yearly from the five designated fishing areas only. Prohibit motorized and nonmotorized boating.	*Fishing Objective*—When available and accessible, allow open water and ice fishing yearly from the five designated fishing areas only. Prohibit motorized and nonmotorized boating. Restrict or eliminate fishing at one or more (or all) of the designated areas to minimize disturbance to migratory bird areas.	*Fishing Objective*—Same as alternative 1.
Nonconsumptive Recreation Subgoal: Provide wildlife-dependent, compatible, nonconsumptive, recreational activities on the refuge that increase public understanding and appreciation of wildlife and its conservation.		
On-site Visitors Objective—None.	*On-site Visitors Objective*—Educate an additional 5,000 on-site refuge visitors about local and regional conservation issues, the National Wildlife Refuge System, and Sand Lake National Wildlife Refuge within 5 years of CCP approval.	*On-site Visitors Objective*—Same as alternative 2.
Nonconsumptive Recreation Objective—Provide opportunities for wildlife observation, wildlife photography, and interpretation annually, from April 1 to October 15, sunrise to sunset daily.	*Nonconsumptive Recreation Objective*—Provide opportunities for wildlife observation, wildlife photography, and interpretation annually. Confine these activities to the headquarters area during the breeding season to reduce human impact on migratory grassland-nesting birds and other breeding wildlife.	*Nonconsumptive Recreation Objective*—Same as alternative 1.

Table 2. Summary of alternatives for the comprehensive conservation plan, Sand Lake National Wildlife Refuge, South Dakota

ALTERNATIVE 1 *Current management—no action*	***ALTERNATIVE 2*** *Maximize biological potential for grassland-nesting birds*	***ALTERNATIVE 3*** *Integrated management—proposed action*
Public Education and Outreach Goal. Provide wildlife- and wildland-viewing opportunities for the public to enjoy and, through education and outreach, encourage them to gain a greater understanding and appreciation of national wildlife refuges and wildlife resources in general.		
Public Education and Outreach Objectives —Annually host an average of two to three on-site special events designed to educate the public about wildlife resources and the National Wildlife Refuge System. —Continue the off-site program and continue working with the radio, television, and print media. Provide an annual average of 24 radio and 8 television interviews, and annually provide information for newspaper articles at least 30 times. —Construct an education center.	*Public Education and Outreach Objectives*—Same as alternative 1.	*Public Education and Outreach Objectives*—Same as alternative 1.
Local School Districts Objective—Provide off- and on-site presentations and school programs when requested. Serve as a source for educational materials and other information to schools and organizations.	*Local School Districts Objective*—Increase and maintain awareness within all local school districts of the education resources and opportunities available at the refuge, through additional on- and off-site programs and workshops within 5 years of CCP approval.	*Local School Districts Objective*—Same as alternative 2.
Communities Objective—None.	*Communities Objective*—Promote awareness of and generate support for the refuge, the Refuge System, and general conservation within local and regional communities by creating five new partnerships with local and regional interest groups. Continue weekly media contacts with the "Refuge Corner Update."	*Communities Objective*—Promote awareness of, and generate support for, the refuge and the Refuge System within local and regional communities through participation in a minimum of 3 additional off-site special events within 5 years of funding.

ALTERNATIVE 1

CURRENT MANAGEMENT—NO ACTION

The no-action alternative would continue current management and would not involve extensive restoration of cropland, grassland, and wetland habitat, or improvements to roads, interpretive, and administrative facilities. No new funding or staff levels would occur and programs would follow the same direction, emphasis, and intensity as they do at present.

MANAGEMENT SUMMARY

Sand Lake National Wildlife Refuge is currently managed to maintain and improve habitat for nesting and resting waterfowl and other migratory birds such as diving and puddle ducks, geese, grebes, herons, egrets, gulls, and terns.

Management would remain focused on the habitat requirements of these priority species, as well as other migratory and resident wildlife such as pied-billed grebe, white-faced ibis, double-crested cormorant, tundra swan, American white pelican, perching birds, ring-necked pheasant, white-tailed deer, and furbearers.

The building of an education center would allow visitors a quality experience and provide a focus point for public use. This new education center, larger than the current headquarters facility, would meet current demand for educational materials and activities, as well as for special events.

MANAGEMENT DIRECTION

Because alternative 1 describes only current management (i.e., no action) with no specific changes to the way the refuge is currently managed, the following text does not contain rationale or discussion for the objectives and strategies.

BIOLOGICAL DIVERSITY GOAL

Promote the natural biological diversity of the area and, through management of refuge habitats, provide for the greatest number of native fauna and flora species within the capabilities of the Sand Lake National Wildlife Refuge.

Threatened and Endangered Species Subgoal: Provide for the protection and welfare of any threatened or endangered plants and animals that may occur on the refuge.

Threatened and Endangered Species Objective: Provide nesting and roosting habitat for bald eagles during the course of the year. Make special efforts to protect and provide for the well-being of any threatened or endangered species, such as the whooping crane, that is found to be present.

Strategy—Allow riparian zone trees, especially cottonwoods, to grow except where affected by habitat management activities.

Waterfowl Resources Subgoal: Provide sufficient habitat (wetlands and grasslands) for the production and maintenance of waterfowl species.

Waterfowl Resources Objective: Provide quality breeding pair and nesting habitat for the annual production of 15,000 ducks. Manage islands and the headquarters exclosure to maximize waterfowl production.

Strategies

— Maintain upland habitats through applied management such as grazing, haying, and prescribed fire.
— Allow riparian zone trees to grow, except where affected by habitat management activities.
— Maintain the predator exclosure in serviceable condition and monitor nest success annually.
— Allow shelterbelts to die out.

Colonial Birds Subgoal: Provide and manage wetland habitats as nesting areas for the tremendous variety of colonial bird species using the refuge.

Colonial Birds Objective: Manage the emergent vegetative zones using water level manipulation to provide nesting and roosting habitat for the hundreds of thousands of colonial-nesting birds that use the refuge. Maintain 750 acres of emergent vegetation south of Highway 10 within the traditional nesting area.

Strategy— Manipulate water levels in the major impoundments.

Resident Wildlife Subgoal: Contribute to habitat requirements for regional populations of resident wildlife including fish, reptiles, amphibians, mammals, and nonmigratory birds.

Resident Wildlife Objective: Work with the South Dakota Cooperative Research Unit and the South Dakota Heritage Program on nongame wildlife issues.

Strategy—Work with the South Dakota Cooperative Research Unit and the South Dakota Heritage Program on inventories and development of habitat management techniques to support resident, nongame wildlife species.

Deer Management Objective: Continue working cooperatively with SDGFP to meet winter food requirements for white-tailed deer.

Strategy—Allow the refuge's share of the farm program crop to remain in the field and available during winter months.

Grassland Habitat Subgoal: Restore, maintain, and provide quality habitat for the life requirements of a diversity of migratory birds and other wildlife species.

Grassland Habitat Objective: Maintain 7,600 acres of grassland habitat.

Strategy—None.

Vegetative Structure and Composition Objective: Keep native grasses and forbs, and tame grass stands, in a vigorous and diverse condition using upland management techniques. Vary treatments and frequency of treatments among fields, as determined by monitoring criteria.

Strategies

— Control invasive plants with integrated pest management (IPM) techniques, primarily chemical, where infestations are seriously affecting grassland habitats or neighboring landowners.
— Control pioneering Russian olives in grasslands.
— Apply a grassland treatment of grazing, haying, or prescribed burning to units every 4–5 years.
— Continue informal habitat monitoring.

Introduced Cool-season Grasses Objective: None.

Seeded Natives Objective: None.

Wetland Habitat Subgoal: Maintain a diversity of quality wetland habitat that meets the needs of wetland-dependent wildlife species.

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Cattail Wetland

Impoundment Objective: Provide 750 acres of nesting and roosting habitat for colonial-nesting birds on Mud and Sand lakes and the five subimpoundments (flood control pool #1, flood control pool #2, Dry Run, Display Pool, and Columbia Marsh).

Strategies

— Maintain the predator exclosure and monitor nest success annually.
— Drop water levels to 1 foot below full-pool level prior to freeze-up to protect structures and dikes from ice damage.
— Perform managed drawdowns to reinvigorate wetlands habitat.
— Maintain consistent water elevations for colonial-nesting birds.
— Periodically flood subimpoundments to control emergent vegetation.

Subimpoundment Objective: See previous impoundment objective and strategies.

Public Use

The six wildlife-dependent priority public uses specified in the National Wildlife Refuge System Improvement Act are hunting, fishing, wildlife observation, wildlife photography, environmental education, and interpretation.

All six activities are allowed and provided for at Sand Lake National Wildlife Refuge within the bounds of refuge mandates and purposes.

Wildlife-dependent Recreational Use Goal

Provide opportunities for quality, wildlife-dependent recreation for visitors to Sand Lake National Wildlife Refuge.

Consumptive Use Subgoal: Provide wildlife-dependent, consumptive, recreational opportunities that are compatible with refuge purposes and contribute to a quality outdoor hunting or fishing experience.

Hunting Objectives:

- Conduct an annual program to permit white-tailed deer, waterfowl, and pheasant hunting. Vary the number and composition of the deer tags annually as necessary to meet management needs.
- Provide and maintain hunting blinds, including one universally accessible blind, for waterfowl hunting until the blinds are deemed unnecessary.
- Provide law enforcement during the waterfowl, deer, and pheasant hunting seasons to ensure that game laws are followed and visitors have a safe, quality hunting experience.

Strategies

— Vary number and composition of deer tags annually depending on population.
— Permit archery deer hunting seasons to conform to state regulations.
— Permit refuge firearm deer seasons based on consultation with the state, local landowners, and hunters.
— Allow waterfowl hunting from spaced blinds.
— Open the refuge to upland bird hunting after the close of rifle deer seasons on the refuge, according to state regulations.

Fishing Objective: When available and accessible, allow open water and ice fishing yearly from the five designated fishing areas only. Prohibit motorized and nonmotorized boating.

Strategy—None.

Nonconsumptive Recreation Subgoal: Provide wildlife-dependent, compatible, nonconsumptive, recreational activities on the refuge that increase public understanding and appreciation of wildlife and its conservation.

On-site Visitors Objective: None.

Nonconsumptive Recreation Objective: Provide opportunities for wildlife observation, wildlife photography, and interpretation annually, from April 1 to October 15, sunrise to sunset daily.

Strategies

— Maintain facilities to provide visitors with safe, pleasurable experiences.
— Maintain information kiosks with leaflet dispensers and interpretation near the headquarters and the Columbia Day Use Area.
— Provide education center exhibits and information within the headquarters building during regular work hours.
— Provide volunteer staffing of the education center on weekends during the spring migration.
— Open the self-guided auto tour route from April to mid-October, conditions permitting.
— Maintain the self-guided hiking trail at Columbia Day Use Area. Create a second nature trail near the display pool, along with a shelter.
— Maintain the observation tower in the headquarters area.
— Issue special-use permits to professional photographers working on specific photography projects.

Public Education and Outreach Goal

Provide wildlife- and wildland-viewing opportunities for the public to enjoy and, through education and outreach, encourage them to gain a greater understanding and appreciation of national wildlife refuges and wildlife resources in general.

Public Education and Outreach Objectives:

- Annually host an average of two to three on-site special events designed to educate the public about wildlife resources and the National Wildlife Refuge System.
- Continue the off-site program and continue working with the radio, television, and print media. Provide an annual average of 24 radio and 8 television interviews, and annually provide information for newspaper articles at least 30 times.
- Construct an education center.

Strategies—None.

Local School Districts Objective: Provide off- and on-site presentations and school programs when requested. Serve as a source for educational materials and other information to schools and organizations.

Strategies

— Provide on-site environmental education programs.
— Explore ways to assist schools with busing issues to continue bringing field trips to the refuge.
— Provide off-site environmental education programs for more than 3,000 students through staff- and teacher-led programs and special events each year. Provide learning trunks and teaching kits for classroom programs. Participate in special events including water festivals, camps, local fairs, and free-fishing day.

Communities Objective: None.

ALTERNATIVE 2

MAXIMIZE BIOLOGICAL POTENTIAL FOR GRASSLAND-NESTING BIRDS

This alternative would maximize the biological potential of the refuge for species of grassland-nesting birds. This would be accomplished through the following:

- Intense management of upland habitat for nesting migratory birds
- Minimal management of habitat for resident species
- Minimization of public use that may interfere with migratory bird production

MANAGEMENT SUMMARY

Upland habitat would be managed to provide tall DNC for migratory birds, especially waterfowl. This would be accomplished through an intense management program of grazing, prescribed burning, haying, reseeding, and aggressive invasive plant control, with an active habitat-monitoring program.

- Cropland acreage would be eliminated and seeded back to grassland cover.
- All shelterbelts would be removed and seeded back to grass to increase grassland block size.
- All grasslands would be managed according to normal protocol and evaluated before and after treatment according to the grassland monitoring plan. Management activities would include

prescribed fire, haying, grazing, invasive plant control, light disking, reseeding, and rest.

- The refuge would require additional water development for livestock if grazing were to be used more efficiently as a management tool. The construction of a small dugout in each grazing unit would probably be the most viable option for meeting short-duration watering needs.
- Management treatments would be used only as frequently as necessary to maintain the stand in a vigorous and healthy condition. Grassland monitoring would indicate when various management treatments would be applied.
- Native trees, such as cottonwoods and willows that naturally grow in the riparian zone and provide habitat for eagles and other prairie raptors, would not be removed.

The refuge would acquire areas approved by the Migratory Bird Conservation Commission when the land becomes available from willing sellers.

The Mud Lake dike and part of the Columbia Road dike would be removed to allow the free-flow of the James River through the refuge. This would be done to slow the silt accumulation. Water levels would vary with flows in the river. Lower water levels overall would result in an increase in grassland acreage.

The five subimpoundments would be managed as shallow water, seasonally flooded wetlands used by waterfowl breeding pairs and broods, nesting black terns, pied-billed grebes, foraging water birds, and shorebirds. Drawdowns would be accomplished in the subimpoundments in different years, depending on the ability to move water out of the unit.

The building of an education center would allow visitors a quality experience and provide a focus point for public use. This new education center, larger than the current headquarters facility, would meet current demand for educational materials and activities, as well as for special events.

To maximize the biological potential of the refuge, current levels of on-site public use would be decreased to minimize wildlife disturbance and reclaim public use areas back to productive native habitat. Several on-site programs may be eliminated, while other on-site activities would be modified.

- Hunting and fishing programs would be modified to minimize wildlife disturbance.
- The Columbia and Hecla day use areas would both be eliminated.
- The auto tour route and other public access roads would be closed to the public during the breeding season.
- All field trips, tours, and environmental education activities would be restricted to the headquarters area.
- Emphasis would be placed on off-site and in-classroom activities.

MANAGEMENT DIRECTION

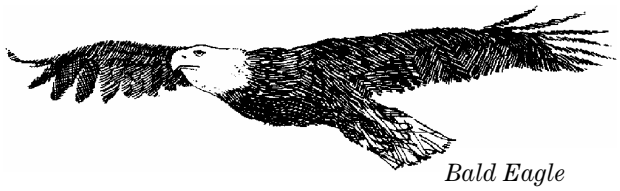
The objectives and strategies below describe how this alternative would be carried out to meet the overall goals for the refuge. Habitat conditions under alternative 2 are shown in figure 9.

BIOLOGICAL DIVERSITY GOAL

Promote the natural biological diversity of the area and, through management of refuge habitats, provide for the greatest number of native fauna and flora species within the capabilities of the Sand Lake National Wildlife Refuge.

Threatened and Endangered Species Subgoal:

Provide for the protection and welfare of any threatened or endangered plants and animals that may occur on the refuge.



Bald Eagle
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Threatened and Endangered Species Objective: Provide nesting and roosting habitat for bald eagles during the course of the year. Make special efforts to protect and provide for the well-being of any threatened or endangered species, such as the whooping crane, that is found to be present. *(Same as alternative 1.)*

Strategy

— Allow riparian zone trees, especially cottonwoods, to grow except where affected by habitat management activities.
(Same as alternative 1.)

Waterfowl and Grassland-nesting Birds Subgoal:

Provide sufficient habitat (wetlands and grasslands) for the production and maintenance of waterfowl and grassland-nesting, nongame bird species.

Waterfowl and Grassland-nesting Birds Objective: Maintain or develop 8,000–12,000 acres of nesting habitat for waterfowl and grassland-nesting, nongame birds within 10 years of CCP approval, as conditions change due to dike breaching.

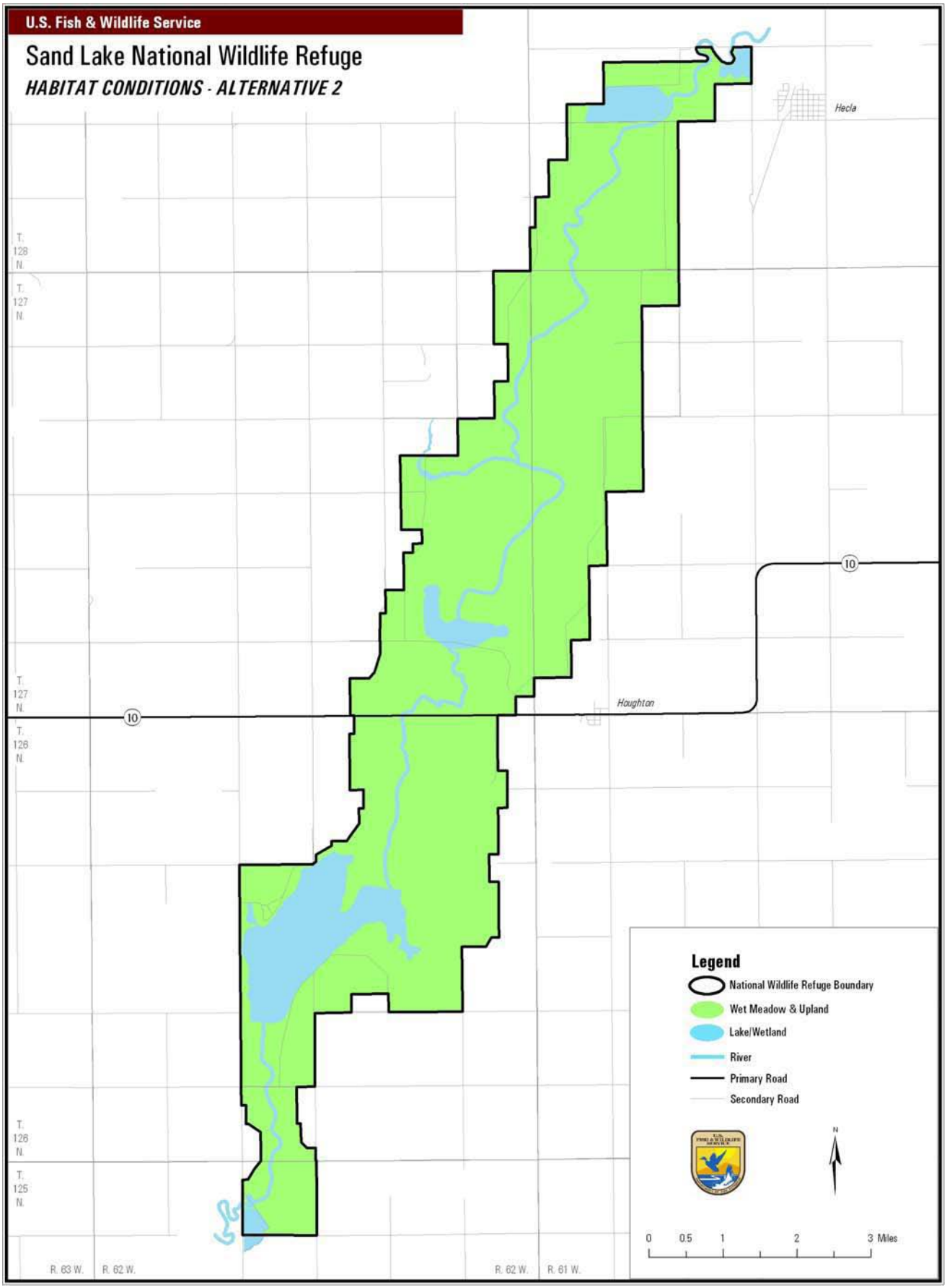


Figure 9. Habitat conditions under alternative 2 for the CCP, Sand Lake National Wildlife Refuge, South Dakota

Strategy

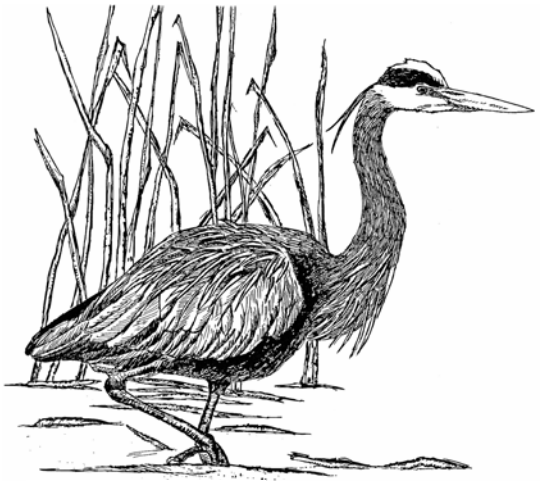
— Maintain upland habitats through applied management such as grazing, haying, and prescribed fire.
(Same as alternative 1.)

Colonial Birds Subgoal: Provide and manage wetland habitats as nesting areas for the tremendous variety of colonial bird species using the refuge.

Colonial Birds Objective: If natural flooding or high flows attract colonial-nesting birds, protect and provide for their well-being.

Strategy

— When colonial-nesting birds are on the refuge, manage nesting areas for maximum nest success. Due to the breaching of the dikes at Mud and Sand lakes, there would be no manipulation of water levels and the refuge would only attract large numbers of colonial-nesting birds during wet years. During dry years, nest success of colonial-nesting birds would likely be decreased due to both lack of suitable habitat and increased predator access, which could have a negative effect on the refuge's classification as a GIBA and WII.



Great Blue Heron
© Tom Kelley

Resident Wildlife Subgoal: Contribute to habitat requirements for regional populations of resident wildlife including fish, reptiles, amphibians, mammals, and nonmigratory birds.

Resident Wildlife Objective: Work with the South Dakota Cooperative Research Unit and the South Dakota Heritage Program on nongame wildlife issues.
(Same as alternative 1.)

Strategy

— Work with the South Dakota Cooperative Research Unit and the South Dakota Heritage Program on inventories and development of habitat management techniques to support resident, nongame wildlife species.
(Same as alternative 1.)

Grassland Habitat Subgoal: Restore, maintain, and provide quality habitat for the life requirements of a diversity of migratory birds and other wildlife species.

Grassland Block Objective: Maintain or develop 8,000–12,000 acres of grassland habitat with a minimum of 80 percent of grassland habitat managed in blocks of at least 300 acres within 15 years of CCP approval.

Rationale

With the United States' grasslands listed as critically endangered, i.e., greater than 98 percent declines (Noss et al. 1995), larger blocks of contiguous grassland would benefit grassland-dependent species.

An extensive, 8-year study in Manitoba, Saskatchewan, and Alberta, Canada found hatching rates of waterfowl were generally higher in larger patches of habitat (Howerter 2002). In Minnesota's tall-grass prairie, nest-depredation rates were lower on large (321–1,201 acres) versus small (40–79 acres) grassland blocks (Johnson and Temple 1990).

By creating larger grassland blocks, more favorable habitat is created for grassland birds of special concern that are known to nest on the refuge (table 3). Of these 15 species, 9 use grassland growth forms in the tall- or medium-height category (Dechant et al. 1998b–d, 1998f, 1999a–c, 1999e, 1999f). These nine species, along with the more abundant savannah sparrow, bobolink, sedge wren, and clay-colored sparrow (Dechant et al. 1998a, 1998e, 1999d; Swanson 1998), have the greatest capacity to indirectly benefit from the management of tall, dense vegetation for nesting waterfowl (table 4).

Eight of these 13 species (table 4) avoid woody vegetation (Dechant 1998a, 1999f; Wildlife Habitat Management Institute 1999); 7 of the 13 are area sensitive (Dechant et al. 1998b, 1998d, 1999a, 1999d, 1999f; Swanson 1998); and 6 of the 13 experience brood parasitism by brown-headed cowbirds (Dechant et al. 1998a–b, 1998f, 1999d–e; Swanson 1998).

Vegetative Structure and Composition Objective: Manage habitat blocks of DNC so that, in 7 out of 10 years, the habitat blocks would have a mean vegetative visual obstruction reading (VOR) of 11 inches, a litter depth of 0.5–2.5 inches, and a habitat composition of 50 percent forbs and 0 percent trees during late spring (May 25–June 15).

Table 3. Grassland birds of special concern with known nesting activity on Sand Lake National Wildlife Refuge[1], South Dakota

	PIF[2] Priority Species[3]		USFWS[2]	Audubon	TNC[2]	SDNHP[2]
Species	*Northern Mixed-Grass Prairie*[4]	*Prairie Potholes*[5]	*Birds of Conservation Concern*[6]	*Watchlist*[7]	*"Unlucky 13"*	*Rare Bird Species*[8]
American bittern		X	X			
Chestnut-collared longspur	X	X	X		X	
Dickcissel			X	X		
Grasshopper sparrow		X	X			
Le Conte's sparrow	X	X	X			X
Loggerhead shrike			X			
Marbled godwit	X	X	X	X		
Nelson's sharp-tailed sparrow	X	X	X	X		X
Northern harrier		X	X			
Sharp-tailed grouse		X				
Short-eared owl		X	X	X		
Swainson's hawk	X	X	X	X		X
Upland sandpiper		X	X			
Willet	X	X	X			
Wilson's phalarope	X	X	X	X		

[1]Source: U.S. Fish and Wildlife Service 1996b, Meeks and Higgins 1998.
[2]PIF=Partners in Flight; TNC=The Nature Conservancy; SDNHP=South Dakota Natural Heritage Program; USFWS=U.S. Fish and Wildlife Service.
[3]Based on input from the breeding bird survey (Sauer et al. 2001) and other sources.
[4]Physiographic area S37 (Partners in Flight 2002a).
[5]Bird conservation region 11 (Partners in Flight 2002b).
[6]U.S. Fish and Wildlife Service 2002.
[7]National Audubon Society 2002.
[8]South Dakota Ornithologist's Union 2002.

Table 4. Species benefiting from grassland management of Sand Lake National Wildlife Refuge[1,2], South Dakota

Species	*Avoids Woody Vegetation*	*Area Sensitive*	*Brown-headed Cowbird Brood Parasitism*
American bittern[3]			
Bobolink	X	X	X
Clay-colored sparrow			X
Dickcissel			X
Grasshopper sparrow	X	X	X
Le Conte's sparrow	X		X
Northern harrier	X		
Savannah sparrow	X	X	X
Sedge wren[3]			
Sharp-tailed grouse		X	
Short-eared owl	X	X	
Upland sandpiper	X	X	
Wilson's phalarope	X	X	

[1]Grassland birds that use grassland growth forms in the tall- or medium-height categories for nesting, which can benefit most from active management for nesting waterfowl. The Nelson's sharp-tailed sparrow also uses grassland growth forms in the tall and medium categories, but was not included due to a lack of information.
[2]This is not an all-inclusive list.
[3]This species would benefit from grassland management, but does not avoid woody vegetation, is not area sensitive, and is not affected by cowbird parasitism.

Introduced, Cool-season Grasses Objective: Manage habitat blocks of introduced, cool-season grasses so that, in 7 out of 10 years, habitat blocks would have a mean vegetative VOR of 7 inches, a litter depth of 0.5–2.5 inches, and a habitat composition of 5 percent forbs and 0 percent trees during late spring (May 25–June 15).

Seeded Natives Objective: Manage habitat blocks of seeded native grasses so that, in 7 out of 10 years, habitat blocks would have a mean vegetative VOR of 11 inches, a litter depth of 0.5–2.5 inches, and a habitat composition of 10 percent forbs and 0 percent trees during late spring (May 25–June 15).

Rationale for the above vegetation, grasses, and natives objectives

Grasslands are categorized as DNC, introduced cool-season grasses, and seeded native grasses. Vegetative structure differs greatly between the three habitat types; therefore, it was necessary to set grassland objectives specific to each habitat type. Despite the quantitative differences between objectives, all three objectives are similar in that they describe the maximum height-density of vegetation that can realistically be achieved for that habitat type within the constraints of climate and soil type.

Refuge grasslands are managed for tall dense cover because it is attractive to ducks. Several studies have reported high nest success in dense cover (Cowardin et al. 1985, Duebbert and Lokemoen 1976, Higgins and Barker 1982, Kirsch et al. 1978, Livezey 1981, Schranck 1972).

In addition to benefiting waterfowl, moderate to tall vegetation is also favored by many other grassland-nesting birds (Dechant et al. 1998a–f, 1999a–f; Swanson 1998).

As the refuge was specifically established to improve and maintain habitat for nesting waterfowl and other migratory birds, managing grasslands in the tall–dense category aligns well with the refuge's mandates and wildlife priorities (table 5).

Table 5. Priority ratings of bird groups relative to habitat management on Sand Lake National Wildlife Refuge, South Dakota

Priority Rating	*Bird Group*
1	Waterfowl
2	Colonial-nesting birds
3	Grassland-nesting passerine birds
4	Shorebirds
5	Other marsh and water birds
6	Raptors
7	Woodland-nesting passerine birds
8	Resident species

A majority of the lands surrounding the refuge are annually managed as cropland or nonresidual grasslands, which provide some habitat in the other categories of short–sparse and medium height density. Therefore, managing grasslands in the tall–dense category of vegetation provides a vegetation class that is not well represented in Brown County.

In the process of applying treatments to habitat in greatest need of management, blocks of grassland that conform to the short–sparse and medium height density vegetation categories would be created, thereby providing a diversity of vegetative structure within any given year.

Forb composition varies with treatment type and time since last disturbance. Forb coverage typically is 20–40 percent of the vegetation in the year following a habitat treatment, and gradually decreases to 10 percent within 5–6 years.

Strategies for the above vegetation, grasses, and natives objectives

— Eliminate all croplands.

All existing cropland would be seeded back to grassland cover, consisting of either a tame grass and legume mixture or a combination of cool-season and warm-season natives.

— Maintain the health and vigor of grassland habitat.

Grasslands would be managed through a program of grazing, haying, and prescribed burning. The management tool selected would be dependent on the availability of water, fences, livestock, ease of firebreak construction, and suitability for haying. Management would be focused on obtaining the maximum height and density of grasslands, with some type of management action occurring every 4–5 years. Grazing would be used most commonly to reduce litter, increase vigor, and stimulate forb species.

— Eliminate shelterbelts.

When the refuge was established in the mid-1930s, hardwood tree and shrub shelterbelts were established to reduce wind erosion, provide cover and protection for winter wildlife, and diversify the habitat. Today, the health and vigor of the shelterbelts are in decline. Shelterbelts are in the process of dying due to excessively high water levels and the perennial flooding of the James River during the past 8 years. Diseases, particularly Dutch elm disease, have also adversely affected American elms.

All existing shelterbelts would be eliminated and seeded back to grassland. Removal of the shelterbelts would reduce areas used for deer- and upland game-hunting and would reduce opportunities for viewing woodland-associated wildlife. However, their removal would provide an estimated 424 additional acres of grassland habitat for waterfowl and other grassland-nesting birds, increase grassland block size, and decrease fragmentation between grassland blocks.

— Eliminate Russian-olive trees.

A major proactive effort would be undertaken to eliminate volunteer Russian olives. These nonnative invaders have spread quickly and proliferated in specific locations. Removal of Russian olives would eliminate a source of food for winter wildlife and reduce nesting sites for some migratory birds. However, it is believed that these benefits are outweighed by the adverse impacts on grassland communities.

— Favor native communities in compliance with other objectives.

Most of the cropland acres would be seeded back to a mixture of warm-season and cool-season native grasses and forbs, depending on the availability of seed. In addition, some of the existing tame grasslands would be converted to a native composition. This approach promotes a more natural setting that is generally more aesthetically pleasing. When established, the native vegetation is easier to manage with prescribed fire and would likely require less chemical control for Canada thistle.

Native grasslands and DNC each support prairie bird species unique to that habitat type (Renken and Dinsmore 1987). Thus, further information is necessary before an investment in funds and staff-power is made towards converting all existing grasslands to native grasslands. In addition, the economic feasibility of increasing forb abundance in native grass seeding needs to be explored.

— Substantially reduce invasive plants.

State and federal laws require landowners to control state-designated primary invasive plants on their properties. In addition, the Federal Noxious Weed Control Act places additional burdens on federal agencies to ensure that sufficient control is achieved on their respective properties.

A major and continuous effort would be made to reduce substantially invasive plants. This strategy would promote healthy grasslands, comply with state and federal regulations, and resolve some of the issues raised by private landowners. Emphasis would be placed on using grassland management techniques in addition to chemical application to control invasive plants if objectives for forb composition are to be met.

— Increase habitat monitoring, especially associated with management treatments.

Management decisions would be based on the step-down plan for habitat management to be

developed after the CCP is approved. The plan would include a monitoring section, which would describe how monitoring could be used to help indicate how and when specific habitat units need management.

Grassland monitoring efforts would be dedicated mostly toward monitoring pre- and postmanagement treatments as a way of evaluating the effectiveness of management strategies. Wildlife response to management treatments may also be evaluated as a supplement to habitat monitoring. History has shown that it is difficult to evaluate the merits of various treatments when relying on wildlife response alone.

In addition, grassland habitat would be systematically monitored to assess the overall health of uplands. However, this type of monitoring would be completed less frequently than the pre- and postmanagement monitoring.

— Round out the refuge boundary.

To maximize the biological potential of the refuge, acquisition would be proposed for areas initially approved by the Migratory Bird Conservation Commission when the refuge was established in 1935. This action would be accomplished when land becomes available from willing sellers or when other options are presented.

— Proactively manage predators.

To enhance nesting success, waterfowl nest predators would be removed from selected areas during the nesting period via trapping. Priority would be given to the predator exclosure, which provides the greatest potential for human manipulation of waterfowl-nesting success. Intensive predator management would be implemented inside the exclosure using Conibear traps. The integrity of the exclosure near the outside boundary would be maintained by removing predators.

In addition, Mud Lake Island has the potential for enhanced nesting success with management, but it would only be managed as time and resources permit.

— Monitor and react to wildlife disease issues.

Avian populations would be monitored for mortality due to avian botulism, West Nile virus, avian chlamydiosis, and other potential wildlife diseases. In the case of a disease outbreak, infected carcasses would be collected and properly disposed. Freshly-collected specimens would be sent for testing to confirm the cause of death.

Personal protective equipment would be used by refuge staff when contact with sick or dead birds and other wildlife presents a human-health risk.

If the threat of chronic-wasting disease increases, refuge staff would cooperate with the SDGFP to assess the impact on the refuge population of white-tailed deer. The refuge would continue to make use of the most current information to stay informed of current wildlife disease threats.

— Improve technological support, especially using the geographic information system (GIS).

Technological support of management actions would be improved. Spatial and GIS data would be collected and analyzed with the assistance of the habitat and populations evaluation team in Bismarck, North Dakota and the area GIS coordinator for North Dakota and South Dakota. Selected staff would be responsible for maintaining and sharing these databases.

To use fully the potential of spatial databases in refuge management, selected staff would become familiar with the use of global positioning systems (GPS), Trimble GPS Pathfinder Office, ERDAS Imagine geographic imaging, Environmental Systems Research Institute (ESRI) ArcView and ArcGIS, and Microsoft Access, or use the expertise of others to analyze spatial data. Additional technological advances including the use of spreadsheets, Microsoft PowerPoint, and statistical software would be increasingly used.

Wetland Habitat Subgoal: Maintain a diversity of quality wetland habitat that meets the needs of wetland-dependent wildlife species.

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Ruddy Duck

Impoundment Objective: Remove or breach the Mud Lake dike and water control structure and the Sand Lake dike and water control structure to reduce sedimentation within the boundaries of the refuge to an average of 0.08 inch or less per year within 10 years of CCP approval.

Rationale

Impoundments on river systems have long been known to have finite life spans, mostly due to sediment deposition. This is true especially in the northern Great Plains, where intensive agriculture

within watersheds has increased soil erosion and the surface runoff that contributes sediment to rivers. Sediment can fill the impoundments and change their hydrology. The potential for sedimentation to degrade, directly or indirectly, wetland productivity and wetland functions is great (Gleason and Euliss 1998).

From a wildlife perspective, sedimentation can alter water depths that are critical to management. Loss of full-pool depth hampers the ability of managers to manipulate water levels to promote the cycling of vegetation and interspersion of cover that is important for wildlife. Mud and Sand lakes, the two main impoundments, are no exception.

During August 2000, personnel from USGS at the Northern Prairie Wildlife Research Center collected sediment cores from Mud Lake to determine vertical accretion rates. Accretion rates were greatest near the dam (0.5 inch per year), with less accretion (0.08 inch per year) occurring in the upper reaches of Mud Lake. As expected, the accretion was highest near the dam where water velocities and greater water depth facilitate sediment deposition.

Since 1959, sediment accretion has reduced the maximum pool depth near the Mud Lake dam by 21.7 inches. Assuming that sediment accretion rates remain the same in the future, it is projected that Mud Lake would have a maximum pool depth of 30.3 inches by 2020 and 20 inches by 2040. Over this same period, water depth in the upper reaches of Mud Lake would be reduced to less than 0.8 inch. This projected future loss of water depth would severely limit the ability of managers to manipulate pool levels in Mud Lake to cycle vegetation and create interspersion of cover and water to meet the wildlife habitat objectives.

It is anticipated that, over the next 20 years, sediments entering Mud Lake would reduce water depths to the point that current wildlife management objectives cannot be achieved through customary water-level manipulations (Gleason et al. 2003).

The removal or breaching of the two main dikes and water control structures would not allow for any active management of water levels. The principal water right for the refuge would probably be lost. Water levels and aquatic vegetation structure within the refuge would be determined by flows and natural fluctuations in the James River. The James River is characterized by high spring flows that gradually diminish, often to near zero, by late summer.

Strategies

— Remove or breach dams.

  The removal or breaching of the dams to decrease the sedimentation rate in the pools would prolong the life and health of the marsh. The natural flows in the James River would determine habitat conditions and resultant wildlife use of the marsh.

— Limit management of the larger expanse of cattails anticipated with this action to manipulation of emergent vegetation through grazing, haying, and prescribed burning.

Subimpoundment Objective: Manage the subimpoundments as dynamic wetland systems that cycle between drawdown and flood events, within 5 years of CCP approval, to provide quality habitat for waterfowl, shorebirds, and wading birds. During periods between drawdowns, manage the subimpoundments to provide 10–75 percent emergent vegetation and annuals, a mean water-column invertebrate biomass of 0.007 ounces per activity trap per 24-hour set during the June sampling period, and water depths of 0.4–9.8 inches over 50 percent of the flooded area for a portion of the time between April 1 and October 15.

Rationale

The subimpoundment objective purposely includes broad ranges, as water levels are intended to vary like natural wetlands. The success and timing of such management actions are subject to dynamic weather patterns.

Plant communities in prairie wetlands are continually changing because of short- and long-term fluctuations in water levels and salinity. Prairie wetlands have evolved under these fluctuating conditions. The process of cycling with wet and dry periods makes prairie wetlands productive. For instance, exposure of mud flats during drought periods is necessary for the germination of many emergent macrophytes and facilitates the oxidation of organic sediments and nutrient releases that maintains high productivity.

Within the framework of a dynamic wetland system, management of the subimpoundments is directed toward waterfowl (foraging, breeding pairs, and broods), shorebirds, and wading birds. This objective sets an upper and lower threshold of emergent vegetation, because an interspersion of emergent vegetation and wetland openings is preferred by both dabbling and diving ducks and their broods (Kantrud 1986).

Interspersed emergent vegetation also benefits other marsh-dwelling birds and mammals (Seabloom 1958, Vogl 1973, Weller and Spatcher 1965). Such conditions may also result in avian communities of greater species diversity or richness (Weller 1978, Weller and Spatcher 1965). In addition, Voigts (1976) found maximum invertebrate abundance occurring where beds of submerged vegetation were interspersed with stands of emergent vegetation.

A lower invertebrate biomass threshold is part of the subimpoundment objective. Invertebrate

abundance is quantified relative to biomass in June, because that is when invertebrate biomass is known to peak in most wetlands (Euliss and Mushet 2003). Abundance of aquatic macroinvertebrates is positively related to waterfowl use (Kaminski and Prince 1981, Schroeder 1973, Swanson and Meyer 1973) and early growth of ducklings (Chura 1961, Perret 1962, Sugden 1973). Aquatic invertebrates also are important food resources for shorebirds (Eldridge 1987), amphibians (Clark 1978, Deutschman 1984), and other marsh birds (Weller 1981).

© John Jave

Avocets in a Sand Lake wetland.

Shallow water conditions during some portion of the year are also favorable. Deep water may reduce the availability of invertebrates to feeding waterfowl (Laperle 1974, Murkin and Kadlec 1986) and shorebirds. Optimum foraging depths for dabbling ducks, shorebirds, and wading birds are 2–9.8 inches, 0–9.8 inches, and 3–23.6 inches, respectively (Jasmer 2000). Diving ducks can also exploit food resources in shallow water (Fredrickson and Reid 1988).

Strategies

— Conduct drawdowns and subsequent reflooding events.

Water could be moved in and out of the five subimpoundments opportunistically, as flows in the James River and water levels in Mud and Sand lakes allow.

When management action is necessary and water elevations in the main pools are not conducive to take advantage of gravity flow, a 16-inch Crisafulli pump could be used to move water into or out of these subimpoundments. This would add significantly to the cost, would be time consuming, and must not violate restrictions placed on the refuge's water rights. However, it could create the desired habitat conditions when other management alternatives are not available.

Most of the subimpoundments are smaller areas separated from the main pools by an embankment. Water could be diverted into or out of the subimpoundments by gravity flow. Because of their smaller size and isolation from the main pools, it would be possible to provide some water level control, thereby influencing the plant and invertebrate communities, as well as the productivity of the subimpoundments.

Plant and invertebrate production could be maximized through carefully planned drawdowns and subsequent reflooding events. Drawdowns of the subimpoundments would be accomplished in different years to provide a diversity of habitat conditions during any given year. The need for rejuvenation of plant and invertebrate communities within each unit and the ability to move water out of the unit would largely determine when drawdowns could be conducted.

— Control cattail.

If the wetland experiences only shallow flooding, emergent vegetation may eventually expand through vegetative propagation to dominate the entire wetland. The resultant buildup of litter and organic material from emergent species can reduce water depth or eliminate shallow water areas (Hammond 1961; Ward 1942, 1968). Decreased waterfowl use is commonly associated with the decreased habitat variation in stands of tall, emergent hydrophytes, which typically form monotypes in the absence of disturbance.

General references (Kozlowski and Ahlgren 1974, Wright and Bailey 1982) indicate that burning of marsh vegetation releases nutrients and opens the canopy and detrital layer. Reduction in the height and density of tall, emergent hydrophytes by fire generally benefits breeding waterfowl. Such benefits are an increase in pair density probably related to increased interspersion of cover and open water, which decreases visibility among conspecific pairs (Kantrud 1986). Grazing by cattle also may remove much organic matter and create open water areas where submersed plants flourish (Schultz 1987).

Prolonged deepwater flooding reduces emergent macrophytes due to extended inundation and the expansion of muskrats and their consumption of macrophytes (Euliss et al. 1999). Drawing the wetlands down early in the summer when mud temperatures are too cool to allow cattail germination helps discourage cattail invasions. Alternately, allowing the subimpoundments to

drain naturally would expose the mud flats in midsummer and likely encourage cattail proliferation.

Public Use

The six wildlife-dependent priority public uses specified in the National Wildlife Refuge System Improvement Act are hunting, fishing, wildlife observation, wildlife photography, environmental education, and interpretation.

All six activities are allowed and provided for at Sand Lake National Wildlife Refuge within the bounds of refuge mandates and purposes.

Wildlife-dependent Recreational Use Goal

Provide opportunities for quality, wildlife-dependent recreation for visitors to Sand Lake National Wildlife Refuge.

Consumptive Use Subgoal: Provide wildlife-dependent, consumptive, recreational opportunities that are compatible with refuge purposes and contribute to a quality outdoor hunting or fishing experience.

Hunting Objective: Allow annual, compatible, fall-hunting opportunities for deer, upland game birds, and waterfowl, consistent with applicable state regulations and principles of sound game management.

Strategies

— Provide hunting opportunities for deer, upland game birds, and waterfowl.

Areas would be designated for deer-, upland game bird-, and perimeter boundary waterfowl-hunting. An additional universally accessible hunting blind and parking area would be developed to increase opportunities for physically challenged hunters.

The refuge would open to upland bird hunting after the close of refuge rifle deer seasons according to state regulations and permit archery and firearm deer seasons based on consultation with the state, local landowners, and hunters.

— Create an updated hunting brochure and map for distribution at various locations around the refuge to provide hunters with up-to-date hunting rules and regulations.

— Develop a proactive law enforcement program including the establishment of a permanent, full-time law enforcement position to regulate hunting activities on the refuge and enforce wildlife laws.

Fishing Objective: When available and accessible, allow open water and ice fishing yearly from the five designated fishing areas only. Prohibit motorized and nonmotorized boating. Restrict or eliminate fishing at one or more (or all) of the designated areas to minimize disturbance to migratory bird areas.

Rationale

Insufficient fishing access creates traffic congestion when anglers use road rights-of-way for fishing. Limited access has produced a high density of users in limited areas. There is also a high demand for ice fishing. Motorized and nonmotorized boating is not allowed and no facilities for fishing exist. Species sought by anglers include northern pike, walleye, and yellow perch. Ice fishing is limited to areas within close proximity to designated fishing areas.

Paul Kerris/USFWS

Fishing is considered opportunistic because fish populations flourish during wet cycles on the James River and winterkill during periods of low flow or lower water levels in refuge lakes. Sand Lake is generally thought of as being too shallow to support a viable game fishery. Water depths at full pool are less than 6 feet, which is insufficient to overwinter game fish except during years of high flows in the James River.

By limiting fishing to the five sites easily accessed from public roads, disturbance to migratory birds is limited. Fishing is not consistent with legal mandates pertaining to migratory birds.

Strategies

— Allow fishing at five designated locations.

The opening day of the fishing season would coincide with the opening of deer hunting, usually November 1, and would close March 1. The public would be made aware of the fishing program through notification of rules, updated brochures, and information in the state fishing handbook.

— Develop a proactive law enforcement program including the establishment of a permanent full-time law enforcement position to monitor and regulate fishing activities and enforce wildlife laws.

Nonconsumptive Recreation Subgoal: Provide wildlife-dependent, compatible, nonconsumptive, recreational activities on the refuge that increase public understanding and appreciation of wildlife and its conservation.

On-site Visitors Objective: Educate an additional 5,000 on-site refuge visitors about local and regional conservation issues, the National Wildlife Refuge System, and Sand Lake National Wildlife Refuge within 5 years of CCP approval.

Strategies

— Increase on-site public education opportunities.

An on-site education center would be constructed to provide space and materials to inform students, educators, and the visiting public about the refuge, wildlife conservation, and the National Wildlife Refuge System.

— Update information kiosks.

Information and interpretive kiosks at the refuge headquarters would be updated to reflect management practices, with themes based on issues described in this document. Kiosks would provide general information about wildlife conservation and the refuge.

Nonconsumptive Recreation Objective: Provide opportunities for wildlife observation, wildlife photography, and interpretation annually. Confine these activities to the headquarters area during the breeding season to reduce human impact on migratory grassland-nesting birds and other breeding wildlife.

Strategies

— Provide nonconsumptive recreational opportunities while decreasing human impacts during breeding season.

Due to direct conflicts and human impacts on breeding, nesting, and brooding wildlife, nonconsumptive recreational activities would be limited to the headquarters service area during the breeding season.

Bob Savannah/USFWS

The Highway 10 viewpoint would be maintained. Staff would work with county and state road departments to develop other highway viewpoint areas that allow visitors to view and photograph wildlife without creating human-caused disturbance to wildlife.

— Update information kiosks.

Kiosks at refuge headquarters would be updated to reflect the new management approach and to educate the public about grassland-nesting birds and habitat needs.

Public Education and Outreach Goal

Provide wildlife- and wildland-viewing opportunities for the public to enjoy and, through education and outreach, encourage them to gain a greater understanding and appreciation of national wildlife refuges and wildlife resources in general.

Public Education and Outreach Objectives

(Same as alternative 1)

- Annually host an average of two to three on-site special events designed to educate the public about wildlife resources and the National Wildlife Refuge System.
- Continue the off-site program and continue working with the radio, television, and print media. Provide an annual average of 24 radio and 8 television interviews, and annually provide information for newspaper articles at least 30 times.
- Construct an education center.

Local School Districts Objective: Increase and maintain awareness within all local school districts of the education resources and opportunities available at the refuge, through additional on- and off-site programs and workshops within 5 years of CCP approval.

Strategy

— Increase educational opportunities while decreasing human impacts.

To decrease conflicts with breeding, nesting, and brooding wildlife, most on-site educational programs would be confined to the headquarters service area. Outdoor classroom programs on other areas would be reduced or eliminated to decrease human impact on nesting and brooding wildlife.

A major shift in education and outreach would occur, from a combination of on- and off-site programs to almost exclusively off-site programs. Facilities at the Columbia and Hecla day use areas would be removed and reclaimed to grassland-nesting bird habitat.

Use of the education center would provide space and materials for students and educators for learning about wildlife and the National Wildlife Refuge System, while reducing impacts on wildlife species.

In-school programs and teacher use of learning trunks would be extensively promoted. Teacher workshops would be established to give teachers the ability to facilitate their own in-classroom wildlife programs.

Communities Objective: Promote awareness of and generate support for the refuge, the Refuge System, and general conservation within local and regional communities by creating five new partnerships with local and regional interest groups. Continue weekly media contacts with the "Refuge Corner Update."

Strategy

— Seek educational opportunities for local and regional communities to promote the refuge and wildlife conservation.

Speakers would be provided for community and civic groups. Refuge staff would frequently update local congressional offices and key staff on emerging or potentially controversial issues. Refuge staff would participate in local fairs, outdoor shows, the Water Festival, and other public events, and continue the annual Eagle Day event.

The refuge's Website would be maintained and improved to provide up-to-date information on refuge policies, regulations, and wildlife.

Educational and interpretive kiosks promoting the refuge and wildlife conservation would be developed and located off-site at the Aberdeen Regional Airport, Wylie Park, Northern State University, and other strategic locations within the community.

News releases and articles would be made available to local media outlets including television, radio, and newsprint.

ALTERNATIVE 3

INTEGRATED MANAGEMENT— PROPOSED ACTION AND DRAFT CCP

This alternative takes an integrated approach with management practices that would serve to improve the biological potential of the refuge for migratory birds. This alternative balances the best management practices for producing migratory birds and finds a balance with reducing cropland, while ensuring depredation is minimized.

MANAGEMENT SUMMARY

Upland habitat management would be geared toward providing tall and dense nesting cover on a high percentage of the uplands for nesting birds, especially waterfowl. Rejuvenation of decadent grasslands and the control of invasive plant species would be emphasized. This would be accomplished through an active management program of grazing, prescribed burning, haying, farming, reseeding, invasive plant control, and habitat monitoring.

- Cropland acreage would be reduced.
- No new shelterbelts would be planted. Existing shelterbelts would be allowed to die out to increase the size of grassland blocks for nesting migratory birds. In addition, selected shelterbelts would be removed and the disturbed sites seeded to grass.
- Invading Russian-olive trees would be removed or controlled where they are threatening the productiveness of grassland-nesting migratory bird species.

The refuge would acquire areas approved by the Migratory Bird Conservation Commission when the land becomes available from willing sellers.

Both Mud and Sand lakes would be managed to provide a wetland category preferred by overwater-nesting birds and waterfowl. The five subimpoundments (figure 10) would be managed as shallow-water, seasonally flooded wetlands—used by waterfowl breeding pairs and broods, nesting black terns and pied-billed grebes, and foraging water birds and shorebirds. Drawdowns would be accomplished, depending on the amount of flow in the James River; water can only be moved out of the units when there are low flows in the river. Siltation problems within Mud and Sand lakes would be addressed.

Wildlife-dependent recreational activities would be expanded and improved on and off refuge lands.

- The building of an education center would allow visitors a quality experience and provide a focus point for public use. This new education center, larger than the current headquarters facility, would meet current demand for educational materials and activities, as well as for special events.
- Support facilities for hunting and fishing opportunities would be improved.
- The Columbia and Hecla day use areas would continue to be managed for public activities. Improvements such as updated signing, interpretive kiosks, and expanded trails would be made to each site.
- On-site tours, school field trips, and educational activities would be promoted and associated facilities would be improved.
- Off-site programs would promote visitation to the refuge.

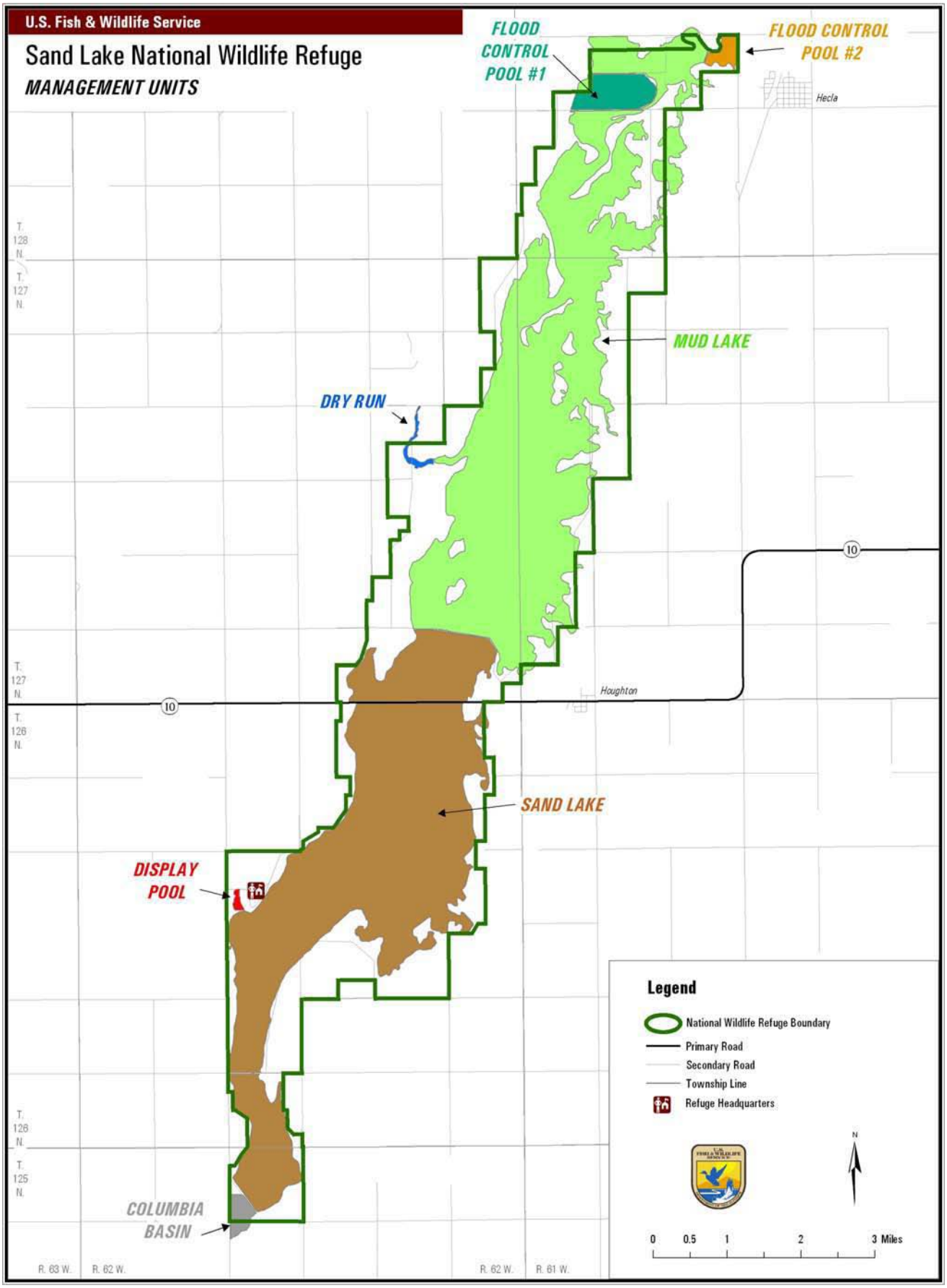


Figure 10. Water management units, Sand Lake National Wildlife Refuge, South Dakota

MANAGEMENT DIRECTION

The objectives and strategies below describe how this alternative would be carried out to meet the overall goals for the refuge. Habitat conditions under alternative 3 are shown in figure 11.

BIOLOGICAL DIVERSITY GOAL

Promote the natural biological diversity of the area and, through management of refuge habitats, provide for the greatest number of native fauna and flora species within the capabilities of the Sand Lake National Wildlife Refuge.

Threatened and Endangered Species Subgoal: Provide for the protection and welfare of any threatened or endangered plants and animals that may occur on the refuge.

Threatened and Endangered Species Objective: Provide nesting and roosting habitat for bald eagles during the course of the year. Make special efforts to protect and provide for the well-being of any threatened or endangered species, such as the whooping crane, that is found to be present.
(Same as alternative 1.)

Strategy

— Allow riparian zone trees, especially cottonwoods, to grow except where affected by habitat management activities.
(Same as alternative 1.)

Waterfowl and Grassland-nesting Birds Subgoal: Provide sufficient habitat (wetlands and grasslands) for the production and maintenance of waterfowl and grassland-nesting, nongame bird species.

Waterfowl and Grassland-nesting Birds Objective: Maintain or develop a minimum of 8,000 acres of nesting habitat for waterfowl and grassland-nesting nongame birds within 10 years of CCP approval.

Strategy

— Maintain upland habitats through applied management such as grazing, haying, and prescribed fire.

Colonial Birds Subgoal: Provide and manage wetland habitats as nesting areas for the tremendous variety of colonial bird species using the refuge.

Colonial Birds Objective: Manage the emergent vegetative zones through water level manipulations to provide nesting and roosting habitat for the hundreds of thousands of colonial-nesting birds that use the refuge. Maintain 750 acres of emergent vegetation south of Highway 10 within the traditional nesting area.
(Same as alternative 1.)

Rationale
(Same rationale as for wetland habitat objectives in alternative 3.)

Strategy

— Manipulate water levels in the major impoundments.
(Same as alternative 1.)

(Same discussion as for wetland habitat strategies in alternative 3.)

Resident Wildlife Subgoal: Contribute to habitat requirements for regional populations of resident wildlife including fish, reptiles, amphibians, mammals, and nonmigratory birds.

Red Fox
Bob Savannah/USFWS

Resident Wildlife Objective: Work with the South Dakota Cooperative Research Unit and the South Dakota Heritage Program on nongame wildlife issues.
(Same as alternative 1.)

Strategy

— Work with the South Dakota Cooperative Research Unit and the South Dakota Heritage Program on inventories and development of habitat management techniques to support resident, nongame wildlife species.
(Same as alternative 1.)

Deer Management Objective: Continue working cooperatively with SDGFP to meet winter food requirements for white-tailed deer.
(Same as alternative 1.)

Strategy

— Allow the refuge's share of the farm program crop to remain in the field and available during winter months.
(Same as alternative 1.)

Grassland Habitat Subgoal: Restore, maintain, and provide quality habitat for the life requirements of a diversity of migratory birds and other wildlife species.

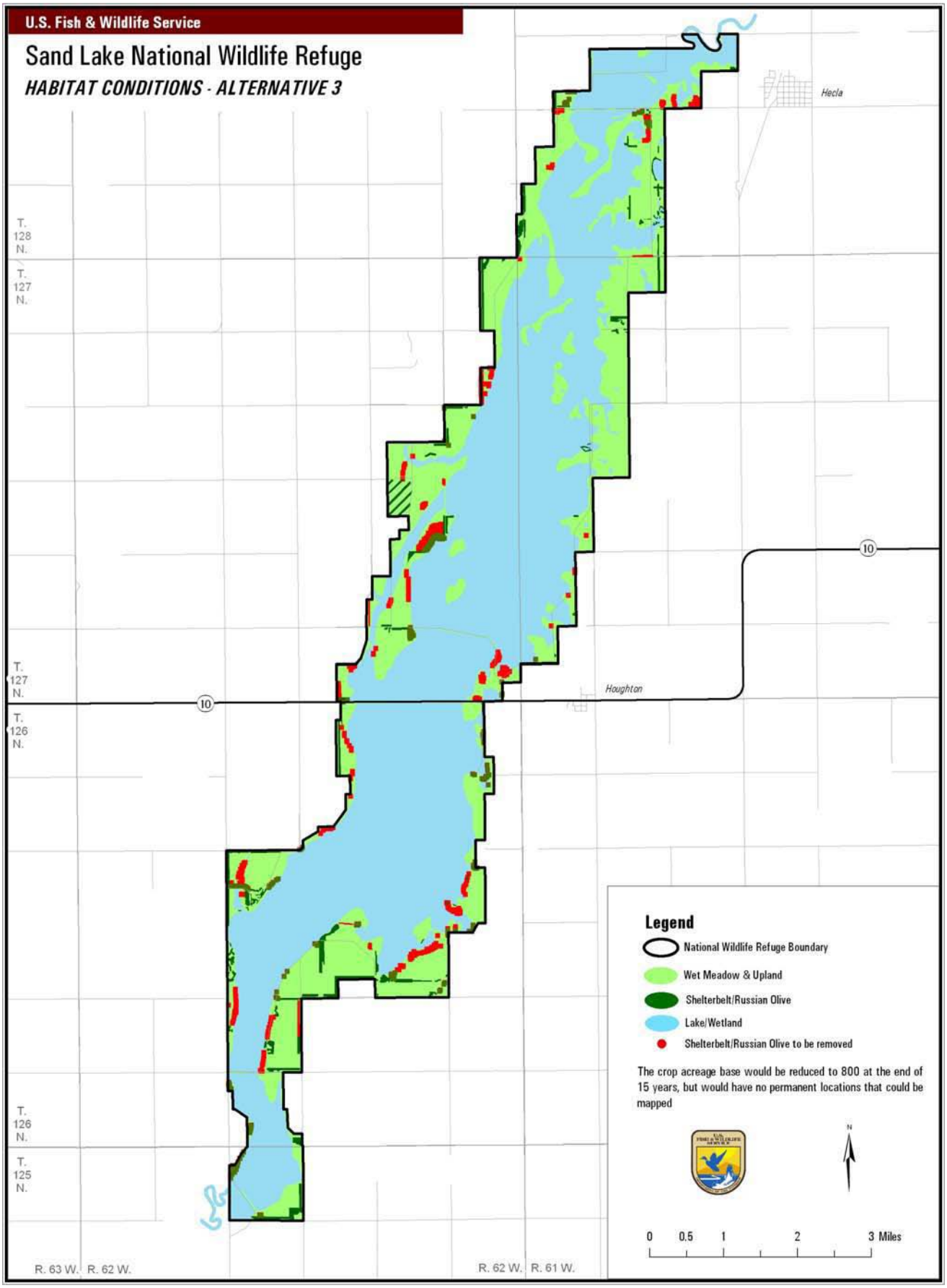


Figure 11. Habitat conditions under alternative 3 for the CCP, Sand Lake National Wildlife Refuge, South Dakota

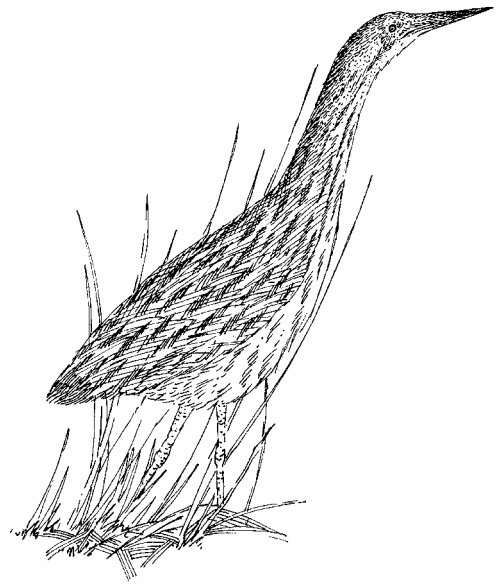
Grassland Block Objective: Manage at least 8,000 acres of grassland habitat with a minimum of 80 percent of the grassland habitat managed in blocks of at least 160 acres within 15 years of CCP approval.

Rationale
(Same as alternative 2.)

With the United States' grasslands listed as critically endangered, i.e., greater than 98 percent declines (Noss et al. 1995), larger blocks of contiguous grassland would benefit grassland-dependent species.

An extensive, 8-year study in Manitoba, Saskatchewan, and Alberta, Canada found hatching rates of waterfowl were generally higher in larger patches of habitat (Howerter 2002). In Minnesota's tall-grass prairie, nest-depredation rates were lower on large (321–1,201 acres) versus small (40–79 acres) grassland blocks (Johnson and Temple 1990).

By creating larger grassland blocks, more favorable habitat is created for grassland birds of special concern that are known to nest on the refuge (table 3). Of these 15 species, 9 use grassland growth forms in the tall- or medium-height category (Dechant et al. 1998b–d, 1998f, 1999a–c, 1999e, 1999f). These nine species, along with the more abundant savannah sparrow, bobolink, sedge wren, and clay-colored sparrow (Dechant et al. 1998a, 1998e, 1999d; Swanson 1998), have the greatest capacity to indirectly benefit from the management of tall, dense vegetation for nesting waterfowl (table 4).



American Bittern
© Cindie Brunner

Eight of these 13 species (table 4) avoid woody vegetation (Dechant 1998a, 1999f; Wildlife Habitat Management Institute 1999); 7 of the 13 are area sensitive (Dechant et al. 1998b, 1998d, 1999a, 1999d, 1999f; Swanson 1998); and 6 of the 13 experience brood parasitism by brown-headed cowbirds (Dechant et al. 1998a–b, 1998f, 1999d–e; Swanson 1998).

Vegetative Structure and Composition Objective: Manage habitat blocks of DNC so that, in 7 out of 10 years, the habitat blocks would have a mean vegetative visual obstruction reading (VOR) of 11 inches, a litter depth of 0.5–2.5 inches, and a habitat composition of 50 percent forbs and 0 percent trees during late spring (May 25–June 15). *(Same as alternative 2.)*

Introduced, Cool-season Grasses Objective: Manage habitat blocks of introduced, cool-season grasses so that, in 7 out of 10 years, habitat blocks would have a mean vegetative VOR of 7 inches, a litter depth of 0.5–2.5 inches, and a habitat composition of 5 percent forbs and 0 percent trees during late spring (May 25–June 15). *(Same as alternative 2.)*

Seeded Natives Objective: Manage habitat blocks of seeded native grasses so that, in 7 out of 10 years, habitat blocks would have a mean vegetative VOR of 11 inches, a litter depth of 0.5–2.5 inches, and a habitat composition of 10 percent forbs and 0 percent trees during late spring (May 25–June 15). *(Same as alternative 2.)*

Rationale for the above vegetation, grasses, and natives objectives
(Same as alternative 2.)

Grasslands are categorized as DNC, introduced cool-season grasses, and seeded native grasses. Vegetative structure differs greatly between the three habitat types; therefore, it was necessary to set grassland objectives specific to each habitat type. Despite the quantitative differences between objectives, all three objectives are similar in that they describe the maximum height-density of vegetation that can realistically be achieved for that habitat type within the constraints of climate and soil type.

Refuge grasslands are managed for tall dense cover because it is attractive to ducks. Several studies have reported high nest success in dense cover (Cowardin et al. 1985, Duebbert and Lokemoen 1976, Higgins and Barker 1982, Kirsch et al. 1978, Livezey 1981, Schranck 1972).

In addition to benefiting waterfowl, moderate to tall vegetation is also favored by many other grassland-nesting birds (Dechant et al. 1998a–f, 1999a–f; Swanson 1998).

As the refuge was specifically established to improve and maintain habitat for nesting waterfowl and other migratory birds, managing grasslands in the tall–dense category aligns well with the refuge's mandates and wildlife priorities (table 5).

A majority of the lands surrounding the refuge are annually managed as cropland or nonresidual grasslands, which provide some habitat in the other categories of short–sparse and medium height density. Therefore, managing grasslands in the tall–dense category of vegetation provides a vegetation class that is not well represented in Brown County.

In the process of applying treatments to habitat in greatest need of management, blocks of grassland that conform to the short–sparse and medium height density vegetation categories would be created, thereby providing a diversity of vegetative structure within any given year.

Forb composition varies with treatment type and time since last disturbance. Forb coverage typically is 20–40 percent of the vegetation in the year following a habitat treatment, and gradually decreases to 10 percent within 5–6 years.

Strategies for the above vegetation, grasses, and natives objectives

— Reduce tilled acreage to 878 acres.

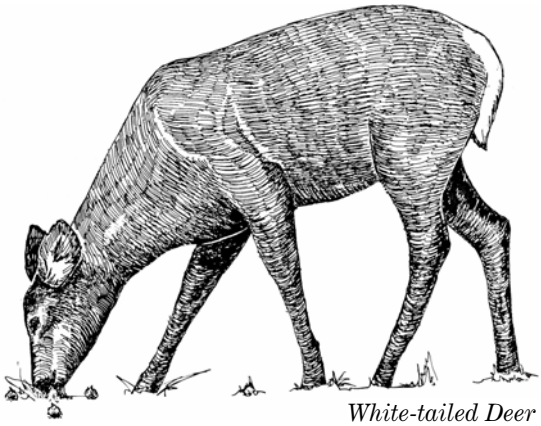
Conversion of cropland to grassland is prioritized according to which conversion projects can create or contribute to the largest grassland blocks. The 80-acre block of cropland adjacent to Goose Corner (cropland block A-99a) was converted to grassland in 2004. Cropland blocks A-94 (202 acres) and A-99 (57 acres), which are adjacent to Goose Corner and Hanson's Point, also have been identified as priority areas for conversion to grassland. Conversion of these three cropland blocks would create a 339-acre contiguous block of grassland and reduce the total cropland acreage from 1,217 acres to 878 acres.

— Use farming as a tool to rejuvenate DNC, fight colonization of invasive plants, prepare ground for native grass seeding, and reduce use of non-selective broadleaf herbicides over the long term.

The focus of the farming program would change. Short of a more effective tool to control invasive plants on the James River flood plain, tillage holds the most promise and would be aggressively applied. By using the 800-acre farm model described under the invasive plant strategy below, the refuge would have the opportunity to renovate 3,000 acres of decadent, invasive plant-infested habitat blocks during the life of this CCP. The future of farming beyond 15 years would be determined by how effective the refuge is at improving upland habitat through use of this tool and others, and by success in developing a management strategy with SDGFP and the public to deal with the deer depredation issue.

— Prepare a management plan in cooperation with SDGFP that deals with wildlife depredation, invasive species management, and upland grassland restoration. The public, in particular local landowners, would be part of the management planning process after the CCP is finalized.

The farming program would provide critical habitat for white-tailed deer during severe winters. Continuation of some level of farming on the refuge would provide for flexibility in management options while working cooperatively on the deer depredation issue with the SDGFP. By recognizing and acting on the fact that the Service has a stake in deer management on and near the refuge, it would preserve credibility with the SDGFP, refuge neighbors, and the public.



White-tailed Deer
Tom Kelley/USFWS

Thousands of acres of cattails provide thermal cover used extensively by the regional deer herd. There is seasonal movement into the James River corridor that appears directly related to winter severity. A study conducted by South Dakota State University between 1992–94 documented movements as far as 132 miles (Kernohan et al. 1994). Local landowner tolerance for whitetails relates directly to deer density and damage to crops, particularly during summer months (Naugle et al. 1994).

Depredation of crops on private lands adjoining the refuge has been, and will continue to be, a concern. The partnership previously described would address this issue.

— Control invasive plants.

The future of the refuge and the value of its grassland habitats would be shaped largely by how effective management is in combating the invasion of Canada thistle. Canada thistle is a pervasive pest for which there is no known control measure available for effective, one-time use on the refuge.

Canada thistle reduction would remain the highest priority until sufficiently controlled. Refuge staff would collaborate with other agencies and specialists to incorporate new control methods as they become available.

Prescribed fire would continue to be used as a tool to control exotic cool-season grasses such as quackgrass, smooth brome, and Kentucky bluegrass in reseeded native grass areas. In addition, grazing, mowing, and haying would continue to be used to fight invasive plants.

Additional exotic species such as purple loosestrife and spotted knapweed would be prevented from colonizing through a rigorous program of monitoring and complete eradication of initial patches.

It is estimated that no less than 3,000 acres of uplands and wetlands are heavily infested with Canada thistle. In the past, an average of 800 acres was treated annually using the Service's IPM program. Current control measures within the integrated pest management program include prescribed fire, chemical application, haying, grazing, biological agents, and rotary mowing. Despite aggressive efforts to control Canada thistle using these control measures, infestations continue to increase.

Grasslands that are infested with Canada thistle would be completely renovated by converting those areas to cropland and replanting them to grassland once the infestation is controlled. This strategy is based on the premise that Canada thistle would not grow in fields planted with genetically modified varieties of "Roundup ready" corn or soybeans that are sprayed with the nonselective herbicide, Roundup. By maintaining these no-till crops in production for several years, the percentage of viable Canada thistle seed in the upper soil layer should be significantly depleted and the germination potential of Canada thistle probably reduced.

Grassland areas that are heavily infested with Canada thistle are the best candidates for conversion to farmed acreage. Meanwhile, farmed acreage deemed to be free of viable invasive plant seed would be replanted to a grass and forb mixture. The farmed acreage would then shift to other weedy grassland areas in need of renovation. Such an approach would provide a cost-effective alternative to control methods such as chemical application or mowing. These control methods, which often contribute to degraded grassland habitat, would likely need to be used only on small areas of infestation within new seeding. As a result, this approach should provide for reestablishment of a more diverse plant community and higher quality habitat for migratory birds.

Averaged over the next 15 years, rotation of 800 acres of cropland would improve control of Canada thistle on an estimated 3,000 acres of upland. Under this CCP, 200 acres per year could be reasonably converted to deal with invasive plants. This would involve "breaking out" (i.e., sod preparation) of 200 acres of invasive plant-infested grassland and planting another 200 acres of retired cropland to a grass/forb mixture. For those 200 acres of invasive plant-infested grasslands identified annually, the rotation would progress as shown below.

Year 1	Till areas dominated by invasive plants and fallow
Year 2	Plant with "Roundup ready" crop variety
Year 3	Rotate field into different "Roundup ready" crop variety
Year 4	Prepare seedbed with "Roundup ready" soybeans
Year 5	Replant to grasses and forbs

In any given year, 200 acres of upland would be in fallow, 600 acres would be in cropland, and 200 acres would be replanted to grasses and forbs. Several key factors would create the dynamic in which this invasive-plant reduction program would be applied, including the following:

— The speed at which Canada thistle is encroaching on farmable uplands
— The time required to significantly reduce the amount of viable invasive plant seed in the upper soil layer
— Funding and staff constraints
— The robustness and growth of the invasive plant problem in other areas such as marsh edges, fence lines, and tree belts, i.e., size of the local source of invasive plant seed
— The ability of the refuge to find interested cooperators as the size of farm fields shrinks
— Annual budgetary constraints associated with the cost of the grass/forb seed mixture and herbicides

Adjustments may need to be made to the extent of the overall invasive plant reduction program and to the acreage slated for cropland retirement in any given year. Regardless of the annual retirement rate, the acreage base of cropland would be reduced to 800 acres at the end of 15 years.

— Use DNC and native grasses to improve waterfowl and grassland bird production.

The value of grassland habitats would be shaped largely by how effectively habitat blocks of decadent DNC and smooth brome are reclaimed. As infestations of Canada thistle expanded, renovation of grassland blocks was minimized to

avoid breaking sod. Without renovation, these stands of tame grass lost their vigor and became root-bound. In addition, use of herbicides to control Canada thistle has degraded the plant diversity within these established grasslands. Much of the desirable broadleaf forb component has been exterminated.

The degraded condition of 2,136 acres of smooth brome and decadent DNC within manageable habitat blocks demands attention. There are also 495 acres of reseeded native grasses that may need to be renovated in the future, should those areas become overrun with invasive species such as smooth brome.

Areas of cropland appropriate for conversion to dense nesting cover or native grass would be identified through development of a step-down plan. As concern for native species restoration continues to increase, some DNC may be converted to native grass where appropriate. Historically, native grass has established better on the east side of the refuge, which is dominated by sandy and loamy soils of the Hecla–Hamar–Ulen association (U.S. Department of Agriculture 1993). Native grasses seem to thrive better in these soils, which are less likely to harden or compact during dry conditions than the silty and sodium-affected silty soils of the Great Bend–Beotia association on the west side of the refuge (U.S. Department of Agriculture 1993).

DNC establishes more aggressively and is more resilient to silty soils and, therefore, may be favored over native grass on the west side of the refuge. Staff would continue to expand their knowledge of restoration techniques including site-specific seed mixes, site preparation, planting, and postplanting methods to improve their ability to successfully establish native grasses and forbs. Additional information is needed on the use of DNC and native and tame grasses by nesting waterfowl and grassland birds to improve management decisions.

— Provide some degree of water development for livestock if grazing were to be used as a tool for management of established grassland blocks.

The construction of a small dugout in each grazing unit is probably the most viable option to meet any short-duration livestock-watering needs.

— Remove selected shelterbelts.

Further fragmentation is not likely to benefit the upland wildlife species of highest priority. As a result, new shelterbelts or tree rows would not be planted. The majority of shelterbelts would be allowed to die out naturally.

In the past, shelterbelts were planted on the refuge, largely by homesteaders and the CCC (figure 6). Shelterbelts in agricultural areas provide substantial benefits for 29 species of birds (Johnson and Beck 1988). Avian communities were dominated by edge and generalist species in planted woodlands in eastern South Dakota (Bakker and Higgins 2003) and farmstead shelterbelts in Minnesota (Yahner 1982).

However, providing edge habitat such as shelterbelts to maximize local wildlife diversity may not always be a desirable objective if it is detrimental to habitat specialists or rare species that are dependent on extensive stands of undisturbed habitat (Hair 1980, Harris 1984). Shelterbelts decrease the size of grassland blocks and increase the amount of edge habitat, which can allow greater invasion by exotic species, predators, and brood parasites (Hagan and Johnston 1992).

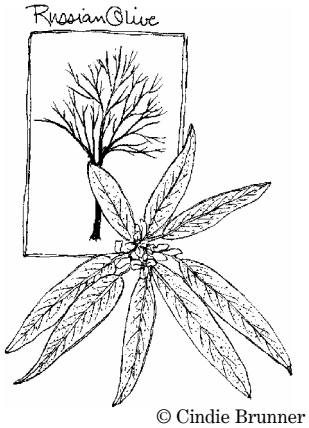
An extensive, 8-year study in Manitoba, Saskatchewan, and Alberta, Canada found that duck-hatching rates increased with distance from a habitat edge (Howerter 2002). Habitat loss and fragmentation on the breeding grounds of grassland birds are known to contribute to poor reproductive success (Best 1978; Gates and Gysel 1978; Johnson and Temple 1986, 1990).

In Minnesota's tall-grass prairie, nest depredation and brown-headed cowbird brood parasitism on grassland birds decreased farther from woody edges (Johnson and Temple 1990). Grassland birds that nested in remnants of tall-grass prairie near wooded edges produced fewer young than birds that nested far from wooded edges (Johnson and Temple 1986).

Due to the high expense of tree removal, most of the current shelterbelts and tree rows would not be actively removed. A few select shelterbelts dividing large grassland blocks with high wildlife potential would be removed when funds allow. For example, the tree row bordered by habitat block SN-16 on the north and D-50 on the south is a high priority for removal as it is dissecting two large grassland areas on Hanson's Point.

— Reduce volunteer Russian-olive trees.

Historically, Russian-olive trees were planted in the shelterbelts. The trees produce a heavy crop of persistent fruit every year that is a favored food of more than 40 kinds of birds and mammals (Borell 1951). However, the species is considered invasive because the



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seeds are widely dispersed by wildlife (particularly birds), remain viable for up to 3 years, and can germinate even on well-vegetated soils (Pearce and Smith 2001).

"Volunteer" Russian-olive trees are invading lowland areas and wetland (figure 6). As a result, Russian-olive woodlands threaten to displace native riparian vegetation (Olson and Knopf 1986a), as they have in many South Dakota marshlands (Olson and Knopf 1986b). In addition, Russian olives may depreciate waterfowl-nesting habitat, as waterfowl may avoid wetlands rimmed by dense stands of Russian olive (Olson and Knopf 1986b).

Volunteer Russian-olive trees in undesirable locations would be removed by cutting the trees and painting or spraying the stumps with an herbicide to prevent regrowth. This control method is most effective (Olson and Knopf 1986b), although repeated aerial application of 2,4-D or 2,4,5-T for 1–2 years has also been found effective for large trees (Bovey 1965).

Removal priority would be given to volunteer Russian-olive trees that are adjacent to or encroaching on valuable wetlands or larger habitat blocks. Russian-olive trees within shelterbelts would be allowed to remain. Volunteer olive trees adjacent to the shelterbelts, which likely originated from seed trees within the shelterbelts, would be removed.

— Proactive predator management. *(Same as alternative 2.)*

To enhance nesting success, waterfowl nest predators would be removed from selected areas during the nesting period via trapping. Priority would be given to the predator exclosure, which provides the greatest potential for human manipulation of waterfowl-nesting success. Intensive predator management would be implemented inside the exclosure using Conibear traps. The integrity of the exclosure near the outside boundary would be maintained by removing predators.

In addition, Mud Lake Island has the potential for enhanced nesting success with management, but it would only be managed as time and resources permit.

— Monitor and react to wildlife disease issues. *(Same as alternative 2.)*

Avian populations would be monitored for mortality due to avian botulism, West Nile virus, avian chlamydiosis, and other potential wildlife diseases. In the case of a disease outbreak, infected carcasses would be collected and properly disposed. Freshly-collected specimens would be sent for testing to confirm the cause of death.

Personal protective equipment would be used by refuge staff when contact with sick or dead birds and other wildlife presents a human-health risk.

If the threat of chronic-wasting disease increases, refuge staff would cooperate with the SDGFP to assess the impact on the refuge population of white-tailed deer. The refuge would continue to make use of the most current information to stay informed of current wildlife disease threats.

— Monitor habitat using adaptive resource management.

Adaptive management requires an ongoing commitment to evaluate and monitor the effects of habitat management strategies and incorporate new knowledge into updated plans and objectives. An upland monitoring plan that is consistent with the requirements of adaptive resource management, as well as the goals and objectives of this CCP, is being developed.

This habitat-monitoring plan emphasizes monitoring on three levels:

— Refuge monitoring determines whether habitat objectives are being met
— Habitat block monitoring determines which habitat blocks are in greatest need of treatment
— Treatment monitoring assesses vegetative response to treatments and determines whether treatment objectives were met

Through treatment monitoring, the future application of successful treatments can be validated and methods that were not successful in meeting treatment objectives can be modified. In addition, monitoring vegetative response to habitat treatments would produce the most reliable information, as site-specific effects are more informative than data gleaned from research conducted elsewhere.

— Improve technological support, especially using GIS. *(Same as alternative 2.)*

Technological support of management actions would be improved. Spatial and GIS data would be collected and analyzed with the assistance of the habitat and populations evaluation team in Bismarck, North Dakota and the area GIS coordinator for North Dakota and South Dakota. Selected staff would be responsible for maintaining and sharing these databases.

To use fully the potential of spatial databases in refuge management, selected staff would become familiar with the use of global positioning systems (GPS), Trimble GPS Pathfinder Office, ERDAS Imagine geographic imaging, Environmental Systems Research Institute (ESRI) ArcView and ArcGIS, and Microsoft Access, or use the expertise of others to analyze spatial data.

Additional technological advances including the use of spreadsheets, Microsoft PowerPoint, and statistical software would be increasingly used.

— Acquire remaining land within the legislated boundary of the refuge.

The boundary of the refuge was established on September 4, 1935, by executive order of President Franklin D. Roosevelt. Of the 23,103 acres encompassed within that original legislative boundary, 21,498 acres have been acquired.

In an effort to provide a wider buffer zone around the edge of the wetland habitat and to establish larger tracts of habitat for grassland-dependent wildlife species, purchase of the final 1,605 acres of privately owned land within the legislated boundary would be strongly considered when that land becomes available for purchase.

Wetland Habitat Subgoal: Maintain a diversity of quality wetland habitat that meets the needs of wetland-dependent wildlife species.

Bill Schultze/USFWS

Forster's Tern

Impoundment Objectives:

- Manage the Mud Lake impoundment for 30–50 percent emergent vegetation within the area from Mud Lake dike to 2 miles north of the dike, with a mean vegetation height of 19.7 inches above water, a mean vegetative VOR of 11.8 inches, and a water depth of 7.9–19.7 inches.
- Manage the Sand Lake impoundment to provide 30–60 percent emergent vegetation within the area from State Highway 10 to 2 miles south of the highway, with a mean vegetation height of 19.7 inches above water, a mean vegetative VOR of 11.8 inches, and a water depth of 7.9–19.7 inches.

Rationale

Overwater colonial-nesting birds rank high on the hierarchy of wildlife priorities of the refuge (table 5). This objective describes the deepwater/dense-emergent category of wetland habitat preferred as overwater nest sites by a high percentage of colonial-nesting birds found on the refuge, as follows:

— Franklin's gull (Burger 1974, Guay 1968)
— White-faced ibis (Ryder and Manry 1994, Zeiner et al. 1990)
— Black-crowned night-heron (Davis 1993)
— Eared grebe (Dechant et al. 2002)
— Western grebe (Short 1984)
— Forster's tern (Gorenzel 1977, McNicholl 1979)

By managing the specified areas of Sand and Mud lakes for overwater-nesting birds, habitat for other wetland birds would naturally be provided in areas of different depth.

— Deepwater/sparse-emergent habitat would be provided along the edges of deepwater/dense-emergent areas and in areas of variable depth.
— Shallow-water/emergent habitat would be provided along the marshy edges of Sand and Mud lakes and in the northern part of Mud Lake.
— Open-water/submergent habitat would be provided in the deeper, center part of Sand Lake and in the deeper pockets of Mud Lake.
— Shallow-water/sparse habitat would be provided along the lake edges and shorelines.

The location and amount of each habitat type would vary with the natural wetland cycles. As emergent vegetation gradually decreases, the habitat type would change. This can happen gradually over time or within several years if water levels are extreme.

Strategies

— Maintain consistent water elevations.

When emergent cover is in optimal condition, conventional water strategies would be applied. This consists of moving spring runoff through the refuge as quickly as possible, until water levels have fallen to full-pool elevation (1,287.52 feet above sea level). Full-pool elevation would be maintained through the nesting season (May 15–August 1). Refuge staff would continue to coordinate with upstream dam managers to minimize negative impacts to overwater nesters.

— Manage drawdowns.

Control of water levels to manage wetland habitats is dependent on the flows of the James River. Conditions on the river can change quickly and need to be continually evaluated.

After multiple years of high water, cattail stands often need to be reestablished through managed drawdowns. The best time to reestablish cattail in Sand Lake is during low-flow years, when water levels can be drawn down during the summer months.

In Mud Lake, drawdowns would be limited by the level in Sand Lake, but conditions should be sufficient to reestablish cattail during low-flow years.

The coordinated release of water from Dakota Lake National Wildlife Refuge, just north of Mud Lake, may also be an option if the releases benefit both refuges or if the benefits to Sand Lake National Wildlife Refuge override the benefits to Dakota Lake National Wildlife Refuge. This would be determined by the managers at both refuges. These releases may be needed to reflood part of Mud Lake after a drawdown or to address a botulism problem in Mud or Sand Lakes.

— Control cattail.

If the wetland experiences only shallow flooding, emergent vegetation may eventually expand through vegetative propagation to dominate the entire wetland. The resultant buildup of litter and organic material from emergent species can reduce water depth or eliminate shallow water areas (Hammond 1961; Ward 1942, 1968). Decreased waterfowl use is commonly associated with the decreased habitat variation in stands of tall, emergent hydrophytes, which typically form monotypes in the absence of disturbance.

General references (Kozlowski and Ahlgren 1974, Wright and Bailey 1982) indicate that burning of marsh vegetation releases nutrients and opens the canopy and detrital layer. Reduction in the height and density of tall, emergent hydrophytes by fire generally benefits breeding waterfowl. Such benefits are an increase in pair density probably related to increased interspersion of cover and open water, which decreases visibility among conspecific pairs (Kantrud 1986). Grazing by cattle also may remove much organic matter and create open water areas where submersed plants flourish (Schultz 1987).

Prolonged deepwater flooding reduces emergent macrophytes due to extended inundation and the expansion of muskrats and their consumption of macrophytes (Euliss et al. 1999). Drawing the wetlands down early in the summer when mud temperatures are too cool to allow cattail germination helps discourage cattail invasions. Alternately, allowing the subimpoundments to drain naturally would expose the mud flats in midsummer and likely encourage cattail proliferation.

— Control sedimentation within the upper James River basin.

The James River is embedded within an agricultural landscape where cultivation of wetland catchment areas has likely increased the intensity of runoff events and decreased the time available for infiltration.

Although all major dams constructed on rivers have a finite life span due to natural sedimentation processes, human-caused influences on sedimentation rates have great potential to fill prematurely Mud and Sand lakes, degrading their wetland functions.

Increased sediment in water generally reduces the depth of the photic zone, reducing the light available for primary production by aquatic macrophytes and algae (Ellis 1936, Robel 1961). Sediment depths of 0.1 inch can significantly reduce species richness, emergence, and germination of wetland macrophytes (Jurik et al. 1994, Wang et al. 1994).

Because of the negative impacts on aquatic vegetation from sediments, water quality functions may be altered (Gleason and Euliss 1998). Such loss of standing vegetation structure and algal biomass generally makes wetlands less productive for invertebrates (Euliss and Grodhaus 1987, Krecker 1939, Krull 1970, Neill and Cornwell 1992). Aside from their obvious role in the feeding ecology of waterfowl and other birds, invertebrates provide critical food chain support for a wide variety of other organisms and play significant roles in nutrient cycling and overall wetland productivity (Murkin and Batt 1987).

In 2000, the USGS estimated the vertical accretion rate of sediment near the Mud Lake dike to be 0.5 inch per year, with sedimentation rates greater than 0.8 inch per year during the 1990s when river flows were especially high (Gleason et al. 2003).

At the current rate of sedimentation, the projected loss of water depth over the next 20 years would prohibit manipulation of water levels in Mud Lake. Lacking the ability to cycle vegetation and create an interspersion of cover and water, current wildlife objectives would not be met. Once Mud Lake fills with sediment, sedimentation rates are expected to escalate in Sand Lake as well.

If Mud Lake basin continues to fill with silt at its current rate, it could lose most of its original wetland volume. Methods to restore the basin would need to be evaluated within the context of economics and the postrestoration potential to provide targeted functions. Future work should assess current sedimentation rates in Sand Lake to project the life span of this impoundment.

Maintenance of the topographic relief of the Mud and Sand lakes basins is essential to maintaining the functions and biological diversity of the wetlands. Management of the upper basin may be the most practical alternative to reducing sediment in these lakes.

Conservation practices that target sustained agricultural production and long-term wetland management can be quite effective in slowing overland input into the James River, as follows:

— fencing out riparian zones
— creating greenways
— establishing grassed waterways and vegetative buffer strips
— implementing the Natural Resources Conservation Service's (NRCS) best management practices

The NRCS has already implemented the wetland reserve and conservation reserve programs on scattered lands along the James River. However, based on lack of significant enrollment in these programs, a new approach may be necessary to achieve coordinated effort among landowners to address effectively runoff issues along the James River.

One approach may include an entirely new program designed specifically for protection of the James River basin. Economic incentives could be used to facilitate landowner implementation of the program. Partners would be needed to develop such a large-scale program and could include the James River Watershed District, soil conservation districts, state and federal agencies, and other conservation organizations.

This approach could also involve a presentation of existing programs with a coordinated effort among multiple state and federal agencies. This outreach effort could be directed toward property owners on the James River flood plain to ensure that they are made aware of their options. Region 6's Partners for Fish and Wildlife Program would be one avenue for promoting new and existing programs to private landowners.

The U.S. Department of Agriculture (USDA) has the conservation reserve enhancement program (CREP), which has great potential although it has not yet been implemented in South Dakota. Based on observations in other states, the CREP program may prove to be a valuable tool to achieve the desired James River environmental goals.

In addition, the possibility of land easements or purchases could be made available. Perpetual protection of the flood plain would be preferable to a temporary solution. However, consideration should be given to the fact that perpetuity clauses may inhibit landowner participation.

Subimpoundment Objective: Manage the subimpoundments as dynamic wetland systems that cycle between drawdown and flood events, within 5 years of CCP approval, to provide quality habitat for waterfowl, shorebirds, and wading birds. During periods between drawdowns, manage the subimpoundments to provide 10–75 percent emergent vegetation and annuals, a mean water-column invertebrate biomass of 0.007 ounce per activity trap per 24-hour set during the June sampling period, and water depths of 0.4–9.8 inches over 50 percent of the flooded area for a portion of the time between April 1 and October 15. *(Same as alternative 2.)*

Rationale
(Same as alternative 2.)

The subimpoundment objective purposely includes broad ranges, as water levels are intended to vary like natural wetlands. The success and timing of such management actions are subject to dynamic weather patterns.

Plant communities in prairie wetlands are continually changing because of short- and long-term fluctuations in water levels and salinity. Prairie wetlands have evolved under these fluctuating conditions. The process of cycling with wet and dry periods makes prairie wetlands productive. For instance, exposure of mud flats during drought periods is necessary for the germination of many emergent macrophytes and facilitates the oxidation of organic sediments and nutrient releases that maintains high productivity.

Within the framework of a dynamic wetland system, management of the subimpoundments is directed toward waterfowl (foraging, breeding pairs, and broods), shorebirds, and wading birds. This objective sets an upper and lower threshold of emergent vegetation, because an interspersion of emergent vegetation and wetland openings is preferred by both dabbling and diving ducks and their broods (Kantrud 1986).


© John Jave

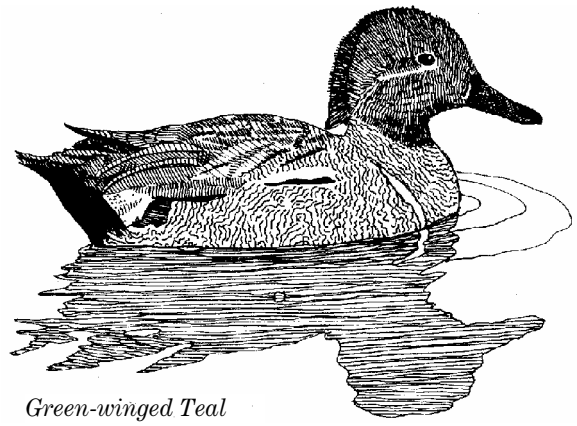
Young eared grebes keep watch from their mother's back.

Interspersed emergent vegetation also benefits other marsh-dwelling birds and mammals (Seabloom 1958, Vogl 1973, Weller and Spatcher 1965). Such conditions may also result in avian communities of greater species diversity or richness (Weller 1978,

Weller and Spatcher 1965). In addition, Voigts (1976) found maximum invertebrate abundance occurring where beds of submerged vegetation were interspersed with stands of emergent vegetation.

A lower invertebrate biomass threshold is part of the subimpoundment objective. Invertebrate abundance is quantified relative to biomass in June, because that is when invertebrate biomass is known to peak in most wetlands (Euliss and Mushet 2003). Abundance of aquatic macroinvertebrates is positively related to waterfowl use (Kaminski and Prince 1981, Schroeder 1973, Swanson and Meyer 1973) and early growth of ducklings (Chura 1961, Perret 1962, Sugden 1973). Aquatic invertebrates also are important food resources for shorebirds (Eldridge 1987), amphibians (Clark 1978, Deutschman 1984), and other marsh birds (Weller 1981).

Shallow water conditions during some portion of the year are also favorable. Deep water may reduce the availability of invertebrates to feeding waterfowl (Laperle 1974, Murkin and Kadlec 1986) and shorebirds. Optimum foraging depths for dabbling ducks, shorebirds, and wading birds are 2–9.8 inches, 0–9.8 inches, and 3–23.6 inches, respectively (Jasmer 2000). Diving ducks can also exploit food resources in shallow water (Fredrickson and Reid 1988).



Green-winged Teal
© Cindie Brunner

Strategies

— Conduct drawdowns and subsequent reflooding events.
(Same as alternative 2.)

Water could be moved in and out of the five subimpoundments opportunistically, as flows in the James River and water levels in Mud and Sand lakes allow.

When management action is necessary and water elevations in the main pools are not conducive to take advantage of gravity flow, a 16-inch Crisafulli pump could be used to move water into or out of these subimpoundments. This would add significantly to the cost, would be time consuming, and must not violate restrictions placed on the refuge's water rights. However, it could create the desired habitat conditions when other management alternatives are not available.

Most of the subimpoundments are smaller areas separated from the main pools by an embankment. Water could be diverted into or out of the subimpoundments by gravity flow. Because of their smaller size and isolation from the main pools, it would be possible to provide some water level control, thereby influencing the plant and invertebrate communities, as well as the productivity of the subimpoundments.

Plant and invertebrate production could be maximized through carefully planned drawdowns and subsequent reflooding events. Drawdowns of the subimpoundments would be accomplished in different years to provide a diversity of habitat conditions during any given year. The need for rejuvenation of plant and invertebrate communities within each unit and the ability to move water out of the unit would largely determine when drawdowns could be conducted.

— Control cattail.
(Same as alternative 2.)

If the wetland experiences only shallow flooding, emergent vegetation may eventually expand through vegetative propagation to dominate the entire wetland. The resultant buildup of litter and organic material from emergent species can reduce water depth or eliminate shallow water areas (Hammond 1961; Ward 1942, 1968). Decreased waterfowl use is commonly associated with the decreased habitat variation in stands of tall, emergent hydrophytes, which typically form monotypes in the absence of disturbance.

General references (Kozlowski and Ahlgren 1974, Wright and Bailey 1982) indicate that burning of marsh vegetation releases nutrients and opens the canopy and detrital layer. Reduction in the height and density of tall, emergent hydrophytes by fire generally benefits breeding waterfowl. Such benefits are an increase in pair density probably related to increased interspersion of cover and open water, which decreases visibility among conspecific pairs (Kantrud 1986). Grazing by cattle also may remove much organic matter and create open water areas where submersed plants flourish (Schultz 1987).

Prolonged deepwater flooding reduces emergent macrophytes due to extended inundation and the expansion of muskrats and their consumption of macrophytes (Euliss et al. 1999). Drawing the wetlands down early in the summer when mud temperatures are too cool to allow cattail germination helps discourage cattail invasions. Alternately, allowing the subimpoundments to

drain naturally would expose the mud flats in midsummer and likely encourage cattail proliferation.

Public Use

The six wildlife-dependent priority public uses specified in the National Wildlife Refuge System Improvement Act are hunting, fishing, wildlife observation, wildlife photography, environmental education, and interpretation.

All six activities are allowed and provided for at Sand Lake National Wildlife Refuge within the bounds of refuge mandates and purposes.

Wildlife-dependent Recreational Use Goal

Provide opportunities for quality, wildlife-dependent recreation for visitors to Sand Lake National Wildlife Refuge.

Consumptive Use Subgoal: Provide wildlife-dependent, consumptive, recreational opportunities that are compatible with refuge purposes and contribute to a quality outdoor hunting or fishing experience.

Hunting Objective: Allow annual, compatible, fall-hunting opportunities for deer, upland game birds, and waterfowl, consistent with applicable state regulations and principles of sound game management.
(Same as alternative 2.)

Strategies
(Same as alternative 2.)

— Provide hunting opportunities for deer, upland game birds, and waterfowl.

Areas would be designated for deer, upland game birds, and perimeter-boundary waterfowl hunting. An additional universally accessible hunting blind and parking area would be developed to increase opportunities for physically challenged hunters.

The refuge would open to upland bird hunting after the close of refuge rifle deer seasons according to state regulations and permit archery and firearm deer seasons based on consultation with the state, local landowners, and hunters.

— Create an updated hunting brochure and map for distribution at various locations around the refuge to provide hunters with up-to-date hunting rules and regulations.

— Develop a proactive law enforcement program including the establishment of a permanent, full-time law enforcement position to regulate hunting activities on the refuge and enforce wildlife laws.

Fishing Objective: When available and accessible, allow open water and ice fishing yearly from the five designated fishing areas only. Prohibit motorized and nonmotorized boating.
(Same as alternative 1.)

Strategies
(Same as alternative 2.)

— Allow fishing at five designated locations.

The public would be made aware of the fishing program through notification of rules, updated brochures, and information in the state fishing handbook.

— Develop a proactive law enforcement program including the establishment of a permanent full-time law enforcement position to monitor and regulate fishing activities and enforce wildlife laws.

Nonconsumptive Recreation Subgoal: Provide wildlife-dependent, compatible, nonconsumptive, recreational activities on the refuge that increase public understanding and appreciation of wildlife and its conservation.

On-site Visitors Objective: Educate an additional 5,000 on-site refuge visitors about local and regional conservation issues, the National Wildlife Refuge System, and Sand Lake National Wildlife Refuge within 5 years of CCP approval.
(Same as alternative 2.)

Strategy

— Develop, update, and maintain visitor services.

An on-site education center would be constructed to provide space and materials to inform students, educators, and the visiting public about the refuge, wildlife conservation, and the National Wildlife Refuge System.

Updated kiosk panels would reflect modern wildlife management practices and conservation issues, and provide general refuge information.

All brochures would be updated, using the Service's graphic standards format, to provide visitors with current information and refuge policies.

Nonconsumptive Recreation Objective: Provide opportunities for wildlife observation, wildlife photography, and interpretation annually, from April 1 to October 15, sunrise to sunset daily.
(Same as alternative 1.)

Strategy

— Develop, update, and maintain on-site nonconsumptive recreational facilities.

The 15-mile auto tour route ("wildlife drive") would be maintained and improved to provide visitors with a quality experience for viewing wildlife. This would include updating the route's self-guided brochure, updating and improving signs on the route, and maintaining pull-off sites.

The observation tower and viewing platform would continue to be maintained for public use. The currently accessible Columbia Day Use Area would be improved to provide better wildlife-viewing opportunities through hiking trails, kiosk information, and wildlife blinds.

At least one permanent photography blind would be constructed to allow photographers better access to wildlife species.

Information kiosks would be enhanced to provide visitors with up-to-date refuge information at the refuge headquarters, the Columbia Day Use Area, and on Highway 10.

An education center would be constructed to provide the visiting public with space and materials for educating about the refuge, wildlife conservation, and the Refuge System.

Public Education and Outreach Goal

Provide wildlife- and wildland-viewing opportunities for the public to enjoy and, through education and outreach, encourage them to gain a greater understanding and appreciation of national wildlife refuges and wildlife resources in general.

USFWS

Students learn hands-on about waterfowl during a school field trip to the refuge.

Public Education and Outreach Objectives

(Same as alternative 1):

- Annually host an average of two to three on-site special events designed to educate the public about wildlife resources and the National Wildlife Refuge System.
- Continue the off-site program and continue working with the radio, television, and print media. Provide an annual average of 24 radio and 8 television interviews, and annually provide information for newspaper articles at least 30 times.
- Construct an education center.

Local School Districts Objective: Increase and maintain awareness within all local school districts of the education resources and opportunities available at the refuge, through additional on- and off-site programs and workshops within 5 years of CCP approval.
(Same as alternative 2.)

Strategy

— Increase education and outreach opportunities.

A survey to determine the level of awareness of the refuge's education programs would be conducted within all local school districts.

An education outreach plan would be developed and an education brochure would be created to promote on- and off-site field trip opportunities and to inform educators of the availability of learning trunks, the education trail, and teacher guides.

Up to 25 additional educational opportunities would be created including teacher workshops, in-classroom programs, promotion of conservation learning trunks, and teacher resource kits.

An on-site education center would be built and would offer space for programs and other materials needed for students and teachers who use the refuge for outdoor classroom activities.

Communities Objective: Promote awareness of, and generate support for, Sand Lake National Wildlife Refuge and the National Wildlife Refuge System within local and regional communities through participation in a minimum of 3 additional off-site special events within 5 years of funding.

Strategy

— Increase outreach activities and education activities.

Opportunities would be sought to promote the refuge and wildlife conservation to the public. Off-site opportunities include: (1) providing speakers for community and civic groups; (2) frequently updating local congressional offices and key staff on emerging or potentially controversial issues; (3) participating in local fairs, outdoor shows, and other public events; and (4) continued participation in the Water Festival.

— The refuge's website would be maintained and improved to provide up-to-date information to the public on refuge policies, regulations, and wildlife.

— New educational and interpretive kiosks promoting the refuge and wildlife conservation issues would be developed at the Aberdeen

— Regional Airport, Wylie Park, Northern State University, and other strategic locations within the community. Five new partnerships with local and or regional interest groups would be sought and fostered to build support for the refuge and general conservation issues.

— A "friends group" would be established to provide the public with an opportunity to support the refuge.

— Weekly media contacts would continue with the "Refuge Corner Update," and news releases and articles would be made available to local media outlets including television, radio, and newsprint.

Monitoring and Evaluation

Habitat management on refuges is an ongoing process and the Service recommends that planning be conducted within the context of adaptive resource management (USFWS 1995b, 1996a).

Vegetative structure, as indicated by VORs, would be the primary method for monitoring vegetation. The dominant and subdominant species of vegetation also would be recorded annually. At present, more detailed species' descriptions are not necessary for the floristically simple habitat blocks.

Vegetative species composition would be evaluated relative to the percentage of forbs present and the percentage of Canada thistle present. More in-depth evaluations of vegetative species may be necessary once seeded natives become a more prominent component of the overall upland habitat.

Time permitting, wildlife response to habitat treatments should also be evaluated. However, monitoring wildlife response must be conducted in concurrence with habitat monitoring, as it is difficult and unreliable to evaluate the merits of various treatments when relying on wildlife response alone. A more specific protocol for the habitat-monitoring plan would be outlined within a section of the step-down plan for habitat management, following approval of the CCP.

Plan Monitoring and Evaluation

Implementation of the CCP would be monitored throughout its effective period, 2005–19.

Accomplishment of objectives listed in this CCP would be monitored annually by the supervisor of the project leader for the refuge. Monitoring of accomplishments is critical to the implementation of the CCP.

It is reasonable to believe that substantial changes could occur within the Service during the next 15 years. The objectives of the CCP would be examined at least every 5 years to determine if revisions are necessary and to allow the addition or deletion of objectives.

Personnel and Funding

The personnel and funding needed to carry out the CCP are described below.

Bill Schultze/USFWS

The staff carpenter builds a footbridge on the refuge's new education trail.

Personnel

Currently, the refuge complex has a staff of 13 full-time employees to manage the refuge and the Sand Lake WMD. Table 6 lists these positions along with seven new positions that are needed for full implementation of this CCP (those positions needed only for the refuge). The proposed positions are also included in the database for refuge operations needs (appendix I).

Funding

Funding to implement the CCP is derived from three sources:

- The refuge operations needs system (RONS) includes requests made to the Congress for funding and staffing above the existing base budget needed to administer programs and carry out projects.

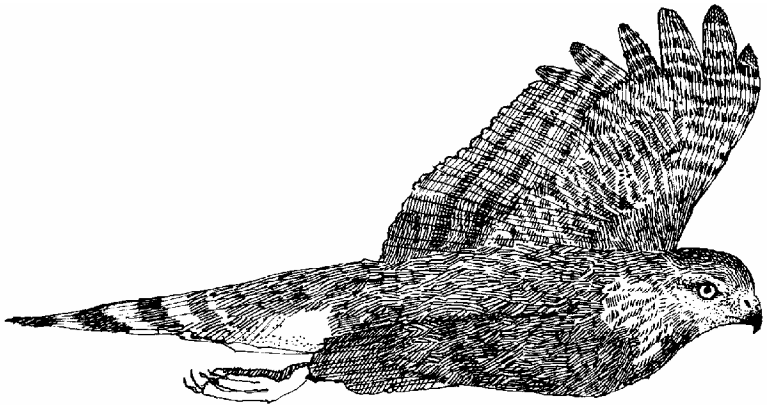
— Five of the seven new refuge positions are associated with RONS projects and would have a first-year cost of $589,500 with an annual cost of $296,000 (this does not include proposed visitor use or fire positions).

- The maintenance management system (MMS) is a database that documents the maintenance and replacement needs for existing equipment, buildings, roads, fences, and other property (appendix J).
- Cost estimates are developed for projects needed to implement the CCP, which are not yet reflected in the RONS or MMS.

Table 6. Current and proposed staff, Sand Lake National Wildlife Refuge, South Dakota

	Current Positions	*Additional Proposed Positions (Unfunded)*
Management Staff	Refuge complex project leader, GS[1]-14 Deputy project leader, GS-13 Supervisory refuge operations specialist[2], GS-12 Refuge operations specialist[2], GS-9 Refuge operations specialist[2], GS-9	Supervisory refuge operations specialist, GS-11
Biological Staff	Refuge complex biologist, GS-12 Biologist trainee, GS-9 Private lands biologist[2], GS-11	Resource specialist, GS-11
Public Use Staff	Outdoor recreation planner, GS-11	Law enforcement officer, GS-9 Law enforcement officer, GS-9 (0.5 FTE[3]) Visitor use assistant, GS-5
Administrative Staff	Administrative officer, GS-9	Clerk, GS-5
Maintenance Staff	Engineering equipment operator, WG[1]-10 Carpenter, WG-9 Biological science technician, GS-6	None
Fire Management Staff	Range technician, GS-6	Fire management officer, GS-9

[1]GS=general schedule employee; WG=wage grade employee.
[2]This position supports both the refuge and the wetland management district (WMD).
[3]FTE=full-time equivalent.



Sharp-shinned Hawk