# CHAPTER 4–Management Direction

The U.S. Fish and Wildlife Service selected the management direction described in this chapter after determining that it does the following:

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

This chapter first describes the management focus for the refuge complex, and then sets out the associated objectives and strategies that the refuge complex staff will carry out to achieve the CCP goals. The stepdown management plans listed in table 15 (section 4.9) will provide implementation details for specific programs. The chapter sections follow:





*The American avocet is a target waterbird for the Bowdoin Refuge Complex.*

## 4.1 Management Focus

The Service will use the best available science and research to determine the most effective methods for protecting, restoring, and enhancing native mixed-grass prairie to provide quality nesting habitat for targeted grassland-dependent birds. Invasive and nonnative plants, particularly Russian olive trees that fragment grassland habitat, will be controlled, reduced, or eliminated and areas will be restored to native plants, as needed.

Refuge complex staff will manage enhanced wetlands to mimic natural conditions for target species of wetland-dependent migratory birds during spring and fall migrations and during the breeding and nesting season. The Service will enhance the waterfowl sanctuary area on the eastern half of Bowdoin Refuge by closing this portion of the refuge to all foot traffic until migrating waterfowl depart, no sooner than December 1. This will not affect current waterfowl-hunting areas.

The Service will work with the State to determine the feasibility of offering a compatible, big game hunt on Bowdoin Refuge. Programs for the other wildlife-dependent public uses—fishing, wildlife observation, photography, environmental education, and interpretation—will be maintained or improved.

The visitor contact area will be expanded, and a visitor services specialist will be added to the staff. All programs will provide visitors with information on the purposes of the refuge complex including the protection of migratory birds and their habitats, the importance of protecting the remaining native mixed-grass prairie, and the mission of the National Wildlife Refuge System.

Increased research and monitoring, staff, funding, infrastructure, and partnerships are required to accomplish the goals, objectives, and strategies for the refuge complex, outlined in this chapter.

Donna Dewhurst / USFWS

*The canvasback duck is one of many migratory bird species that use Lake Bowdoin.*

## Salinity and Blowing Salts

The Regional Director selected "Salinity Alternative 4" (from the draft CCP and EA) as the preferred alternative to address the salinity and blowing salts issue at Bowdoin Refuge. The Service will design and construct an underground injection well to force saline water from Lake Bowdoin below the lowermost geologic formation containing drinking water. This pumping will continue until a salinity objective of 7,000 mg/L is achieved. At that time, the Service will determine the best way to recreate a flow-through water system that maximizes the flushing effects of natural flooding. The pump may also be operated periodically to maintain this saline objective. Section 4.5 provides background information about the salt situation and management considerations at Bowdoin Refuge, followed by specific objectives and strategies.

## Divestiture of Lake Thibadeau Refuge

The Regional Director selected "Lake Thibadeau Alternative 2" (from the draft CCP and EA) as the preferred alternative—divestiture—for Lake Thibadeau National Wildlife Refuge. The Service will prepare a proposal to divest this refuge from the National Wildlife Refuge System. This proposal will be reviewed by the Migratory Bird Conservation Committee and require an Act of Congress to be approved. The refuge and flowage easements will then be revoked and the water rights voluntarily relinquished back to the State. Subsequently, all other rights will be given to the landowner, including the management of all structures or the Service may choose to remove them. This divestiture process will be completed within 5 years. The goals, objectives, and strategies described in this chapter do not apply to this refuge.

# Refuge Complex Objectives and Strategies

Sections 4.2–4.8, organized by goal, set out the objectives and strategies that serve as the steps needed to achieve the CCP goals for the four refuges (not including Lake Thibadeau Refuge) and Bowdoin Wetland Management District. While a goal is a broad statement, an objective is a concise statement that indicates what is to be achieved, the extent of the achievement, who is responsible, and when and where the objective should be achieved—all to address the goal. The strategies are the actions needed to achieve each objective. Unless otherwise stated, the refuge complex staff will carry out the actions in the objectives and strategies. The rationale for each objective provides context such as background information, assumptions, and technical details.

Appendix B contains the required compatibility determinations for public and management uses associated with the CCP.

# 4.2 Goal for Upland Habitat and Associated Wildlife

*Protect, enhance, and restore grassland habitat for breeding and migratory birds and other wildlife while maintaining the biological diversity and integrity of native prairie grasslands.*

# Native Grassland

Prairie ecosystems thrive on the intermittent disturbance brought by frequent fire and the irregular mosaic of vegetation carved out by insects and native grazers, especially the periodic passage of bison. These disturbances and subsequent renewal have shaped the life cycle of every native prairie organism. More than 150 years ago, bison were replaced with cattle, which grazed differently and did not migrate. Historically, continuous cattle grazing was allowed on the refuge complex until the mid-1970s. This, combined with a lack of fire for at least 70 years, has resulted in a loss of plant structure and species diversity, both of which are necessary for a healthy and productive grassland ecosystem. The more palatable, tall, cool-season grasses such as green needlegrass and bluebunch wheatgrass have been replaced by increasers such as blue grama, fringed sagewort, and clubmoss. While these plants are an important part of native prairie, they should be components of a more diverse community (Lacey et al. 2005). The loss of variety in plant species and structure can be detrimental to grassland-dependent birds, which require a variety of habitats for nesting and foraging.

Today, cattle grazing can be a valuable tool in the absence of bison. If applied or used properly, grazing of native prairie by cattle can be used to stimulate vegetative and reproductive growth of plants. However, it is important that it be closely monitored and follow a prescription to achieve a habitat objective.

Grassland-nesting birds are one of the most rapidly declining groups of wildlife in North America, primarily due to habitat loss (Peterjohn et al. 1999). The Service has selected six target species of upland birds; these species depend on native prairie habitat and are listed as species of concern by Federal, State, and private entities (table 8). The upland habitat objectives, for both native and disturbed grasslands, focus on providing quality habitats (table 9) for these target species. The resulting habitats should benefit a much broader group of secondary bird species as well as a variety of other wildlife, both migratory and resident. This includes several of the target species of waterbirds (refer to section 4.3).

## Native Grassland Objective 1

Over the next 15 years or more, manage for native grassland plant species composition that approximates the historical plant community consisting of (1) 80–90 percent grasses and grass-like plants including green needlegrass, bluebunch wheatgrass, and western wheatgrass, (2) 8–12 percent forbs such as American vetch, dotted gayfeather, purple prairie clover, and other native forbs, and (3) 4–6 percent shrubs such as winterfat, silver sagebrush, and rubber rabbitbrush.

### *Strategies*

- Complete a baseline inventory of native grasslands in the refuge complex to determine abundance and overall health of grasses, forbs, and shrubs including whether remnants of the historical climax plant community exist and can serve as a seed source for restoration efforts.
- Determine if native ungulates are overbrowsing forbs and shrubs.
- Determine priority areas for restoration using the baseline inventory.
- Develop a grassland habitat management plan that incorporates tested methods for preserving and enhancing native grassland.

**Table 8. Conservation status of target species of upland birds at Bowdoin National Wildlife Refuge Complex, Montana.**

| *Species* | *Montana species of concern*[1] | *U.S. Fish and Wildlife Service focal species*[2] | *Partners in Flight priority*[3] | *Bureau of Land Management*[4] | *National Audubon Watch List*[5] |
|---|---|---|---|---|---|
| Baird's sparrow | S2 | √ | 1 | Sensitive | Red |
| Sprague's pipit | S2 | Candidate | 1 | Sensitive | Yellow |
| Chestnut-collared longspur | S3 | √ | 2 | Sensitive | Yellow |
| Greater sage-grouse | S3 | Candidate | 1 | Sensitive | Yellow |
| Long-billed curlew | S2 | √ | 2 | Sensitive | Yellow |
| Marbled godwit | — | √ | 2 | Sensitive | Yellow |

[1] S2=*At risk because of very limited and potentially declining numbers, extent, or habitat, making it vulnerable to global extinction or extirpation in the State.* S3=*Potentially at risk because of limited and potentially declining numbers, extent, or habitat, even though it may be abundant in some areas. (Montana Fish, Wildlife & Parks; Montana Natural Heritage Program)*

[2] Candidate=*A species under consideration for official listing, for which there is sufficient information to support listing.*

[3] 1=*Needs conservation action.* 2=*Needs monitoring.*

[4] Sensitive=*Proven to be imperiled in at least part of its range and documented to occur on Bureau of Land Management lands.*

[5] Red=*Declining rapidly or having very small populations or limited ranges and facing major conservation threats; typically of global conservation concern.* Yellow=*Declining or rare; typically of national conservation concern.*

**Table 9. Nesting habitat requirements for target species of upland birds at Bowdoin National Wildlife Refuge Complex, Montana.**

| *Species* | *Vegetation height (inches)* | *Litter depth*[1] *(inches)* | *Shrub cover (percent)* | *Area sensitive*[2] | *Use of nonnative vegetation* |
|---|---|---|---|---|---|
| Baird's sparrow | 8.3–13.4 | 1.6–8.3 | <25 | Yes | Low |
| Sprague's pipit | 10–12.5 | 0.8–4.3 | 5–20 | Yes | Low |
| Chestnut-collared longspur | 5.9–11.8 | <2.5 | <25 | Yes | Low |
| Greater sage-grouse | >5.9 | — | 15–31 | Yes | — |
| Long-billed curlew | 2.5–11 | — | 0 | Yes | Some |
| Marbled godwit | 5.9–11.8 | 0.8–3.5 | — | Yes | Low |

*Source: Davis (2004), Dechant et al. (2003), Dieni and Jones (2003), Green et al. (2002), Jones (2010), MSGWG (2005).*

[1] *(—)=No data found.*

[2] *Area sensitive=Species are more abundant or occur more frequently in larger patches of mixed-grass prairie; size of the area varies with the species.*

- Use a variety of management techniques such as prescribed burning, prescriptive grazing, and "interseeding." Use care with prescribed fire in this arid climate—to determine if and when an area should be burned, consider weather patterns (for example, annual rainfall since an area was last burned), vegetation, plant diversity, and current use by target bird species.

- Plant silver sagebrush on the Korsbeck and Beaver Creek WPAs to provide additional breeding, nesting, and feeding habitat for greater sage-grouse.

- To determine the effectiveness of management techniques, use a scientifically credible and conservative adaptive management monitoring scheme including evaluating the response of target upland bird species. Use this adaptive management approach to determine if the most effective methods and technologies are being used to achieve this objective.

- Collaborate with the Bureau of Land Management to monitor the prairie dog town on Hewitt Lake National Wildlife Refuge to ensure that it is maintained. Possibly pursue an agreement to close the entire prairie dog town to shooting year-round.

Gary A. Monroe / USDA–NRCS PLANTS Database

*Silver Sagebrush*

- Use habitat evaluations on Bowdoin Refuge to determine potential effects (and their degree) of native big game grazers such as white-tailed deer and pronghorn overbrowsing desirable native plant species, which would affect both species diversity and structure.

***Rationale.*** Restoration of the historical plant community in the uplands is a long-term project that goes well beyond the 15-year scope of the CCP. Ideally, upland habitats in the refuge complex will consist, over time, of grassland that provides a diversity of native vegetation and a mosaic of vegetative structure across a broad landscape. This mosaic of vegetation communities supports a greater diversity of grassland birds (Fuhlendorf et al. 2006, Madden et al. 2000) and other wildlife; however, whatever treatments are used for restoration must take into account the dry climate and the needs of the target bird species. The fact that many of the target birds are present and nesting on uplands in the refuge complex indicates that these areas are already providing some habitat for these species. Using both monitoring and adaptive management will be important before choosing where, how, and when to enhance the vegetative and structural diversity of an area.

The Society for Ecological Restoration defines ecological restoration as "the process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed" (Society for Ecological Restoration International 2004). As stated in their International Primer on Ecological Restoration, ecosystems may be altered "to the point at which the ecosystem cannot recover its predisturbance state or its historical developmental trajectory. Restoration attempts to return an ecosystem to its historic trajectory." It is not known how far the refuge complex will get along the restoration trajectory over the 15 years of the CCP; but with an initial baseline inventory, the Service could at least track that uplands were moving toward the ideal plant community and structure described in this objective.

A reference ecosystem that serves as a model is necessary to design restoration. Historical conditions are a good starting point for restoration design. The conditions described in this objective are based on the U.S. Department of Agriculture (USDA)–Natural Resource Conservation Service's ecological site description for the silty 10- to 14-inch precipitation zone (Lacey et al. 2005). Ecological site descriptions are based on "relic areas and other areas protected from excessive disturbance," illustrating the historical climax plant community as further described below (Natural Resources Conservation Service 2003):

> *The historic climax plant community for a site in North America is the plant community that existed at the time of European immigration and settlement. It is the plant community that was best adapted to the unique combination of environmental factors associated with the site […] Natural disturbances, such as drought, fire, grazing of native fauna, and insects, were inherent in the development and maintenance of these plant communities […] Plant communities that are subjected to abnormal disturbances and physical site deterioration or that are protected from natural influences, such as fire, for long periods, seldom typify the historic climax vegetation and may exist in a steady state that is different from the historic climax plant community. The historic climax plant community of an ecological site is not a precise assemblage of species for which the proportions are the same from place to place or from year to year.*

The ecological site description describes the grass, forb, and shrub species that compose the historical climax plant community and how the site may be affected by management actions such as lack of fire and overgrazing and environmental conditions such as prolonged drought. According to the ecological site description, most of the native uplands in the refuge complex are classified as "Plant Community C," which is characterized by a loss of tall bunchgrasses (green needlegrass, bluebunch wheatgrass, and porcupine grass) and an overabundance of clubmoss, blue grama, and prairie Junegrass.

Bowdoin Refuge may support as many as 300 white-tailed deer and pronghorn. Pronghorn graze some portions of the refuge year-round. While the full effect of this constant grazing is unknown, observations of sentinel forbs and shrub species on portions

of the refuge show signs of severe overgrazing (Bob Skinner, wildlife biologist, U.S. Fish and Wildlife Service, Lewistown, Montana; personal communication, March 2007). Sentinel species are those species of desirable native plants that are often overbrowsed. These grazers, although native, can have detrimental effects on species diversity and structure due to their plant preferences. The Service will need to determine the severity of the grazing and, if necessary, determine how to better distribute and reduce herd sizes.

M.C. Stensvold / USDA–NRCS PLANTS Database

*Clubmoss*

## Native Grassland Objective 2

Within 3 years, use various treatment methods to determine the most effective technique for treating and restoring refuge uplands that have become unnaturally dominated (greater than 30-percent cover) by clubmoss.

### *Strategies*

- Thoroughly research clubmoss effects and other studies dealing with clubmoss.
- Network with other agencies and universities that are dealing with clubmoss such as Natural Resources Conservation Service, The Nature Conservancy, and Montana State University.
- Recruit graduate students to carry out clubmoss studies on the refuge complex.
- Initially, establish small research plots of approximately 0.5 acre (=148 feet×148 feet) within a designated 5-acre, native-grassland study area that contains at least 30-percent clubmoss cover. Locate plots in areas with no nearby infestations of invasive plants.
- Investigate the effectiveness of using methods for treating and removing clubmoss: prescribed fire, grazing, "interseeding" of historical climax plant community species, fertilizing, herbicides, and other mechanical techniques.
- Map and monitor all treatment and control plots and document the clubmoss response.

***Rationale.*** While clubmoss is a natural component of native uplands, overgrazing, drought, and lack of fire have allowed it to increase as herbaceous cover decreased. Clubmoss spreads slowly but tolerates drought better than most native grasses and forbs. According to the Natural Resources Conservation Service ecological site description, clubmoss cover in the historical plant community varied from none to trace amounts. Vegetation measurements taken in native prairie (four study plots, 445 acres total) on Bowdoin National Wildlife Refuge from 1998 to 2001 show clubmoss cover to average 21 percent with a standard deviation of 15 percent (Dieni and Jones 2003).

The role of clubmoss in plant communities is not well understood. It has been theorized that clubmoss outcompetes other vegetation by forming dense mats that intercept water and prevent seed germination (Heady 1952, Majorowicz 1963). Other studies have rejected this hypothesis and have suggested that (1) clubmoss does not affect water use by other plants (Colberg and Romo 2003) and (2) that seed germination is more affected by the species of seeds in the seedbanks (Romo and Bai 2004). Clubmoss may also reduce runoff, increase water infiltration in heavy rain events ,and prevent invasive plants from becoming established in native grasslands that have been stressed by past overgrazing or drought (Van Dyne and Vogel 1967).

Furthermore, little is known about the value of clubmoss to wildlife. Dieni and Jones (2003) found that some grassland-nesting songbirds such as Baird's sparrows and western meadowlarks select nest patches (1.64 foot–radius plots around nests) with little or no clubmoss cover, while chestnut-collared longspurs favor sites with more cover. Sprague's pipits, did not indicate a preference.

While not seeking to eliminate clubmoss, reducing its abundance in some areas will help in the restoration of the uplands to the historical climax plant community. Small research plots and a combination of treatments will be used to simultaneously reduce clubmoss and reintroduce decreaser species such as green needlegrass and bluebunch wheatgrass. Suc-

D.M. Prellwitz / USFWS

*Refuge employees apply bands to grassland-nesting birds such as Baird's sparrow to gather scientific information.*

cessful methods will be used for future management of clubmoss to create a diversity of native vegetation and a mosaic of vegetative structure across uplands in the refuge complex.

# Disturbed Grassland

Of the 4,477 acres of disturbed grasslands in the refuge complex, 4,008 acres are on the wetland management district and 469 acres on Bowdoin Refuge. These disturbed grasslands are areas where the soil has been disrupted either by Service activities or by former landowners for agricultural purposes. These lands have been seeded to dense nesting cover (DNC), a mixture of several tame wheatgrasses and legumes that is particularly attractive to nesting waterfowl. The predominant grass species in the DNC mix were intermediate wheatgrass, tall wheatgrass, slender wheatgrass, pubescent wheatgrass, and western wheatgrass; the legumes were alfalfa and sweetclover.

Many of the DNC fields in the refuge complex are in poor condition with respect to plant diversity. These fields have only two to three of the originally planted species remaining and in many cases are dominated by exotic cool-season grasses (for example, crested wheatgrass and cheatgrass). Proper management of DNC is very intensive. A successful planting may provide quality habitat up to 8 years without disturbance; however, it is the periodic vegetation treatments such as burning and haying that capitalize on the relationship between young, vigorous stands of vegetation and higher wildlife production (Duebbert et al. 1981). With a rotational management plan that periodically rejuvenates the stand, the lifespan of a DNC seeding is about 15 years (Higgins and Barker 1982, Lokemoen 1984). Most of the refuge complex's DNC fields are well past this 15-year period.

Due to the intensive management requirements and the limited lifespan of DNC plantings—combined with recent studies indicating minimal benefits to grassland-nesting birds in DNC plantings in areas with an abundance of perennial cover (Arnold et al. 2007)—the refuge complex will gradually work to reseed the disturbed grasslands to native vegetation.

## Disturbed Grassland Objective 1

Over the next 15 years, reseed at least 500 acres to native herbaceous mixtures on areas that have become decadent and overrun by nonnative, cool-season grasses to comprise more than 60-percent native grasses and forbs within 10 years after seeding.

### *Strategies*

- Use the Natural Resources Conservation Service's ecological site descriptions, based on soil type, to determine characteristic vegetation composition for each site.
- Use locally collected seeds for planting to maintain the genetic strain of native plants found in the area, based on availability and cost.
- Use appropriate techniques for site preparation to ensure weed-free seedbeds.
- Use farming activities to prepare appropriate seedbeds.
- Manage habitat using tools such as prescribed fire and prescriptive grazing, haying, and resting.
- Use integrated pest management strategies to reduce invasive plants including noxious weeds.

- Use the best available science and updated techniques for restoration and monitoring response.
- Work with universities and other partners to pursue graduate student and research projects that address specific management challenges for restoring and managing disturbed grasslands including controlling clubmoss and crested wheatgrass.
- Monitor the response of target species of upland birds before and after treatment to determine the success of management techniques, and use adaptive management to ensure the refuge complex is using the most effective methods and new technologies.
- In restored areas, continue to trap mammalian predators such as raccoons and skunks (1) to decrease predation on ground-nesting migratory birds and their nests and (2) to protect birds that have been live-trapped for banding or disease detection. Continue to use only live traps in these situations to ensure that only targeted predator species are removed from the area (use no leg hold traps).

***Rationale.*** Using appropriate management techniques to emulate the natural disturbances under which native prairie plants evolved, the native plant seeding should persist in perpetuity. The native plantings will reduce habitat fragmentation and attract grassland birds that have adapted to the diverse structure of native prairie; whereas DNC limits the structural diversity of the vegetation and likely attract those bird species that key into tall dense cover. Native grass, although more difficult to establish and usually more expensive, can be maintained in a vigorous condition longer without the need for constant rejuvenation.

## Disturbed Grassland Objective 2

Over the next 15 years, continue to use and maintain DNC on disturbed grasslands for wildlife habitat; maintain DNC every 4–7 years to promote the optimal vigor of present plant species.

### *Strategies*

- Use appropriate techniques for site preparation to ensure weed-free seedbeds.
- Use farming activities to prepare appropriate seedbeds.
- Seed DNC on highly erodible lands in Bowdoin Wetland Management District.
- Manage habitat using tools such as prescribed fire and prescriptive cattle grazing and haying to establish and maintain DNC.
- Use integrated pest management strategies to reduce noxious weeds and other invasive plants.

***Rationale.*** Disturbed grasslands that have not been targeted for native plantings will be maintained in their current state of cover, and periodic treatment will remove accumulated duff and rejuvenate plants. Vegetative cover including DNC plantings older than 15 years will be managed to maintain their vigor, so these areas could continue to provide value to wildlife and increased soil stabilization for reduced sedimentation into wetlands.

Some areas might be reseeded to DNC if needed to maintain structure and productivity. Fields dominated by exotic cool-season grasses such as crested wheatgrass and cheatgrass might become source sites from which these exotic grasses could invade adjoining grasslands. In these situations, it might be more appropriate due to funding availability to plant DNC rather than a native grass mixture. In those seed mixes, viable grasses will be western wheatgrass, slender wheatgrass, and tall wheatgrass and alfalfa will be a compatible legume. On highly erodible land that has lost its topsoil layer due to years of farming, planted DNC could reduce erosion and initiate the redevelopment of a topsoil layer for future native seed establishment.

# 4.3 Goal for Wetland Habitat and Associated Wildlife

*Provide wetland habitat for breeding and migratory birds and other wildlife that maintains biological diversity and integrity of prairie pothole wetlands.*

Wetlands in the Bowdoin National Wildlife Refuge Complex are a mixture of managed and natural wetlands of different types, sizes, and water quality. Managed wetlands are areas created or restored through water management, such as using water control structures to manually flood areas and to conduct water drawdowns. The focus for managed wetlands is to mimic natural wetland conditions whenever possible.

Temporary, seasonal, and semipermanent wetlands are by far the most important types of wetlands for most species of waterfowl that breed throughout the Prairie Pothole Region (Kantrud et al. 1989). Waterfowl, shorebirds, and other waterbirds depend on this complex of wetland types to fulfill various needs

throughout their life history, particularly during the breeding season (Baldasarre and Bolen 2006). For example, during a radio-telemetry study of mallards nesting North Dakota, eight females used 7–22 different wetlands during the breeding period; the birds preferred temporary, seasonal, and, to a lesser extent, semipermanent wetlands (Dwyer et al. 1979).

By understanding how waterfowl and other waterbirds use resources, managers are able to attract and hold these species on managed wetlands. Manipulation of soil and water to produce essential habitat structure or foods may be necessary. The sharp increase in invertebrate populations when wetlands flood following a dry phase is an important reason for artificially flooding and draining wetlands to enhance waterfowl habitat (Cook and Powers 1958, Kadlec and Smith 1992), and it is the basis for the modern-day practice of moist-soil management (Fredrickson and Taylor 1982).

To promote seed-producing wetland plants for fall migrants like waterfowl, it is important to know the regional growing seasons. Managers can use this information to schedule gradual drawdowns of managed wetlands to achieve the most productive plant response. Plant promotion is also good structure for production and diversity of invertebrates. The average length of the growing season in Phillips County, Montana, is 130 days (PhillCo Economic Growth Council, Inc. 2001). Where the growing season is shorter than 140 days, wetland drawdowns are described as early or late drawdowns. Early drawdowns are those that occur during the first 45 days of the growing season, whereas late drawdowns occur in the latter 90 days of the growing season (Fredrickson 1991). In areas characterized by summer droughts, early drawdowns often result in good germination and newly established plants have time to establish adequate root systems before dry summer weather predominates. For example, smartweed tends to respond best to early drawdowns, whereas sprangletop responds best to late drawdowns. Drawdowns can be natural or mechanical (by means of water control structures).

Drawdowns attract a diversity of foraging birds such as shorebirds and white-faced ibis to wetlands with abundant food resources, concentrated in smaller areas and at different water depths (Fredrickson 1991). Slow drawdowns (2–3 weeks) are usually more desirable for plant establishment and wildlife use. Slow release of water concentrates and traps invertebrates, making them readily available to foraging birds. Furthermore, drawdowns scheduled to match the spring migration are beneficial to migratory waterbirds.

Dave Menke / USFWS

*The sora is a small marshbird that uses ponds in the Bowdoin Refuge Complex.*

## Managed Wetlands

Lake Bowdoin attracts thousands of ducks, swans, and geese during the spring and fall migrations. The lake is a 4,470-acre (at full pool) natural, subsaline, permanent wetland that, during the early history of Bowdoin Refuge, was modified to create additional wetland habitat for migratory birds. Modifications to the lake included water control structures and a dike system for holding delivered water and capturing floodwaters and runoff.

Additionally, the Service manipulates water in several ponds in the refuge complex that attract a tremendous diversity of waterfowl and shorebirds, including the threatened piping plover. The deepwater impoundments have emergent vegetation such as bulrush and cattails and are important nesting, brood-rearing, and feeding sites for diving ducks such as the canvasback, as well as for the marsh wren, sora, and others.

Some of the managed semipermanent wetlands in the refuge complex lack full-management capabilities from off-refuge irrigation return flows, subirrigation, and seepage from Nelson Reservoir. Examples of these are Ducks Unlimited Pond, Patrol Road Pond, and Strater Pond.

## Target Waterbird Species

The Service has selected a diverse group of target waterbird species, including ducks and shorebirds (table 10). Table 11 displays the habitat needs for

**Table 10. Conservation status of target species of waterbirds at Bowdoin National Wildlife Refuge Complex, Montana.**

| *Species* | *Montana species of concern*[1] | *U.S. Fish and Wildlife Service focal species* | *Partners in Flight priority*[2] | *Bureau of Land Management*[3] | *National Audubon Watch List*[4] |
|---|---|---|---|---|---|
| Northern pintail | — | √ | — | — | — |
| Mallard | — | √ | — | — | — |
| Redhead | — | — | — | — | — |
| Tundra swan | — | — | — | — | — |
| Piping plover | S2 | Threatened | 1 | Special status | Red |
| White-faced ibis | S1 | — | 2 | Sensitive | — |
| Willet | — | — | 3 | — | — |
| Franklin's gull | S3 | — | 2 | Sensitive | — |
| Wilson's phalarope | — | √ | 3 | Sensitive | Yellow |

[1] S1=*At high risk because of extremely limited or rapidly declining numbers, range, or habitat, making it highly vulnerable to global extinction or extirpation in the State.* S2=*At risk because of very limited and potentially declining numbers, extent, or habitat, making it vulnerable to global extinction or extirpation in the State.* S3=*Potentially at risk because of limited and potentially declining numbers, extent, or habitat, even though it may be abundant in some areas. (Montana Fish, Wildlife & Parks; Montana Natural Heritage Program)*

[2] 1=*Needs conservation action.* 2=*Needs monitoring.* 3=*Local concern.*

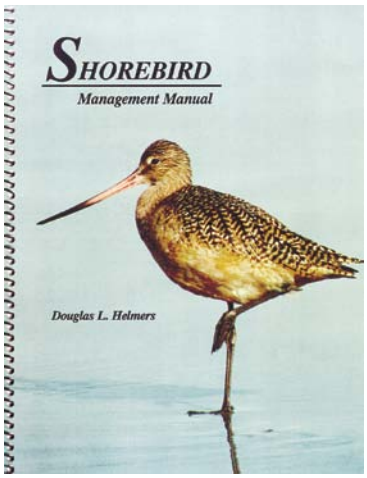
[3] Special status or Sensitive=*Proven to be imperiled in at least part of its range and documented to occur on Bureau of Land Management lands.*

[4] Red=*Declining rapidly or having very small populations or limited ranges and facing major conservation threats; typically of global conservation concern.* Yellow=*Declining or rare.*

these target species. Managing for the life history needs of these species provides the natural wetland diversity and conditions needed not only for these targeted species but also for an even greater variety of wetland-associated wildlife. Monitoring will focus on these targeted species to determine their response to wetland management.

## Shorebird Habitat Target Species

Nearly 40 species of shorebirds migrate through the interior region of North America and 13 species breed in this region (Helmers 1992). Shorebirds exploit upland habitats associated with wetlands by foraging in shallowly flooded pastures or irrigated agricultural fields with short, sparse, residual vegetation left from mowing, haying, grazing, or burning practices. Migratory shorebirds consume large numbers of invertebrates. Invertebrate availability in wetlands is a function of the hydrologic regime. Many shorebirds feed predominantly on chironomid larvae (bloodworms), which occur in open shallow habitats with a silt substrate relatively free of vegetation.




Most shorebird use occurs where vegetation cover is less than 25 percent. Shorebirds prefer short vegetation, generally less than half the height of the bird. Nest sites for the target shorebirds range from sand or gravel substrate with no vegetation (piping plover) to midgrass prairie (marbled godwit, willet). Managing for a range of wetland habitat conditions, from sparsely vegetated mudflats to moderately vegetated open shallows, will provide shorebirds with required habitats throughout their migratory and breeding periods.

Eleven species of shorebirds have been documented breeding on the Bowdoin National Wildlife Refuge Complex: piping plover, killdeer, long-billed curlew, common snipe, upland sandpiper, marbled godwit, willet, spotted sandpiper, American avocet, Wilson's phalarope, black-necked stilt, and mountain plover. Shorebird habitat management in the refuge complex emphasizes provision of breeding habitat for three target species: piping plover, marbled godwit, and willet (table 12). These species represent different guilds (groups of species all members of which use similar resources in a similar way). Meeting the diverse habitat requirements for these species will likely provide quality habitat for all shorebirds.

Spring migration habitat should be available on the refuge complex

**Table 11. Life history needs of target species of waterbirds at Bowdoin National Wildlife Refuge Complex, Montana.**

| *Species* | *Arrival date* | *Forage depth (feet)* | *Peak nesting month* | *Nesting site (distance above water line)* | *Departure date* |
|---|---|---|---|---|---|
| Northern pintail | Mid-March to early April | ≤1.5 | Mid-May | Shortgrass uplands | November |
| Mallard | Mid-March | ≤1.5 | May | Uplands, 2 feet | Freeze-up to November |
| Redhead | April[1] | 3.3–9.8 | Late May | Emergent vegetation (cattails and hardstem bulrush), 0.2–0.8 feet | Early October[1] |
| Tundra swan | Late March and late September | 0–3.3 | — | — | Early April and November |
| Marbled godwit | Late April[2] | 0.2–0.4[3] | May | Midgrass uplands, <0.5 feet[4] | September |
| White-faced ibis | May[2] | 0–1 | May | Cattails and bulrushes, 3 feet | September |
| Franklin's gull | Mid-April | 0–0.5[5] | May | Cattail or bulrush mats | Mid-October |
| Wilson's phalarope | Early May | 0–0.25 | June | Uplands and wet meadows | Mid-August to early September |

*Source: Unless otherwise the noted, this information came from Birds of North America Online (Poole 2005) and Montana Field Guide (2010).*

[1] *Frank Belrose (1980).*

[2] *Ryan and Renken (1987).*

[3] *Melcher et al. (2006).*

[4] *Eldridge (1992).*

[5] *Refuge staff observations.*

**Table 12. Nest site and habitat characteristics of target, interior-nesting shorebirds at Bowdoin National Wildlife Refuge Complex, Montana.**

| *Species* | *Nest site* | *Substrate* | *Wetland type* | *Vegetation height* | *Vegetation density* | *Nesting behavior* |
|---|---|---|---|---|---|---|
| Piping plover | Beach or peninsula | Open, salt flats, or gravel | Alkaline or saline | None | Sparse | Semicolonial |
| Marbled godwit | Upland | Open or vegetated | Freshwater or saline | Medium | Moderate | Solitary |
| Willet | Upland prairie | Open or vegetated | Freshwater or saline | Medium | Moderate | Solitary |

*Source: Helmers (1992).*

by mid-April that provides foraging water depths of 0 (dry mud) to 0.6 foot (18 centimeters), which meets the needs of these species, as specified below and in figure 37:

- *Piping plover*: 0–0.1 feet (0–3 centimeters)
- *Marbled godwit*: 0.1–0.5 feet (4–16 centimeters)
- *Willet*: 0–0.5 feet (0–16 centimeters)

# Wetland Habitat Objectives

The following objectives address management of the temporary, seasonal, and semipermanent wetlands within the Bowdoin Refuge Complex.

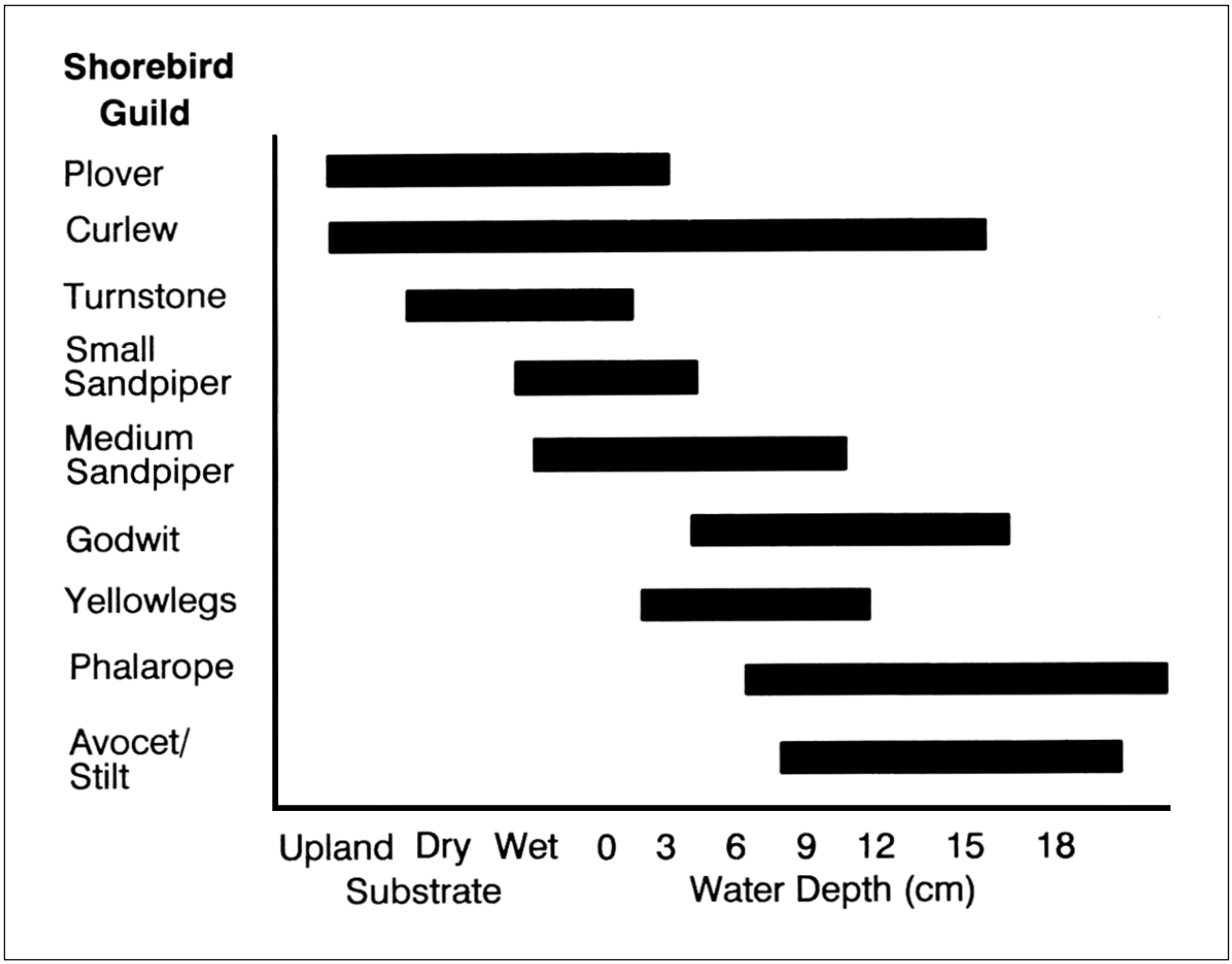



**Figure 37. Graph of water depth and substrate preferences of shorebird foraging guilds (Helmers 1992).**

## Wetland Habitat Objective 1

Depending on the availability of delivered water and environmental conditions, fill at least 70 percent of the temporary wetlands to a maximum of 1.5 feet in spring (by April 15) for 3 out of every 5 years to provide breeding, nesting, feeding, and migration habitat for target waterbirds and feeding and breeding habitat for resident waterfowl and shorebirds.

***Strategies***

- Coordinate with Malta Irrigation District for timely water delivery to ensure water is available for peak migration periods for waterbirds.
- Develop new ground-water wells to supplement wetland management needs in the refuge complex.
- Develop water-pumping sites on Beaver Creek WPA and McNeil Slough WPA to create wetland habitat for migratory birds.
- Manipulate water levels with flooding and drawdowns (natural and physical releases).
- Monitor the response of target waterbirds to habitat management.
- Monitor the response of plants and invertebrates to the timing of flooding and drawdowns.
- Monitor for undesirable plants such as cattail and bulrush. To maintain no more vegetation than a ratio of 70:30 for vegetation to open water, conduct management actions necessary to set back monocultures of these plants through flooding, prescribed burning, prescriptive grazing, or chemical use.
- Time flooding and drawdowns to mimic natural hydroperiods (wet cycles).
- Conduct all water manipulations slowly, so invertebrates can adjust to the changes in water level and temperature.

- Use mid- to late-summer water deliveries as part of managing large monocultures of cattails that reduce the availability of open-water habitat for waterbirds.

- Allow wetlands to go dry by late spring or early summer through evaporation or water level management.

- Identify and map potential areas to create or enhance wetlands.

***Rationale.*** Wetland vegetation is important to waterbirds such as waterfowl because they produce seeds, tubers, browse, and nesting sites and serve as litter or food for invertebrate populations. Temporary, seasonal, and semipermanent potholes are by far the most important wetland areas for breeding waterfowl (Kantrud and Stewart 1977, Stewart and Kantrud 1973). They provide migratory bird habitat for spring migration, feeding, and resting. In addition, potholes provide breeding habitat for the target species that depend on temporary wetlands. These wetlands are particularly important breeding habitat for early nesting species such as northern pintail and mallard and also serve as habitat for migrating waterfowl and shorebirds (Baldasarre and Bolen 2006). Temporary wetlands hold water for only a few weeks after snowmelt and occasionally for a few days following heavy rainstorms in late spring, summer, and fall. They are especially important, because they provide isolation and spacing for pairs of breeding waterfowl. Temporary wetlands are shallow basins; therefore, waters warm rapidly and are the first to become ice-free in late winter and early spring and provide the first sources of invertebrates (Baldasarre and Bolen 2006, Swanson et al. 1974).

Timing, speed, and duration of water deliveries and wetland drawdowns have important effects on the composition and production of wetland plants, invertebrate production and accessibility, and use by waterbirds. Fall flooding provides waterfowl and other waterbirds access to invertebrates and to seeds produced by wetland plants. Wetland edges with mudflats or shallow areas create feeding habitat for shorebirds and resting areas for other waterbirds. As a wetland deepens toward the center, it creates different feeding depths for various species of waterbirds.

## Wetland Habitat Objective 2

Depending on the availability of delivered water and environmental conditions, fill at least 70 percent of the seasonal wetlands to a maximum of 1.5 feet in the spring or fall, or both, for 4 out of every 5 years to provide feeding, breeding, nesting, brood-rearing, and migration habitat for target waterfowl, shorebirds, and other waterbirds.

***Strategies***

- Coordinate with Malta Irrigation District for timely water delivery to ensure water is available for peak migration periods for waterbirds.

- Acquire funding to buy additional delivered water from Malta Irrigation District (when available) for Lake Bowdoin during the spring or fall, or both.

- Manipulate water levels with flooding and drawdowns (natural and physical releases).

- Time flooding and drawdowns to mimic natural hydroperiods.

- Conduct all water manipulations slowly, so invertebrates can adjust to the changes in water level and temperature.

- Monitor the response of plants and invertebrates to the timing of flooding and drawdowns.

- Monitor for undesirable plants such as cattail and bulrush. To maintain no more vegetation than a ratio of 70:30 for vegetation to open water, conduct management actions necessary to set back monocultures of these plants through flooding, prescribed burning, prescriptive grazing, or chemical use.

- Gradually fill temporary wetlands in late summer (September) over a 2- to 3-week period to provide feeding habitat for fall-migrating shorebirds. Continue filling to a maximum of 1.5 feet by October 30 for use by fall-migrating waterfowl and other waterbirds and in preparation for the following spring migration.

- Gradually begin filling wetlands by the beginning of April over a 2- to 3-week period for spring migrants. Continue filling to a maximum of 1.5 feet by April 15 for use by spring-migrating waterfowl and other waterbirds.

- Provide a 70:30 ratio of emergent vegetation to water over 7–8 years, with cattails not occupying more than 70 percent of a wetland. Remove 80–100 percent of cattails by using disking, burning, or chemical treatment when cattails exceed 70 percent of the wetland surface.

- Use chemicals approved by the Service for aerial spraying to kill undesirable plants in wetlands.

***Rationale.*** Seasonal wetlands maintain water in spring and early summer but normally are dry by late summer and early fall. They provide migrating, feeding, and resting habitat for migratory waterbirds. In addition, seasonal wetlands provide habitat for breeding and brood rearing for species such as northern pintail, mallard, and marbled godwit. These wetlands provide abundant invertebrate foods and other components of breeding habitat, including nesting cover for those species of ducks that nest over water (Baldasarre and Bolen 2006, Kantrud et al. 1989).

Waterfowl have various tolerances for the height and density of vegetation. Mallards and blue-winged teal readily use habitats with dense vegetation; northern pintails prefer shallow, open habitats where visibility is good and vegetation sparse. Shallow water is essential for dabbling ducks such as northern pintails and mallards whose optimum foraging depth is 0.2–0.8 feet. Wetland vegetation is important, because it provides seeds, tubers, browse, and nesting sites for waterfowl; this vegetation serves as litter or food for invertebrate populations.

Timing, speed, and duration of water deliveries and of wetland drawdowns all have important effects on the composition and production of wetland plants, invertebrate production and accessibility, and use by waterbirds. The key to managing habitat for migrating shorebirds is to encourage invertebrate production, and then make the invertebrates available to the birds. The proper regime of drawdown and flooding can stimulate plant growth and decomposition and create a detrital food source for invertebrates. When the water is drawn down slowly (0.8–1.6 inches per week) during the appropriate times of the year, shorebirds are attracted to the available invertebrates. Shorebirds feed primarily on midge larvae during migration. Several studies revealed that, irrespective of wetland type, midge larvae are often the most abundant invertebrate. Midges are often most abundant in areas of shallow, open water that is not shaded by submergent and emergent vegetation. Because many waterfowl hens and broods also consume midge larvae, management of habitat for shorebirds is also beneficial for waterfowl (Eldridge 1992). Fall flooding provides waterfowl and other waterbirds access to invertebrates and to any seeds produced by wetland plants and prepares the wetland for the following spring migrants.

## Wetland Habitat Objective 3

Depending on the availability of delivered water and environmental conditions, fill at least 70 percent of the semipermanent wetlands to provide shallow areas of a maximum of 1.5 feet (for dabbling ducks such as northern pintail and mallard and for wading birds such as white-faced ibis and willet) and deep areas of 3–4 feet (for deep-water species such as lesser scaup). Allow emergent vegetation to establish as nesting habitat for overwater nesters, but allow no more vegetation than a ratio of 70:30 of emergent vegetation to open water.

### *Strategies*

- Time the delivery of the Malta Irrigation District water to achieve this objective.
- Manipulate water levels with flooding and drawdowns (natural and physical releases).
- Time flooding and drawdowns to coincide with the migration periods.
- Conduct all water manipulations slowly, so invertebrates can adjust to the changes in water level and temperature.
- Monitor the response of target waterbirds to these manipulations.
- Monitor the response of plants and invertebrates to the timing of flooding and drawdowns.
- Monitor for undesirable plants such as cattail and bulrush. To maintain no more vegetation than a ratio of 70:30 for vegetation to open water, conduct management actions necessary to set back monocultures of these plants through prescribed burning, prescriptive grazing, flooding, mechanical treatment, or chemical use.
- Flood the uplands surrounding the emergent vegetation zone in early spring to kill wet meadow plants, allowing midges to rapidly colonize the detritus. Maintain the high water level, and then slowly lower it to expose the decomposing vegetation during the peak shorebird migration.
- Through the nesting period, maintain 2–3 feet of water in areas with emergent vegetation for birds that nest over water.
- Fill 50 percent of the semipermanent wetlands to full capacity (at least 2–3 feet of water below the emergent vegetation) by May 15 to provide migration habitat for waterbirds, to serve as brood-rearing habitat for waterfowl, and to provide nesting habitat for overwater nesters such as white-faced ibis, Franklin's gull, and grebes. Annually rotate the wetlands that are flooded, allowing some to remain dry.
- Use drawdown structures or allow natural evaporation on these semipermanent wetlands to

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*White-faced ibis congregate in a wetland at Bowdoin Refuge Complex.*

encourage nutrient recycling and increase production of invertebrates and desirable wetland plants and seeds. Determine the timing of these drawdowns depending on weather conditions (particularly increasing temperatures to aid evaporation) and management objectives.

- Use chemicals approved by the Service for aerial spraying to kill undesirable plants.

***Rationale.*** Semipermanent wetlands ordinarily retain water through spring and summer and frequently into fall and winter. They are highly important to diving ducks and especially important for dabbling ducks in years when drought limits the availability of temporary and seasonal wetlands. During drought conditions in North Dakota, mallard broods occurred only on semipermanent wetlands (Baldasarre and Bolen 2006, Talent et al. 1982), and 58 percent more duck broods were recorded using semipermanent potholes in comparison with other types of wetlands in North Dakota and South Dakota (Baldasarre and Bolen 2006, Duebbert and Frank 1984). Semipermanent wetlands provide migration habitat for migratory waterbirds such as diving ducks (redhead and lesser scaup) both in the spring and fall (if they still have water) but, more significantly, habitat for brood rearing and overwater nesting for waterbirds such as white-faced ibis. These wetlands also provide escape cover.

The structure created by emergent vegetation is an essential feature of wetland habitats. Weller and Spatcher (1965) recorded maximum diversity and abundance of birds on marshes in Iowa where the ratio of emergent vegetation to water was 50:50 and referred to this form of wetland physiognomy as hemimarsh (Baldasarre and Bolen 2006). Bulrushes and especially cattails are among the most common plants in emergent communities. These plants are primarily important as cover, although alkali bulrushes are key food producers (Baldasarre and Bolen 2006). When conditions allow these plants to become a monoculture and overtake a wetland, animal and plant diversity declines. Wetland vegetation is important to waterbirds such as waterfowl because they produce seeds, tubers, browse, and nesting sites and serve as litter or food for invertebrate populations. Timing, speed, and duration of water deliveries and of wetland drawdowns all have important effects on the composition and production of wetland plants, invertebrate production and accessibility, and use by waterbirds. Filling wetlands in the fall will make seeds from wetland plants more readily available to migrating waterbirds.

R.H. Mohlenbrock / USDA–NRCS PLANTS Database

*Alkali bulrush is a common emergent plant in the refuge complex.*

## Wetland Habitat Objective 4

On semipermanent wetlands having limited management capabilities, manage emergent vegetation as a hemimarsh to provide open water and cover for migratory birds.

***Strategies***

- Monitor for undesirable emergents such as cattail and bulrush. To maintain no more vegetation than a ratio of 70:30 for vegetation to open water, conduct management actions necessary to set back monocultures of these plants through the use of a glyphosate or, where possible, through flooding, prescribed burning, prescriptive grazing, mechanical treatment, or chemical use.

- Restore the natural vertical structure in riparian corridors using native species such as cottonwood, willows, and native shrubs to provide habitat for migratory birds and other native wildlife. Continue to fence riparian areas to protect them from trespass cattle grazing.

- Use chemicals approved by the Service for aerial spraying to kill undesirable plants.

- Monitor the response of waterbirds to management actions.

***Rationale.*** Cattails are of little value as duck food but are more important as escape, loafing, and nesting cover for some species of waterfowl, other waterbirds, and red-winged and yellow-headed blackbirds. However, when unchecked, cattail stands often expand rapidly to the exclusion of other vegetation and open water; such conditions severely restrict waterfowl and shorebird use (Baldasarre and Bolen 2006, Kaminski et al. 1985).

The desired optimal wetland condition that provides the greatest diversity and number of birds is hemimarsh. In hemimarsh conditions, wetland vegetation cover and water in a semipermanent wetland is at a 50:50 ratio (Weller and Spatcher 1965). Wetland birds that find hemimarsh conditions favorable include various waterfowl and shorebird species such as herons, gulls, terns, blackbirds, and grebes. All of the target species regularly use these particular semipermanent managed wetlands at various times of the year. In addition, they provide ideal nesting cover for birds that nest over water. It is important to avoid undesirable plants and monocultures of plants in hemimarsh wetlands. Undesirable plants are plants that quickly shift diverse floral systems toward monocultures, are difficult to reduce in abundance, have minimal values for wetland wildlife, or outcompete plants with greater value (Fredrickson and Reid 1988b).

Through limited water level management or chemical use, or both, the Service anticipates being able to achieve emergent vegetation to open water ratios close to the 50:50 ratio (such as 30:70 and 70:30 ratios) recommended by Weller and Spatcher (1965) in most years (approximately 11 out of 15). Because of the dynamics involved with these particular wetland conditions over time, the coverage of emergent vegetation may fall well outside the target range (30- to 70-percent coverage) in some years and, during years of extreme drought, cover of emergents such as cattail and bulrush may exceed the upper target of 70 percent.

The Drumbo, Goose Island, Patrol Road, Strater, and Black Coulee Ponds are considered semipermanent and the Service does not have complete management capabilities in these wetlands because of subirrigation and irrigation return flows entering the refuge. Consequently, cattails have overgrown these wetlands.

# Avian Disease

The refuge complex staff completed a Disease Contingency Plan in 2006 for the Bowdoin National Wildlife Refuge Complex. The Bowdoin Refuge has a history of botulism outbreaks, which generally begin in July and last into September. The numbers of waterfowl affected has varied greatly from year to year, while the location of disease hotspots—areas with the highest mortalities—has changed little: the southwestern and southeastern bays of Lake Bowdoin, the northeast shore of Big Island in Lake Bowdoin, and the northwest portion of Drumbo Pond.

A sudden die-off of pelicans on Lake Bowdoin in 2003 was the result of West Nile virus, and the disease has been documented in the area every year since this time. Outbreaks begin as early as July and can last into fall.

While not documented at the refuge complex, new disease threats continue to emerge such as highly pathogenic avian influenza and Newcastle disease. The Service can no longer afford to rely on past informal protocols for avian diseases.

## Avian Disease Objective

Manage wetlands to minimize or avoid outbreaks of avian botulism on the Bowdoin Refuge throughout the 15-year CCP. Continue to monitor for existing and new avian diseases throughout the refuge complex, particularly for those that might transfer to other wildlife and humans.

***Strategies***

- Follow the monitoring and response protocols outlined in the disease contingency plan.
- Annually review and update the disease contingency plan and continue to monitor for disease outbreaks within the refuge complex.
- Maintain a supply of personal protective equipment for emergency cleanup operations.
- Cooperate with partners who are responsible for detecting and monitoring existing and new wildlife diseases.
- Continue to submit tissue samples to the National Wildlife Health Center for disease diagnosis.
- Avoid fluctuating water levels in botulism hotspots between early July and early September when outbreaks are likely to occur; plan water deliveries during early spring (through May 15) and late summer (early September).
- As temperatures rise in the summer, monitor wetlands weekly for disease outbreaks. Send sample carcasses to the National Wildlife Health Center for analysis. Remove birds in areas with high visitor use.
- Continue to educate staff and visitors on how to avoid contact with wildlife diseases that have the potential to be transferred to humans.
- Continue to allow the U.S. Interagency Working Group to monitor the refuge complex for avian influenza outbreaks.
- When approved, implement the Mountain–Prairie Region policy for a mosquito control plan to address potential outbreaks of West Nile virus or avian influenza.

***Rationale.*** America's global economy and the ability for individuals to easily travel around the world have escalated the transfer of new diseases, harmful to both animals and humans, to North America. Most recently, concerns have been raised over the potential migration to North America of highly pathogenic avian influenza. The Service's response to this outbreak could rapidly change management of Service lands. Unlike avian botulism, highly pathogenic avian influenza and West Nile virus pose serious human health risks (USFWS 1999a). Service employees and visitors are made aware of disease symptoms and avoiding the risks of contracting these diseases before going into the field. Unfortunately the symptoms of these diseases make it impossible to detect their presence and spread among wildlife until mortality occurs (Centers for Disease Control and Prevention 2010).

Avian botulism is a paralytic disease caused by ingestion of the *Clostridium botulinum* bacteria. The bacteria can exist as a dormant spore in soil for many years until a combination of warm temperatures, a protein source, and an anaerobic (no oxygen) environment allows the bacteria to become active and release its toxin. Decaying vegetation attracts a large number of aquatic invertebrates that pick up the toxin and are then ingested by waterfowl and shorebirds. A cycle develops when the affected birds die and the fly larvae that feed on the carcasses are, in turn, ingested by other birds. Sudden water drawdowns during this period could expand the spread of the botulism toxin by causing significant die-offs of aquatic invertebrates (Davis et al. 1971, USFWS 1999a). By avoiding the flooding of botulism hotspots during July through September, an outbreak would be avoided or at least reduced in severity.

# Piping Plover

The northern Great Plains population of piping plover consists of about half of the world population of this plover. This population is expected to go extinct in 50–100 years unless significant conservation activities are started. Bowdoin National Wildlife Refuge has more than 1,300 acres of critical habitat designated for the piping plover. The Service has collaborated with Reclamation and Ducks Unlimited to restore and create habitat for this threatened species.

## Piping Plover Objective 1

Over 15 years, annually monitor and protect piping plover nests found within the refuge complex and monitor the success of protected nests and hatched young. Strive for fledging rates of more than 1.36 fledglings per breeding pair of plovers (USFWS 2003).

***Strategies***

- Continue to participate in the International Piping Plover Census and annually monitor for the presence of piping plovers on Bowdoin and Hewitt Lake refuges.
- Survey wetlands for piping plovers by the most appropriate means (for example, by boat, walking the shoreline, or viewing from a vehicle with a spotting scope). Conduct surveys between late May and mid-June.

- Erect wire mesh cages with netted tops over piping plover nests that are in danger of being trampled or subjected to predation by birds.

- Move or elevate active nests that are in danger from rising water (Prellwitz et al. 1995).

- Monitor the success of protected nests by searching for "pip chips" (small pieces of egg shell left in the nest bowl during the hatching process) in or near the nest bowl or by timing nest visits based on known (or suspected) nest initiation date, laying rate, and average incubation period.

- Monitor hatched young to when they fledge.

***Rationale.*** The northern Great Plains population of piping plovers is listed as threatened in the United States (USFWS 1985) due to a poorly understood decline in abundance. Mabee and Estelle (2000) suggested that nest predation is a major problem limiting the nest success of piping plovers throughout their range. However, according to Murphy et al. (2003), predators can successfully be deterred from depredating eggs of piping plovers by placing large (10-foot diameter) mesh exclosures (cages) over individual nests. Recruitment has improved with the use of these cages in the northern Great Plains (Murphy et al. 2003). Exclosures placed after one or more eggs have been laid in the nest bowl have resulted in less than 2-percent nest abandonment (Atkinson and Dood 2006).

Beginning in 1991, biologists throughout North America collaborated in a monumental effort known as the International Piping Plover Census (Haig and Plissner 1993). Breeding and wintering habitats are censused at 5-year intervals to (1) establish benchmark population levels for all known piping plover sites, (2) survey potential breeding and wintering sites, and (3) assess the current status of the species relative to past population estimates.

## Piping Plover Objective 2

Over 15 years, improve and protect breeding, nesting, and feeding habitat on Piping Plover Pond at Bowdoin Refuge. Manage for gravel or alkaline beaches with no vegetation or vegetation that is short (less than 0.3 feet) and sparse (less than 10 percent cover), that are at least 65.6 feet wide, and that provide water for foraging throughout the breeding and brood-rearing season.

### *Strategies*

- Monitor Piping Plover Pond for encroachment of invasive plants, trees, and other tall vegetation. Maintain at least 90-percent bare gravel on nesting beaches.

- Apply herbicides, mechanical disturbance, or other means to remove upland vegetation before the breeding season or after plovers have left the area. Restrict control activities between May 15 and August 7 (Stewart 1975) or any time that piping plovers are present on the beaches.

- Acquire money to buy the water resources necessary to properly manage piping plover habitat at Bowdoin Refuge.

- Continue to work with Reclamation and other agencies to acquire additional knowledge and resources to improve and protect piping plover habitat on Piping Plover Pond at Bowdoin Refuge.

- Deliver water to Piping Plover Pond during the fall or spring, before the breeding season (refer to above Managed Wetlands section).

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*Piping Plover Chick*

***Rationale.*** In Montana, spring arrival of piping plovers usually occurs from late April through early May and departure is by late August (Lenard et al. 2003, Montana Piping Plover Recovery Committee 1997). Soon after spring arrival, male piping plovers begin establishing and defending territories that include a section of shoreline and an area of open ground (Whyte 1985).

Studies and observations of nesting habitat used by piping plovers indicate that the birds prefer a combination of suitable nesting substrate, lack of vegetative cover, existence of favorable water conditions, and availability of suitable forage habitat (Corn and Armbruster 1993, Licht 2001, Prindiville-Gaines and Ryan 1988, Root and Ryan 2004, Schwalbach 1988, Ziewitz et al. 1992). Sites with gravel substrate appear to provide the most suitable habitat and eggs there are more likely to hatch than those on alkali

substrate (Prindiville-Gaines and Ryan 1988, Whyte 1985). Espie et al. (1996) found that, in Saskatchewan, depredated piping plover nests were generally closer to vegetation than successful nests. Prindiville-Gaines and Ryan (1988) found that breeding piping plovers chose territories with an average beach width of 82 feet, with optimal habitat characteristics of greater than 65.6 feet. Nesting sites studied by Schwalbach (1988) were found to be characteristically barren or with short (less than 0.3 feet) and sparse (less than 10-percent) vegetative cover.

## 4.4 Objectives that Support the Goals for Upland and Wetland Habitats

To meet the goals for both upland and wetland habitats, the Service will treat invasive and nonnative species, suppress wildfires, and carry out habitat protection and acquisition. All of these activities directly affect the ability of the Bowdoin Refuge Complex to meet the goals for upland and wetland habitats.

## Invasive and Nonnative Species

Invasive species, nonnative species, and noxious weeds are major threats to native upland and wetland ecosystems in the United States. Infestations of invasive species have a direct effect on the ability of the Bowdoin National Wildlife Refuge Complex to fulfill its wildlife conservation mission including species recovery, biological diversity, biological integrity, and natural functions.

Montana's noxious weed list contains 32 species and the Montana Department of Agriculture has categorized noxious weeds into four categories based on the invasion stage of each species:

- *Priority 1A*—weeds that are not yet found in Montana
- *Priority 1B*—weeds that have a limited presence in the State
- *Priority 2A*—weeds that are common in isolated areas of Montana
- *Priority 2B*—weeds that are abundant and widespread

The refuge complex does not have any priority 1A or 1B species. At Bowdoin Refuge, there is an infestation of perennial pepperweed, which is a priority 2A species. Most of the refuge complex's noxious weeds are in the priority 2B category: leafy spurge, spotted knapweed, Canada thistle, yellow toadflax, and saltcedar. In addition, the refuge complex has infestations of other nonnative, invasive species that, although they are not listed as noxious weeds by the State, may have negative effects on desirable refuge habitats: Russian olive, crested wheatgrass, reed canarygrass, Japanese brome, and *Phragmites*.

Some of the undesirable, nonnative species are within shelterbelts in the refuge complex. These shelterbelts were probably planted in the 1930s or 1940s for wildlife and around existing homesteads before the land was purchased by the Service; the shelterbelts consist mostly of Russian olive trees and caragana and cover about 8 acres.

### Invasive and Nonnative Species Objective 1

Over 15 years, eradicate at least 25 acres of Russian olive trees and other nonnative trees and shrubs. Restore the sites to native herbaceous species that, in 10 years postestablishment, will comprise more than 60-percent native grasses and forbs throughout the refuge complex.

#### *Strategies*

- Map all treatment sites.
- Cut all standing trees and treat stumps with appropriate herbicide.
- As appropriate, use chemicals approved by the Service for aerial spraying to kill Russian olive trees.
- To remove woody material, use machinery to cut and shred trees and bushes or pile and burn them.
- Remove vegetation that is impeding water delivery systems and boundary fences.
- Begin removing all shelterbelts to create more contiguous blocks of grassland habitat, and restore it to prevent invasive species from encroaching. Allow no additional shelterbelts.
- Monitor and diligently re-treat areas to prevent reinfestation.
- Restore bare areas resulting from the removal of Russian olive trees to native grass cover and monitor the results.

- Develop a program that provides information to the local community, partners, media, and other interested individuals or groups about the need to remove Russian olive trees to reduce the fragmentation of grassland habitat and to maintain the refuge canals used for managing wetlands.

- Collaborate with the Malta Irrigation District and Reclamation to treat Russian olive trees that occur along the Dodson South Canal, which is the major water delivery canal for Bowdoin Refuge.

- Network with other agencies and refuges to stay current on effective treatment methods and to share equipment and resources.

- Map current infestations and actively monitor (at least every 3 years) these sites for new invasions. Immediately treat any new invasion to prevent expansion.

***Rationale.*** Research indicates that native grassland birds need large, uninterrupted tracts of treeless grasslands (Bakker et al. 2002, Herkert 1994, Winter et al. 1999). Preventing the encroachment of woody vegetation into grassland systems contributes significantly to the recovery of grassland bird populations (Herkert 1994). The literature overwhelmingly indicates that planted and exotic trees in prairie landscapes often negatively affect a variety of birds (Bakker 2003). Specifically, trees on the prairie are correlated with negative consequences to ducks (Rumble and Flake 1983), other wetland birds (Naugle et al. 1999), prairie grouse (Hanowski et al. 2000, Niemuth 2000), grassland passerines (Grant et al. 2004, Winter et al. 2000), and ring-necked pheasants (Schmitz and Clark 1999, Snyder 1984). The effect of trees on the prairie landscape is greater than their "footprint," because they also affect the surrounding habitat. Many grassland birds avoid areas near trees, and bird abundance and nest success increases as distance to trees increases (Delisle and Savidge 1996, Gazda et al. 2002, Helzer 1996, Johnson and Temple 1990). For example, at one time there were nine active lek sites on Bowdoin Refuge. Today there are none. This may be directly tied to the invasion of Russian olive trees into what was once contiguous grassland habitat. Research supports this theory, including numerous studies that determined sharp-tailed grouse leks were abandoned as tree cover increased, even as far away as 2 miles (Hanowski 2000). A study of active and inactive leks in Minnesota concluded that active sharp-tailed grouse leks had significantly lower proportions of upland forest and brush cover types and higher percentages of native grasses than inactive leks (Hanowski 2000). Gregg (1987) and Prose (1987) showed preferred lek sites by sharp-tailed grouse are characterized by low, sparse vegetation and that an excess of woody cover, within 2,625 feet of the lek site (well over half a mile), has a negative effect on the number of dancing males. Although Russian olive trees and other woody vegetation are often planted to benefit birds like grouse and pheasants, Kelsey et al. (2006) found that the detrimental effects of fragmenting grassland habitat, which reduces nesting success and increases predation, far outweighed any benefits to these species.

The Russian olive infestation on Bowdoin Refuge is so extensive that it can seem overwhelming (figure 38). After more than 30 years of unchecked growth and expansion, some areas such as the northwest corner of Big Island, Dry Lake Canal, and around Dry Lake Pond have become virtual Russian olive forests. The Russian olive stand on Big Island was chosen as the first target area because it is mostly native prairie, the infestation is relatively small (12 acres), and it is an "island" isolated from other areas making it unlikely to be reinvaded. A second target area is about 7 acres of trees around Piping Plover Pond. This wetland was enhanced to provide nesting habitat for piping plovers, and removing trees will benefit this threatened species. In addition to the two target areas, about 8 acres of shelterbelts in the refuge complex will be removed, and additional Russian olive removal will take place as needed.

By removing Russian olive trees, the positive effects on grassland-nesting birds in the native prairie can be substantial. For example, using a 328-foot (100-meter) buffer around groups of trees, the Service estimates that removing 12 acres of Russian olive trees on Big Island may actually improve at least 50 acres of prairie habitat for some grassland birds (figure 39). Improving nesting habitat for migratory birds through removal of Russian olive trees is necessary and required, by policy, to support and achieve the establishing purposes of the units within the refuge complex.

Combining treatments—such as mowing saplings, cutting trees, girdling, burning, grinding and chipping stands of small and possibly large trees, and chemical use—is the most effective means of controlling Russian olive because the effects are cumulative and act on the plant at all life stages (Natural Resources Conservation Service 2002). Treatment requires funding, equipment, and staff for effective control and possible eradication of small infestations. Complete eradication of Russian olive is often impractical; however, it is practical for small isolated stands where the cost of control and time investment is small (Natural Resources Conservation Service 2002).

The removal of at least 25 acres of Russian olive trees over 15 years may seem like a small amount given the timeframe and infestation. However, it is difficult to control this species in this part of Montana, making this a realistic objective for the following reasons:

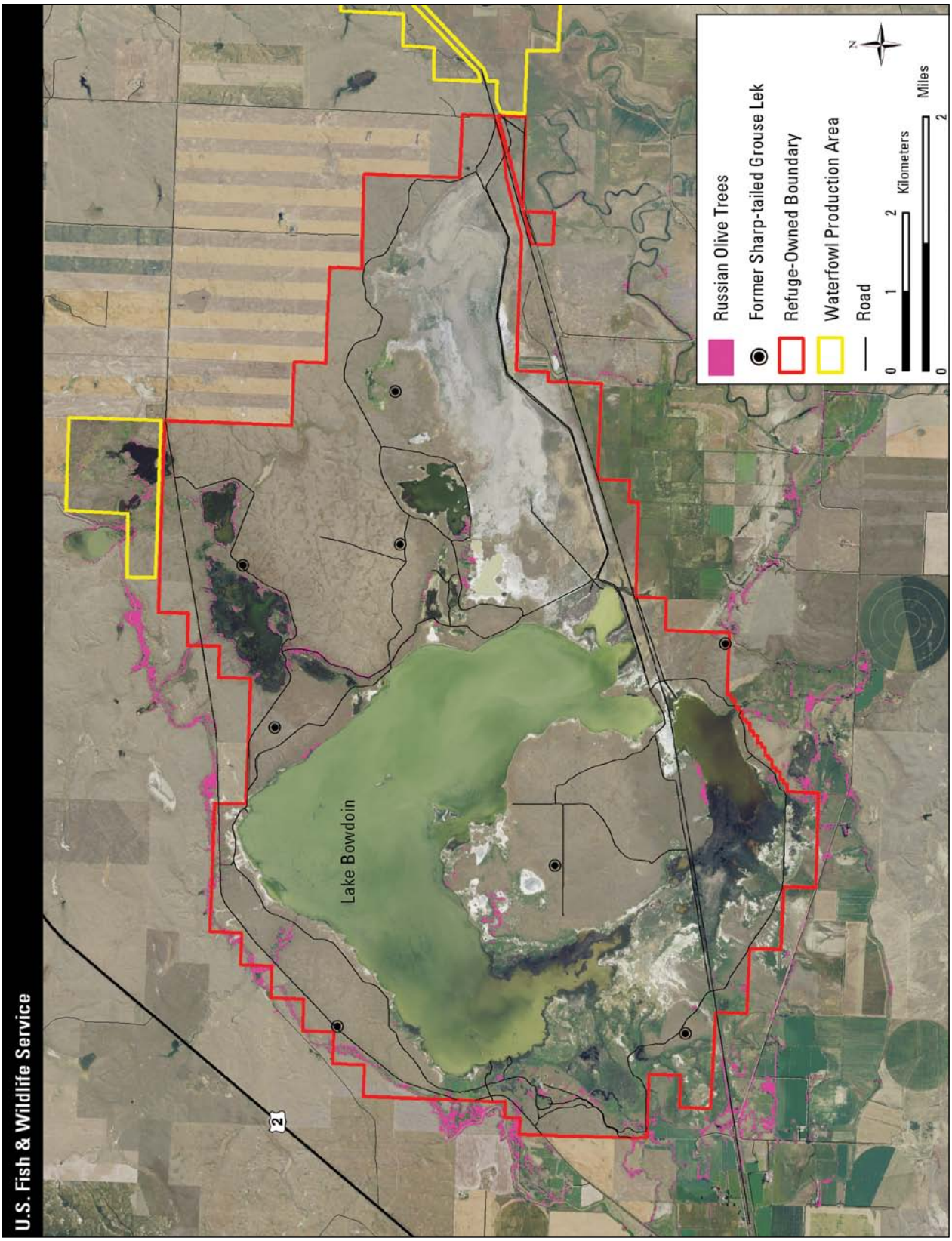


**Figure 38. Map of Russian olive tree infestations in and around Bowdoin National Wildlife Refuge, Montana.**

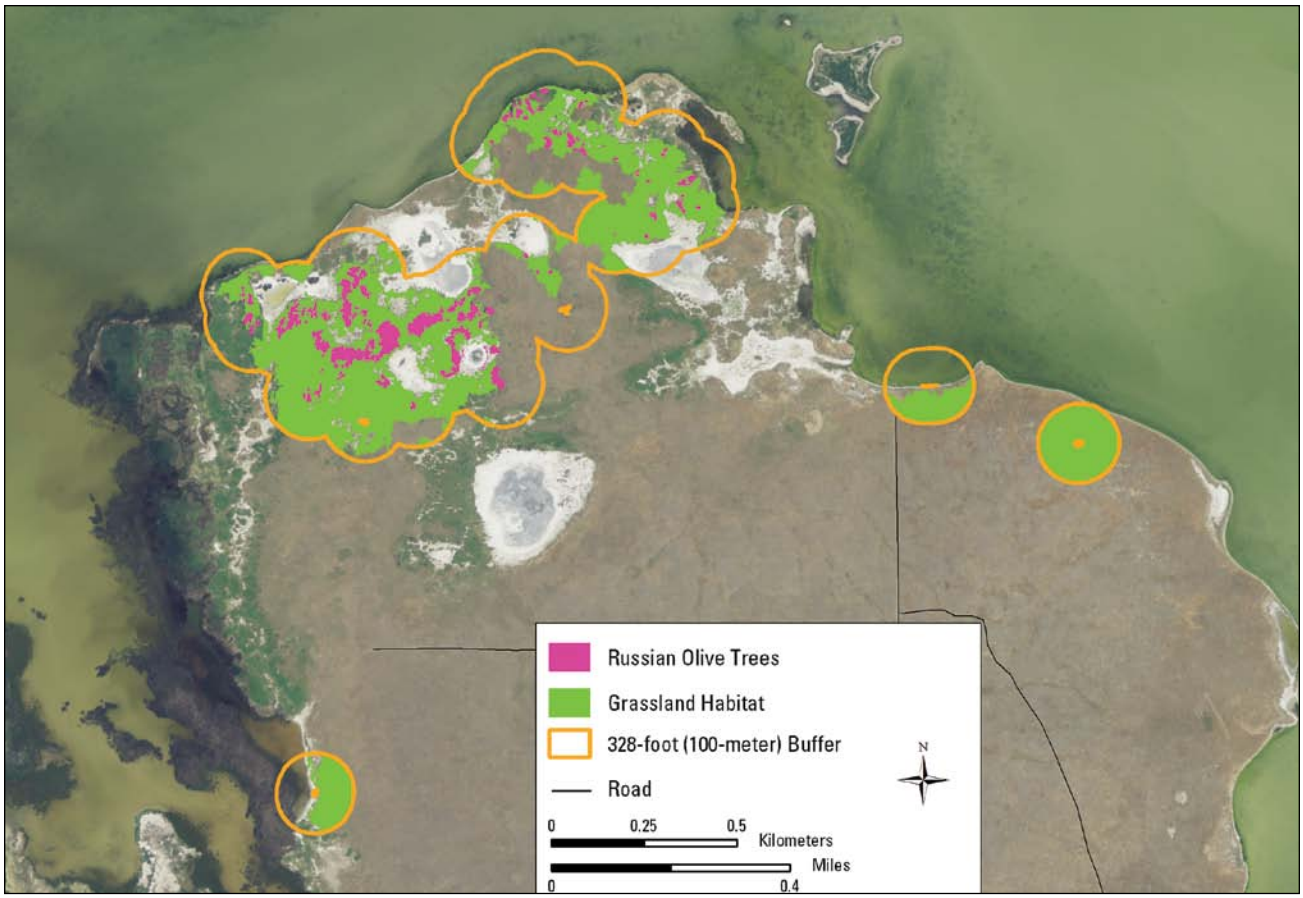


**Figure 39. Map of Russian olive evaluation areas (Big Island) for grassland restoration at Bowdoin National Wildlife Refuge, Montana.**

- Removal of Russian olive trees on this scale is time- and labor-intensive. In the past, the lack of funding and staff has meant that removal has been sporadic and slow.

- Current treatment methods and available herbicides are inefficient. For example, trees on Bowdoin Refuge that the Service has cut and treated often resprout from the roots, so the same areas must be re-treated for up to 5 years in some cases for good control. Plants are generally produced from stratified seed, but plants can grow from stump sprouts, stem cuttings, and root pieces (Natural Resources Conservation Service 2002). (Note: Because the embryos of many tree and shrub seeds are immature when the seeds fall, the embryos require time in a moist, cool environment to develop to the point where they can germinate—a process called stratification.)

- Cutting, grinding, and treating the trees is only the first step. If the Service is unable to use machinery to grind up the trees, the debris must be removed or gathered into piles and burned. This often involves heavy equipment that can disturb the surrounding grassland. To prevent invasive plant infestation, the entire area will have to be reseeded to native herbaceous vegetation. Revegetation should be done with the objective of providing plants that are well adapted and that can suppress the spread and growth of Russian olive (Natural Resources Conservation Service 2002). Continued monitoring and treatment of these areas will take many years.

- Russian olive trees on private land surround Bowdoin Refuge (figure 38). The Dodson South Canal (owned by Reclamation and maintained by the Malta Irrigation District), which delivers water to the refuge, is lined with Russian olive trees for miles. Even if every Russian olive tree on the refuge were removed, there would be a constant source of seeds from across the boundary fence and coming into the refuge with delivered water.

However, increased funding or staff, or improved treatment methods, could increase the amount of acres treated and restored over the life of the CCP. Russian olive is not listed as a noxious weed in Montana but is listed in several other western States;

Mike Artmann / USFWS

*Nonnative Russian olive along Lakeside Canal in the Teal Pond area.*

subsequently, the Federal, State, and local agencies in these States are becoming more active in controlling Russian olive. The Salt Cedar and Russian Olive Control Demonstration Act, passed in 2006, directed the Secretaries of the Interior, Agriculture, and Defense to establish a Federal program aimed at finding and carrying out the best means of controlling and eradicating Russian olive and saltcedar.

## Invasive and Nonnative Species Objective 2

Within 2 years, establish a baseline inventory of all invasive plants including noxious weeds for Service lands. Eliminate small infestations of saltcedar, spotted knapweed, and yellow toadflax on Bowdoin National Wildlife Refuge Complex. Reduce leafy spurge, perennial pepperweed, reed canarygrass, Japanese brome, and *Phragmites* on the refuge complex by at least 50 percent (measured by canopy cover) over 15 years.

### *Strategies*

- Write an integrated pest management plan within 2 years.
- Complete the baseline inventory with help from the Service's Invasive Species Strike Team.
- Using the Invasive Species Strike Team, Montana Conservation Corps, or refuge staff, repeat the inventory of all invasive plants including noxious weeds on Service lands every 5 years.
- Store all inventory data in the Refuge Lands Geographic Information System (RLGIS) database.
- Use integrated pest management to control invasive plants, and review literature for updated information on control techniques. Allow use of aerial applications of chemicals as outlined by the chemical label and Service policy for the use of aerial applicants.
- Coordinate the control of invasive plants by meeting and cooperating with county weed boards, irrigation districts, and other partners to share information and discuss control strategies.

Sheri Hagwood / Bureau of Land Management

*Reed Canarygrass*

- Map sites of invasive plant treatment each year in RLGIS.
- Monitor infestation rates and effectiveness of control efforts.
- Increase the Service's ability to control and monitor invasive plants by pursuing additional money through partnerships, grants, and invasive species' programs.
- Familiarize all staff with State-listed noxious weeds including staying current on potential new threats to Service lands.
- Map and store in RLGIS the invasive plant infestations noted by Service staff while conducting other work activities.
- Deploy early detection and rapid response strategies to attack newly found infestations before they become larger, causing harm and becoming more costly to treat.

***Rationale.*** These problem plants can displace native vegetation over large areas, have the ability to form nearly monotypic stands in the absence of management, and, therefore, threaten native biodiversity (Bedunah 1992, Hutchison 1992, Svedarsky and Van Amburg 1996, Trammel and Butler 1995, Watson 1985). The control or elimination of invasive plants on Service lands will comply with State and Federal laws for invasive and noxious species.

Trying to manage an invasive plant infestation without any idea of the size, canopy cover, or rate of spread jeopardizes the efficiency of the control efforts and waste precious time and resources. An inventory will help prioritize the strategies for elimination of new and isolated infestations and containment or reduction of larger infestations.

## Invasive and Nonnative Species Objective 3

Within 5 years, treat 20 acres of native grassland with varying degrees of crested wheatgrass infestation using a mix of treatments to determine effectiveness. Based on the results, add crested wheatgrass management to the integrated pest management plan.

### *Strategies*

- Work with local universities to recruit graduate students to conduct research projects on controlling crested wheatgrass on the refuge complex.
- Within 2 years, ground-truth the vegetation map to verify the extent of the crested wheatgrass infestation on Bowdoin Refuge.
- Identify four 5-acre plots on Bowdoin Refuge that are in various stages of crested wheatgrass infestation, from initial invasion with individual plants making up less than 5 percent of the cover to where the cover is more than 50-percent crested wheatgrass. Using the best available science, apply to the plots and monitor effectiveness of a combination of treatments (such as wicking or spot spraying with herbicides, haying, prescriptive grazing, prescribed burning, and seeding of native grasses and forbs).
- Use the results of the plot treatments to develop a plan for management and reduction of crested wheatgrass across the entire refuge complex.
- Continue to work with other refuges, Grasslands National Park (Saskatchewan), University of Regina, and other agencies and organizations to apply adaptive management to control of crested wheatgrass as new data and treatment methods become available.

***Rationale.*** Planted to stabilize soil on abandoned cropland during the drought of the 1920s and 1930s and as a hay and forage crop for cattle ever since, there are 15–26 million acres of crested wheatgrass on this continent today (Lesica and DeLuca 1996). Although it may be useful for agricultural purposes, rangeland dominated by crested wheatgrass has reduced value to wildlife, especially migratory birds, compared to native rangeland. Lloyd and Martin (2005) found that reproductive success of chestnut-collared longspurs was significantly lower in crested wheatgrass stands than in native prairie.

In addition to its negative effects on plant and wildlife diversity, crested wheatgrass can be detrimental to soil conditions by making it harder to get native seeds established, which can cause erosion and increase the chances of invasion by invasive plants (Ambrose and Wilson 2003, Jordan et al. 2008, McWilliams and Van Cleave 1960).

Researchers from the University of Regina and Grasslands National Park, both in Saskatchewan, Canada, have been conducting extensive research on crested wheatgrass infestations. They have also started studies of this species at Medicine Lake National Wildlife Refuge, east of Bowdoin Refuge Complex. Grasslands National Park is about 200 miles northeast of Bowdoin Refuge. The work of these Canadian researchers and that of other researchers suggests that a combination of treatments is necessary to control crested wheatgrass. Depending on

whether the crested wheatgrass is invasive, planted, or a new infestation versus an old infestation, one site may need a different combination of treatments than another (Johnson 2004, Wilson 2000, Wilson and Gerry 1995, Wilson and Pärtel 2003). The Bowdoin Refuge staff has formed an informal working group with other refuges in Montana, Grasslands National Park, and the University of Regina to share resources and ideas for controlling crested wheatgrass.

Mike Granger / USFWS

*Prescribed fire can be an effective tool to manage grassland vegetation.*

# Wildfire Management

The use of prescribed fire is a potential strategy for meeting several of the previous objectives for upland and wetland habitats. The following objective primarily addresses wildfire.

## Wildfire Management Objective

Over the next 15 years, suppress all wildfires occurring within the refuge complex, maintaining an initial attack success rate of 95 percent or higher.

### *Strategies*

- Conduct hazardous fuel treatments to reduce the threat of catastrophic wildfire to values at risk.
- Use BAER (Burned Area Emergency Response) or BAR (Burned Area Rehabilitation) monies as needed following wildfires.
- Within 1 year, complete the draft fire management plan and ensure it reflects the goals and objectives in the CCP.
- Have several refuge staff members maintain the necessary qualifications to conduct prescribed burns and to respond to wildfires.
- Require the fire management program for the refuge complex to continue following applicable laws, Department of the Interior and Service policies, and guidance established at national, regional, and local levels.

***Rationale.*** The refuge complex is within the Service's Eastern Montana Fire Management District. Fire management staff and equipment may be used to respond to wildfire anywhere within the fire management district, using local refuge staff as well as other Federal and non-Federal partners to assist in wildfire suppression.

Treatment of hazardous fuel, thereby reducing the threat of catastrophic wildfire, is important to protect sensitive habitats and species, cultural resources, Federal and private infrastructure and facilities, and nearby local residences. Historically, wildfires had the ability to burn vast areas; with settlement, there is a high probability that wildfires on refuge complex lands would damage neighboring properties.

The community of Malta is identified as a "Community at Risk." Due to the small size of Service lands, the rapid rates of spread from grass fuel, and the potential for wildfire to cross onto adjacent lands, the Service has chosen to suppress all wildfires to reduce potential threats to neighboring private land.

Following a wildfire, BAER treatments are intended to protect public safety, to stabilize resources, and to prevent further degradation of natural and cultural resources. These treatments are considered emergencies and are done within 1 year of wildfire containment.

The BAR treatments are nonemergency efforts made within 3 years of wildfire containment. The treatments (1) will improve fire-damaged lands that are unlikely to recover to management-approved conditions and (2) will repair or replace minor facilities damaged by wildfire.

The use of BAER and BAR monies will follow national and regional policy and guidance. It is likely BAR money will be used the most within the refuge complex, including repairing or replacing fences dam-

aged by wildfire and treating burned areas to prevent the spread of invasive plants.

Service policy requires that every Refuge System unit with burnable vegetation must have a fire management plan. The fire management plan is a stepdown plan from the CCP and provides specific guidance for how the fire management program will be carried out to meet national, regional, and refuge complex goals and objectives. An approved fire management plan allows the manager to consider a wide range of suppression alternatives and to conduct prescribed burns. Intended to be dynamic and reflect current policies and situations, the fire management plan is periodically reviewed or revised; required updates and revisions will follow national and regional policy and guidance.

To maintain the high initial attack success rate, it is important that refuge staff maintain and develop their qualifications to safely and effectively respond to wildfires and to use prescribed fire. In addition, local agreements between Federal and non-Federal partners will be maintained or pursued.

Appendix I further describes the fire management program for the refuge complex.

# Habitat Protection and Acquisition

Habitat protection and acquisition will ensure the long-term protection of upland and wetland breeding habitat for waterfowl and other migratory birds. Conversion of grasslands to cropland has generated a need for upland habitat protection adjacent to wetlands. The Prairie Pothole Region probably once produced 15 million ducks each year but now produces about one-third that number, with drainage of wetlands the main reason for the difference (Belrose 1976). In addition, agriculture activities associated with annual crop production is the predominant factor affecting the landscape in the Prairie Pothole Region (Kantrud et al. 1989).

Native prairie grassland (upland) and wetland are the most productive habitat types in Montana, particularly in the Prairie Pothole Region. Although some laws protect these areas, which mostly occur on private lands, these vital habitats continue to be lost. The Service has committed to work with willing landowners in Montana to compensate them for protecting these habitats, primarily through perpetual grassland or wetland conservation easements. As of 2009, willing landowners have been compensated for protecting more than 50,000 acres of grassland and wetland habitat in the refuge complex.

Habitat protection needs evaluation through a priority system to identify critical areas and the most effective means of protection—through either fee title or easement. Conservation easements have several advantages over outright purchase of lands by the Service. First, easements are more cost-effective both in terms of initial purchase and in long-term management responsibilities. While easement contracts require attentive enforcement to ensure habitat protection, they do not carry the other burdens of ownership such as maintenance of facilities, fences, and signs; control of noxious weeds; and mowing of roadside ditches. Second, the landowner still owns and manages the land that has a conservation easement. The Service developed the conservation easement program to protect natural resources on the landscape while minimally affecting normal farm and ranch operations.

## Upland Habitat

Livestock grazing is the primary land use in the Prairie Pothole Region of north-central Montana, where large tracts of contiguous grassland (more than 4,940 acres) remain, and where populations of nest predators such as red fox and raccoon are sparse and the coyote is the dominant predator (Ball 1995). The loss of upland-nesting cover and plant foods has reduced the value and productivity of associated wetlands for nesting waterfowl and their broods and other migratory birds and wildlife. This makes the Bowdoin National Wildlife Refuge Complex uniquely important for the continued conservation of habitat that remains intact and valuable for migrating and breeding waterfowl and other migratory birds.

Grassland conservation easements are perpetual and protect both existing and restored grasslands from being cultivated. Additional purposes of the grassland easement program are (1) to improve and

Dave Menke / USFWS

*The northern shoveler is one of the duck species that nests in upland habitats.*

protect the water quality of wetlands, (2) to maintain upland-nesting habitat for ground-nesting birds, (3) to protect highly erodible soils, and (4) to provide an alternative to the purchase of uplands in fee title by leaving land in private ownership. Grassland conservation easements are real property interests that the Service buys from willing landowners. These easements prohibit any alteration of permanent grassland cover including cropland conversion or development and haying or mowing until after July 15 (when most upland nesting by ducks is over). Provisions under grassland conservation easements do not prohibit or regulate livestock grazing.

Funding for grassland conservation easements comes from a variety of sources including Migratory Bird Hunting and Conservation Stamp Act (with Governor approval), North American Wetland Conservation Act grants, and Land and Water Conservation Funds. Thirty-three grassland easements have been purchased in the Bowdoin Refuge Complex, covering 39,767 acres. Through effective enforcement, these easement lands continue to provide important waterfowl breeding habitat in Montana.

In addition, the refuge complex administers four perpetual FmHA conservation easements. The Consolidated Farm and Rural Development Act of 1985 authorized the establishment of easements for conservation, recreation, and wildlife purposes on properties that were foreclosed on by the Federal Government ("inventories" properties), and the Service was designated manager of those easements worthy of inclusion into the National Wildlife Refuge System.

## Wetland Habitat

Glacially created wetlands in the Prairie Pothole Region, in combination with the surrounding grasslands, provide breeding habitat that supports half of the continent's waterfowl production (Kantrud 1983). More than a million acres of potholes in the prairie States were drained between 1943 and 1961 (Briggs 1964). By the late 1950s, the loss of important waterfowl habitat was apparent. These two significant factors led to conservation movements by citizens and pressure from waterfowl hunting interests to reverse the loss of wetland habitat.

In response to this pressure, the Service sold Duck Stamps to fund a program of wetland acquisition and for purchase of wetland conservation easements (van der Valk 1989), waterfowl production areas, and national wildlife refuges. The Migratory Bird Hunting and Conservation Stamp Act, passed in 1934 and commonly known as the Duck Stamp Act, requires the purchase of a Federal hunting stamp by all waterfowl hunters ages 16 and over. Receipts from the sale of the stamps are used for the acquisition of migratory bird refuges under the provisions of the Migratory Bird Treaty Act. Waterfowl production areas and wetland conservation easements are purchased from willing sellers through the Small Wetlands Acquisition Program (authorized by Congress in 1958 by an amendment to the Migratory Bird Hunting and Conservation Stamp Act) to ensure long-term protection of breeding habitat for migratory birds, primarily within the Prairie Pothole Region of the United States.

The Bowdoin Wetland Management District—comprised of waterfowl production areas and conservation easements—was established in 1973 under the authority of the Migratory Bird Hunting and Conservation Stamp Act to reduce waterfowl habitat loss in north-central Montana.

Mike Artmann / USFWS

*The sharp-tailed grouse is a year-round resident on the Bowdoin Refuge.*

- The district's first waterfowl production area was purchased on April 19, 1977, in Blaine County. The Service manages these fee-title areas to provide breeding waterfowl with quality wetlands for courtship and brood rearing, as well as suitable grasslands for nesting. The Bowdoin Wetland Management District has nine waterfowl production areas totaling 9,504 acres.

- The first wetland conservation easement was purchased on April 14, 1977, in Phillips County. To date, 125 wetland easements have been purchased within the refuge complex, covering 10,635 wetland acres. Wetland conservation easements are perpetual and prohibit the filling, leveling, draining, or burning of wetlands under easement. These easements are real-property interests that the Service buys from willing landowners and are permanent fixtures to land titles. The land remains in private ownership and the landowner controls public access. Through effective enforcement of easement provisions, the lands under easement provide important waterfowl breeding habitat.

## Habitat Protection and Acquisition Objective 1

Over the next 15 years, protect at least 900 acres of depressional wetlands and 16,000 acres of grasslands on private land within the refuge complex through the purchase of perpetual conservation easements or fee title from willing sellers.

### *Strategies*

- Work with the Habitat and Population Evaluation Team (HAPET) to develop a waterfowl-pair density map for the counties within the wetland management district.

- Implement the conceptual waterfowl habitat model developed by HAPET to identify and prioritize areas for protection with conservation easements.

- Focus the protection of wetlands with conservation easements in areas where the Service is also protecting priority grasslands.

- Use mass mailings and public meetings to provide prospective sellers with information about the conservation easement program.

- Continue to piggyback on the Partners for Fish and Wildlife Program as a way to inform prospective sellers of the conservation easement program.

- Buy additional waterfowl production areas including "round-outs" and inholdings from willing sellers.

- Use the Service's strong partnership with Ducks Unlimited and other conservation organizations to generate other funding sources to buy easements or receive transferred lands.

- Use funding from the North American Wetland Conservation Act and other grants to buy easements.

***Rationale.*** If the Service has a constant acquisition budget over the next 15 years, at least 16,000 acres of grassland and 900 acres of wetland can be protected through acquisition of conservation easements (Danielle Kepford, realty specialist, U.S. Fish and Wildlife Service, Lewistown, Montana; personal communication, 2008). The amount of additional acres protected in fee title will be negligible. Priorities for acquisitions will be based on HAPET's conceptual waterfowl habitat model, as described below (USFWS 2007):

> *"The Service's Partners for Fish and Wildlife Program (PFW) in Montana completed a strategic planning process to identify conservation focus areas in 2007 … The process identifies priority species and guilds for conservation and uses available data and models to focus conservation in the best habitat on the landscape. Waterfowl were identified as a priority group for the glaciated plains portion or prairie pothole region of Montana. A conceptual waterfowl habitat model was developed by the FWS Region 6 Habitat and Population* [Evaluation] *Team office (HAPET) to identify and prioritize waterfowl habitat within the glaciated plains of Montana. Currently, an empirical model for waterfowl in the state does not exist. The conceptual model is based on the two primary components of waterfowl habitat, upland nesting cover, and wetlands.*
>
> *Extensive research has focused on how ducks settle on the breeding grounds. A correlation between the number of wetlands and number of breeding ducks at different scales is well known (Crissey 1969, Dzubin 1969, Stewart and Kantrud 1974, Johnson and Grier 1988, Batt et al. 1989, Cowardin and Blohm 1992). The PFW waterfowl habitat model used FWS National Wetland Inventory delineated wetlands and the public land section survey geographical information system (GIS) layers to identify areas with the highest wetland densities per square mile* [figure 40]. *Wetland den-*

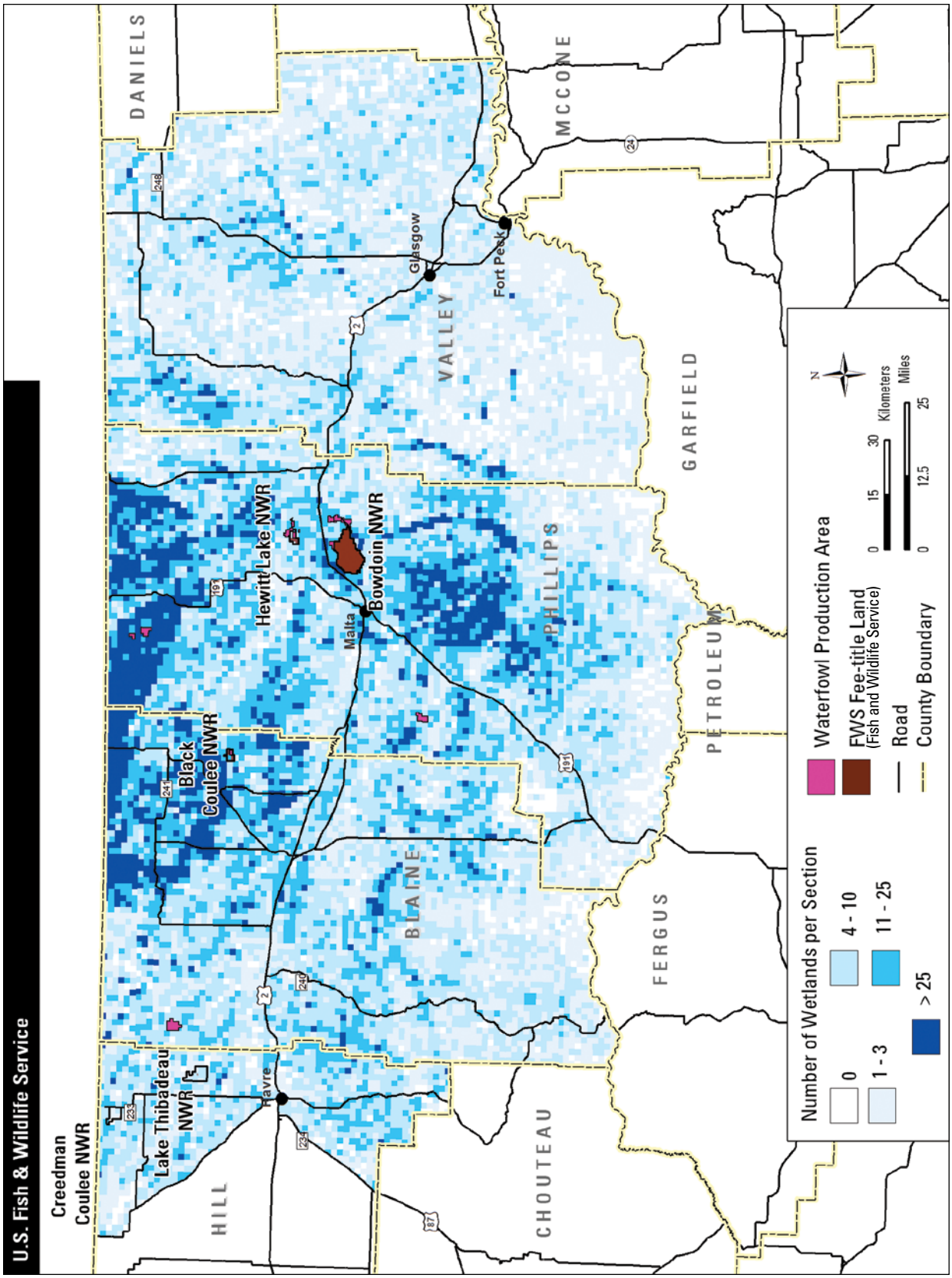


**Figure 40. Map of wetland density per square mile in Bowdoin National Wildlife Refuge Complex, Montana.**

*sities were categorized using levels identified by the HAPET office and allow the landscape to be divided into discrete groups for conservation prioritization. The categories include wetland densities of 1–3, 4–10, 11–25 and more than 25 per mi$^2$.*

*Landscape characteristics surrounding wetland basins may also influence how breeding ducks use those basins. Krapu et al. (1997) found a negative effect of cropland on number of breeding pairs when temporary and seasonal pond area increased in 50.8 km$^2$* [12,553-acre] *plots. Reynolds et al. (2007) found that duck pairs selected wetlands differently when embedded in cropland, grazed land, and undisturbed grass cover. Reynolds et al. (2001) found that nest survival was positively related to grassland cover within a 10.4 km$^2$* [2,570-acre] *area site. The PFW conceptual waterfowl model used GIS modeling techniques with the statewide landcover layer developed by the Montana Gap Analysis Program to identify areas on the landscape with the highest density of undisturbed nesting cover (e.g., grassland). The upland nesting GIS layer consisted of 90m×90m pixels and used a moving window analysis to identify areas on the landscape with the highest density of grassland* [figure 41]. *A moving window incorporating an area of 4 square miles was used to approximate the home range size of a breeding mallard hen. Grassland density categories include 0–10%, 10–40%, 40–80% and 80–100% grassland cover within the four square mile window. The final model combined the priority wetland density layer and the grassland density layer to identify areas on the landscape with high wetland and grassland densities* [figure 42]. *Future revision of the model will include updated landcover and wetland layers until an empirical model can be developed."*

## Habitat Protection and Acquisition Objective 2

Over 15 years, use active monitoring and law enforcement to protect all refuge, flowage, FmHA, wetland, and grassland areas under Service easement, according to the provisions of the easement contracts and agreements.

### *Strategies*

- Following the guidelines contained in the "Administrative and Enforcement Procedures for U.S. Fish and Wildlife Service Easements within the Prairie Pothole States" (known as the easement manual) and other enforcement procedures, conduct annual surveillance flights to detect potential conservation easement violations and promptly follow up with needed enforcement action.

- Send letters to new landowners informing them of existing conservation easements on their property and associated easement provisions.

- Review FmHA easements to ensure all wetland provisions are enforced.

***Rationale.*** With an annual precipitation of less than 13 inches, the retention of water on the land to support the primary land use of grazing is more desirable to landowners than drainage. Counties within Bowdoin Wetland Management District have between 20 percent and 30 percent of the land base designated as cropland (cereal grains or hay) or prior cropland, for example, as part of the Conservation Reserve Program. Annual surveillance of wetland conservation easements is necessary not only in croplands where water is drained from fields for greater crop production, but in rangelands where wetlands are drained to consolidate water into larger basins for livestock watering.

Since most of the grassland conservation easements protect native prairie, the major enforcement concern is conversion to cropland. While violations involving the conversion of native prairie to cropland are extremely rare, full restoration of native prairie in these situations is impossible. Nevertheless, landowners could plant grass in areas they had plowed, which would help them regain compliance with the easement provisions. Enforcement that ensures compliance is essential to the protection of these habitats. Any haying, mowing, or harvesting seed before July 15 would be in violation of easement provisions and could cause direct losses to waterfowl and other grassland-nesting birds. While the cutting of hay on native prairie is not common, it is more likely to occur on grassland easements with tamegrass seeding such as those in the Conservation Reserve Program. Enforcement of haying restrictions affords another opportunity to meet and visit with landowners and operators. These contacts may serve to remind landowners and operators of the easement provisions and hopefully prevent more serious violations in the future, which would achieve the goal of voluntary compliance.

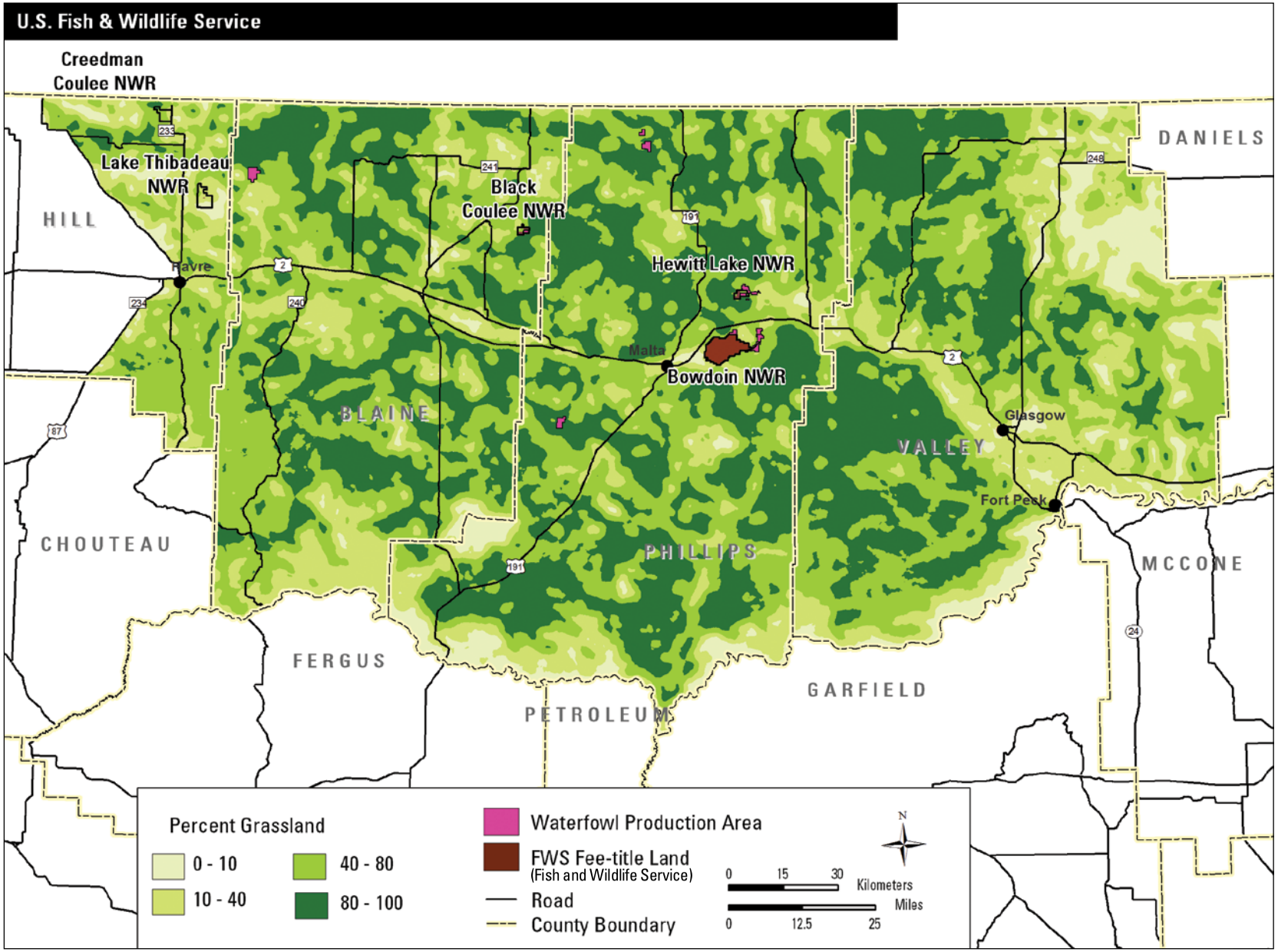


**Figure 41. Map of grassland density in Bowdoin National Wildlife Refuge Complex, Montana.**

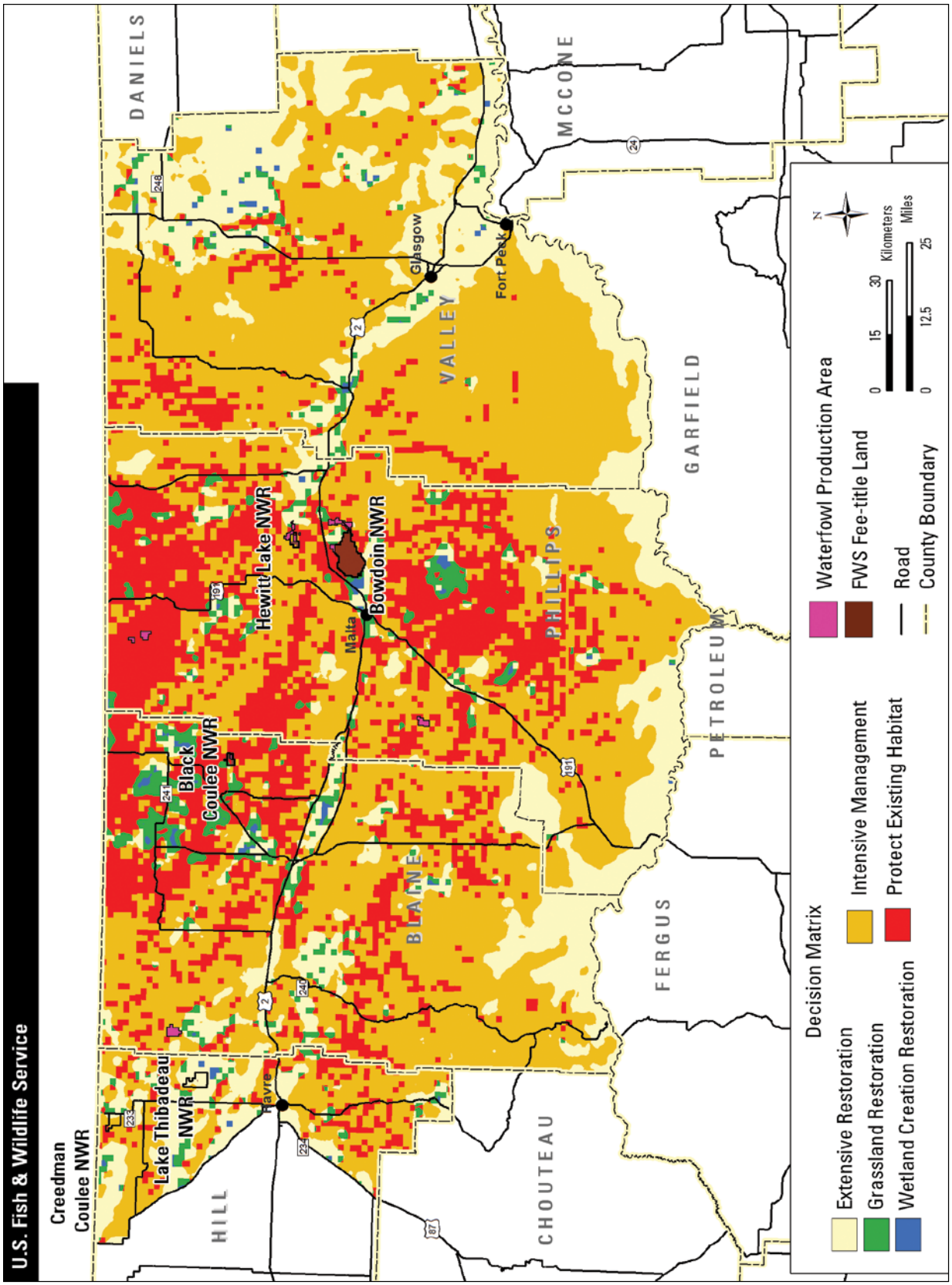


**Figure 42. Map of areas with high densities of wetlands and grasslands for use as a decision matrix to determine protection priorities in Bowdoin National Wildlife Refuge Complex, Montana.**

# 4.5 Goal for Salinity and Blowing Salts

*Develop a water management system on Bowdoin National Wildlife Refuge that protects the environment and mitigates current and future blowing salt concerns for neighboring properties, while providing quality water and wildlife habitat for migratory birds and other wetland-dependent wildlife.*

# Salt and Water Management

Management of salts at Bowdoin Refuge is tied to water management. An understanding of the salt balance and the water supply at the refuge will guide management actions in the short term and over time for a functioning lake system that benefits plant and animal communities and does not negatively affect nearby landowners and water users.

## Salt Management

The long-term target for salt management is to have enough water, at an acceptable quality, to reestablish a flow-through system from Lake Bowdoin into Beaver Creek. This flow-through system will allow salts to pass through the refuge rather than accumulating in Lake Bowdoin. With the current salt concentrations, a flow-through system is not possible due to the potential environmental impacts to primarily downstream water users along Beaver Creek. If the refuge was able to maintain acceptable salt concentrations in Lake Bowdoin as defined by State regulations, a flow-through system could be restored if a sufficient water supply was secured.

The short-term target is to use management actions to remove sufficient salts so the Service can release water to Beaver Creek without significantly increasing the salinity of the creek water or negatively affecting downstream users. This management will also prevent the salts in Lake Bowdoin from becoming extremely concentrated, which would negatively affect wetland habitat and wildlife. The salt concentration objective for this type of management removal will average around 7,000 mg/L at a lake elevation of 2,209 feet (figure 43). However, the salt concentration of Lake Bowdoin will vary depending on water levels. With increased deliveries of water, it is estimated that at a lake elevation of 2,212 feet, salt concentration may decrease to approximately 5,000 mg/L. Conversely, if the water level were to drop to 2,207 feet, primarily as a result of drought, salt concentrations may again increase to over 25,000 mg/L.

The objective of maintaining a TDS concentration of 7,000 mg/L assumes the future input of water will match the historical delivery rates (1990–2007). The modeling effort to predict future salinity concentrations assumes that in some years there will be floods and in other years there will be droughts. In addition, modeling for the short-term target assumed that additional water supplies will not be received. As a result of maintaining a TDS concentration of 7,000 mg/L, approximately 80,000 tons of salt will remain on the refuge, primarily stored in the water in Lake Bowdoin.

The Service does not wish to completely remove all salts from refuge waters; in fact, these wetlands are naturally brackish. The 7,000 mg/L objective was selected based on the relatively high number of plant (both emergent and submergent) and invertebrate communities that can be supported (Gleason et al. 2009). These communities in turn support a wide range of migratory birds that visit the Bowdoin Refuge every year. However, the overriding target (long- and short-term) for any salt management program is to improve the water quality on the refuge over time so that releases of water to Beaver Creek or the Milk River will either: (1) not require an "authorization to degrade" permit from the State; or (2) if an "authorization to degrade" were required, the restrictions would be such that the approved release rate out of Bowdoin Refuge provided a reliable method to maintain the salt balance.

## Water Management

The desired long-term water management plan is a flow-through system where the refuge receives a sufficient quantity of water that could eventually spill into Beaver Creek, carrying with it a quantity of salts equal to what has entered the refuge. By reestablishing a flow-through system, blowing salt events will be minimized and wildlife habitat will be improved.

To reach as quickly as possible the target salinity level needed for a flow-through system, there may need to be a reduced amount of water delivered to Lake Bowdoin. This will not only minimize the amount of salts entering the refuge but concentrate the salts that are already in the water, allowing them to be more easily removed. Additionally, where practical, the inflow of salts could be reduced at the source by lining portions of irrigation canals and managing saline seeps and irrigation return flows.

## Obstacles to Implementing a Flow-Through System

The Service needs to address several obstacles in developing an effective flow-through system: the lack of needed water supply, the potential need for State permits, and the removal of structures.

***Additional Water Supply.*** Modeling efforts by Service hydrologists (using models developed in large part by State hydrologists), show the amount of water currently delivered to the refuge under the MOA with Reclamation—up to 3,500 acre-feet under normal water years—is not sufficient to implement a flow-through system for Lake Bowdoin even if water quality issues were resolved.

To address this shortfall, the Service has filed for an additional 8,000 acre-feet of water, based on the maximum delivery from the Milk River on record of 11,540 acre-feet. This historical use right is not part of the ongoing Federal water rights compact and will be litigated as part of the adjudication process for basin 40J (Milk River watershed). The Service understands this water right will likely be junior to most of the other water rights on the canal and would only be taken during periods when water is available.

Additional water will provide the following benefits to the refuge:

- Provide flushing opportunities after water quality issues are addressed.
- Help offset evaporation, which can exceed 3 feet per year.
- Provide the opportunity to manage Dry Lake and Drumbo Pond as a flow-through system.
- Allow all units to fill periodically (whereas many are dry now).
- Allow additional management options including more flexibility in filling Piping Plover Pond, developed to provide nesting habitat for the threatened piping plover.

Mike Artmann / USFWS

*Refuge staff use this outflow dropboard structure to release water from Drumbo Pond to control the pond's water level.*

***Permits.*** Before discharging water into Beaver Creek or the Milk River, the discharge of refuge waters into State waterways must first meet the DEQ's water quality standards (DEQ–7). Currently, the Lake Bowdoin water does not meet these standards. The DEQ water quality standards program has two levels of protection: (1) protection of designated uses of water; and (2) prevention of significant degradation of high-quality waters.

Salinity standards have not been established for the Beaver Creek or the Milk River. The water discharged from Lake Bowdoin, when mixed with water from Beaver Creek or the Milk River, must not exceed the threshold determined by DEQ. As an example, in other rivers, a TDS concentration range from 960–1,600 mg/L during the irrigation season has been established (Bauder et al. 2007). To prevent impairment of aquatic life in Beaver Creek or the Milk River, the TDS concentration will have to be maintained below a threshold of 1,000 mg/L.

In addition to the salinity, elevated levels of sulfates, arsenic, and uranium are obstacles to releasing water. For example, to safely release water into Beaver Creek or the Milk River without harming aquatic life, a low calculated release rate (estimate of 200:1) from Lake Bowdoin would be permitted to avoid causing harm from sulfates. Therefore, if 200 cubic feet per second (cfs) were the rate of flow of the receiving water, only 1 cfs would be permitted from Lake Bowdoin. This mixing ratio could decrease under scenarios where sulfates are reduced.

The pollutants arsenic and uranium are both carcinogens, as defined in DEQ–7. Any release from Lake Bowdoin where the concentrations of either arsenic or uranium were greater than the receiving water concentration would require an "authorization to degrade" permit from the State. It is probable, with the addition of ground water inputs and the history of evapoconcentration, that an "authorization to degrade" permit will be necessary for any surface water release from Lake Bowdoin.

***Current Structures and Dikes.*** To obtain the most effective flow-through system, the Service ideally needs to remove the stoplogs (logs or beams that prevent water flow) in the water control structures to allow water to flow between Lake Bowdoin and Beaver Creek during flood events. However, removing stoplogs will only be possible if salinity issues were resolved sufficiently or extreme flooding conditions were such that releases from Lake Bowdoin and Dry Lake were necessary to protect infrastructure. These flood water releases will be conducted safely in coordination with downstream irrigators and in accordance with State guidance from DEQ. The quality of the discharged water will be monitored. Until that time, the refuge staff will maintain the stoplogs, dikes, and spillways primarily to prevent accidental

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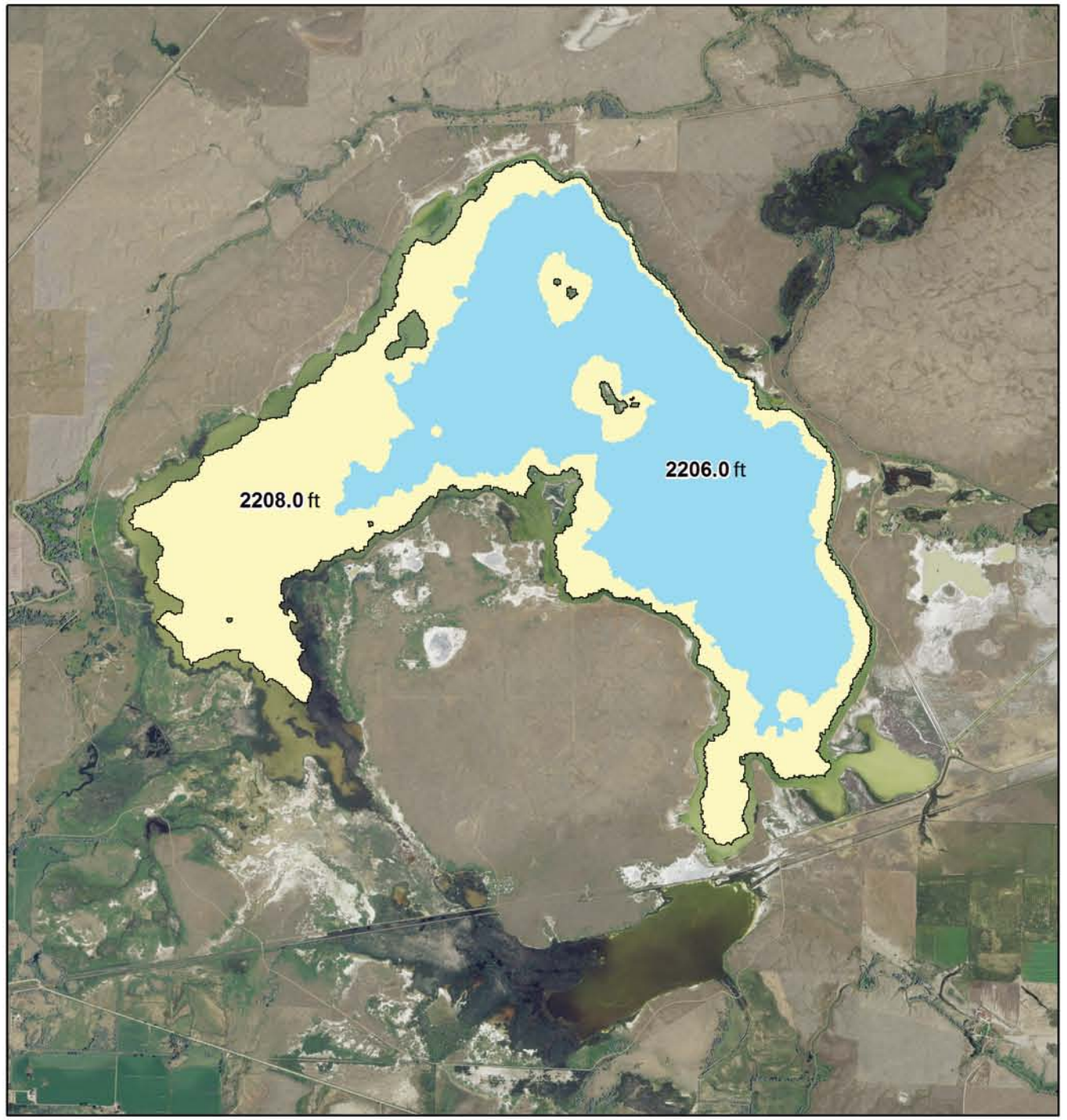
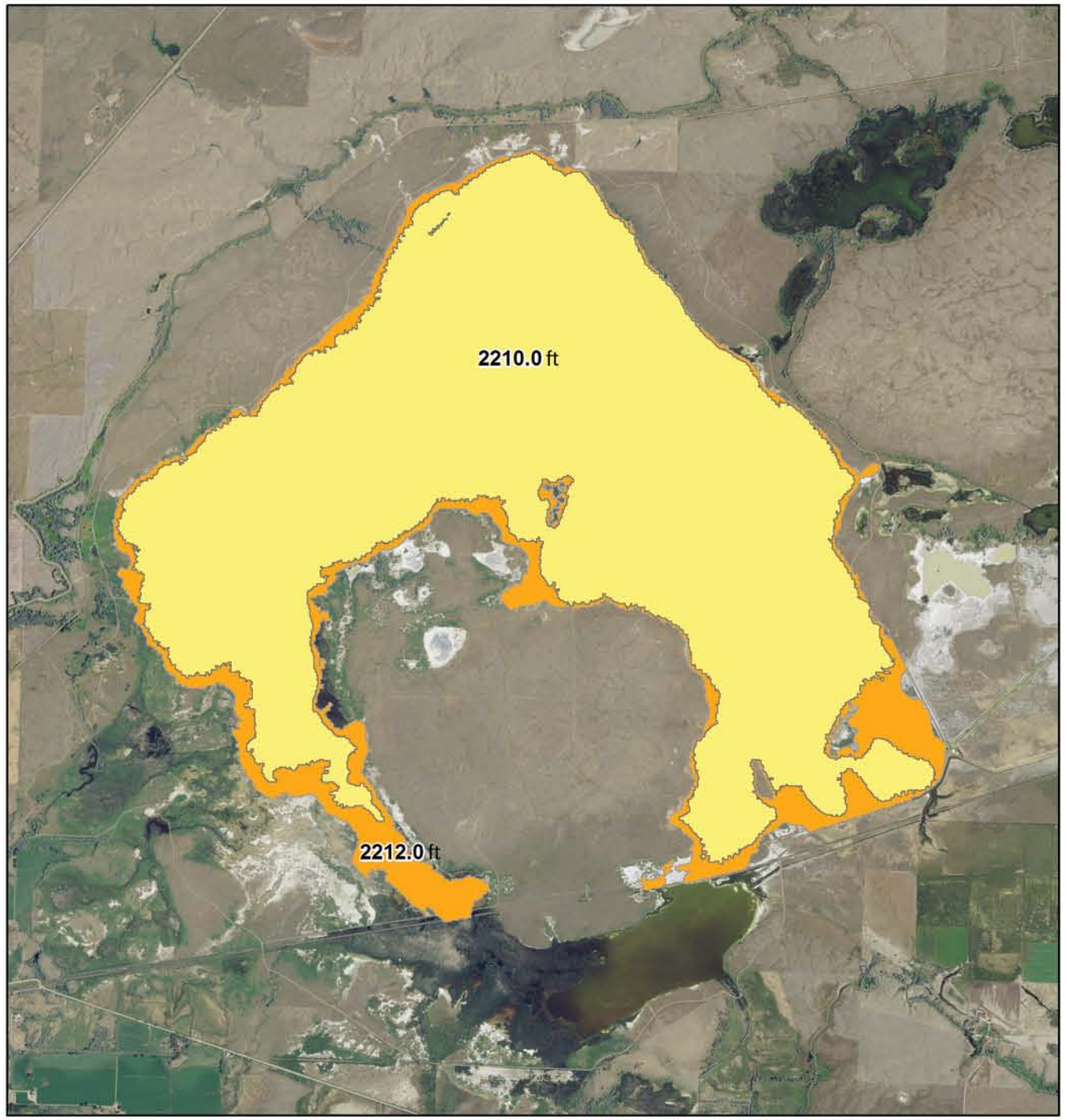
Lake Extent at 2206.0 ft and 2208.0 ft Elevation




Lake Extent at 2210.0 ft and 2212.0 ft Elevation




At Lake Elevation of 2206.0 ft
Estimated Volume of water = 1,030 acre-feet
Surface Area = 1,521 acres

At Lake Elevation of 2208.0 ft
Estimated Volume of water = 5,472 acre-feet
Surface Area = 2,828 acres

At Lake Elevation of 2210.0 ft
Estimated Volume of water = 11,748 acre-feet
Surface Area = 3,498 acres

At Lake Elevation of 2212.0 ft
Estimated Volume of water = 19,351 acre-feet
Surface Area = 4,082 acres

**Figure 43. Map of the extent of Lake Bowdoin at various water elevations.**

releases. In addition, the refuge will manage water levels to reduce the chance of a breach in the dike.

## Salt and Water Management Objectives

The objectives for the salt and water management program follow:

- Achieve and maintain an average salt concentration of 7,000 mg/L at a lake elevation of 2,209 feet in Lake Bowdoin.
- Limit blowing salts.
- Obtain an additional 8,000 acre-feet of canal deliveries to allow for a flow-through system, while meeting all DEQ standards.
- Use the additional 8,000 acre-feet of canal deliveries for more management options.

The salinity and blowing salts issue at Lake Bowdoin is a result of a complex series of factors that have changed the fundamental flow of water into and out of the lake for more than a century. Montana water quality laws protect receiving waters from point and nonpoint sources of pollution. In this case, salts and trace heavy metals are the concern at Lake Bowdoin. As a result, the lake, which once was a flow-through system, must be managed today as a closed basin.

Random droughts and historical floods can and have functioned to remove salts from the lake system. However, relying on these periodic events is not a viable long-term solution. The short-term solution is to inject the salts and heavy metals deeply and safely into the ground. However, in the long term, the Service's goal is to acquire enough water to institute a flow-through system.

# Objectives for Salinity and Blowing Salts

The following objectives guide the management actions for addressing the issue of salinity and blowing salts at Bowdoin Refuge.

## Objective for Salinity and Blowing Salts 1

Before drilling the injection well, provide at least 2,000 acres of subsaline (more than 9,600 mg/L), permanent, wetland habitat for migratory birds and associated wetland-dependent wildlife on Lake Bowdoin.

### *Strategies*

- Continue to receive water supplies and pursue available excess water from the Milk River Project to provide habitat for migratory birds.
- Continue to work with the State of Montana during the adjudication process for the Milk River watershed to claim an additional 8,000 acre-feet historical use right.

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*Alkali salt blows off Dry Lake at Bowdoin Refuge, Phillips County, Montana (1988).*

- Continue to monitor existing surface sites, ground water–monitoring wells, and the lake's water level elevation.

- In the spring, transport available water to Lake Bowdoin in early March and end by May 15 to reduce the chance of disease outbreaks and flooding of overwater nesters.

- In the fall, start transporting available water after September 1 to provide migratory bird habitat.

- Continue to monitor for avian disease outbreaks and the use of islands by colonial-nesting birds.

***Rationale***. Until the injection well project starts, the refuge will continue to manage for quality habitat under the current subsaline wetland conditions. In the absence of a large flood event, conditions in Lake Bowdoin will remain in the subsaline category, because there is no means to remove salts from the lake.

Wetland habitat is highly dependent on the available water delivered by the Malta Irrigation District; the lake has historically provided habitat for a variety of waterfowl and other waterbirds. Water deliveries in early spring will continue to provide wetland habitat throughout summer and fall. The refuge will continue monitoring salinity and wildlife use. In addition, collection of baseline data will be needed to effectively monitor the results of the injection well project.

## Objective for Salinity and Blowing Salts 2

While implementing the objectives to reduce salinity on Lake Bowdoin, provide valuable information on the process, benefits, and results of this salt reduction program to the public; local, State, and Federal governments; other agencies; and partners.

### *Strategies*

- Inform people about the salinity situation and options with news releases to the media.

- Provide salinity information and monitoring results to the public in several ways including: presentations to community groups, distribution of brochures, and up-to-date Web pages.

- Conduct tours of the saline treatment site (injection well).

***Rationale.*** It is likely that the injection well will not be operational for at least 5 years. During this time, the Service will continue to provide information on the progress for getting money and starting construction. This will be accomplished through news articles and presentations provided at Bowdoin Refuge and to community groups. When the Service starts the injection well process, the refuge staff will develop a fact sheet and other outreach methods to describe the installation and operation plan for the injection well, including where the injection well will be drilled. Once the project was fully implemented, the Service will provide updates on how the project was proceeding and meeting the objectives.

## Objective for Salinity and Blowing Salts 3

Within 15 years after construction of the injection well, reduce salt concentrations in Lake Bowdoin to an average TDS (salts) of 7,000 mg/L at a lake elevation of 2209.0 feet while accepting all salt and water inputs, to provide the water quality needed to improve the diversity and quantity of wetland plants and invertebrates that can support healthy populations of waterbirds and other wetland-dependent species.

### *Strategies*

- Develop a stepdown plan and required environmental analysis for the design, placement, installation, operation, and maintenance of the injection well in coordination with DEQ, DNRC, EPA, Reclamation, U.S. Geological Survey, irrigation districts, and other partners (table 13).

- Work with the local community including landowners, the conservation district, Natural Resources Conservation Service, and DNRC for long-term management to reduce saline inputs. Emphasize land use changes that will reduce the shallow ground-water levels that provide some of the salt load.

- Work with the irrigation district and landowners to improve irrigation water management to reduce salt leaching into shallow ground water that eventually resurfaces when ground water evaporates.

- Work with the irrigation district to line portions of the canal known to leak and cause salt accumulation on the refuge.

- Acquire project funding: (1) minimum of $6.7 million to design and construct the project; and (2) $100,000 to operate and maintain the system annually.

- Coordinate with local oil and gas companies and other consultants to determine the most cost-effective methods to drill and operate the injection well.

**Table 13. Partner agencies and expertise for the injection well project at Lake Bowdoin, Montana.**

| *Agency* | *Expertise and coordination* |
|---|---|
| Montana Department of Environmental Quality | Contaminants<br>Water quality standards<br>Regulatory standards |
| Montana Department of Natural Resources and Conservation | Hydrology and technical assistance<br>Water quality monitoring<br>Water rights |
| U.S. Environmental Protection Agency | Well permit<br>Well operation<br>Well monitoring |
| Bureau of Reclamation | Water delivery<br>Negotiations with irrigation districts |
| U.S. Geological Survey | Wetland ecology<br>Salinity and hydrological monitoring<br>Geologic formations |
| Milk River Basin Joint Board of Control (irrigation districts) | Water quantity<br>Water delivery |
| Oil and gas companies | Injection well drilling<br>Geologic formations |
| Nongovernmental organizations | Grants<br>Other funding sources |

- Work with the Montana Bureau of Mines and Geology in determining how deep the injection well should be drilled to avoid potable ground water and the best placement location.
- Collect baseline information on plant and wildlife diversity and water quality as a basis for monitoring the effects of reducing salinity concentrations and the effectiveness of the method.
- Within 5 years, install the infrastructure necessary to achieve the objective including an injection well, intake pipes, power source, and pump house.
- Allow the water level of Lake Bowdoin to naturally recede to achieve maximum concentrations of salts for efficient injection. Limit fall water deliveries to maximize winter salt concentration levels.
- Until the salinity objective is achieved, operate the pump year-round to remove the maximum amount of salts annually. Use the pump to maintain the salinity objective as needed.
- Using additional maintenance staff and contractors, maintain or replace the pump and associated infrastructure as needed.
- Once the salinity objective is reached, determine the feasibility of modifying the wetland management structures to help maintain the objective's conditions by allowing Beaver Creek flooding to flush Lake Bowdoin. If additional water supply is granted, use this water to create a flow-through system.

***Rationale.*** Salinity concentrations in Lake Bowdoin have steadily increased since 2000 due to drought conditions and a management decision not to place saline water into Dry Lake during the winter. Levels currently exceed 10,500 mg/L with higher average levels on the east side of the lake. Currently, there is no acceptable way to remove salts from the lake, thus this upward trend would continue in the future until a major flood or accidental spill occurred that lowered the salt load, at least temporarily.

Salinity concentrations are a function of water volume and salt loads. Nearly 7,000 tons of salt are added to the lake every year through various input sources (Kendy 1999; Stan Jones, personal communication, 2009). There may be opportunities to reduce some of these salt inputs. This will require working closely with surrounding landowners and the organizations focused on salinity issues in Montana, in particular, the Montana Salinity Control Association. Extended droughts, which tend to occur on decadal

patterns (that is, they reoccur every decade or once every few decades) in this area (Gleason et al. 2009), result in lower lake levels and elevated salt concentrations. It is estimated that, under relatively normal precipitation and an average water level of 2,210 feet in Lake Bowdoin, salinity would surpass 15,000 mg/L in the near future.

The salinity objective of 7,000 mg/L with normal water input is an aggressive target. This level was selected for the following reasons:

- It is well within the tolerances of several key invertebrate and plant communities including sago pondweed (Gleason et al. 2009).
- It is below levels considered harmful to waterfowl and other wetland-dependent birds.
- It provides managers with flexibility in operating the lake at higher water levels and reduced salinities.

Plant and invertebrate diversity is significantly lower in wetlands with high salinity concentrations (Euliss et al. 1999, Gleason et al. 2009, Swanson et al. 1984). Plant communities in highly saline wetlands favor a few species (Gleason et al. 2009). While salt-tolerant plants provide habitat for a suite of birds, a larger diversity of plant communities is more capable of providing for the needs of many species of wetland-dependent wildlife. Most invertebrates do not have the capacity to survive in water with salinity concentrations exceeding about 9,000 mg/L (Gleason et al. 2009). The importance of invertebrates is substantial for a variety of bird groups; invertebrates are critical for shorebirds (Helmers 1992, Skagen and Oman 1996), ducks (Krapu and Swanson 1975, Swanson et al. 1984), swans, cranes, grebes, and many others. Differences in how and where birds feed, as well as differing bill lengths and body size, allow birds to use invertebrates in different locations within a wetland, thereby reducing competition for resources. A lack of invertebrate diversity could result in food resources available for a narrower range of migratory birds that use the lake.

From 1990 to 2003, the refuge produced an average of 3,600 ducklings per year. Undoubtedly, many of these broods spent part of their development on Lake Bowdoin. Waterfowl broods, especially those less than 4 days old, are most at risk by elevated salinity concentrations. At salinity concentrations as low as 3,000 mg/L, reduced growth rates throughout development can occur (Mitcham and Wobeser 1988). If no fresh water is available, lethargy in ducklings can occur at 9,000 mg/L, 10-percent mortality at 12,000 mg/L, and near 100-percent mortality at levels higher than 18,000 mg/L (Moorman et al. 1991, Swanson et al. 1984). The influx of water into Lake Bowdoin—via the Black Coulee drainage and the Dodson South Canal—provides a source of fresher water for ducklings, thereby minimizing the threat of direct mortality.

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*Three-square bulrush grows on the salt-covered shoreline along the southwestern edge of Lake Bowdoin.*

At a water elevation of 2,208 feet, Lake Bowdoin is about 2,800 acres, contains nearly 5,500 acre-feet of water, and has an average depth of about 2 feet. In contrast, at an elevation of 2,210 feet, which is the average operating level, the lake is about 3,500 acres, contains 11,750 acre-feet of water, and has an average depth of 3.3 feet. If the salinity objective was met and maintained, the resulting salt concentrations of the lake with more water (higher lake level) would be considerably less.

This objective and the strategies for operation of the injection well address the EPA regulations for a class 1 injection well, as summarized below:

- Inject below the lowermost geologic formation containing an underground source of drinking water.
- Identify and correct any penetrations within the surrounding area that would allow fluid to move out of the injection well.
- Obtain approval of the construction plan.
- Operate the well to ensure saline water is fully contained in the formation.
- Continuously monitor the injected water, movement of fluid in the formation, and mechanical operations.
- Plug and abandon the well correctly when complete.

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*Glasswort plants are scattered on the salt-covered edge of southeastern Lake Bowdoin.*

Working with local groups, irrigation districts, partners, and congressional members is essential to garnering support to develop and operate the injection well and reduce salt inputs. The small refuge staff needs expertise and support from partners to successfully carry out the project. The Service will seek expertise from public and private entities (oil and gas companies) to help guide the project.

## Objective for Salinity Monitoring

Monitor, document, and evaluate the effects of fluctuating lake elevations and salinity concentrations on wetland plants, invertebrates, and associated wildlife to measure the effectiveness and impacts of the salt reduction project.

### *Strategies*

- Before project construction, work with partners to collect baseline inventory information on current species of wetland plants, associated migratory birds and other wildlife, and invertebrates.
- Drill monitoring wells along Black Coulee drainage to monitor ground water flow and quality.
- Install a gauging station to monitor the rate of surface flow at Patrol Road Pond and Black Coulee culvert.
- Following requirements of the EPA relating to a class 1 injection well, monitor the containment of fluid in the injection zone.
- Continue to monitor salinity at the established monitoring sites across Lake Bowdoin to determine the changes in salinity from the injection well project. Add additional monitoring sites as needed.
- Design and implement a study to determine the effects of the injection well project on wetland plants, associated migratory birds and other wildlife, and invertebrates.
- Continue to monitor for disease outbreaks and for effects on colonial-nesting areas in response to changes in lake elevation and salinity.
- Monitor heavy metal concentrations during active salt removal and before releasing water into Beaver Creek.

***Rationale.*** Refuge staff has collected a variety of water quality data, including salinity, for Lake Bowdoin and the surrounding wetlands for more than 30 years. This information has been critical in understanding the water and salt balance for the lake, and it is important to continue this data collection. The Black Coulee drainage is least understood in terms of water quality and water quantity. Additional monitoring wells are needed in this area to document the characteristics of source flows.

Additional biological information is needed to understand plant and animal responses to fluctuating salinity concentrations. To establish pre-injection well conditions, baseline information on plant and animal occurrences and their distribution throughout the lake is needed.

Several islands in Lake Bowdoin provide colonial-nesting areas for several species of birds including American white pelican. An estimated 1,350 nests were present on two islands during 2009. Woody Island contained the largest number of nests and would be subject to the most disturbance if the lake level were consistently in the 2,208-foot range for extended periods during salt removal. Expanded surveys and monitoring will help document any effects on these birds. Additional coordination would be needed with individuals and groups conducting surveys if it was documented that local breeding populations had shifted their geographical locations.

Fluctuating water levels, both planned and unplanned, will be a part of managing salt levels in Lake Bowdoin. There will be times when the lake level needs to be low to facilitate more salt being removed from the system. Adaptive management will be used extensively throughout this process.

## Objective for Salinity Management Research

Pursue and develop research projects that provide information on how to better manage and monitor the

injection well project and improve the diversity and productivity of managed subsaline and brackish wetlands.

***Strategies***

- Work with partners to identify research and data needs.
- Develop partnerships with universities to provide opportunities for graduate study projects.
- Pursue partnerships with individuals and organizations with the required expertise to conduct this research.
- Evaluate the results of research projects to determine the need and feasibility of modifying the management direction.

***Rationale.*** Implementing this project will provide opportunities for researchers to study the effects of not only drilling and operating the injection well but also the subsequent changes to habitat and wetland-associated wildlife.

The Service will develop partnerships with universities to provide potential projects for graduate students and will work with other agencies that have the expertise and interest in evaluating the effectiveness of the injection well. Studying the area before and after installing the injection well could provide valuable information for addressing salinity on other public lands and on private lands.

The results of these analyses will assist the refuge in determining how successful the project was in achieving the salinity objective and expected habitat improvement. These results will also help to determine if modifications were needed in the stepdown plan for installation and operation.

# 4.6 Goal for Visitor Services and Cultural Resources

*Provide visitors of all abilities with wildlife-dependent recreation, interpretation, and education opportunities that fosters an appreciation and understanding of the unique wildlife, plant communities, and cultural resources of the Montana Prairie Pothole Region.*

## Visitor Services

The Bowdoin National Wildlife Refuge Complex manages nearly 85,000 acres of lands and waters, some of which are open for wildlife-dependent and compatible public use (appendix B contains compatibility determinations for public uses associated with the CCP). Because the refuge complex is spread over four counties, it is impossible for Service staff to meet and interact with each visitor that comes to enjoy the habitats, fish, and wildlife found on the refuge complex. There are brochures, signage, and interpretive panels that visitors can use to independently explore and learn about the refuge complex; nevertheless, there are still visitors who are even unaware that they are on a national wildlife refuge.

Additional programs, staff, and funding are needed for a broad-based program that reaches the maximum number of visitors to achieve the goal. Current staff might be able to provide some of the additional opportunities in these objectives and strategies but not without sacrificing the ability to conduct other visitor, biological, or maintenance programs. Meeting the visitor services objectives is contingent on hiring one permanent full-time visitor services specialist, one permanent full-time maintenance worker, and one permanent full-time law enforcement officer.

### Hunting Objective

Continue to provide hunters with safe, reasonable harvest opportunities with uncrowded conditions, minimal conflicts with other users, and satisfaction with their overall experiences.

***Strategies***

- Continue to provide compatible hunting opportunities for waterfowl and upland gamebirds on 40 percent (western portion) of Bowdoin Refuge (refer to figure 36 in chapter 3), according to State and Federal regulations.
- Continue to require hunters to use approved nontoxic shot for hunting of migratory and upland gamebirds on Service lands.
- Continue to allow trapping on designated areas within the wetland management district, excluding Holm WPA, according to State seasons and limits. Continue to allow trappers to use body-gripping traps, commonly known as Conibear® traps, and live traps. Continue to prohibit leg-hold traps.
- Continue to issue special use permits for a limited number of trappers on Bowdoin Refuge to remove burrowing animals that threaten to damage or cause failure of water control structures, roads, dikes, and canals.

- Continue to issue special use permits on Bowdoin Refuge to permit the trapping of mammalian predators that are negatively affecting migratory birds. Continue to prohibit leg-hold traps.

- Continue to permit compatible hunting opportunities for upland gamebirds in the waterfowl sanctuary portion of Bowdoin Refuge (refer to figure 36 in chapter 3) as late-season hunting (no sooner than December 1), contingent on waterfowl migrating off the refuge when the wetlands freeze. Restrict the first 2 days of this hunt to hunting only by young people.

- Continue the hunter registry at Bowdoin National Wildlife Refuge and expand the form to include extra columns that allows hunters to describe their hunting experience and satisfaction.

- Consider conducting limited-draw hunts to address overcrowding if hunter satisfaction decreases.

- Conduct random surveys on the wetland management district to determine hunter satisfaction.

- Evaluate future acquisitions for new hunting opportunities.

- Create a public use brochure for Bowdoin Wetland Management District.

- Continue to maintain the accessible boardwalk and hunting blind at the Pearce WPA for hunters with disabilities.

- Post changes in hunting regulations, seasons, and bag limits at the hunter kiosk and Bowdoin Refuge headquarters, on the refuge complex's Web site, and through news releases.

- Update the hunting regulation sections of the public use brochures as needed.

- Use the refuge signage and brochures to provide hunters with information on hunting regulations and where to hunt on the refuge complex to ensure compliance with public use regulations.

- Recruit one permanent, full-time, law enforcement officer.

- Continue to allow the public, including hunters, to park in designated parking areas on the north end and southeast boundaries of Bowdoin Refuge and to walk through the refuge to access Pearce WPA to the north and Beaver Creek WPA to the east (refer to figure 36 in chapter 3).

- Improve public access to compatible, wildlife-dependent activities on Black Coulee National Wildlife Refuge by developing the entrance road and parking for the reservoir.

- Close the eastern portion of Bowdoin Refuge to all foot traffic from the beginning of the waterfowl hunting season through at least November 30, or until waterfowl have left the refuge, to provide continued sanctuary. Although the auto tour route remains open through this portion of the refuge, require visitors to remain on the tour route outside of the hunting areas.

- Work with the State to determine the feasibility of providing a limited big game hunt on portions of Bowdoin Refuge that are currently open to public use. Address the compatibility of the hunt and the safety of hunters and other refuge visitors.

***Rationale.*** Habitat that normally supports healthy wildlife populations produces harvestable surpluses that are a renewable resource. As practiced on Bowdoin Refuge Complex, hunting does not pose a threat to the wildlife populations, and in some instances, is necessary for sound wildlife management. Harvesting wildlife on the refuge complex is carefully regulated to ensure equilibrium between population levels and wildlife habitat.

Trapping is a tool used by the Service to remove animals that are damaging water management structures or preying on migratory birds, particularly nesting birds. All lands within the Bowdoin District will continue to be open to some form of hunting and trapping with the exception of Holm WPA. Trapping on the district is conducted according to State seasons and regulations.

Mike Artmann / USFWS

*Black Coulee Pond is one of several ponds that are overgrown with cattail.*

Trapping on Bowdoin Refuge is by permit only. The refuge encourages the use of live traps to prevent the capture of nontarget species. The Service prohibits the use of leg-hold traps on Bowdoin Refuge but allows the use of Conibear® traps.

Closing the eastern half of Bowdoin Refuge to foot traffic during the waterfowl season provides additional protection and rest for waterbirds and may actually improve hunting on other parts of the refuge. The western portion (40 percent of the refuge) is open to compatible hunting of waterfowl and upland gamebirds in accordance with State and Federal hunting regulations. The waterfowl sanctuary portion of the refuge (60 percent) is only open to late-season hunting (December 1–31) of upland gamebirds, contingent on when waterfowl migrate off the refuge due to the freezing of refuge wetlands. These hunting seasons are monitored and enforced to ensure regulations are followed and the provide hunters with a safe, quality experience.

The refuge complex currently has one wildlife refuge specialist with a minimum of 25 percent of their duties committed to collateral law enforcement patrols and enforcement. The wildlife refuge specialist's remaining responsibility is managing the wetland management district: 158 grassland and wetland conservation easements, 1 flowage easement, 4 FmHA easements, 9 waterfowl production areas, and 4 satellite refuges with 29 associated refuge and flowage easements. This individual is also responsible for conducting law enforcement activities across the refuge complex. Expansion of hunting and other visitor services programs is contingent on the ability to recruit one, permanent, full-time law enforcement officer to protect refuge resources and provide the public with a safe experience.

## Fishing Objective

Following State and Federal regulations, continue to allow compatible recreational fishing on Beaver Creek and McNeil Slough WPAs.

### *Strategies*

- Continue to require visitors to follow State and Federal regulations for fishing on designated areas within the refuge complex.

- Include information on fishing locations and regulations in the new brochure for the waterfowl production areas.

- Continue to provide anglers information about other fishing opportunities on areas surrounding the refuge complex.

***Rationale.*** Fishing is considered by many to be a legitimate, traditional, recreational use of renewable natural resources. The National Wildlife Refuge System Act of 1966, other laws, and Fish and Wildlife Service policy permit fishing when it is compatible with the purposes for which the refuge or district was established and acquired. Compatible recreational fishing opportunities are available at McNeil Slough WPA (primarily on the Milk River) and Beaver Creek WPA (primarily on Beaver Creek). The remainder of the wetlands within the district have minimal habitat or do not support harvestable game fisheries or populations.

Anglers have many exceptional fishing opportunities within 100 miles of Bowdoin Wetland Management District including fishing at the Nelson Reservoir, Cole Ponds, Milk River, Missouri River, Fort Peck Lake, and stocked ponds and reservoirs on public and private lands (Montana's Missouri River Country 2007).

## Wildlife Observation and Photography Objective

Provide increased opportunities for wildlife observation and photography that enhance the visitor experience and encourages an appreciation and connection to the northern prairie.

### *Strategies*

- Recruit one permanent, full-time, visitor services specialist.

- Maintain year-round opportunities for wildlife observation and photography along the existing auto tour route on Bowdoin Refuge including the accessible nature trails. Develop an accessible wildlife observation site with spotting scopes and an expanded parking area at stop number 5 along the auto tour route (refer to figure 36 in chapter 3).

- Maintain the refuge complex's two accessible photography blinds at Bowdoin Refuge and Pearce WPA.

- Install a remote camera for observing grouse lek activities.

- Provide regularly scheduled wildlife observation tours.

- Update the Bowdoin Refuge brochures for known mammal, reptile, and amphibian species.

- Notify the local media of opportunities to view migrating birds, particularly unique species.

- Close the east end of Bowdoin Refuge to all foot traffic at the start of the waterfowl-hunting season (at least through November 30) or until waterfowl depart the refuge, to provide sanctuary areas for migratory waterfowl and shorebirds (refer to figure 36 in chapter 3). Keep the auto tour route open but require visitors to remain on the auto tour route in designated sanctuary areas.

- Encourage visitors to provide their observations and experiences at the end of a visit through contacts in the visitor contact area and during random field encounters, requesting they provide feedback in the brochures and through the refuge complex's Web site.

***Rationale.*** Most visitors that come to the Bowdoin National Wildlife Refuge Complex are here to view and photograph wildlife and scenery. Wildlife observation and photography are among the six, wildlife-dependent, recreational uses that have been found compatible on the refuge complex. Wildlife observation often serves as the foundation for an individual's environmental ethics. This happens when people begin to appreciate and care about the wildlife they are able to enjoy and experience firsthand; they take this appreciation and awareness back to their own communities and backyards.

Enhancements to the photography and wildlife-viewing areas within the refuge complex will not only enhance the visitor's experience and opportunity to view and photograph wildlife but also provide a connection to the area's unique habitat and wildlife. This connection may result in a greater understanding and appreciation of the refuge complex and the important grassland and wetland habitat protected within its boundaries.

These uses have the potential to negatively affect resources, particularly use by visitors who are permitted to explore the refuge complex on foot. Studies have shown that individuals or groups walking disturb wildlife, particularly waterfowl, even more than vehicles. To minimize some of these effects at the most popular area for wildlife viewing—Bowdoin Refuge—the east end of the refuge will be closed to foot traffic during the waterfowl-hunting season. This provides an undisturbed resting area for waterfowl and other waterbirds until hunting season ends around November 30. Visitors could still view these birds from the auto tour route but need to remain in their vehicles in designated sanctuary areas.

## Environmental Education and Interpretation Objective 1

Continue and expand environmental education programs and activities for adults and students on and off the refuge complex, focusing on the native prairie and wetland habitats and the natural, cultural, and historical resources of the Bowdoin National Wildlife Refuge Complex. Design these programs and activities to develop awareness of and promote advocacy for refuge resources and management activities for more than 500 visitors and students annually.

***Strategies***

- Recruit one permanent, full-time, visitor services specialist.

- Develop additional education kits specific to refuge programs and resources including field exploration kits (for example, backpacks with field equipment) and field activity pages.

- Develop a series of environmental outreach programs with specific themes (such as prairie and wetland conservation and grassland birds) that can be used for on- and off-refuge programs.

- Maintain and update a list of available environmental education kits and lending library materials for teachers.

- Every 5 years, facilitate a workshop for local teachers.

- Participate annually in at least two community events where the opportunity is available to educate the public about the refuge complex and its resources.

- Provide programs for at least six school groups, or 300 students, per year onsite at the refuge complex.

- Provide at least three onsite staff-led group programs on the refuge complex per year.

- Conduct at least 10 offsite visits to local schools within the wetland management district or with other groups or organizations to present information on the history, purposes, and natural resources of the refuge complex.

- Host events for International Migratory Bird Day and National Wildlife Refuge Week.

- Pursue opportunities to expose middle school, high school, and college students to the field of natural resource management.

- Work with partners to develop programs to introduce young people to safe, effective, and ethical hunting techniques and methods.

- Develop programs for introducing young people to the enjoyment of the outdoors and instilling ethical, safe, and effective skills for observation, identification, and photography of wildlife.

- Work with schools and teachers within the wetland management district to develop programs that support their curriculum objectives.

- Pursue grants and other funding sources to support environmental education programs.

***Rationale.*** Environmental education is a process designed to teach citizens and visitors, children and adults, the history and importance of conservation and scientific knowledge about the Nation's natural resources. Through this process, the Service can help develop a citizenry that has the awareness, knowledge, attitudes, skills, motivation, and commitment to work cooperatively toward the conservation of environmental resources. Environmental education within the Refuge System incorporates onsite, offsite, and distance-learning materials, activities, programs, and products that address the audience's course of study, refuge purposes, physical attributes, ecosystem dynamics, conservation strategies, and the Refuge System mission.

Highly structured programs do not have the same effect as allowing students to explore on their own. Programs must not be so rigid so that children cannot learn by using their own imaginations and senses and yet achieve a balance that ensures the student learns something new and exciting about the resources they encounter.

Environmental education is among the six compatible, wildlife-dependent recreational uses identified in the Improvement Act. Due to limited staff and resources, the Bowdoin National Wildlife Refuge Complex has been conducting minimal environmental education activities, typically only by invitation from local schoolteachers. Since today's children are tomorrow's land stewards, it is essential to help them become aware of the natural world around them and what they can do to help protect and restore it.

## Environmental Education and Interpretation Objective 2

Provide additional interpretive opportunities for the public that focus on native prairie and wetland habitats, the refuge complex's purposes, and natural, cultural, and historical resources. Design these opportunities to promote awareness of and advocacy for the National Wildlife Refuge System and the refuge complex's resources, management challenges, and programs.

***Strategies***

- Recruit one permanent, full-time, visitor services specialist.

- Design and install interpretive panels at the accessible wildlife observation stop (number 5) along the auto tour route.

- Work with the city of Malta to install an informational kiosk in town that provides refuge information and directional maps.

- Develop a display at the Phillips County museum highlighting the history of the refuge complex.

- Expand the visitor contact area at refuge headquarters into the conference room and add additional interpretive literature and activities.

- Develop a portable refuge-specific display that can be used for programs and events.

- Engage partners and challenge cost-share opportunities (such as the local film school) to develop a short refuge film for the refuge Web site and other outreach activities.

- Install interpretive panels describing the uses of prescribed fire, grazing, and haying.

- Install informational kiosks at the Beaver Creek and McNeil Slough WPAs to interpret wetland management in these areas.

- Expand the visitor contact area, providing access to visitors of all abilities. Use this additional space for improved interpretive displays and more materials.

***Rationale.*** Interpretation is the identification and communication of important messages about natural and cultural resources to diverse audiences. Interpretation is designed to reveal relationships about the nature, origin, and purpose of a resource, landscape, or site in a way that forges connections between the interests of the audience and meanings inherent in the resource (National Association for Interpretation (no date). As a resource management tool, interpretation is designed to develop understanding—through understanding, appreciation—and through appreciation, protection (National Park Service 2009).

Interpretation is one of the six compatible, wildlife-dependent, recreational uses identified in the Improvement Act. Due to limited staff and resources, the Bowdoin National Wildlife Refuge Complex has

been conducting minimal interpretation activities. It is essential to help the public become aware of the natural world around them and what they can do to help protect and restore it.

# Cultural Resources

The refuge complex has some historical structures, including a few dams and spillways. In addition, there are remnants of prehistoric use—tipi rings have been found throughout the refuge complex.

## Cultural Resources Objective 1

Through partnerships, continue to develop a comprehensive cultural resource inventory of the refuge complex and preserve and protect all known cultural resources while ensuring future activities comply with section 106 of the National Historic Preservation Act.

### *Strategies*

- Work with the Service's zone archaeologist and with contractors, universities, and tribal and State historic preservation officers and culture committees to continue developing the cultural resources inventory.
- Document all cultural resource sites found during refuge activities.
- Work with archaeological staffs of the Service and the State Historic Preservation Office to ensure refuge complex activities comply with section 106 of the National Historic Preservation Act.

***Rationale.*** Ideally, a comprehensive inventory would help ensure the protection of cultural resources. Throughout the life of this 15-year plan, the refuge complex staff will work with partners and the regional archaeologist and staff to begin documenting cultural sites.

Federal laws and policies mandate the identification and protection of cultural resources on Federal lands. Section 106 of the National Historic Preservation Act requires Federal agencies to consider the effects on cultural resources before conducting any Federal action. Without a complete inventory, the refuge complex's identification of all cultural resources is likely incomplete. Nevertheless, the law requires all Federal activities that have the potential to impact cultural resources be evaluated. Until the inventory is completed, the staff will continue to work with the regional archaeologist to evaluate projects with the potential to have impacts, on a case-by-case basis.

## Cultural Resources Objective 2

Improve public awareness and appreciation for the cultural resources and history of the refuge complex and the northern prairies while creating a greater understanding of this history's connection to the natural resources of the area.

### *Strategies*

- Work with the city of Malta to install a kiosk in the community with information on the area's cultural resources and history of the refuge complex.
- Work with interested tribes to identify and interpret the cultural history of resources within the refuge complex.
- Include cultural resource interpretation in the expanded visitor contact area.

***Rationale.*** Cultural resources interpretation communicates important messages about the area's history, context, and resources to diverse audiences. Refuge complex lands have a rich history of Native American and Euro-American presence. Historical structures include the stone pillars at the entrance into Bowdoin Refuge, which were built by workers in the Works Progress Administration.

Carmen Luna / USFWS

*Petroglyph*

As a resource management tool, interpretation is designed to develop understanding; through understanding, appreciation; and through appreciation, protection (National Park Service 2009). Working with the city of Malta to interpret these resources and create a display in the city will generate additional interest and understanding of these resources while encouraging people to visit the refuge complex to learn more.

# 4.7 Goal for Partnerships

*Maintain and expand partnerships that preserve, restore, and enhance healthy and productive prairie/wetland complexes on Bowdoin National Wildlife Refuge and the wetland management district.*

# Public, Government, and Industry Partners

Partnerships are vital to achieving the Service's mission. Present and future conservation activities conducted on Service lands and conservation easements have the potential to positively influence adjoining landowners and surrounding communities.

## Partnership Objective 1

Continue to participate in and expand partnerships that contribute to the understanding and conservation, restoration, and enhancement of diverse, healthy, productive grassland and wetland systems and the goals of the National Wildlife Refuge System.

### *Strategies*

- Develop a Friends group to support the refuge complex's goals and programs.
- Continue to support the Partners for Fish and Wildlife Program work on private lands.
- Continue working with Montana Fish, Wildlife & Parks to conduct habitat improvement projects in areas open to hunting.
- Work with other Federal land managers to determine if their infrastructure and management actions could be used to enhance the refuge complex's wetland system.
- Cooperate with the weed boards within the four counties covering the refuge complex.
- Continue to cooperate with neighboring communities, counties, tribes, landowners, and nongovernmental organizations to accomplish projects of mutual interest.
- Coordinate with universities to develop an ongoing program of graduate projects that could be used to research and resolve refuge management issues.
- Continue expanding partnerships with the counties to improve roads that provide public access to the refuge complex.

***Rationale.*** Regular communication with partners, various groups, communities, and individuals through meetings, local events, and activities will not only help garner support for refuge management activities and the National Wildlife Refuge System, but also allow managers to hear and understand their concerns. This open dialog and involvement with partners will help build and maintain support for the refuge complex's programs. Furthermore, many of the Bowdoin National Wildlife Refuge Complex's wildlife, habitat, and public use programs and habitat projects could not continue without the funding and support from partners.

## Partnership Objective 2

Following current and future Service policy, work with energy developers—who are exploring and extracting reserved and excepted mineral rights on conservation easements and fee-title lands—to reduce impacts by ensuring that disturbance and physical occupancy is kept at the minimum space compatible with efficient mineral operations.

### *Strategies*

- Work with energy developers who hold mineral leases below Service lands to encourage on- and offsite habitat improvements in exchange for disturbances caused by their exploration and development activities.
- Evaluate future land acquisitions to determine the status of reserved and excepted oil, gas, and mineral rights to evaluate the potential impacts of energy development on wetland habitat.
- Use time, place, and manner stipulations to minimize impacts to habitats and associated wildlife (FWS Oil and Gas handbook and 50 CFR 29.32).
- Ensure compliance of permitted mineral exploration and extraction activities with section 106 of the National Historic Protection Act of 1966, as amended.
- According to the Endangered Species Act, complete a section 7 evaluation for permitted mineral and extraction activities on lands that have the potential to support threatened and endangered species.
- Where appropriate, use 43 CFR 3101.5 (Issuance of Leases, National Wildlife Refuge Sys-

tem Lands) to manage Federal minerals below Service-owned land. Work with Bureau of Land Management resource specialists to include stipulations on Federal permits to protect wildlife and habitat.

***Rationale.*** Energy exploration and development on Service lands can occur when the minerals rights have been either severed from the surface title or retained by the United States Government. In the case of severed minerals on Service land, a prior owner of both surface and mineral rights, sold or granted by deed the mineral rights underlying his or her property. The landowner may have reserved or retained all or a portion of the mineral rights as part of the sale of the property to the Service. One of the rights included in the mineral estate is the implied right of the mineral estate owner (Alspach 1989) to use as much of the surface as reasonably necessary to explore for and produce minerals (*Placid Oil Co.* v. *Lee*, 243 S.W.2d 860; Tex. App. 1951). These activities are deemed reasonable if consistent with current practices of the industry. Without this right, the reservation of minerals is worthless to the grantee or reserver.

State laws overseeing the activities of exploration and production of minerals give some protection to the surface owner, because both parties must agree on compensation for surface damages (State of Montana 2009). Federal law for mineral rights reserved and excepted on Service land requires persons holding mineral rights to the greatest extent practicable conduct operations in such a manner as to prevent damage, erosion, pollution or contamination to the lands, water, facilities and vegetation of the area (50 CFR 29.32). In addition, physical occupancy of the area must be kept to the minimum space compatible with the conduct of efficient mineral operations. The Mineral Leasing Act of 1920 is the Federal law that authorizes the leasing of mineral rights owned by the United States Government. These Federal minerals are leased under the authority of the Bureau of Land Management. Regulations pertaining to the leasing and extraction of Federal minerals are found in 43 CFR.

Conservation easement contracts and waterfowl production areas are purchased subject to all valid existing mineral rights. In these situations, mineral rights are the dominant estate, and the rights of the surface owner or easement contract are the servient estate. There are several instances in the refuge complex where the Service owns surface title over Federal minerals. In most of these cases, the Federal minerals were leased before the Service obtaining ownership of the surface estate. The mineral lessee as afforded in the lease has the authority to occupy Service land and extract the minerals. When the Federal minerals have not been leased, section 3101.5–1 of 43 CFR states that there shall be no oil and gas mineral leasing on lands within a national wildlife refuge to give complete protection to the wildlife populations and habitats for which these lands were established. The exception to this rule is when drainage of the Federal minerals can be documented. To protect Federal minerals from drainage the Bureau of Land Management requests leasing recommendations from the Service. As a rule, the Service recommends a stipulation of no surface occupancy be added to the lease. This protects the Service's surface rights but allows for the Federal mineral extraction from surfaces outside the boundaries of a refuge or waterfowl production area.

Regardless of the circumstances, the Service will work closely with the mineral producer and Bureau of Land Management specialists to impose reasonable restrictions or conditions required to minimize adverse effects to wildlife and habitat resources (42 CFR 3101.1–2). Stipulations used to protect the resource will address time, place, and manner of activities. Guidance for handling mineral exploration and development is found in the Mountain–Prairie Region's "Fish and Wildlife Service Handbook on Management of Oil and Gas Activities on Fish and Wildlife Service Lands" (U.S. Fish and Wildlife Service 2009a).

## 4.8 Goal for Operations

*Prioritize for wildlife first and emphasize the protection of trust resources in the utilization of staff, funding, partnerships, and volunteer programs.*

# Staff

The staff of the Bowdoin Refuge Complex has a huge challenge in managing almost 85,000 acres of Service lands scattered throughout a four-county, 17,183-square-mile area. Current staff at the refuge consists of five permanent full-time employees. Table 14 shows the current staff and additional staff required to fully implement the CCP. If all positions are funded, refuge staff will be able to carry out all aspects of this CCP, which will provide maximum benefit to wildlife, improve facilities, and provide for public use. Projects that have adequate funding and staffing will receive priority for accomplishment. Staffing and funding are requested for the 15-year life of this CCP.

**Table 14. Current and additional staff for Bowdoin National Wildlife Refuge Complex, Montana.**

| *Program* | *Current positions* | *Position changes and additions* |
|---|---|---|
| Management | GS–485–12 refuge manager<br>GS–485–09 wildlife refuge specialist | GS–485–13 refuge manager[1]<br>GS–485–12 supervisory wildlife refuge specialist[2] |
| Biology | GS–486–11 wildlife biologist | GS–404–8 biological science technician[1] |
| Administration | GS–303–07 administrative support assistant | GS–326–5 office generalist[1] |
| Maintenance | WG–4749–08 maintenance worker | WG–4749–8 maintenance worker[1]<br>WG–3502–5 laborer[1] (career seasonal) |
| Visitor services | None | GS–025–9 visitor service specialist[1]<br>GS–025–9 law enforcement officer[1] |

[1] *Added position.*
[2] *Reclassification of current GS–12 refuge manager position.*

## Staff Objective

In addition to current employees, recruit additional staff and volunteers needed to fully carry out the actions in the CCP including maintenance, monitoring, inventory, and research.

### *Strategies*

- Retain the current refuge complex positions (permanent, full time): one GS–486–11 wildlife biologist, one GS–485–9 wildlife refuge specialist (wetland district manager and collateral law enforcement officer), and one WG–4749–08 maintenance worker.
- Recruit a permanent, full-time, GS–485–13 wildlife refuge manager to oversee implementation of the CCP and direct the actions of the expanded staff.
- Convert the current GS–485–12 refuge manager position to a supervisory wildlife refuge specialist to function as the deputy refuge manager.
- Recruit a permanent, full-time, GS–326–5 office generalist.
- Recruit a permanent, full-time, GS–025–9 visitor services specialist to design and carry out the expanded public use programs.
- Recruit a permanent, full-time, GS–404–8 biological science technician.
- Recruit a permanent, full-time, GS–025–9 law enforcement officer.
- Recruit an additional permanent, full-time WG–4749–8 maintenance worker.
- Recruit a permanent, seasonal, WG–3502–5 maintenance laborer to maintain and rehabilitate current and future refuge facilities and equipment.
- Increase outreach to recruit additional volunteers needed to carry out the actions for the public use, maintenance, and biological programs.
- Retain at the refuge complex a biologist assigned to the Partners for Fish and Wildlife Program.
- Reinstate the Youth Conservation Corps program by hiring four youths and one GS–186–5 social services aid (temporary seasonal) to lead the program.
- Work with Montana universities to develop a volunteer program by providing college credits in exchange for volunteer work experience.

***Rationale.*** The current staff of five, permanent, full-time employees lacks the time and expertise needed to fully implement the habitat management and monitoring projects, facilities maintenance, and expanded public use programs. In addition, the current staffing level remains well below that prescribed by the minimum staffing model developed by the Service for all refuges (USFWS 2008c). The model recommends adding the equivalent of 6.5 full-time positions—a maintenance worker, wildlife biologist, deputy refuge manager, visitor services specialist, law enforcement officer, wildlife refuge specialist, and a seasonal biological science technician. The addition of any staff is fully dependent on the appropriation of funds available to the Service and the priorities for the Refuge System in Region 6. Even if additional staff are not provided, there are opportunities to change the priorities of current resources to address some of the issues and management actions described in this plan.

# Facilities and Equipment

The refuge complex staff is responsible for maintaining a vast system of lands, roads, trails, fences, signs, buildings, equipment, and other infrastructure necessary to manage habitat and public use programs.

The success of management operations throughout the refuge complex is dependent on having adequate facilities including offices, housing, and storage buildings. Additionally, the staff needs vehicles and various heavy equipment machines to conduct the work specified in the objectives and strategies.

## Facilities and Equipment Objective 1

Maintain, expand, or enhance facilities, equipment, and supplies to support all biological, visitor services, and maintenance programs including accommodation of additional staff and volunteers and protection and storage of all needed equipment and vehicles.

### *Strategies*

- Maintain equipment for operations and replace as money becomes available.
- Maintain the current buildings and refuge housing as needed, as well as other refuge complex facilities and infrastructure to achieve management objectives.
- Acquire vehicles as needed for the added staff.
- Replace outdated heavy equipment such as the road grader, scraper, farm tractor, and front-end loader.
- Acquire attachments for the farm tractor (for example, a farm disc, grapple fork, and mowers) for habitat management.
- Expand or enhance the refuge office facilities to accommodate the additional staff.
- Construct a 10-bay parking storage facility for existing and future vehicles.
- Construct a four-bay cold-storage building to house additional heavy equipment.
- Expand the visitor contact area, making areas accessible to visitors with disabilities, and improve the interpretive displays and materials.
- Expand the bunkhouse to accommodate up to 8 individuals.
- Develop one campsite with a concrete pad, septic system, water, and electricity for a volunteer with a recreational vehicle.
- Maintain a separate ground water well for the two refuge complex residences.
- Convert the office, apartment, two houses, and shop buildings to a solar energy system.
- Acquire a mower and marsh master to manage vegetation in wet areas for control of undesirable plant species and to create open-water habitat.

***Rationale.*** The current storage facilities are insufficient to store existing vehicles; most remain outside exposed to the harsh climates of this area. The refuge headquarters is sufficient for existing staff including seasonal employees but needs to be expanded when permanent staff are added. Although recently remodeled, the bunkhouse is still not adequate to provide housing for all seasonal and volunteer staff. Availability of this housing is critical to recruitment of seasonal staff, because rental housing is very limited in the surrounding rural communities.

## Facilities and Equipment Objective 2

Identify the boundaries of all refuge complex units and fence the boundaries, as needed, using wildlife-friendly fence designs to prevent trespass cattle grazing. Adequately sign unit boundaries to identify Service lands and permissible public use and to better orient visitors.

### *Strategies*

- Evaluate fences to determine the need to replace, remove, add, or repair the fences needed to prevent cattle trespass and provide wildlife-friendly fencing.
- Work with the State to determine the important migratory paths for pronghorn through Bowdoin Refuge. Evaluate the need for fences in these areas and remove, modify, or replace them using fencing standards that allow for wildlife passage while supporting the refuge's prescriptive grazing program.
- Acquire funding to replace dilapidated boundary fence, gates, and parking areas.
- Continue to work with the landowner on Hewitt Lake National Wildlife Refuge to exchange the fee-title lands needed to create a more manageable and enforceable boundary and bring awareness of the refuge boundary.

- Continue to maintain entrance signs on refuges with more than 40 percent of land within their boundaries in fee title.

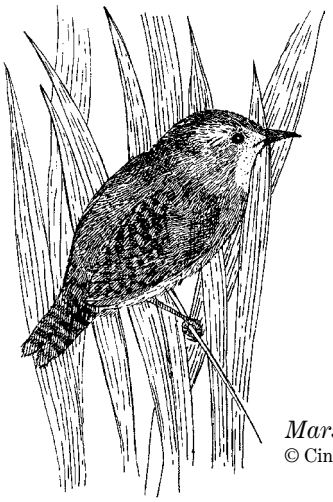
- Continue to maintain entrance signs on all waterfowl production areas.

- Continue to work with the regional Division of Realty to acquire or exchange lands with willing sellers that would resolve issues related to trespass, boundary "round-outs," and boundaries that are difficult to post and maintain due to their odd shape or location.

- Appropriately identify waterfowl production areas within refuge boundaries.

***Rationale.*** Most of Montana is considered open range, so according to State law the Service and other landowners must build a fence to keep cattle from grazing their lands. The existing fences are in good condition but need to be replaced with wildlife-friendly designs, including replacement of the bottom strand with smooth wire at least 18 inches off the ground. This will take considerable staff and resources to accomplish but is important to ensure refuge complex fences do not impede or harm migrating wildlife, particularly on Bowdoin Refuge, which is part of a migratory corridor for pronghorn. The refuge will work with the State to identify these corridors and evaluate the existing fences to determine whether they are needed for the prescriptive grazing program and how best to modify or replace them, as appropriate.

Overall, the refuge complex boundaries are well signed and visitors are oriented. Maintaining and replacing these signs is time-consuming but critical for protecting refuge habitats and preventing trespass. Bowdoin Refuge and Hewitt Lake Refuge have irregular boundaries that are difficult to sign or boundaries that are located across bodies of water. The refuge complex staff will continue to work with the regional Division of Realty and willing landowners to address these issues.



*Marsh Wren*


## 4.9 Stepdown Management Plans

The CCP is a broad umbrella plan that provides general concepts and specific objectives for habitat, wildlife, public use, cultural resources, partnerships, and operations over the next 15 years. The purpose of the stepdown management plans is to provide details to Service staff for carrying out specific actions and strategies authorized by the CCP. Table 15 lists the stepdown plans needed for the refuge complex, status, and next revision date.

**Table 15. Stepdown management plans for Bowdoin National Wildlife Refuge Complex, Montana.**

| *Plan* | *Completed (year approved)* | *New or revision (completion year)* |
|---|---|---|
| Disease management | 2006 | 2013 |
| Fire management | 2002 | 2012 |
| Habitat management | — | 2018 |
| Hazard communication | 2007 | 2012 |
| Integrated pest management | 2003 | 2014 |
| Occupant emergency | 2008 | Annual |
| Refuge safety | 2007 | Annual |
| Salt management | — | 2017 |
| Sign | 1984 | — |
| Spill prevention | 2007 | 2012 |
| Upland management | 1992 | 2018 |
| Visitor services | 2008 | 2018 |
| Wetland management | — | 2018 |
| Wildlife management | — | 2018 |

Mike Artmann / USFWS

*Pronghorn graze in the eastern uplands along Lake Bowdoin.*

## 4.10 Research, Monitoring, and Evaluation

Appendix B contains the compatibility determination for research and monitoring. Furthermore, the Service proposes to most efficiently deal with the uncertainty surrounding habitat management with adaptive resource management (figure 44) (Holling 1978, Kendall 2001, Lancia et al. 1996, Walters and Holling 1990). This approach provides a framework within which objective decisions can be made and the uncertainty surrounding those decisions reduced. The key components of an adaptive resource management plan, such as this CCP and the stepdown plans, follow:

- Clearly defined management goals and objectives
- A set of management actions with associated uncertainty as to their outcomes
- A suite of models representing various alternative working hypotheses describing the response of species or communities of interest
- Monitoring and assessment of the response of target organisms
- Use of monitoring and assessment information to direct future decisionmaking through the selection of a best model

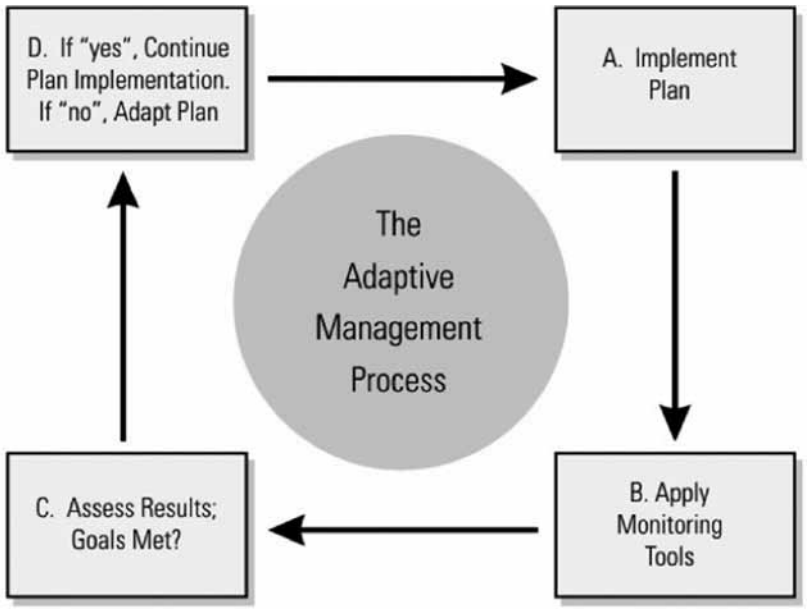



**Figure 44. Adaptive management process.**

The first three components—goals, actions, and models—are largely defined before initiation of an adaptive resource management plan. The latter two components, monitoring and directed decisionmaking, compose a repetitive process whereby, each year, the predictive ability of models are tested against what was observed during monitoring. This may result in a new best model, greater support for the existing best model, or new models constructed from emerging hypotheses. In this way, management can evolve as more information about the refuge complex is gained and uncertainty is reduced.

USFWS

*Refuge employees record data about vegetation to measure conditions and response to management actions.*

Development of adaptive resource management plans for habitat management will allow the refuge complex staff to "learn by doing," while focusing on management objectives. Knowledge gained from assessing management actions is as integral to the process as the management actions themselves. This emphasis on gaining knowledge about the refuge complex creates a situation whereby the staff can refine its habitat management with feedback between management and assessment.

## 4.11 Plan Amendment and Revision

The Service will annually review the final CCP to determine the need for amendment. An amendment would occur if significant information became available such as a change in ecological conditions. Revisions to the CCP and the stepdown management plans will be subject to public review and compliance with NEPA. At a minimum, the Service will evaluate the plan every 5 years and revise it after 15 years, if needed.