

## Chapter 4



Steve Vittum/USFWS

*Maquam/Black Creek nature trails*

# Management Direction and Implementation

- Introduction
- Relating Goals, Objectives, and Strategies
- General Refuge Management
- Refuge Goals, Objectives, and Strategies

## Introduction

This comprehensive conservation plan includes an array of management actions that, in our professional judgment, work toward achieving the purposes of the refuge, its vision and goals, and state and regional conservation plans. In our opinion, it will effectively address the key issues, and is both reasonable and practicable.

In all program areas, this CCP will enhance the quality and sustainability of current resource programs, develop long-range and strategic step-down plans, promote partnerships, and preserve, manage, and restore habitat.

## Relating Goals, Objectives, and Strategies

We presented our goals in chapter 1. Goals are intentionally broad descriptions of desired future conditions on the refuge. By design, they define management targets prescriptively rather than quantitatively. They articulate the principal elements of refuge purposes and our vision statement, and provide the foundation for developing specific management objectives. This chapter details the goals further into objectives and strategies. We considered a range of possible management objectives that would help us meet our goals. Essentially, objectives are incremental steps we take to achieve a goal; they further define the management targets of each goal in measurable terms. Objectives provide the basis for determining more detailed strategies, monitoring refuge accomplishments, and evaluating our successes. Service guidance in “Writing Refuge Management Goals and Objectives: A Handbook” (November 2003), recommends that objectives possess five properties in the mnemonic acronym “SMART”: they should be : (1) Specific, (2) Measurable, (3) Achievable, (4) Results-oriented, and (5) Time-fixed.”

The objectives we considered ranged from those that require only minimum levels of funding and staffing to those that require considerable increases in funding, staffing, and developing infrastructure and partnerships. Some of them relate directly to managing habitat, while others relate to meeting population targets tied to species recovery or other regional plans.

We include a rationale in every objective, so you can understand its context and why we consider it important. We will use the objectives in this CCP in writing refuge step-down plans, including the Habitat Management Plan (HMP). We will measure our success by how well we achieve those objectives.

Finally, we developed strategies for each objective. Strategies are specific actions, tools, techniques, considerations, or a combination of those, which we may use in achieving the objectives. Most likely, we will carry them over directly into subsequent, step-down plans; but, we may revise some of them in the process of developing those plans. The availability of staff, volunteers, funding, and other resources may affect the way we implement them.

## General Refuge Management

We primarily developed our management direction hierarchically from goals to objectives and strategies. However, we also found that many actions we wanted to highlight either relate to multiple goals or represent general administrative or compliance activities. We present them in this section.

## Habitat Management Plan

A habitat management plan (HMP) for the refuge is the first step in achieving the objectives under goals 1 and 2. For example, it establishes what specific strategies are necessary to enhance, restore, and manage important habitats and minimize impacts on significant species assemblages. It also describes the timing of those actions, and identifies how we will measure our success. We drafted a HMP at the same time as the CCP so their habitat objectives would be consistent.

<b>Funding Considerations</b>	We would implement the management activities and projects proposed as funds become available.
<b>Federal Regulations</b>	We will comply with all applicable federal laws and regulations in implementing the CCP.
<b>Protecting Historical and Cultural Resources</b>	We will comply with all regulations and existing methods for protecting historical and cultural resources across the refuge. We will comply with the National Historic Preservation Act by reviewing individual projects for their potential to affect cultural resources and planning for resource protection in consultation with the Vermont Division for Historic Preservation. Our regional cultural resources staff will evaluate projects that fall in certain categories of management actions. Those include new facilities such as hunt blind sites, boat access, boardwalks, and dike extensions.
<b>Land Conservation</b>	We will conduct a biological analysis of the importance of undeveloped lands within 5 miles of the existing refuge boundary in order to identify those areas that will improve resource protection for federal trust species and aid in fulfilling the mission of the System and the purposes of the refuge. We will focus the review on intact, fully functioning wetlands and associated riparian areas as well as adjacent uplands that maintain or expand the protection of large unfragmented blocks of habitat for area sensitive species. If the review reveals that additional land protection that involves Service ownership is necessary, we will prepare a conservation proposal for consideration by the Director of the Service to expand the boundary of the refuge. If the Director grants approval to continue the effort, we will prepare a separate Environmental Assessment and Land Protection Plan to analyze all factors involved in a refuge expansion and propose an alternative for public consideration. We expect that any proposal which might emerge from this process will include significant public involvement in decision making, involve partners in the protection effort, and make considerable use of easement acquisitions as a protection method.
<b>Special Designation Areas</b>	<p>We describe the current status of special designation areas on the refuge in appendix A. We will implement the inventory conclusions and recommendations in appendix A which propose to withdraw support for the proposed Shad Island wilderness area, but continue to administer and manage the RNAs for Shad Island and Maquam Bog. In summary, the rationale for withdrawing support for the proposed Shad Island wilderness area is based on the fact we believe it no longer meets the “naturalness” criterion required under the Wilderness Act. The significant accumulation of debris that lodges throughout the island during the annual spring flooding is a principle challenge to maintaining naturalness. The types of debris include 55 gallon drums, propane tanks, tires, and plastics of all sizes. Its buildup is largely outside the control and jurisdiction of the Service because it is being deposited in state or Canadian waters. Other existing conditions and future management considerations that impact naturalness character are discussed in appendix A. We will submit a proposal to remove Shad Island from proposed wilderness designation within 5 years of CCP approval.</p> <p>Our continued support and management for the Shad Island and Maquam Bog RNAs includes a commitment to develop management area plans within 5 years of CCP approval.</p>
<b>Refuge Revenue Sharing Payments</b>	Annual refuge revenue payments to the towns in which refuge lands lie will continue as law and policy allow. Future payments will be made in accordance with approved, appraised values, considering new acquisitions, and the level of congressional appropriations each year. Please refer to chapter 3 for additional information on refuge revenue sharing payments.
<b>Outreach and Partnerships</b>	We will enhance our outreach and partnerships with the local communities, expand the role and numbers of our Friends Group, and strengthen our

relationships with our neighbors and elected officials to build support for our management priorities. The majority of our management strategies support partnerships to the fullest extent possible. They are vital in successfully managing all aspects of the refuge, from habitat and species management to public use.

**Friends Group Support**

We will continue to support the Friends of Missisquoi association. We expect that group to provide us with valuable assistance in implementing the management strategies in this final CCP.

**Volunteer Opportunities**

This CCP will continue our successful volunteer program. Volunteers perform thousands of hours of work in administration, public use, and the biological program, and have enhanced our ability to complete many tasks associated with refuge management.

**Existing Facilities Maintenance**

The periodic maintenance and renovation of existing facilities is a critical need to ensure safety and accessibility for refuge staff and visitors. Appendix I lists new construction projects from our Refuge Operating Needs System (RONS) database and projects from our Service Asset Maintenance Management System (SAMMS) that identify repairs, replacements, and other work needed for existing facilities and equipment.

**Refuge Activity, Hunting, and Special Use Fees**

Refuge lands offer many recreational opportunities. However, the costs to maintain those activities continue to increase, and revenues continue to decline. Maintaining the boat launch, gravel roads, and other facilities and structures requires increasing staff time and financial resources. To help offset the increasing administrative costs associated with managing and overseeing those recreational uses, we will implement an activity fee program and continue to charge a user fee for hunting as well as special permit fees.

These fees will be reinvested at the refuge to enhance visitor services and reduce the backlog of maintenance needs for recreation facilities and the cost of collection. Eighty percent of recreation fee receipts are retained at the refuge, while 20 percent of recreation fee receipts are used in the region for projects to improve and maintain visitor services, address health and safety within the Refuge System, and to offset Service administrative costs.

In addition to the fee program outlined below, we anticipate that the Friends of Missisquoi National Wildlife Refuge, Inc. will continue to support the refuge using a portion of the funds collected from membership dues and fund raising activities each year.

**We will implement the following new components for the fee program for Missisquoi Refuge**

- Visitors will be encouraged to make voluntary contributions at collection boxes at the trailheads and boat launch. Additional donation boxes, similar to the one now located at the Black Creek/Maquam Creek trailhead, will be installed at the Old Railroad Passage and Stephen J. Young Marsh trailhead, the Discovery trailhead, the Louie’s Landing boat launch site, and the Mac’s Bend boat launch/Jeep Trail site. Voluntary contributions will continue to be welcome, and will be collected from refuge visitors and other individuals and groups
- We will also evaluate the effectiveness of instituting a lottery permit system for deer hunting on the delta to alleviate hunter conflicts

**Strategies that apply to all goals**

**Continue to:**

- Recruit, train, and recognize students, interns, and volunteers to assist with all refuge goals, programs, and operations, and provide housing where possible

- Encourage a broad-based Friends of Missisquoi National Wildlife Refuge group that supports refuge goals, programs, and operations
- Provide visitor safety, protect resources, and ensure compliance with refuge regulations for more than 60,000 visitors each year, projected to increase to 150,000 visitors over the next 15 years, through law enforcement patrols and public use contacts
- Annually evaluate a minimum of 12 miles of refuge boundary. Delineate refuge boundaries with signs as needed
- Reach out to refuge communities to build awareness, understanding, and support for refuge biological and land protection programs and activities and demonstrate the role of the Missisquoi Refuge in the Refuge System
- Acquire from willing sellers, the privately owned properties (inholdings: 8 parcels; 253 acres) remaining within the approved, acquisition boundary of the refuge, as they become available for purchase



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*Great horned owl sitting on refuge sign*

**Within 5 years of CCP approval:**

- Hire a law enforcement staff (GS 7/9): Improve on-refuge law enforcement by hiring dedicated law enforcement personnel and establishing cooperative agreements with partnering law enforcement agencies to address habitat and wildlife protection challenges, the growing threat of international terrorism and other international border-related illegalities, and enhance staff and visitor safety
- Hire or use management capability to secure seasonal maintenance worker (WG 5/6) or contract assistance: Increase the ability of refuge staff to maintain and improve refuge facilities, equipment, and habitats by hiring additional maintenance staff and by engaging and training skilled volunteers
- Hire or use management capability to secure seasonal park ranger (GS 7/9) or contract assistance: Facilitate utilization of new refuge headquarters and other wildlife-oriented developments by increasing refuge public use staff who will further improve and increase community outreach, environmental education, interpretation, and volunteer utilization efforts
- Hire or use management capability to secure seasonal biological technician (GS 5–7–9) or contract assistance: Expand the refuge biological staff and the cadre of trained and skilled volunteers to complete essential field work and ensure the implementation of the best science and technology available in support of wildlife and habitat management programs and planning

**Strategies that apply to all the objectives under goals 1 and 2**

**Within 5 years of CCP approval:**

- Evaluate all the data from completed baseline surveys of birds, amphibians, reptiles, mammals, plants, and other species to determine what additional baseline surveys are needed to determine presence/absence in respective habitat types and to determine what additional surveys are needed to address management questions
- Evaluate the breeding bird data to determine if more surveys or survey points are needed to document the presence of species of conservation concern in floodplain forest and other habitats not surveyed well in the past

- Explore opportunities to engage volunteers and students in monitoring migrating birds on the refuge and consider entering data into the Cornell Lab of Ornithology ebird database (www.ebird.org)
- Work with partners to continue and enhance monitoring and control of non-native invasive species including water chestnut, Eurasian water milfoil, purple loosestrife, common reed, Japanese knotweed, and zebra mussel

**Within 5 to 10 years of CCP approval:**

- Work with UVM, Natural Resource Conservation Service (NRCS), and others to compile a comprehensive Geographic Information System (GIS)-based database for the Missisquoi River watershed to identify topographic features, land uses, and habitat types for long-term planning and monitoring of resources
- Conduct a refuge survey to locate and map upland and aquatic invasive species
- Refine map of habitat types by ground-truthing the natural communities mapped by Clews (2002) to guide more precise habitat management planning

**Refuge Goals, Objectives, and Strategies**

The following goals, objectives, and strategies include an array of management actions that, in our professional judgment, work best toward achieving the purposes of the refuge, the mission of the System, our vision and goals for the refuge and the goals of state and regional conservation plans. In our opinion, they will also most effectively address the major issues raised during the planning process. We judge them reasonable and practical.

**GOAL 1. Maintain the ecological integrity of the Missisquoi River Delta to ensure a healthy, diverse river ecosystem providing a full range of natural processes, community types, and native floral and faunal diversity.**

**Background**

The Missisquoi River Delta is the largest wetland complex in the Lake Champlain Basin. Over 50 percent of the waterfowl that use the lake during fall migration (late August through mid-November) are found in this wetland ecosystem. Floodwaters seasonally inundate Lake Champlain, its tributaries, and associated wetlands. A peak lake level of 99 to 101 feet mean sea level (msl) is common in spring. Typically, the lake level recedes during the summer, reaching its seasonal low of 94 to 95 feet msl between August and October. The seasonal pattern of flooding stimulates and maintains the dynamic nature of the delta and its inhabitants. The shape and pattern of the present-day delta is a snapshot in time of an ever-changing system.



*Roots of Silver Maple-Sensitive Fern Floodplain Forest*

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Influenced by those seasonal and annual variations in water levels, the Missisquoi River Delta supports a rich diversity of plants and animals, including thousands of migrating waterfowl, nesting herons, ducks, black terns and other marsh birds, rare turtles, mussels and fish, extensive wild rice beds, a large peatland, high quality floodplain forest, and other unique natural features. That richness attracts many recreational users: hunters, anglers, boaters, walkers, and birders. The Missisquoi River Delta, and hence, the refuge is impacted by run off from residential, agricultural, and industrial sources. Pollutants, invasive species, and other concerns in Missisquoi Bay also affect the refuge. The refuge must favor the management of important wildlife habitats over competing interests among

recreational users, while combating threats to the ecological integrity of the lands and waters that fish and wildlife depend on.

**Objective 1.1 Silver Maple-Sensitive Fern Floodplain Forest**

Maintain 1,089 acres of mature (more than 100 years old) silver maple-sensitive fern floodplain forest by allowing natural processes and controlling non-native invasive species to provide breeding habitat for great blue heron, wood duck and other cavity-nesting waterfowl, Baltimore oriole and other Neotropical migratory birds, and protect vernal pools.

**Rationale**

The Missisquoi delta supports over a thousand acres of silver maple-sensitive fern floodplain forest, composing 16 percent of the refuge (map 4-1). The dominant tree species are silver maple, green ash, and eastern cottonwood with some swamp white oak, red oak, and American elm. The forest is flooded each spring, and is easily navigable by canoe for much of May. As the waters recede, they leave behind large quantities of woody debris, seeds, and fertile soil forming a luxuriant understory of sensitive fern and other herbaceous plants. This is an uncommon (S3) community type in Vermont, and the Missisquoi floodplain forest is the largest and perhaps highest quality example remaining in the State (Sorenson et al.1998, Thompson and Sorenson 2000, Clews 2002), See appendix C for definitions of “S” rankings.



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*Silver Maple-Sensitive Fern Floodplain Forest*

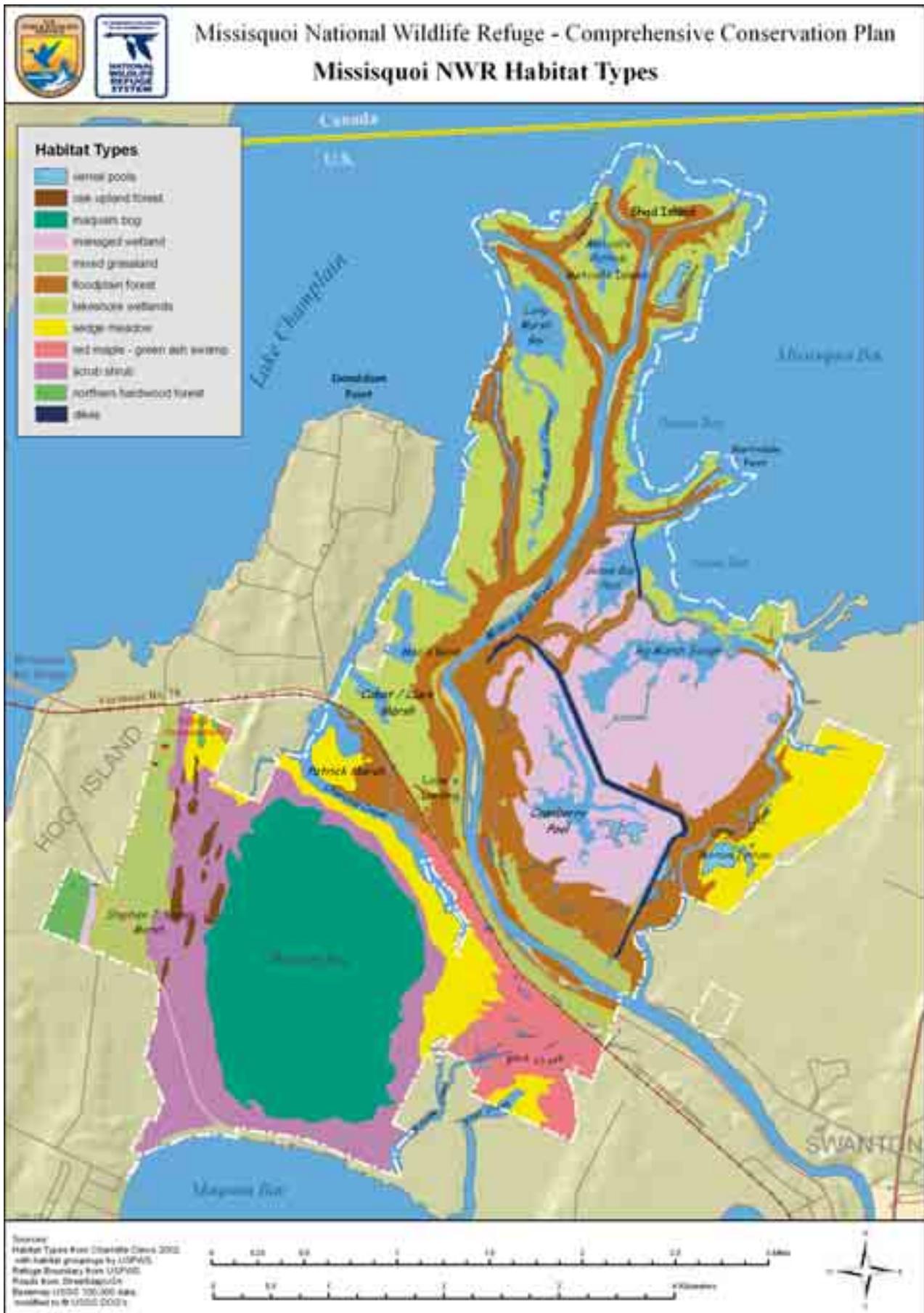
This habitat supports the largest great blue heron rookery in Vermont on Shad and Metcalfe Islands in the “bird’s foot delta.” The islands supported 275 and 266 heron nests in 2004 and 2005, respectively; the number of nests peaked at 600 in 1999/2000. Double-crested cormorants, considered a species of management concern in BCR 13 due to their potential negative impacts on vegetation (Hartley et al. 2006), began nesting on Shad Island in 1996. They are increasing in the heron rookery, with more than 100 active nests in 2004 and 86 nests in 2005. Surveys indicate that, with the exception of one successful nest in 2004, no cormorants have successfully reproduced here. The population growth of cormorants in the Lake Champlain Basin has resulted in significant negative impacts on vegetation in other nesting colonies, although no such impacts are noted yet for the Missisquoi Refuge colony. Two to three great egrets successfully nested among the heron colony in recent years. See appendix F for a more detailed discussion of the cormorant and heron issue.

Wood duck, common goldeneye, and hooded merganser are three cavity nesters that breed in the refuge floodplain forest along with black duck and mallard. The use of artificial nesting structures for wildlife began in earnest in the 1940s and 1950s to increase the availability of nest sites for specific cavity nesters, such as wood ducks. The loss of habitat (including cutting floodplain forest) and the over-harvest of wood ducks



James Prince/USFWS

*Wood Duck*



in the early 1900s caused the population to crash. Since then, the Migratory Bird Treaty Act, harvest regulations and management actions have enabled the population to grow dramatically. In the Northeast, rebounding beaver populations and the increasing availability of mature cavity trees, in addition to artificial nest boxes, have bolstered that population growth. Breeding Bird Survey (BBS) data indicates that the wood duck population is steadily increasing (DeGraaf and Yamasaki 2001). About 7,800 juveniles are produced annually in nest boxes at all national wildlife refuges in the Northeast combined, or 0.24 percent of the fall population of juvenile birds. The refuge now maintains 130 nest boxes. We recorded a 61-percent usage by wood duck, hooded merganser, or common goldeneye in 2000. Missisquoi is proposing to evaluate artificial wood duck nest boxes to determine if natural structures meet management objectives.

The nesting osprey population on the refuge increased from one pair in Long Marsh in 1989 to 32 pairs on the Missisquoi River delta in 2005. Ospreys have increased throughout the Lake Champlain Basin. The refuge and the State of Vermont on the adjacent Maquam WMA have actively managed osprey by providing nesting platforms and installing predator guards. Given its recovery across the region, the osprey was recently removed from the State's endangered species list. The refuge will evaluate the use of platforms and natural structures by osprey to determine whether active nest structure management and monitoring should continue.

More than half the songbirds that breed in North America are migratory. Many of these birds are considered Neotropical migrants—they fly to subtropical and tropical regions to winter. Small, migratory songbirds typically cannot store enough energy to fly nonstop, and require several stopover areas along their migration route. Researchers are using radar detection of migrants leaving stopover areas along the mid-Atlantic coast combined with land use and land cover data to identify which habitats are most important for migrating songbirds. Floodplain forests are an important stopover habitat for migratory birds in these studies (New Jersey Audubon, unpublished data, <http://www.njaudubon.org/Education/Oases/>).

The floodplain forest on the Missisquoi Refuge is important for breeding migratory songbirds of conservation concern, including wood thrush, black-billed cuckoo, Canada warbler, rose-breasted grosbeak, and Baltimore oriole, all priority species in BCR 13 (Hartley et al. 2006). The refuge has the second highest abundance of breeding orioles among the refuges in the Northeast. The refuge likely serves as important refugia for those songbirds in a regional landscape dominated by agricultural lands. The refuge is just on the edge of the range of the declining cerulean warbler. Although none have been recorded here, the refuge supports ideal habitat for that bird of highest conservation priority in BCR 13 (Hartley et al. 2006).

Researchers at the USFWS Ecological Services Office in Concord, New Hampshire and the University of New Hampshire (UNH) continue to explore the distribution and potential causes of amphibian deformities in the Northeast (Pinkney et al. 2005). Missisquoi Refuge is one of the malformed frog study sites. Despite some evidence of deformities, the refuge supports an abundant, diverse frog community in the floodplain habitat, including northern leopard, green, pickerel and wood frog, and bullfrog. Vernal pools supporting spotted and blue-spotted salamanders are embedded in the floodplain forest community.

Clews (2002) identifies a distinct river shore grassland community that follows the length of the Missisquoi River. The shoreline is seasonally scoured by river ice, then flooded during the spring thaw, and finally, left high and dry by mid-June. Those communities, maintained through natural processes, often form the transition zone between river mud shore and floodplain forest communities.

Those grassland communities, when seasonally flooded, provide habitat for northern pike, pickerel, yellow perch, and other aquatic organisms.

**Strategies**

*Continue:*

- Continue annual monitoring of the great blue heron colony
- Post “no disturbance” or “area closed” signs near osprey nests, the great blue heron rookery, and black tern nesting areas as soon as possible in the spring or after the birds select their nesting sites to prevent boating disturbance; monitor for disturbance and, if necessary, close areas around nests during nesting season.

*Within 5 years of CCP approval:*

- Evaluate breeding bird survey points in floodplain forest with particular emphasis on priority bird species including wood thrush, black-billed cuckoo, Canada warbler, rose-breasted grosbeak, cerulean warbler and Baltimore oriole to determine if ongoing surveys are needed
- Survey for the presence of endangered Indiana bat in floodplain forest every 3 to 5 years or as recommended by bat experts
- Work to protect the sensitive floodplain forest and associated wetlands that border the refuge
- Identify sensitive areas along floodplain banks and post signs to protect vegetation from trampling by the public where this might be a problem
- Evaluate cormorant interactions with great blue herons and cormorant impacts to the floodplain forest habitat to set thresholds for active cormorant management, if necessary
- Evaluate the osprey nesting data to determine the use of natural snags versus platforms, to determine the need for ongoing annual productivity surveys, and to determine the need to maintain or add additional artificial platforms considering the removal of the osprey from the State endangered species list

*Within 5 to 10 years of CCP approval:*

- Partner with researchers on studies of the floodplain forest to evaluate the impacts, if any, of human uses on the habitat and associated plant and animal species and to understand the importance of the floodplain forest to Neotropical birds, fish, turtles, vernal pool obligates, and other species of concern
- Evaluate the amount of staff and volunteer time spent on maintaining, monitoring, supervision, and reporting for the wood duck nest box program and identify the number of boxes targeted for each species, the population status of the species being managed, the annual cost of replacement boxes, and the extent of use of the boxes by target species.

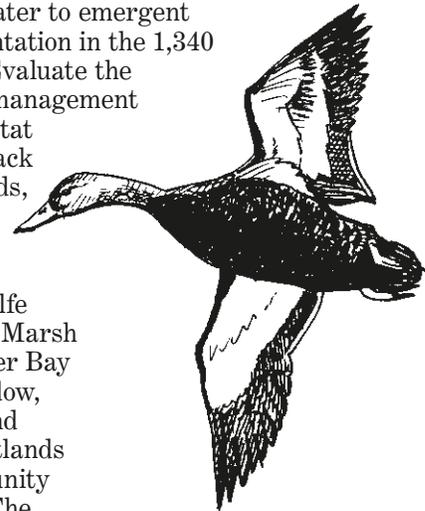


Wood Duck Box

- Survey the abundance and condition of natural cavities in this habitat to determine need, if any, for artificial nest boxes
- Identify for removal those nest boxes that are not generally productive, attract undesirable species, have a history of dump nesting, or are subject to high rates of predation. Do not replace old and dilapidated nest boxes in these areas
- Evaluate the natural succession of fields 1, 2, 3, 6, 7, and 43 acres of field 5 to determine which if any of these fields should be allowed to continue to naturally succeed to floodplain forest. This involves surveying for shrub-dependent species of conservation concern and the feasibility of maintaining these areas as shrublands versus allowing the natural succession to floodplain forest

### Objective 1.2 Lakeshore and River Shore Wetlands

By 2010, determine the proportion of open water to emergent vegetation and determine the rate of sedimentation in the 1,340 acres of lakeshore and river shore wetland. Evaluate the need for and the feasibility of implementing management actions to maintain foraging and resting habitat for migrating waterfowl, nesting areas for black terns, American bittern and other marsh birds, and basking sties for spiny softshell turtles.



*American black duck*

### Rationale

The lakeshore wetlands in and around Metcalfe and Shad Islands, Cabot-Clark Marsh, Long Marsh Channel, Saxes Creek, Goose Bay, and Gander Bay are composed of wild rice marsh, sedge meadow, buttonbush swamp, deep broadleaf marsh, and bulrush marsh (map 4-1). The river shore wetlands encompass the sedge meadow natural community along Charcoal and Dead Creeks (map 4-1). The sedge meadow, buttonbush swamp, and wild rice marsh natural community types are closely related.

They are distinguished by three different dominant species: tussock sedge, buttonbush, and wild rice, respectively. Those three plant species are nearly ubiquitous across the permanently saturated wetlands of the Missisquoi delta, and form a matrix of wetland habitat on the refuge. These wetland communities are seasonally inundated as the lake level rises each spring, and are covered by 5 to 12 inches of standing water by early summer. The soils are generally shallow and composed of organic muck (Clews 2002). The proportion of open water to vegetation varies from year to year, and is affected by lake level variations and increased upstream erosion and sedimentation.

The deep bulrush marsh occurs along the outer margins of the delta, is permanently inundated with water, and is subject to strong wave action resulting in low plant species diversity. Soft- and hard-stem bulrushes are the dominant plants. This is a common community type around Lake Champlain. Here, pied-billed grebes and common moorhens forage among the bulrushes. Small patches of deep broadleaf marsh occur in the more sheltered portions of the delta. Plant species diversity is usually higher here, although a single species may dominate the others. Pickerelweed, broad-leaved arrowhead, and giant bur-reed are common. Both types of marshes provide important shelter and foraging areas for ducks and other marsh birds.

The lakeshore wetlands are an important staging area for thousands of migrating waterfowl. Their numbers are highest during fall migration (late August through

mid-November), and peak in October. Green- and blue-winged teals are the early migrants, arriving in late summer and early fall. About 60 percent of the migrant waterfowl are mallards. In October, up to 10,000 mallards and an average of 5,000 black ducks come through. In some years, 500 to 1,000 American wigeons congregate on the refuge. Migrant numbers depend on seasonal water levels. The State of Vermont conducts aerial waterfowl surveys before the hunting season and before numbers peak, and compiles the data in an annual Champlain Valley report. The migration period ends with the freezing of the delta, which remains frozen until spring.

The lakeshore wetlands are important breeding habitat for mallard, American bittern, and black tern. A handful of breeding least bittern, Caspian tern, and green-backed heron nest or forage in the refuge wetlands. The refuge is not currently a significant stopover for migrating shorebirds. Migrant shorebird densities depend on water levels. In drought years, when the water level drops below 94 feet msl, exposing mud flats, thousands of shorebirds appear in the delta. The Champlain Valley is an important shorebird migration corridor, so when conditions are good at the refuge, the birds stop over. American black duck, blue-winged teal, mallard, American and least bitterns, and black tern are all high-priority species in BCR 13 (Hartley et al. 2006).

The black tern has experienced range-wide population declines for unknown reasons for the past 30 years, and is listed as endangered in Vermont. Missisquoi Refuge supports a significant population of black terns: in the last decade the refuge has supported 50-100 pairs which annually comprise over 90% of the entire nesting population in Vermont. In 2005, the entire Vermont black tern nesting population of 103 pairs nested on the refuge; Charcoal Creek (north of 78) - 52 pairs, Charcoal Creek (south of 78) - 4 pairs, Long Marsh - 28 pairs, and Cranberry Pool - 19 pairs. Although the refuge provides optimal habitat for the black tern, the fact that the entire state population concentrates in one spot makes it highly vulnerable to local disturbance that could wipe out the colony. Year-to-year variations in water level also affect their nesting success. The Cranberry Pond colony on the refuge, which typically supports 10 nesting pairs, failed completely in 2000 due to predation (possibly due to low water levels that improved access for mammalian predators) (Shambaugh 2001).

Black terns nest semi-colonially in large, emergent wetlands, and feed their young both insects and fish. They build nests of sticks and reeds on floating mats of dead vegetation or small mud flats in emergent wetlands with small patches of open water. Flooding and predation on eggs and chicks, not habitat availability, seem to be the limiting factors. Predators of eggs and chicks include herons, bitterns, mink, raccoons, and predatory fish (McCullough et al. 2003). There appears to be an inverse relationship between tern numbers and lake level during the period of May 15–31. If water levels are too high, terns will not nest. An optimal mean level may be in the 96- to 99-foot range. Typically they start laying eggs on June 1; incubation lasts 3 weeks by early July, and all birds have fledged by about August 1 (Shambaugh 2001).

The refuge staff observes high numbers of raccoons on the refuge, although it does not conduct systematic surveys. Raccoons den in cavity trees in the floodplain forest and other wooded areas on the refuge. They forage in the lakeshore and river shore wetlands, managed wetlands, and in floodplains during low water as well as in grasslands, preying on the eggs and nestlings of ducks, terns, and other ground-nesting birds. The refuge has used trapping by refuge staff and private trappers to reduce raccoon predation on black terns and other species of concern.

**Strategies**

*Continue:*

- Post advisory signs at the entrance to the middle branch of the Missisquoi River to alert canoeists and other boaters to avoid disturbing basking spiny softshell turtles
- Continue to partner with Vermont Audubon to annually monitor the black tern population
- Continue to annually post areas where black terns establish nests as closed to public entry and use.

*Within 5 years of CCP approval:*

- Collaborate with researchers to evaluate historical and current data (e.g., aerial photos, archaeological reports) on rates of sedimentation and changes in open water vegetation in lakeshore and river shore wetlands
- Partner with others to determine a threshold for management actions within lakeshore and river shore wetlands based on historical, current, and projected habitat changes and rates of sedimentation
- Research the efficacy of various vegetation removal methods to create pockets of open water among the vegetation to benefit wetland-dependent wildlife; implement management actions as necessary
- Evaluate the refuge potential to provide habitat for nesting and hibernating spiny softshell turtles
- Survey the raccoon population on the refuge and evaluate impact to nesting birds, and implement control measures as necessary
- Increase annual management and LE patrols to ensure integrity of closed areas to protect black tern nesting areas.

**Objective 1.3 Managed Wetlands**

Maintain the current mosaic of 865 acres of wild rice, sedge meadow, and buttonbush swamp in Big Marsh Slough, Goose Bay Pool, and Cranberry Pool to provide foraging and resting habitat for migrating waterfowl and nesting habitat for pied-billed grebes and other marsh birds, through natural flooding in spring and slow subsidence during the growing season. Maintain the 2-acre Stephen J. Young marsh impoundment to benefit marsh birds and waterfowl and provide an easily accessible public viewing area.



*Maintaining dike along Goose Bay Pool*

USFWS

**Rationale**

Three impoundments on the refuge form 865 acres of managed wetlands (map 4-1 and 4-2). We completed these impoundments—Big Marsh Slough, Goose Bay Pool, and Cranberry Pool—by 1969 to provide nesting, foraging, and migrating habitat for waterfowl. Those pools are a mix of open water and emergent vegetation composed primarily of wild rice, buttonbush and tussock sedge. We manipulate the water levels in the impoundments, where possible, to encourage the growth of waterfowl food and cover plants such as wild rice



and buttonbush. Goose Bay Pool and Cranberry Pool have control structures; Big Marsh Slough has a dike, but no water control structure. In 1995, with the assistance of DU, a water control structure was installed at the Stephen J. Young Marsh to create a 2-acre wetland to benefit a marsh birds and waterfowl and provide an easily accessible public viewing area.

The dikes at the refuge allow the normal annual spring flood level of the river to inundate the managed marshes. That annual event provides an opportunity for the water exchange and nutrient replenishment that occurs throughout the floodplain delta each spring. In many ways, the natural hydrology of the delta is proceeding uninterrupted as water overtops low-level dikes in Goose Bay Pool and Big Marsh Slough or freely enters Cranberry Pool from the Missisquoi River. The dynamics of the managed marshes and their relationship to adjacent, unmanaged delta marshes creates a mosaic of water levels and vegetative habitats that serves the annual needs of many wildlife species. Future projects will strive to incorporate low-level dikes and water control structures that will continue to provide for the natural movement of water.

The dikes that define the managed marshes at the refuge are not complete. Due to either the confirmed or suspected presence of archaeologically significant remains along a portion of the Missisquoi River, the 3-mile dike that encompasses much of Cranberry Pool does not tie in along the river for a distance of about one and a quarter miles. That situation allows spring flood water levels to enter the pool at an elevation of about 98.80 ft. above msl, as the water spills over the riverbanks and begins inundating the floodplain. The rest of the dike is about 4 feet higher than that flood level elevation. The pool will hold spring flood-level water until Lake Champlain begins to recede. Water flows out of the pool until its elevation reaches 98.80 msl once again, usually around late May. After that, we manage the water levels inside Cranberry Pool with a water control structure that allows us to maintain and hold water into the summer to provide nesting, brood-rearing, and feeding habitat for numerous migratory birds, including Vermont-listed threatened and endangered species. No mechanized pumping system is in place to add water, so due to normal processes of evaporation and transpiration, water levels normally recede over the summer. During very dry years, the pool may nearly dry out by early fall when it is normally recharged by fall rains.

The dike at Goose Bay Pool was built in 1958. Like the one at Cranberry Pool, it was constructed at an elevation of 103.00 ft. above msl, separating Goose Bay Pool from Goose Bay, an important, productive inlet of the much larger Missisquoi Bay. The dike had begun to deteriorate, gradually eroding to the point that no vehicles of any kind could drive along the top. An imminent risk of floodwater breaching the dike was apparent in 2001. We issued a renovation contract that year to lower the dike to an elevation of 99.00 msl. The project included placing concrete revetment mats on the Lake Champlain side of the dike to reduce wind-driven wave action against its new slopes. The very gradual slopes on the inside were designed to maximize vegetative response (seed catch) and create a thick, protective growth of grasses and forbs. The renovated low-level dike creates a small, but productive, managed wetland that will hold water much longer, providing excellent habitat for many wildlife species.

The dike at Big Marsh Slough is an extension of the Goose Bay Pool dike construction. This short dike serves more as a “plug” than as a dike that would hold water for long periods. The dike was constructed across a small depression that historically would allow much of the water gained through spring inundation to be removed as water levels in Lake Champlain declined. The small dike that contained a 30-inch water control structure served to retain water through the summer and into the fall except during extremely dry years. The dike and water control structure have deteriorated over time, and retain only a portion of their original capability. However, during very dry years, the remnants of the dike

still help to retain water in Big Marsh Slough, providing excellent shallow water habitats for migrating waterfowl, wading birds and other wetland-dependent species.

Big Marsh Slough and Goose Bay Pool, along with Charcoal Creek, support 10,000 to 15,000 ring-necked ducks migrating in the fall. Historically, wild celery in the marshes and bays around the refuge have been a key food resource for those waterfowl. Migrating ring-necked ducks concentrate more than other waterfowl, and therefore, are easier to count. Pied-billed grebe and Virginia rail (BCR 13 priorities) and common moorhen and sora nest in these managed wetlands (Hartley et al. 2006). The refuge is one of the few places in Vermont that supports nesting pied-billed grebe. These managed wetlands are also important foraging areas for great blue herons.

Waterfowl banding started on the refuge about 40 years ago to document and track waterfowl population dynamics. The Atlantic Flyway Council assigns each state a banding quota that includes the total number, proportion of males and females, and the age groups of each species for banding. The refuge assists the State of Vermont in meeting its quotas. Although the refuge traditionally bands most species captured during banding, we focus on black ducks, wood ducks, and mallards. Those species make up the bulk of migratory waterfowl using the refuge. Banding information helps the Atlantic Flyway Council determine harvest rates, and sheds light on the use of migration corridors by various species of waterfowl.

The number of black ducks banded since the mid 1980s on the refuge as well as in other parts of the Northeast has declined noticeably, despite a consistent banding effort. The reasons for that reduced banding success are unknown. The number of birds banded on the refuge per banding season (from August through September) has dropped from between 500 and 800 before 2000 to between 200 and 300 since 2000. Since 2000, banding success using either cannon nets or swim-in traps has not been particularly productive on the refuge. The reason for the decline is unclear; however, black duck numbers have declined over that 20-year period in the fall migration surveys as well. In contrast, mallard and wood duck numbers have increased over the same period. The same banding decline has not occurred at other banding sites operated by the VT FWD or by Canadian banding operations just north of the refuge in Quebec.

Beavers and muskrats thrive in the shallow, managed waters of the refuge and associated borrow ditches, streams, creeks and the river. Although both species are important elements of a healthy, complete ecosystem, their presence is both beneficial and detrimental, and often cannot be left unchecked. Annual surveys are conducted to determine and document the numbers and locations of beavers and muskrats on the refuge. This information helps determine the necessity for a fall public trapping program aimed at maintaining these populations at levels compatible with habitat management objectives for the area.



*Muskrat*

Beavers help control the encroachment of brushy vegetation into wetland impoundments. Other species of wildlife use their lodges for perching or occasionally nesting (e.g., Canada geese or osprey). However, they can also become a nuisance in managing the water levels in the impoundments by

plugging up the control structures. In addition, beavers burrow into the refuge dikes to establish their dens. That behavior can easily compromise the integrity of the dike and cause leaking which, if left unchecked can lead to the complete failure of the dike system. Beavers in areas other than impoundments typically do not create management conflicts, and usually are left alone. Beavers also kill some oaks that provide acorns as food for other wildlife.

Muskrats can be beneficial in wetlands by feeding on and controlling cattails and other vegetation that, left unchecked, will choke out the open water areas important for waterfowl. As with beavers, muskrats burrow into refuge dikes for shelter, creating a management conflict. Muskrats are prolific breeders, and every year muskrats are trapped along the refuge dikes in an effort to reduce the amount and extent of their burrowing. Muskrats are legally trapped or shot on the Missisquoi River and Dead Creek where they flow through the refuge. Muskrats are also predators of mussels, and can decimate local populations when their numbers are too high or when a mussel species is particularly vulnerable (VT DFW 2005a). Missisquoi Refuge hosts many such freshwater mussel species.

The non-native mute swan, a species of management concern in BCR 13 and a state-regulated species, is just appearing in the area; none are known to nest on the refuge. Mute swans, native to Eurasia, were introduced into the United States in the late 1800s. These swans are one of the most aggressive species of waterbirds, vigorously attacking other waterfowl while defending a very large breeding territory. They consume large quantities of SAV daily, decreasing the suitability of those areas for other nesting waterfowl (Ciaranca et al. 1997). The refuge follows the VT FWD policy on mute swan control (VT FWD 2005b). If they appear, the refuge “shall immediately remove all mute swans, including nests and eggs, from lands and waters of the Refuge.”

### **Strategies**

#### *Continue:*

- Continue to annually monitor and trap beaver and muskrat to minimize impacts of those animals that damage the function of dikes, water control structures, and cause mortality to oak trees, freshwater mussel populations, and other habitats or wildlife populations
- Continue to implement mute swan control as necessary, consistent with the VT FWD mute swan control policy

#### *Within 5 years of CCP approval:*

- Compile historic trapping data on the refuge to assess impacts of beaver, muskrat, and raccoon populations on dikes, water control structures, and migratory bird resources to guide development of a protocol for future management of these species
- Conduct an ecological study (e.g., vegetative and invertebrate baseline data; water level regimes that affect food resources) in the impoundments to assess quantity and quality of food resources for nesting and foraging waterfowl and marsh birds and to guide future impoundment management (including enhancement of dikes) to sustain quality habitat
- In partnership with the State, conduct appropriate level of waterfowl banding on the refuge to help meet Atlantic Flyway banding goals
- Increase management effort to monitor black tern nesting attempts and evaluate success and failure. Apply appropriate management activity to increase nesting success based on limiting factors identified.

*Within 5 to 10 years of CCP approval:*

- Evaluate the potential benefits of extending the existing, 97- to 98-ft msl low-level dike approximately half a mile from Goose Bay through Big Marsh to improve water-holding capability, maintain the mosaic of wild rice, buttonbush and sedge meadow, and retard the intrusion of woody vegetation;
- Implement that dike enhancement if deemed beneficial

#### **Objective 1.4 Rivers and Creeks**

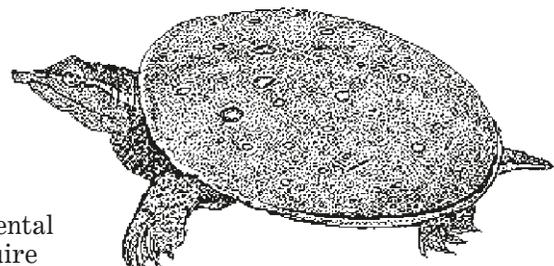
Maintain more than 12 miles of natural riparian vegetation on both banks of the Missisquoi River and tributary creeks within the refuge and, with partners, protect an additional 5 miles of riparian corridor to enhance water quality by preventing phosphorus loading and sediment and nutrient runoff. Good water quality is crucial for state-listed threatened or endangered freshwater mussels, basking and foraging spiny softshell turtles, lake sturgeon, the eastern sand darter, and other aquatic-dependent wildlife.

#### **Rationale**

This habitat objective covers the main stem of the Missisquoi River, Dead Creek, Maquam Creek, First Creek, and Charcoal Creek, encompassing 12 miles of riparian vegetation on both sides of the waterways (map 4-1). Those tributaries to Lake Champlain host a unique assemblage of aquatic species often found nowhere else in Vermont. However, land uses in the upper parts of the watershed contribute high sediment loads and contaminated runoff that affects the quality of the aquatic habitat on the refuge.

The Missisquoi River contains one of the most diverse assemblages of freshwater mussels in the Lake Champlain Basin. Freshwater mussels are one of the most highly endangered taxonomic groups in North America. Twelve mussel species are recorded for the lower Missisquoi River, including seven that are regionally rare and listed as endangered or threatened in Vermont. Eight of the 12 species, including the pink heelsplitter, fragile papershell, giant floater, cylindrical papershell, pocketbook, eastern lampshell, eastern elliptio, and eastern floater pocketbook, are found in the stretch of the river on the refuge (Fichtel and Smith 1995). The refuge is an important habitat for rare mussels such as fragile papershell, pink heelsplitter, and giant floater, which are being impacted by the non-native invasive zebra mussels in Lake Champlain. Recreational boats may inadvertently introduce zebra mussels into the river, although its low calcium levels may limit the development of dense populations. The refuge needs to continue to monitor the rare mussel populations and the presence of zebra mussels in the river (Marangelo 1999). Mussels are important indicators of environmental quality, as they are sensitive to pollutants such as heavy metals, pesticides, agricultural nutrients, and heavy sediment loads.

The spiny softshell turtle is a threatened species in Vermont and Canada and proposed as a species of special concern in New York. The northern Lake Champlain region supports a disjunctive population of spiny softshells that has declined significantly over the last 200 years. Stresses on the population include habitat loss, human disturbance, habitat degradation, nest predation, accidental capture, and environmental contamination. These turtles require suitable habitat for hibernation, nesting, basking and feeding. A majority of the



*Spiny softshell turtle*

softshell turtles hibernate for six months of the year at the Missisquoi Bay Bridge. Female softshells nest from late May to late June in shale substrates on beaches with minimal tree cover, a limited habitat type in northern Lake Champlain due to development and the use of large rip-rap to stabilize beachfront property.

The Missisquoi Refuge is an important basking and feeding area for softshell turtles; they use exposed logs, rocks, and banks along the Missisquoi River, Dead Creek, and the Cranberry Dike borrow ditch (Madeleine Lyttle, USFWS, unpublished data). Spiny softshells feed primarily on crayfish and mollusks. The Service evaluated turtle response to boating traffic on the Missisquoi River. See objective 4.4, “Boating” for the results of the study.

The lower Missisquoi River is one of the few remaining spawning grounds for the state-listed endangered lake sturgeon. That fish species is limited by habitat loss and degradation as a result of the construction of migration barriers (e.g., dams) eliminating access to historic spawning areas, sedimentation altering spawning habitat and egg survival, low population size, and life history characteristics (e.g., the age of maturity is 14 to 20 years). Typical spawning sites are rocky and boulder-filled areas at the outside bend of rivers. Lake sturgeon eggs require clean river bottoms for survival (VT DFW 2005a).

The state-listed threatened eastern sand darter is another fish species in the lower Missisquoi River. The eastern sand darter is associated with sandy areas of rivers and streams with slow to moderate currents, where it spends most of its time burrowed into the sand with only its eyes or head protruding. It is quite sensitive to sedimentation and poor water quality (VT DFW 2005a).

The lake sturgeon, eastern sand darter, and freshwater mussels are important indicators of water quality. The only confirmed native population of muskellunge (“muskie”) remaining in Vermont lives in a stretch of the Missisquoi River between the Swanton and Highgate dams. Although the origin of the only other population is unknown, it lives in the lower Missisquoi River below the Swanton Dam, including the stretch through the refuge. The muskellunge is a species of high priority in the Vermont Wildlife Action Plan (WAP) (VT DFW 2005a).

The Lake Champlain Basin Program identified phosphorus reduction as one of the top management priorities for the lake in the basin plan “Opportunities for Action” (Lake Champlain Steering Committee 2003). In 1991, Missisquoi Bay had the highest phosphorus concentration in the entire Lake Champlain Basin. The Vermont Water Quality Standards include phosphorus targets for each segment of Lake Champlain: the Missisquoi Bay segment is 0.025 mg/l average phosphorus concentration. The refuge’s contribution in reducing phosphorus is to protect and maintain native vegetation along the Missisquoi River, preventing runoff and other sources of contamination. See objective 1.5, “Open Water and Bays,” for more discussion on phosphorus loading.

That the jurisdiction and control of the river is uncertain but very important to the management capability of the refuge became apparent during the development of this CCP. Determining the jurisdiction of the refuge, or the lack thereof, on the Missisquoi River, Dead Creek and the Lake Champlain shoreline will determine the extent to which the refuge manager and staff can protect and manage some habitats and species. Vermont law enforcement authorities are empowered to enforce the provisions of a Vermont statute that prohibits speed in excess of 5 mph within 200 feet of a shoreline, but that provision is not enforced in the vicinity of the refuge or in most other waters of the state. We

have not ascertained the legal ability of the Service to effect closures or special regulations on those waters. For instance, our being able to restrict speed or enforce closures on parts of the river will facilitate managing the refuge

- during critical nesting periods near osprey nests or near the Shad Island heron rookery;
- during periods when egg-bearing female spiny softshell turtles are basking to ensure proper egg development; or
- during the waterfowl nesting season near sensitive areas.

### Strategies

#### *Continue:*

- Continue to work with VT FWD to protect basking softshell turtle habitat on the refuge and identify opportunities, if necessary and feasible, to create additional basking habitat (e.g., adding basking logs or other structures) and potential new nesting and hibernating areas
- Continue working with State, university, and Canadian biologists to further understand spiny softshell turtle habitat and conservation needs and implement those actions that are feasible for the refuge
- Continue to assist the Lake Champlain Fish and Wildlife Resources office on surveys of lake sturgeon and eastern sand darter related to habitat conditions and water quality
- Continue to control muskrat populations to protect water control structures and dikes as well as to control predation on state-listed threatened and endangered freshwater mussels

#### *Within 5 years of CCP approval:*

- Monitor the distribution of state-listed threatened or endangered freshwater mussel species (e.g., fragile papershell, pink heelsplitter, and giant floater) on the refuge portion of the Missisquoi River

#### *Within 5 to 10 years of CCP approval:*

- Determine water quality threshold parameters for state-listed threatened or endangered freshwater mussels and continue working with others to achieve those parameters.
- Evaluate the role of the refuge in monitoring for zebra mussels, and implement a monitoring protocol if needed
- Research which entities have jurisdiction of the river, which affects the ability of the refuge to fulfill its management
- Collaborate with VT FWD and the USFWS Lake Champlain Fish and Wildlife Resources office to investigate the abundance and distribution of muskellunge in the Missisquoi River and evaluate the feasibility of restoring connectivity between the populations that are now isolated by the dams

### Objective 1.5 Open Water and Bays

Restore at least 25 percent of native submerged aquatic plant community in the open water and bays around the refuge by replacing invasive milfoil with native vegetation to maintain foraging and staging areas for migrating waterfowl, such as lesser scaup, common merganser, and snow geese.

### Rationale

In addition to the refuge lakeshore wetlands, the open water bays in and around the refuge are important for migrating waterfowl (map 4-1). Lesser scaups, common goldeneyes, and 5,000 to 10,000 common mergansers congregate in deep open water on the lake and in large open bays, not in the delta. Common loons and common terns forage in the open water in the breeding and migrating seasons. All of those species are a priority in the BCR 13 plan (Hartley et al. 2006).

During spring migration at the end of April, up to 900,000 snow geese stage in the St. Lawrence River Valley. During fall migration, 10,000 to 20,000 snow geese stage on northern Lake Champlain. They roost on the water and feed on aquatic plant rhizomes in the bulrush marshes. When fields are wet, the geese shift to neighboring agricultural fields, yanking out plants to feed on the roots and causing damage to hayfields and green pastures. Their huge numbers draw tourists to the area and to the many snow goose festivals in Quebec. For those reasons, greater snow geese in the region are viewed both as a priority for conservation and as a nuisance.

Phosphorus is the nutrient that poses the greatest threat to water quality in Lake Champlain. High phosphorus levels entering the lake produce large algal blooms, reducing water clarity and depleting oxygen supplies, thus affecting fish and wildlife habitat. Missisquoi Bay has one of the highest phosphorus levels in Lake Champlain and nuisance algal conditions nearly half of the time. Businesses have closed beaches and pets have become sick from high blue-green algae levels as conditions worsen each year. Point sources (wastewater treatment and industrial discharges) contribute 20 percent of the phosphorus loading, while nonpoint sources (lawn and garden fertilizers, agricultural and pet waste, failing septic systems, and disturbed soils) contribute 80 percent of the phosphorus loading (Lake Champlain Steering Committee 2003).



Normandeau Associates, Inc.

*Spiny softshell turtle in blue green algae bloom on Missisquoi Bay*

Water quality experts use phosphorus budgets and models to determine the maximum loading capacity in metric tons per year of phosphorus that can enter the bay and still meet the 0.025 mg/l target. That is the Total Maximum Daily Load (TMDL): the maximum amount (load) of a single pollutant from all contributing point and nonpoint sources that a water body can receive and still meet water quality standards. A TMDL is required for Lake Champlain because phosphorus concentrations in many segments of the lake are higher than the levels allowed in the Vermont Water Quality Standards (Vermont Department of Environmental Conservation (VT DEC) website [http://www.vtwaterquality.org/lakes/htm/lp\\_phosphorus.htm](http://www.vtwaterquality.org/lakes/htm/lp_phosphorus.htm))

The TMDL assigns a phosphorus load limit to each point source (e.g., wastewater treatment plants in the basin). The TMDL subdivides the nonpoint source load according to the three major land use categories: forest, agriculture, and

developed land. The TMDL requires an overall load reduction of 80 metric tons per year (27 percent) from nonpoint sources in Vermont, relative to the levels measured in 1991.

Practices that reduce or stabilize phosphorus loading include adhering to “Accepted Management Practices (AMPs) for Maintaining Water Quality on Logging Jobs in Vermont” (Vermont Department of Forests, Parks, and Recreation 1987), reducing manure and fertilizer runoff and controlling erosion on farms, protecting streamside buffer areas, and controlling erosion at construction sites, minimizing the creation of new impervious areas. Stream bank and stream channel erosion in unstable rivers represent a potentially enormous source of phosphorus loading in Lake Champlain. The problem arises with all types of land use, including forest, agricultural, and developed land (Smeltzer 2002).

The Missisquoi Refuge can contribute to that overall reduction by continuing to protect or restore riparian vegetation, one of the most effective ways to reduce phosphorus loading. In addition, as described under goal 6, the refuge engages in several partnerships to enhance water quality through changes in land use in the Missisquoi River watershed and in the greater Lake Champlain Basin.

Nuisance, non-native aquatic invasive species are one of the biggest problems in the Lake Champlain Basin. Non-native plants and animals can displace native species, degrade wetlands and other natural communities, and reduce natural diversity and wildlife habitat values. They out-compete native species by dominating light, water, and nutrient resources. The refuge staff is concerned that, once established, invasive plants are expensive and labor-intensive to eliminate. They are able to establish easily, reproduce prolifically, and disperse readily, making eradication difficult. Preventing new invasions is extremely important in maintaining biological diversity and native plant populations.



*Zebra Mussel on Native Mussels*

USFWS

For example, water chestnut readily and quickly displaces other aquatic plant species, is of little food value to wildlife, and forms dense mats that change habitat and interfere with recreational activities. The most extensive infestations grow in the southern portion of the lake and on the South River, which is a tributary of the Richelieu River located just south of Montreal. Despite mechanical harvesting and hand pulling since 1982, a water chestnut infestation on the southern part of the lake severely restricts boat traffic and other recreational uses. The Vermont Department of Conservation, Water Resources and the Service recently increased surveys for this aggressive invasive plant near Missisquoi Bay and the refuge. Since 2004, refuge staff and the Lake Champlain Fish and Wildlife Resources office staff have surveyed those waters by airboat to prevent the plant from gaining a foothold there. They discovered no plants in 2004, but discovered the first occurrence of water chestnut on the refuge on July 28, 2005: 6 to 7 rosettes in a patch of hardstem bulrush just north of the east branch of the Missisquoi River. They removed that single, immature plant before its seeds matured, but that incident proved the importance of intensive surveys.

Other examples of aquatic nuisance species in Lake Champlain include alewife, sea lamprey, zebra mussel, white perch, Eurasian water milfoil, and purple loosestrife.

Water milfoil and other invasive aquatic plants are of particular concern at the refuge because they typically displace natural beds of SAV. SAV beds provide crucial foraging habitat for the thousands of waterfowl that use the refuge and the bay during migration. Current research suggests that the sea lamprey was native to the basin. However, the lamprey is considered out of balance with the ecosystem, resulting from improvements in water quality in spawning areas and an increase in one of their host species, the salmon, through stocking.

### Strategies

*Within 5 years of CCP approval:*

- Inventory and map the distribution and species composition of native SAV
- Evaluate need for restoration and identify SAV restoration techniques, in addition to invasive species removal
- Inventory and map the distribution of existing invasive aquatic plants (e.g., water milfoil) among the native SAV
- Prevent establishment of water chestnut on the Missisquoi Bay and delta by annual monitoring of the shoreline of Missisquoi Bay in mid-summer using an airboat and engage volunteers to monitor other portions of the refuge not accessible by airboat and immediately remove any water chestnut plants that are found
- Work with partners to develop effective techniques to control invasive Eurasian water milfoil and implement milfoil controls

### Objective 1.6 Red Maple-Green Ash Swamp

Maintain 243 acres of red maple-green ash swamp and 25 percent (60 acres) as early successional seral stage to provide singing ground, nesting, and foraging habitat for American woodcock, with the remainder in mid- to late-successional stages to sustain this uncommon community type and provide nesting and migration habitat for Neotropical migrant birds, such as rose-breasted grosbeak.

### Rationale

Two variations of this community type grow on or near the refuge. Red maple and green ash dominate the more mature variation, which grows mostly outside the refuge near the northeast boundary along Dead Creek, and is considered an excellent example of this community type (Vermont Nongame and Endangered Wildlife Program 2004). The early successional variation of this community grows south of the old refuge headquarters around Black Creek. Here, slippery elm, alder, silky and red osier dogwoods and white birch abound among the red and silver maple, green ash, and swamp white oak. This swamp is stratified, and has a thick mid-story with an herbaceous layer of cinnamon and ostrich fern (Clews 2002). The refuge historically maintained the 30-acre “Field 8” as a wet meadow until about 1960. Subsequently, it allowed that field to succeed naturally into a young red maple-green ash swamp similar to the adjoining habitat (see maps 4-1 and 4-2).

All known examples of red maple-green ash swamp in Vermont are found in the Champlain Valley, the result of suitable growing conditions—flatter topography, warmer climate, fine-textured soils, and calcium-rich bedrock—compared to other parts of Vermont. Those swamps are characterized by a long period of inundation by spring floods, and by saturated soils the rest of the growing season. High-quality examples of the red maple-green ash swamp community type are uncommon (S3) but not rare in Vermont (Sorenson et al. 2004). Vermont Natural

Heritage considers this an excellent example of the community type. This natural community is common on the New York side of the Champlain Valley.

The Missisquoi Refuge has embraced the management of early successional hardwood forests for the benefit of various wildlife species, particularly American woodcock. Other species that will likely benefit include brown thrasher, gray catbird, Canada warbler, black billed cuckoo, rufous-sided towhee, ruffed grouse, wild turkey and white-tailed deer. We propose to maintain a portion of the hardwood species in this plant community, such as birch, alder, green ash, red and silver maple, aspen, and cottonwood, in an early successional stage using equipment such as a Hydro-ax and Brontosaurus. That equipment is designed to cut and mulch small trees, saplings, and brush to create sunlit openings that allow those species to regenerate from root suckers or seed.



*American Woodcock*

Approximately 30 acres of the red maple-green ash habitat on the refuge will be treated using 100 ft wide strips, on a 10-year rotational cycle. We will adjust that cycle, shorter or longer, depending on the response of the woody plants after cutting. Under that schedule, trees should not achieve an age older than 10-15 years allowing some additional time in the event that growth response is slow on some parcels or operational factors delays treatment. This habitat component complements other forest habitats on the refuge, such as the floodplain forest and other portions of the red maple-green ash swamp that are allowed to mature naturally. The refuge breeding bird surveys indicate high abundance of northern waterthrush and veery in the red maple-green ash swamp habitat, compared to other areas in Vermont. Those species, among others, use the older age classes of the red maple-green ash swamp. We may adjust the proportion managed as early successional habitat based on additional information gathered with conservation partners, including Vermont Natural Heritage.

### Strategies

*Within 5 years of CCP approval:*

- Establish annual spring singing woodcock counts in the red maple-green ash swamp, Stephen J. Young Marsh/northern hardwoods, and the grassland/shrub transition along Tabor Road to monitor woodcock response to early successional habitat management
- Work with Vermont Natural Heritage Program to identify and map areas of ecological significance within the red maple-green ash swamp that should not be actively managed as early successional stages
- Evaluate and modify the location and extent, as needed, of the current early successional habitat management within this habitat type to benefit woodcock while protecting the ecologically sensitive areas

### Objective 1.7 Maquam Bog

Maintain the ecological integrity of the approximately 1,000-acre Maquam Bog, including its hydrological conditions, to protect the pitch pine, large population of rhodora, and the state-listed threatened Virginia chain fern.

### Rationale

The 998-acre Maquam Bog, one of Vermont's largest, contains the state's largest populations of rhodora, as well as pitch pine and Virginia chain fern, a state-listed threatened species (map 4-1).

The center of the bog is about 100 feet above sea level, with an overall hummock-hollow relief of less than 8 inches. A natural gravel berm separates the bog from Maquam Bay to the south; Charcoal Creek, an old tributary of the Missisquoi River, defines the northern border; and the uplands of Hog Island form the western border (Strimbeck 1988).



USFWS

*Maquam Bog*

The bog was designated a RNA in 1991. We recognize those plant communities as important components of the region's native biological diversity, and seek to maintain their health in keeping with the Service "Biological Integrity, Diversity, and Environmental Health" policy (601 FW 3).

No other peatland in New England grows pitch pine. It is the most abundant tree in the peatland; black spruce and tamarack grow only in two small areas. Pitch pine grows across the bog as scattered individuals and in groups of 10 to 20 trees. Strimbeck (1988) describes how fire and flooding likely combine to promote its establishment and reproduction. Most of the bog is shrub-covered, and has obvious vegetational zonation. Clews (2002) classifies the shrub-sedge zone in the heart of Maquam Bog as mixed shrub sedge bog, one of the largest examples of an ombrotrophic (rain-fed) bog in New England. Virginia chain fern, a rare plant in Vermont, grows here (Clews 2002).

Evidence indicates at least five fires here over the past 120 years, including major fires in 1910, 1949, and 1960. Periodic flooding by lake and river water stimulates the growth of flood-tolerant plants (Strimbeck 1988). Likely, the fire regime maintains the pitch pine-chain fern-rhodora plant community, while the periodic flooding and lack of fire tends to encourage tall, woody vegetation. Some form of prescribed burning may be needed to maintain the diversity of the flora and fauna in the Maquam Bog, although the cyclical disturbance caused by variations in flooding also maintains its habitat diversity. Anecdotal indications are that the bog is shrinking, although we do not know if that is a natural, cyclical process. The bog is now relatively free of invasive species, although purple loosestrife grows at its south end, near Maquam Bay

Short-eared owl and northern harrier, BCR 13 high-priority and moderate priority species, respectively, forage and winter on Maquam Bog, with some evidence of possible breeding. Shrubland-dependent species, including swamp sparrow, common yellowthroat, yellow warbler, and song sparrow, are common breeders in the bog.

The refuge hosted a site walk with two bog ecologists in July 2005. Appendix F provides a summary of that walk.

### Strategies

*Within 5 years of CCP approval:*

- Develop a management plan for the Maquam Bog RNA. The management plan should include criteria for designation, use objectives and restrictions, management objectives, summary of known information about the bog, and protection objectives and strategies including prescribed fire

- Monitor for presence of non-native invasive species in the bog and implement control measures as appropriate

*Within 5 to 10 years of CCP approval:*

Identify research partnerships to study the surface topography, hydrology, and fire history of Maquam Bog to guide management of this unique ecosystem

### **Objective 1.8 Scrub-Shrub**

Maintain 591 acres of existing scrub-shrub habitat surrounding Maquam Bog, and allow 132 acres of shrubland that emerge as grasslands along the Missisquoi River corridor to succeed naturally to scrub-shrub, as foraging and resting habitat for American woodcock and nesting and migrating habitat for Neotropical birds including willow flycatcher and black-billed cuckoo.

#### **Rationale**

Historically, the refuge concentrated on migratory waterfowl habitat acquisition and management. We also need to consider other migratory bird populations, and actively manage early successional cover types that provide important life cycle requirements for woodcock and other migratory birds of conservation concern, including black-billed cuckoo, willow flycatcher, eastern kingbird, brown thrasher, blue-winged and golden-winged warblers, eastern towhee, and Canada warbler.



USFWS

*Eastern Kingbird*

Nearly a dozen species of conservation concern depend on early successional or shrubland habitat. Golden-winged warbler and sedge wren are two species, among others, that Vermont's recently completed WAP identifies as "species of greatest conservation need" (VT FWD 2005a). The BCR 13 plan also identifies the willow flycatcher as a priority species (Hartley et al. 2006). All three species inhabit wet shrubland. Golden-winged warblers expanded their range into New England in the late 1800s with the emergence of widespread early successional habitat after farm abandonment. Its populations seem to be retracting as natural forest succession continues, although other issues throughout its range may be contributing to its decline. The Missisquoi Refuge lies at the northern edge of its range, but supports appropriate habitat—dense, brushy areas bordering lowland areas (DeGraaf and Yamasaki 2001). The state-listed endangered sedge wren occurs in wet meadows, and might occur on the margins of the shrub-grassland interface near Tabor Road. Willow and alder flycatchers use similar wet shrubland habitat, and can be distinguished only by their songs: "fitz-bew" for the willow flycatcher and "fee-bee-o" for the alder flycatcher.

Alders, willows, dogwoods, and birches dominate the shrublands around the Maquam Bog and bordering the Tabor Road fields, and are relatively persistent. The refuge will need to monitor those areas to determine if trees are invading. If so, we will evaluate opportunities to set back succession to retain the shrubland component.

Several of the fields that the refuge now mows to benefit grassland-nesting birds are not supporting them, either because the fields are too small or too isolated. In addition, some of those fields are difficult to maintain as grassland because of the nature of their soils or other site conditions. We will allow them to revert to shrubland. The refuge will monitor that successional change, and further evaluate whether to maintain those new shrublands or allow them to continue to mature

into floodplain forest. Managing small patches as shrubland habitat can be more effective for many of the shrubland-breeding birds than managing such relatively small patches for other habitat types, such as grassland or forest, because of the relatively low patch size sensitivity many shrubland birds exhibit, compared to some of the grassland and forest birds.

The Service developed the “American Woodcock Management Plan” to help stem the decline in American woodcock (USFWS 1990). The number of displaying males was unchanged from 2002 to 2003 in the eastern United States, according to singing-ground surveys. Longer trends show declines of –1.3 percent per year from 1993 to 2003 and –2.3 percent per year from 1968 to 2003. Functional foraging habitat for woodcock occurs on moist, rich soil dominated by dense shrub cover (75 percent to 90 percent); alder is ideal, although young aspen and birch are also suitable as feeding areas and daytime (diurnal) cover. Woodcock require several different habitat conditions very near one another. Those include clearings for courtship (singing grounds), large openings for night roosting, young second growth hardwoods (15 to 30 years) for nesting, brood-rearing, and foraging areas (Sepik et al. 1981, Keppie and Whiting 1994).

### Strategies

*Within 5 years of CCP approval:*

- Conduct annual spring singing woodcock counts in the managed scrub-shrub habitat to monitor woodcock response to early successional habitat management
- Maintain existing shrublands using mechanical tree cutting, as needed, to maintain the scrub-shrub habitat structure
- Allow 132 acres of grassland (fields 1–7) to succeed to shrubland; survey grassland-nesting birds in the southern part of field 4 and field 5 before allowing them to revert to shrubland (see objective 2.3).

*Within 5 to 10 years of CCP approval:*

- Implement a breeding bird survey in all the refuge shrublands to monitor for BCR 13 priority bird species

*Within 10 to 15 years of CCP approval:*

- Evaluate the new riverine shrubland areas (previously grassland) to determine if we should allow any to succeed naturally to floodplain forest for the benefit of high-priority bird species

## **GOAL 2. Provide diverse upland habitats for Federal trust species including migratory birds and other species of conservation concern in all seasons.**

### **Background**

The Missisquoi Refuge is a stopover on the migration routes of many bird species. For some, this is a northern breeding area; for others, it is a resting and refueling stop on the way to nesting areas farther north and wintering areas to the south. The refuge is naturally diverse in cover types and species. Although uplands compose only 5 percent of the refuge, those habitats contribute to the diversity of the refuge and support such species of conservation concern as bobolink, eastern meadowlark, and woodcock.

### **Strategies that apply to all the objectives under this goal**

**Within 5 Years of CCP approval:**

- Gather existing information on the refuge-administered conservation easements and incorporate these easements in land management decisions under the respective habitat objectives

- Continue to monitor bat and bird activity and response to the wind turbine erected at the new headquarters

**Objective 2.1 Dry Oak Upland Forest**

Maintain the ecological integrity of the 48 acres of oak hardwood islands in the scrub-shrub habitat around the Maquam Bog.

**Rationale**

This dry oak upland forest forms small islands, from 1 to 10 acres in size, in the middle of the alder swamp at the western edge of Maquam Bog (map 4-1). The oaks are mature and form a nearly complete canopy. The transition to this community type is abrupt and follows the border between soil types (Clews 2002). We have not completed a botanical survey in this habitat. However, casual surveys through the forest suggest a high plant diversity unique from the rest of the refuge. Oak regeneration is evident in the understory. These oak forests provide an important food source for the range of resident and migratory wildlife that forage on acorns in the fall.

**Strategies**

- Every 5 years, monitor forest vegetation to ensure oak regeneration and evaluate the condition of the canopy forest

**Objective 2.2 Northern Hardwood Forest**

Maintain 49 acres of northern hardwood forest by actively managing 20 acres in early successional seral stages as foraging habitat for American woodcock and the remainder in mid- to late-successional stages for nesting and migrating Neotropical birds such as black-billed cuckoo.

**Rationale**

Northern hardwood forest is the matrix forest type of Vermont, but it is not common on the refuge (map 4-1). This forest requires well-drained soils, and appears in small pockets on upland areas on and around the refuge, primarily in the Steven J. Young marsh. Since 1992, the refuge has maintained a 20-acre portion of the northern hardwoods around the Stephen J. Young Marsh in early successional stands of aspen, birch, alder, and other hardwood species, using a mechanical mowing operation. We use a Hydro-ax (an 8-foot-wide mower attached to the frame of a large pay loader-type chassis) to cut approximately 100-foot-wide strips of varying lengths. The Hydro-ax cuts and chip small softwoods up to 8 inches in diameter and small hardwoods up to 5 to 6 inches in diameter. Cuts are applied on 8- to 10-year intervals over a 25- to 30-year cycle so that trees remain in an “early successional” stage. That habitat condition benefits American woodcock, ruffed grouse, white-tailed deer, and many migrating songbirds of conservation concern.

The decision to establish a MAPS station was a mutual effort of Audubon Vermont and the Missisquoi Refuge initiated in 2000. (See chapter 3 for a description of the MAPS program.) Active management of habitats is ongoing in the area where the MAPS station is located. This situation is somewhat contrary to most MAPS stations, where active forest management is not encouraged during the 10- to 20-year life of a study area.



*Hydroax*

USFWS

We believe the information we gather from the MAPS station, although not obtained from a traditional site, may still yield valuable information on

avian wildlife species that depend on very early successional (0–10 yrs), mid successional (10–20 yrs) and late successional (20–30 yrs) seral growth stages. Recording treatment years and comparing the avian response through MAPS data collection may reveal avian species requirements that were not apparent, especially avian response to newly created openings within the patchwork of other age classes.

In addition to potential wildlife information, the MAPS station provides a great opportunity to teach the visiting public about migratory bird anatomy, their habitats and habits. The expertise of many of the volunteer birders helps people better understand and appreciate wildlife, especially birds, and in this MAPS situation, how habitats that are carefully manipulated affect which species are captured, banded and released.

### Strategies

*Continue:*

- Manage the northern hardwoods and habitats surrounding Steven Young Marsh as a mosaic of open field, marsh, shrubland, young forest, and mature forest

*Within 5 years of CCP approval:*

- Conduct annual spring singing woodcock counts in Stephen J. Young Marsh/northern hardwoods, the red maple-green ash swamp, and along the grassland/shrub transition along Tabor Road to monitor woodcock response to early successional habitat management
- Evaluate and update the woodcock management prescriptions in the northern hardwood forest to create quality foraging and breeding habitat, following Sepik et al. (1988)
- Evaluate the MAPS program and data to determine its value to guiding management decisions and to refuge interpretive programs; if not providing valid data then consider discontinuing.

### Objective 2.3 Grassland

Reduce the present 338 acres of grassland to 139 acres (“Fields 9, 10, 11,” and the field next to the Stephen J. Young marsh) along Tabor Road, maintaining these high quality grasslands to provide nesting habitat for bobolinks and eastern meadowlark, roosting habitat for American woodcock, and foraging opportunities for such raptors as northern harrier and American kestrel. Evaluate 67 acres (portions of “Fields 4” and “Field 5”) of grassland adjacent to the Missisquoi River for nesting birds before allowing them to revert to shrubland.

### Rationale

The refuge now manages a dozen fields that vary in their physical (size, shape, and landscape context) and ecological (soil type, drainage, and vegetative structure) characteristics to benefit grassland-dependent wildlife (map 4-2). The largest grasslands on the refuge lie along Tabor Road; several smaller grasslands lie along Route 78 and the Missisquoi River corridor (map 4-1). Grassland bird surveys began on the refuge in 1998 along Tabor Road and in the grasslands along the Missisquoi River. The Tabor Road survey documented a diverse grassland bird community including bobolink, savannah sparrow, eastern meadowlark, red-winged blackbird, red-tailed hawk, and tree swallow.

Grassland-nesting birds are highly area-sensitive, and typically avoid habitat patches below a threshold size, or of highly irregular shape, or within a

landscape lacking other grassland patches, regardless of the ecological condition of the field. Generally, fields less than 20 acres are unsuitable for most obligate grassland-breeding birds, and we should consider other management options. Grassland management is both labor- and resource-intensive. The pace of natural succession is rapid if we leave fields unmowed or unburned. Soil type, moisture regime, and the presence of invasive species influence the quality and rate of woody plant succession in a field. Norment (2002) finds that humans created most of the grasslands in the Northeast: pastures and hayfields dominated by introduced, cool-season grasses; and that those, rather than native, warm-season grasses, provided the optimal habitat for grassland birds in this region.



*Bobolink*

USFWS

The refuge is modifying its grassland management program to maximize benefits for wildlife dependent on that habitat, while shifting some fields to shrubland and floodplain forest conditions that benefit other priority species, including American woodcock, willow flycatcher, and Neotropical migratory songbirds. We will continue to manage the larger grasslands, dominated by cool season grasses, by mowing them after July 15. Much of the private land next to Tabor Road and the refuge is also large hayfields, thus increasing the effective area of the refuge grasslands, although the owners of those private fields mow them earlier in the summer, during the nesting season (USFWS 2005), which is when the hay is a higher quality and suitable for cattle feed.

### Strategies

*Within 5 years of CCP approval:*

- Allow 132 acres (Fields 1, 2, 3, 5, 6, 7, and 43 acres of Field 4) of grasslands to naturally revert to shrubland habitat and evaluate site capability for natural succession to floodplain forest
- By 2007, conduct a breeding marsh bird, waterfowl, and harrier survey of the southern 57 acres of field 4 and the 10 acres of field 5, before changing the management objective from grassland to shrubland
- Maintain fields 9,10, and 11 and the field around the Stephen J. Young marsh in grassland habitat by mowing after July 15
- Establish species monitoring transects in the fields (1, 2, 3, 5, 6, 7, and 43 acres of Field 4) that are allowed to revert to shrubland to determine wildlife use and evaluate whether to allow them to continue to succeed to floodplain forest
- Pursue, with partners, opportunities to conserve additional grassland habitat bordering the high-value, refuge grasslands along Tabor Road to maintain landscape conditions conducive to area-sensitive species; a key parcel is already up for sale

Table 4.1 lists the fields we mowed, their size and location, and our proposed management strategies. Map 4-2 shows their location.

**Table 4.1. Proposed management of current refuge grasslands**

<b>Field Name</b>	<b>Acres</b>	<b>Comments</b>	<b>Proposed Management</b>	<b>Purpose</b>
Fields 1 and 2	24	Long and narrow fields along floodplain; seasonally flooded, not used by obligate grassland-nesting birds; some evidence of snipe nesting and seasonal use by waterfowl, although habitat available elsewhere	Given their proximity to floodplain and their size and shape, allow them to revert to shrubland and, potentially, floodplain forest; monitor vegetation changes over time	Shrubland and riparian forest-dependent birds: woodcock, Canada warbler, black-billed cuckoo, wood thrush, rose-breasted grosbeak, orchard oriole
Field 3	13	Long and narrow field south of the barge slip on the east side of the Missisquoi River; not used by obligate grassland birds	Given their proximity to floodplain and their size and shape, allow them to revert to shrubland and, potentially, floodplain forest; monitor vegetation changes over time; continue to maintain the access road that runs through fields 3, 4, and 5	Same as above
Field 4	100	Northern 43 acres is already reverting to woody growth; southern 57 acres still maintained as grassland but is a mix of reed canary grass and sedges and not used by nesting birds	Allow northern 43 acres to revert to shrubland and, potentially, floodplain forest. Continue to evaluate southern 57 acres as grassland habitat—soil types not conducive to maintaining in grassland, consider reverting to shrubland	Same as above
Field 5	10	A small field south of the Cranberry Pool dike access trail; only suitable as grassland habitat in combination with adjacent field 4.	Manage same as field 4.	Same as above
Field 6	28	Too narrow for grassland-nesting birds	Discontinue haying; allow to revert to natural woody vegetation; ensure management does not increase road mortality of wildlife; adjust management as needed when Rt. 78 is relocated away from the river	Same as above
Field 7	24	Too narrow for grassland-nesting birds	Same as field 6	Same as above
“Field 8”	30	Until ~1960 kept open as a wet meadow; natural succession followed with growth of silver and red maple, green ash, speckled alder, aspen, and other species; since 1970s and continuing to today openings in the alder were created to benefit woodcock. No longer a field	Evaluate this area in partnership with the NH Natural Heritage and Fish and Wildlife to delineate potential exemplary red maple-green ash swamp and best areas for woodcock management.	Woodcock, chestnut-sided warbler; maintain uncommon plant community

Field Name	Acres	Comments	Proposed Management	Purpose
Field 9	25	Fields 9, 10, and 11 provide best grassland obligate nesting cover and also an opportunity to manage as a mosaic of grassland, shrubland, and wet meadow habitat	Maintain at least 100 acres of fields 9, 10, and 11 as large, contiguous grassland habitat by mowing annually after July 15 <sup>th</sup> and document lime and fertilizer applications. Maintain the remaining portion of these fields bordering the woodland and shrubland that has already grown up into willows and dogwoods. Use soils map to delineate poorly and somewhat poorly drained soils for shrublands and well-drained and moderately well-drained soils for grasslands	Bobolink and woodcock; also, willow flycatcher, golden-winged warbler, and other shrubland- and grassland-dependent wildlife
Field 10	49	Same as field 9	Same as field 9	Same as field 9
Field 11	54	Same as field 9	Same as field 9	Same as field 9
Field adjacent to Steven J. Young Marsh	11	The Stephen J. Young marsh are along Tabor Road encompasses an 11-acre field, 11-acre marsh, and 49 acres of northern hardwoods—20 of which are managed as early successional habitat	Maintain the open field near the road for public viewing and environmental education; continue to manage the early successional and upland forest for woodcock and other species; maintain the impounded marsh as a wildlife viewing site	Woodcock roosting and singing grounds
CURRENT TOTAL IN GRASSLANDS	368			
PLANNED TOTAL IN GRASSLANDS	232			

**GOAL 3. Provide high quality education and interpretative programs to promote an understanding and appreciation for the conservation of fish and wildlife and their habitats, as well as the role of the refuge in conserving the Missisquoi River Delta.**

**The following strategies apply to all the objectives under this goal.**

**Within 5 years of CCP approval:**

- Hire interns and students (e.g., SCEP students, Eco-Interns) to assist in implementing outreach and environmental education and interpretation programs.
- Open the Visitor Contact Station to public on expanded hours, including weekends
- Develop interpretive materials to promote the cultural heritage resources of the Missisquoi region

**Objective 3.1 Interpretive Programs**

Beginning in 2008, 90 percent of refuge visitors will be able to identify the refuge’s purpose, name at least one refuge habitat and associated wildlife species of management concern, or know the importance of the Missisquoi Refuge to

the health of the Missisquoi River delta through their experiences at the Visitor Contact Station, by walking refuge trails, or participating in another refuge program.

**Rationale**

The new, 7,250-square-foot Missisquoi Refuge Headquarters/Visitor Contact Station was completed in 2005. It provides opportunities for expanded educational and interpretive displays, programs, and training areas for volunteers and interns. It houses an administrative section that includes offices, storage closets, and conference room, a public use section that includes a 1000-sq-ft. interpretive and educational exhibit area, a cooperating association retail sales area, offices for the Friends of Missisquoi National Wildlife Refuge and refuge volunteers, a multipurpose room, public rest-rooms, and an orientation and reception area.

Approximately 38,000 people visit the refuge each year. They include

- students from pre-K to college,
- tourists who happen upon the sign on route to other destinations,
- users of the Northern Forest Canoe Trail and the Lake Champlain Birding Trail, both of which pass through the refuge,
- local families who frequent the area to fish, hunt, and walk along the nature trails,
- local conservation groups,
- wildlife photographers and observers,
- day-trippers within Vermont,
- short term vacationers who are in the area for just a day or several weeks who hunt, fish, or walk on the refuge trails,
- long term vacationers who migrate to summer homes or camps in the area for the duration of the summer and who visit the refuge for fishing and trail use,
- hunters and fishermen from outside the local area or out of state whose destination is or includes the refuge,
- commercial tour guides and their customers, and others.

With the opening of the new Visitor Contact Station and exhibits, nearby trails and observation areas, we realistically expect our annual visitation to increase substantially: up to 85,000 visitors over the next 15 years.

The refuge keeps a series of walking trails open to the public year-round, including the Black Creek and Maquam Creek trails, the Mac's Bend Road from Louie's Landing to Mac's Bend, the Stephen J. Young Marsh Trail, the Old Railroad Passage Trail, and the Jeep Trail. We will enhance those trails to provide greater interpretation of wildlife and their habitats and greater accessibility for a broader audience we expect to visit the refuge (map 4-3).



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*Refuge visitors out on a trail*



### Strategies

*Within 5 years of CCP approval:*

- Evaluate the MAPS program and data to determine its value for refuge interpretive programs and its potential impact on migrating birds
- Erect a camera on the refuge to enhance wildlife observation for live local television and Internet coverage to compliment Visitor Contact Station exhibits. Choose site to maximize year-round wildlife viewing, minimize visibility of tower – possibly in one of the impoundments
- Implement an educational campaign to assist users of the refuge public access areas in recognizing and preventing the spread of nuisance and invasive species, such as zebra mussel, Eurasian milfoil, and water chestnut
- Incorporate information on invasive species and good fishing practices (e.g., alewives illegal as bait fish) into educational materials, including boat ramp kiosks
- Complete a self-guided walking Discovery Trail at the Visitor Contact Station and build an outdoor classroom in conjunction with the trail, including a platform near the two ponds and benches in the wooded area for educational activities; use appropriated federal highway funds and seek additional funding as needed
- Complete the self-guided walking trail at the Stephen J. Young Marsh using our YCC crew
- Develop a demonstration area for “Backyard/Schoolyard Wildlife Habitat” around the Visitor Contact Station, following the National Wildlife Federation program
- Place a kiosk at the existing parking lot for the Railroad Passage Trail and the Stephen J. Young Marsh Trail, and develop interpretive panels for the kiosk



USFWS

*Refuge visitors reading railhead sign*

*Within 5 to 10 years of CCP approval:*

- Update existing materials and develop new interpretive materials, including brochures, interpretive panels, kiosks, and exhibits that highlight refuge resources
- Install trailhead signs at Discovery and Stephen J. Young Marsh trails to match the current design used on Maquam and Black Creek nature trails, Old Railroad Passage trail, and the Jeep trail
- Develop an American with Disabilities Act (ADA)-accessible new trail (Discovery Trail)

### Objective 3.2 Outreach

Provide at least 10 opportunities for the local community and visitors to learn about the Misisquoi River Delta ecosystem and the role of the Refuge System in protecting and managing those resources.

### Rationale

The Service is America's voice for wildlife, speaking for the wild creatures that cannot speak for themselves. To be effective, we must do so in a way that provokes public understanding and support (USFWS National Outreach Strategy). Outreach is two-way communication between the Service and the public to establish mutual understanding, promote involvement, and influence attitudes and actions, with the goal of improving joint stewardship of our natural resources. Communication is essential to the refuge resource mission. Good communication builds understanding, and helps the public make informed decisions about the future of fish and wildlife resources. Marketing research shows a clear correlation between positive awareness and a willingness to act on behalf of a particular product or service.

This objective focuses on achieving such positive awareness for the refuge through better communications. Although the refuge must manage many controversial issues, it also enjoys significant strengths including dedicated staff and volunteers, and strong public interest in fish and wildlife. To meet the refuge challenges and take advantage of its strengths, the strategies under this objective recommend a more unified and strategic communications program that will help the refuge carry out its resource conservation mission. Our approach is to make the most effective use of staff time and resources by focusing our messages into something people can easily understand, and making sure it delivers that message to concerned people in a timely way.

Local businesses that cater to users of the Missisquoi River Delta region are important potential constituents that can help promote responsible, nature-based tourism, provide guidance on the area's sensitive natural resources, and encourage responsible behavior around sensitive wildlife habitats and populations.

### Strategies

*Continue:*

- Send news releases to local papers and television and radio stations about refuge and wildlife happenings
- Work with the Vermont Department of Transportation to post a Refuge Informational Sign on I-89

*Within 5 years of CCP approval:*

- Display refuge information and post upcoming events at rest stops and welcome centers in Franklin and Grand Isle Counties and secure a set time period each year for a larger refuge display
- Develop a portable, traveling exhibit that emphasizes the importance of the Missisquoi Refuge. The exhibit will be used for off-refuge festivals and events and displayed at various public buildings
- Establish a short-range AM radio station for visitors traveling through the refuge on Route 78
- Enhance the refuge website with more information on refuge biological resources, recreational opportunities, regulations and policies, and the Service and refuge missions
- Enhance efforts to invite television, newspaper, radio, and other media to major refuge events throughout the year (e.g., International Migratory Bird Day, Wildlife Festival, National Wildlife Refuge Week, Jr. Waterfowl Hunter Training Day, Kids Fishing Derby.)

- Send refuge information to businesses, chambers of commerce, rest stops, and others that cater to public uses in the Missisquoi River Delta region
- Develop public outreach with any nest box removal emphasizing the refuge focus on providing high-quality, natural cavities for all cavity-nesting species on both private and public lands

*Within 5 to 10 years of CCP approval:*

Work with local businesses and landowners to promote responsible nature-based tourism by erecting signs and kiosks at off-site boat-launch sites where visitors can access refuge information prior to visiting the refuge from an off-site location

### **Objective 3.3 Environmental Education**

Develop three to five key environmental education messages and activities associated with each message about the refuge flora, fauna, habitats and ecosystems that can be used in environmental education programs with local elementary and secondary school teachers, college faculty, and youth group leaders.

#### **Rationale**

Environmental education is a priority public use identified in the Improvement Act, and is one of the most important ways we can raise our visibility, convey our mission, and identify the significant contribution the refuge makes to wildlife conservation.

This objective focuses on creating curriculums or other structured programs on and off the refuge with local schools and teachers and other educational programs. Several Swanton and Highgate teachers already have wetland and wildlife habitat topics in their curriculum. The refuge can provide educational material to these teachers, augmenting their existing curriculum, on the importance of the Missisquoi River Delta for waterfowl and wading birds, marsh birds and songbirds, rare freshwater mussels and softshell turtles, and other wildlife and plant communities.

The refuge is a Vermont Envirothon partner, and provides staff to assist with student training and the overall competition. The Envirothon is a program for high school students to learn about their state's environmental issues related to forestry, wildlife, soils and water resources. The program provides an opportunity for in-class activities and hands-on field experience that culminate each May in a daylong Vermont Envirothon event. Students learn the importance of science-based investigations in helping to resolve environmental issues. More than 400 students from 25 different schools have participated in the Vermont Envirothon since it began here in 1996. Students represent public schools, private schools, home schools, and vocational tech centers.

Ecology Culture History Opportunity (ECHO), at the Leahy Center for Lake Champlain, works with key community partners, including the refuge, to provide an excellent experience at the 2-acre campus on the Burlington waterfront. ECHO educates and infuses people with enthusiasm about the "Ecology, Culture, History, and Opportunities" for stewardship of the Lake Champlain Basin. The goal is to allow individuals to develop informed, educated decisions to create a better future for the lake and the basin.



*Refuge volunteers presenting environmental education program at the ECHO site*

USFWS

The refuge's Visitor Services Specialist serves as Vermont's Junior Duck Stamp Coordinator. The Federal Junior Duck Stamp Conservation and Design Program is a dynamic, active, art, and science program designed to teach wetlands habitat and waterfowl conservation to students in kindergarten through high school. The program guides students, using scientific and wildlife observation principles, to communicate visually what they have learned through an entry into the Junior Duck Stamp art contest. This non-traditional pairing of subjects brings new interest to both the sciences and the arts. It crosses cultural, ethnic, social, and geographic boundaries to teach greater awareness of our nation's natural resources.

Preparing for participation in the program often includes a visit to a national wildlife refuge: a prime location for observing our nation's wildlife, but also for experimentation and hands on experiences. Students are encouraged to include a conservation message on their entry form with their art design that explains something the student has learned about wetlands habitat, conservation or waterfowl.

### Strategies

#### *Continue:*

With the help of volunteers participate in educational events such as school conservation and earth day celebrations, ECHO Center programs, Dead Creek Wildlife Day

#### *Within 5 years of CCP approval:*

- Develop three to five key environmental education messages and associated activities about the refuge flora, fauna, habitats and ecosystems
- Conduct up to 20 educational refuge tours and presentations for school groups, Vermont YCC, scouts, Vermont Audubon, VT FWD, Shelburne Farms, ECHO Center, and other educational groups interested in natural resources and conservation
- Continue to organize, promote, and host the annual Federal Junior Duck Stamp Conservation and Design Contest in Vermont and enhance the program by involving many more kids.
- Actively participate in Vermont Envirothon through refuge staff and volunteers participating on Envirothon committees and formulating test questions, and by volunteers and staff hosting one of the test stations on competition day.
- Train volunteers to assist in hosting an annual Project Wild teacher's workshop to enhance coordination and collaboration with area teachers.



Steve Vittum/USFWS

*Vermont YCC working at the refuge*

#### *Within 5 to 10 years of CCP approval:*

Train volunteers to work with teachers to adapt existing environmental education curriculums with a focus on refuge wetlands and associated wildlife consistent with Vermont Department of Education standards

**GOAL 4. Increase appreciation and stewardship of the Missisquoi River Delta and the Lake Champlain Basin by providing compatible, positive, wildlife-dependent recreation including wildlife observation and photography, hunting, and fishing.**

**Background**

The Improvement Act identifies six priority public uses for refuges: hunting, fishing, wildlife observation and photography, and environmental education and interpretation. Fishing and hunting have regionally been identified as the top two priority Areas of Emphasis at the refuge. These two activities will be highlighted above all other priority public uses, resulting in the wise use of staffing and funding resources and enabling the refuge to provide fewer, but higher quality, big six experiences. Those are to receive enhanced consideration in refuge planning, and opportunities for visitors to engage in them should be provided to the extent that they are compatible with the Refuge System mission and the purposes of the Missisquoi Refuge. Goal 3 covered environmental education and interpretation. Goal 4 covers the issues and opportunities regarding public access and recreation on the refuge.

The Missisquoi Refuge is popular among hunters, anglers, boaters, and wildlife watchers. Visitors who seek recreational experiences include local residents, U.S. and Canadian tourists, and others. The waters in and around the refuge receive a variety of boating traffic, including kayaks, canoes, anglers, speedboats, airboats, and personal watercraft; some conflicts arise between motorized and non-motorized watercraft.

Boating supports the six priority public uses at Missisquoi Refuge by getting people out on the waters which surround the Refuge. Hunting for waterfowl and big game is popular on the refuge. The refuge is becoming increasingly popular for all recreational uses, and is experiencing greater law enforcement challenges, such as illegal access into closed areas, conflicts among user groups, impacts on wildlife and habitats, littering, and other harmful activities. Current interpretative materials contain messages that address these challenges.



*Young Birdwatcher*

USFWS

Refuge regulations state that dogs must be kept under control on a leash no longer than 10 feet. Refuge brochures and signs publish that regulation. Over the years, refuge staff and volunteers have observed visitors violating that regulation. Many of them are repeat offenders. Because of those violations, we are proposing a “no dogs” policy to protect sensitive habitats, wildlife, and visitors from dogs running loose. Problems with unleashed dogs encountered on the refuge include lost dogs, other hikers and their dogs intimidated by unleashed dogs, thus depriving them of a peaceful visit, and harassment and injury to wildlife.

**Strategies that apply to all the objectives under this goal**

- Replace old, outdated, and faded signs (e.g., boundaries, hunt zones, closed areas) using current standard Service signs
- Coordinate with Missisquoi River Basin Association, scout groups, and others to conduct regular clean-up days on the refuge

- Seasonally post sensitive wildlife areas as closed to public access as needed
- Whenever possible, utilize interpretive materials, including brochures, interpretive panels, kiosks, and exhibits to inform visitors of refuge rules and regulations

**Within 5 years of CCP approval:**

- Implement the new fee program described in the “General Management” section above.
- Expand public access to a 1-mile stretch of Mac’s Bend Road between Louie’s Landing and Mac’s Bend Boat Launch to vehicles and bicycles from April to December (currently open Sep—Dec). Install an electronic gate that allows entrance from dawn to dusk
- Enhance gate and signage at Mac’s Bend Launch to ensure pedestrian-only traffic on Jeep Trail
- Expand visitor counts at boat launch sites, trail heads, and headquarters to determine number of visitors currently accessing the refuge and what activities they are participating in
- By 2007, institute a no dogs policy on refuge, except where allowed by hunting regulations, for disabilities, or emergencies (currently require dogs on leash)
- Install locks with timers on public restrooms at Louie’s Landing to keep them open from sunrise to sunset only; if problems persist at the restrooms, then permanently close or consider moving them to Mac’s Bend or other location
- Compile a list of all commercial tour guides (e.g., canoe, hunting, fishing) using the refuge and require these guides to operate under a Special Use Permit and update the list annually

**Within 5 to 10 years of CCP approval:**

- Create partnerships with community-based organizations to adopt specific refuge trails, boat launches, and other areas for cleanup, etc.

**Objective 4.1 Wildlife Observation and Photography**

Within 2 years of CCP approval, at least 80 percent of refuge visitors engaged in wildlife viewing and nature photography will report a high-quality experience.

**Rationale**

The 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation indicates that 496,000 residents and non-residents participated in wildlife watching (i.e., observing, feeding, or photographing) in Vermont in 2001. That group spent more than \$203 million on wildlife-watching-related activities and equipment (USFWS 2002).

The refuge facilitates opportunities for wildlife observation and photography through self-guiding nature trails as well as staff- and volunteer-led tours and walks. In 2004, refuge staff and volunteers conducted 40 refuge tours and walks, including bird walks, owl prowls, winter ecology bog walks, boat tours, canoe tours, and woodcock walks, among others. We strive to provide safe, accessible wildlife observation opportunities while protecting wildlife and their habitats at sensitive times and in sensitive places on the refuge. Providing high-quality opportunities for the public to engage in those activities on the refuge promotes visitor appreciation and support for refuge programs.

**Strategies**

*Continue:*

- Promote walking, cross-country skiing, and snowshoeing on existing refuge trails as a means to facilitate wildlife observation and photography
- Annually provide 5 to 10 staff- or volunteer-led tours into closed areas to facilitate wildlife observation and photography.
- Annually provide 30 to 40 staff- or volunteer-led canoe tours, wildflower walks, and birding trips.



*Visitor engaging in wildlife photography*

*Within 5 years of CCP approval:*

- Provide literature on wildlife viewing opportunities at kiosks and other visitor contact facilities
- By 2007, enhance the end of the Maquam Creek trail by adding an elevated boardwalk and signs
- Implement the following trail closures (trails will be posted as “Closed”)

**Jeep Trail**

- ◆ April 1–August 1 (Nesting Season Closure)
- ◆ Youth Deer Hunt Weekend (Early November–2 days)
- ◆ Muzzleloader Season (Early December – 10 days)

**Discovery Trail**

- ◆ Regular Season – shotgun and rifle (Mid-November–16 days)
- ◆ Youth Deer Hunt Weekend
- ◆ Muzzleloader Season

**Old Railroad Trail**

- ◆ Regular Season – shotgun and rifle
- ◆ Youth Deer Hunt Weekend
- ◆ Muzzleloader Season

**Stephen J. Young Marsh Trail**

- ◆ Regular Season – shotgun and rifle
- ◆ Youth Deer Hunt Weekend
- ◆ Muzzleloader Season

- Implement the following trail advisories (Trails will be posted to advise hikers and users that the area is open to hunting—visitors may proceed with caution)

**Jeep Trail**

- ◆ Waterfowl Hunt Season

**Discovery Trail**

- ◆ Archery Season (Early October – 23 days)
- ◆ Upland Game Seasons (includes gray squirrel, rabbit and hare, ruffed grouse)

Old Railroad Trail

- ◆ Archery Season
- ◆ Upland Game Seasons (includes gray squirrel, rabbit and hare, ruffed grouse)

Stephen J. Young Marsh Trail

- ◆ Archery Season
- ◆ Upland Game Seasons (includes gray squirrel, rabbit and hare, ruffed grouse)

*Within 5 to 10 years of CCP approval:*

- Shorten the Jeep Trail to end where the trail is close to the river (where the river branches). Place a bench here to identify the end of the trail.
- On Old Railroad Passage trail construct access (such as a boardwalk) to reach Maquam Bay and to a Maquam Bog overlook in collaboration with the landowner, the VT FWD. At each site erect camouflaged blind, interpretive signs, and bench

**Objective 4.2 Hunting**

Provide hunting opportunities for small game, big game, and waterfowl consistent with sound biological principles and in accordance with the approved Refuge Hunt Plan ensuring that at least 90 percent of hunters have a positive experience.

**Rationale**

The 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation indicates that 100,000 residents and non-residents participated in hunting in Vermont in 2001. That group spent more than \$52 million on activities and equipment related to hunting (USFWS 2002). We recognize hunting as a healthy, traditional, outdoor pastime deeply rooted in American heritage and one that, when managed appropriately, can instill a unique understanding and appreciation of wildlife, their behavior, and their habitat needs. Hunting is a priority public use that when found compatible will be facilitated.



*Waterfowl hunter*

USFWS

Approximately 110 people applied for upland/big game hunting permits, and 250 people applied for the waterfowl lottery hunt on the refuge in 2004. We permit hunting on the refuge in compliance with a hunt program that we adjust annually to ensure safety and good wildlife management (maps 4-4 and 4-5). In addition, the refuge manager will expand the review process for the annual hunt plan to include the evaluation of lands that are now closed but may have the potential to accommodate safe hunting. We support hunting opportunities that can accommodate hunting biologically, ecologically, and safely within state and federal guidelines. The refuge is proposing to discontinue woodcock and snipe hunting in the delta lakeshore area due to the lack of birds utilizing that habitat type and opening up the Stephen J. Young Marsh area, west of Tabor Rd., to woodcock and snipe hunting since this area supports early successional species including woodcock and snipe at harvestable levels. The refuge provides details on its annual hunt programs in refuge brochures, 2005 Upland Game/Big Game Hunting Map, Regulations and Permit; and Migratory Game Bird Hunting Map and Regulations.





Providing a high-quality hunt on the refuge promotes visitor appreciation and support for refuge programs. According to our draft policy on hunting on national wildlife refuges, issued in the January 16, 2001 Federal Register, a quality hunting experience is one that

- 1) maximizes safety for hunters and other visitors;
- 2) encourages the highest standards of ethical behavior in taking or attempting to take wildlife;
- 3) is available to a broad spectrum of the hunting public;
- 4) contributes positively to or has no adverse effect on population management of resident or migratory species;
- 5) reflects positively on the individual refuge, the System, and the Service;
- 6) provides hunters uncrowded conditions by minimizing conflicts and competition among hunters;
- 7) provides reasonable challenges and opportunities for taking targeted species under the described harvest objective established by the hunting program;
- 8) minimizes the reliance on motorized vehicles and technology designed to increase the advantage of the hunter over wildlife;
- 9) minimizes habitat impacts;
- 10) creates minimal conflict with other priority, wildlife-dependent recreational uses or refuge operations; and
- 11) incorporates a message of stewardship and conservation in hunting opportunities.



*Vermont State Game Warden on patrol on refuge waters*

These are all criteria we will use to evaluate our hunt program.

A \$10 big game permit fee was initiated in 1999 to help defer the administrative costs of the hunt program and to be consistent with hunt permit fees at other refuges in the northeast region. The permit fee has resulted in a slight increase in the number of returned bag reports due to the reporting requirement on the permit stating that failure to complete and return bag report by December 31 will result in denial of the permit for the following year.

The refuge is proposing a no-dog policy except for disabilities, emergencies, waterfowl hunting, and, as appropriate, for upland game hunting. We encourage the use of retrieving dogs for waterfowl hunting and require their use for hunting waterfowl in the following areas on the refuge: Maquam Swamp Area, Long Marsh channel/Metcalf Island, and Saxes Pothole/Creek and Shad Island Pothole (see map 4-4). Retrievers are able to recover birds that otherwise might be lost. Their instinctive ability to scent crippled or dead birds in heavy cover and their ability to move through heavy cover and negotiate muddy conditions allows them to get to the bird faster, thus reducing crippling and allowing them to retrieve down and dead birds for the hunter.

### **Strategies**

*Continue:*

- Work with Vermont Game Wardens to patrol the refuge, particularly during hunting season to ensure hunter safety, provide contact information, and enforce compliance with State and Federal regulations
- Collect a fee for big game permits and require hunters to return harvest data by December 31. Any hunter who does not return a harvest report is subject to suspension of a big game permit the following year

- Collect a permit fee for waterfowl blinds and require hunters to return bag reports.
- Evaluate the success of blinds after each waterfowl season and change blind locations as necessary to maintain high quality hunting opportunities.
- Provide Junior Waterfowl Hunting Areas to young hunters 12 to 15 years of age who have completed refuge-sponsored Junior Waterfowl Hunter program
- Post information at off-site hunter information kiosks at public boat launch areas for those hunters accessing the refuge from these areas

*Within 5 years of CCP approval:*

- By 2007, hire a Law Enforcement officer (GS 7/9) to increase law enforcement presence during hunting seasons, ensure hunter safety, and monitor compliance
- Institute a lottery permit system for deer hunting on the delta (including both sides of the river) to alleviate hunter conflicts and to increase the quality of the hunt.”
- Increase public knowledge of safety zones around trails during hunting seasons by erecting more signs and including information on kiosks
- Annually post the refuge boundary earlier, by June 1, to prevent duck hunters from placing blind stakes within the refuge boundary
- Explore opportunities to expand the number of blinds sites within existing hunt areas and in new areas such as Burton’s Pothole (i.e., 3-4 blinds for 2 days/week)
- Develop opportunities for seniors to hunt waterfowl on the refuge, such as a Senior Hunt day, using the Junior Hunt blind sites
- Maintain and update a database to record and track blind sites and their use, water conditions, payments, and harvest information. Post that information on the refuge website
- Discontinue woodcock and snipe hunts in the delta lakeshore area
- Open the Stephen J. Young Marsh area, west of Tabor Road, to woodcock and snipe hunting
- Consider opening Burton’s Pothole for late bow/muzzleloader season
- Expand current opportunities for juniors and disabled big game hunters (e.g., open closed areas or expand seasons such as Cranberry Pool for late (Dec) bow season)
- By 2007, improve the quality and size of waterfowl maps and identify blind sites in maps, in brochures, and on display boards
- Develop a big game hunter education program

*Within 5 to 10 years of CCP approval:*

- Expand current adult waterfowl hunter orientation day to an adult waterfowl hunter training program (similar to the junior waterfowl hunter training program)

### Objective 4.3 Fishing

Provide opportunities for fishing on the refuge in a manner that minimizes conflicts between fishing and biological resources, particularly nesting birds, and that ensures at least 75 percent of anglers have a positive experience.

#### Rationale

The 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation indicates that 171,000 residents and non-residents participated in fishing in Vermont in 2001. That group spent more than \$92 million on activities and equipment related to fishing in Vermont (USFWS 2002).

Refuge visitors may fish from the banks of the Missisquoi River. Fishing is also allowed from a boat on the Missisquoi River and Lake Champlain in areas that are not posted as closed to public access (map 4-6). Fishing access is available to disabled individuals at Louie's Landing. We strive to provide fishing opportunities while protecting wildlife habitats at sensitive times and in sensitive places on the refuge. Some studies and anecdotal information indicate fishing and other boating-related activities may create some level of disturbance (see objective 4.4, "Boating," on the potential impacts of boating on turtles).



*Refuge Manager helping a young fisherman bait his hook at the annual Kid's Fishing Derby*

We define a high quality fishing program as one that

- 1) maximizes safety for anglers and other visitors;
- 2) causes no adverse impact on populations of resident or migratory species, native species, threatened and endangered species, or habitat;
- 3) encourages the highest standards of ethical behavior in regard to catching, attempting to catch, and releasing fish;
- 4) is available to a broad spectrum of the public that visits, or potentially would visit, the refuge;
- 5) provides reasonable accommodations for individuals with disabilities to participate in refuge fishing activities;
- 6) reflects positively on the Refuge System;
- 7) provides uncrowded conditions;
- 8) creates minimal conflict with other priority, wildlife-dependent recreational uses or refuge operations;
- 9) provides reasonable challenges and harvest opportunities; and
- 10) increases visitor understanding and appreciation for the fishery resource.

#### Strategies

*Continue:*

Support National Fishing Week by hosting a Kids Fishing Derby each June.

*Within 5 years of CCP approval:*

- By 2006, hire law enforcement officer to increase patrol of fishing areas to more closely regulate illegal fishing along the marsh channel and other closed areas and to prevent disturbance to nesting birds (same position as Objective 4.2).



- Explore additional ways to increase land based fishing opportunities by emphasizing access and facility development that is biologically and ecologically compatible with refuge objectives; opening Mac's Bend Road in April and the Rt. 78 realignment will provide opportunities.
- Explore opportunities to expand handicapped access fishing opportunities.
- Annually post the entrance to Long Marsh Channel as soon as possible after ice-out with Refuge "Area Closed" signs to prevent disturbance to waterfowl and ospreys from anglers
- Consider closing Long Marsh Bay to fishing year-round or seasonally to prevent disturbance to migratory birds

#### Objective 4.4 Boating

Beginning in 2008, at least 50 percent of boaters on the Missisquoi River, its tributaries, and around the lakeshore will receive information on the refuge role in conserving migratory birds and their habitats and the importance of the Missisquoi Refuge for the health of the Missisquoi River Delta and their (the boaters') role in respecting those resources.

Boating is allowed on the Missisquoi River and Lake Champlain and often facilitates the six wildlife-dependent recreational uses (hunting, fishing, wildlife observation and photography, and environmental education and interpretation) as defined by the National Wildlife Refuge System Improvement Act of 1997. Since Missisquoi Refuge is comprised mainly of wetlands, a boat is one of the best ways to see its many habitats and wildlife. Many people visit the refuge by boat specifically for the purpose of wildlife observation and photography, while others visit by boat because of the outstanding fishing and waterfowl hunting opportunities offered.

A boat launch at Louie's Landing is open year-round as open water permits. A second boat ramp, on Mac's Bend Road, is open from September to November. Boating is allowed on the Missisquoi River and Lake Champlain. Parts of the refuge are closed to boaters to protect wildlife habitat. The waters in and around the refuge receive a variety of boating traffic, including kayaks, canoes, fishing boats, speedboats, airboats, and personal watercraft. The Coast Guard has the authority to control boating on the river. The refuge is concerned about the effects of these activities on stream bank erosion, basking turtles, freshwater mussels, the heron rookery and other wildlife, and potential conflicts among user groups.



*Canoeing on the Refuge*

USFWS

In 2001, the Service conducted a study of eastern spiny softshell turtle response to boat traffic on the Missisquoi River. The researchers reported disturbances to basking turtles: 92 percent of the disturbances were from boat traffic, and approximately 40 percent of the time, those disturbances resulted in the turtles leaving their basking site. The researchers found no major differences between turtle responses to motorized and non-motorized boats; however, boats of moderate speed seem to have the least impact. Fast-moving motorized boats

washed turtles from their basking sites by creating high wakes or generating enough noise to disturb them. Slow-moving boats stay in the area longer, and often are associated with jerky motions such as paddling or fishing. The moderate-speed boats appear to move through more quickly, quietly, and with fewer jerky, physical movements, thus causing fewer disturbances of basking turtles (Meyer 2001).

**Strategies**

*Within 5 years of CCP approval:*

- Develop canoe/kayak route brochure and post route signs at mouth of Dead Creek and east branch of the Missisquoi River to guide boaters
- Work with the Coast Guard/Homeland Security and the State of Vermont on enforcement issues on the refuge, including the Missisquoi River
- Provide educational brochure to boaters and anglers on how to minimize the impact of boating on the environment at boat launches and kiosks, include this information in other refuge brochures, and provide to user groups such as tour operators and boat rental businesses

**Within 5 to 10 years of CCP approval:**

- Develop a new canoe/kayak access point at the proposed Casey pull-off to be created when Rt. 78 is realigned, to provide better access to Dead Creek
- Explore the possibility of allowing the Friends group or a concessionaire to provide canoe/kayak rentals
- Partner with research institution to study the intensity and types of boating and impacts on the Missisquoi River and refuge wildlife and habitats

**GOAL 5. Preserve the cultural and historical resources on the refuge for current and future generations and to sustain an appreciation of the past.**

**Background**

The Missisquoi Refuge and the adjacent communities of Swanton and Highgate are areas of great historical and cultural significance. Three archaeological surveys on the refuge (Thomas and Robinson 1979, Corey et al 2002, Doherty et al. 2002) discovered 34 archeological sites. Thirteen of those are prehistoric sites; most of the rest are historic farmsteads or other historic buildings. The entire refuge has not been surveyed for additional historical resources. The Missisquoi River Delta is considered to contain some of the richest archaeological deposits in the northeast (Thomas and Robinson 1979).

More than 50,000 archaeological artifacts found on the refuge are on long-term loan and curation at UMaine in Farmington and at UVM. Some are stored at the Regional Office in Hadley, Massachusetts. No centralized location in Vermont currently meets federal standards for curation to house the entire collection of artifacts. Given the dispersed location of the repositories across New England, the artifacts are not readily accessible to researchers or for educational purposes.

Most recently, UMaine at Farmington, under a contract with the Vermont



Archaeological survey on Route 78

USFWS

Agency of Transportation (VTrans), initiated archaeological work along Route 78, from just west of Swanton into the refuge approximately 1 mile in anticipation of safety and environmental improvements to this roadway. See appendix H for more on the VTrans study of Route 78. Their findings complement earlier work underscoring the importance and use of the refuge area by native peoples going back 8,000 years.

#### **Objective 5.1 Cultural Resource Conservation**

Protect all the known cultural and historical sites on the refuge (currently 34) in compliance with the Archaeological Resources Protection Act, the Native American Graves Protection & Repatriation Act, and the National Historic Preservation Act.

#### **Rationale**

More than 50,000 archaeological artifacts have been excavated from the refuge. The Service is interested in finding ways to make those artifacts more available for education and research. The Archaeological Resource Protection Act (ARPA) of 1979 reinforces the responsibility of federal land managers to safeguard cultural and historic resources on lands they administer. The refuge lacks a cultural resources overview and a comprehensive cultural resources management plan outlining strategies for protecting, interpreting, and investigating its cultural resources.

Given the shifting nature of the Missisquoi River and its tributaries and increased erosion, the likelihood of cultural resources being displaced and lost along the riverbanks is high. In addition, people may be collecting artifacts from eroding banks along the river, without documenting the sites or the artifacts. That issue extends beyond refuge boundaries, as residents are concerned about similar losses or disturbance of cultural resources in the Monument Road area across the river and upstream from the refuge.

In 2001, a landowner started building a new home on Monument Road. That portion of the road lies in the Town of Highgate, right next to the Missisquoi River, approximately a quarter-mile upstream of the refuge, in an area known to contain Native American cultural resources. The landowner had acquired the necessary permits from the local and state governments.

The excavation for the foundation unearthed what appeared to be Native American remains. A heated exchange quickly ensued between the landowner and representatives of the local Native American tribe, the Abenaki Nation of Missisquoi, who were present in anticipation of just such a happenstance. The landowner wished to continue construction after the removal of the remains, while the Abenaki Nation of Missisquoi desired a cease and desist action to retain the sanctity of a sacred site.

After receiving no assurance from the landowner or local authorities that construction would cease, the Abenaki Nation of Missisquoi chose to barricade Monument Road at its intersection with U.S. Route 7, approximately 1 mile distant from the excavation. Their action prevented access to the site by the contractor, and required anyone else attempting to pass onto Monument Road to prove the need to do so to the Abenaki Nation of Missisquoi. Local law enforcement officials are credited with carefully handling the sensitive incident: no arrests or citations followed.

After more discussions, the Abenaki Nation of Missisquoi removed their barricade after several days, and the landowner agreed to work with state and local officials to protect the site from further development. Similar sites

are known in the surrounding area, and the Abenaki Nation of Missisquoi sought protection for all of them, rather than having to react every time private landowners tried to develop their land.

One response to this conflict was to establish the Monument Road Working Group to seek a solution. The group initially included local representatives of the Swanton and Highgate governments, the Abenaki Nation of Missisquoi, the State Historic Preservation Office, the Natural Resources Conservation Service, affected landowners, and Senator Patrick Leahy's office. After the initial meeting, Senator Leahy's office asked the refuge manager to attend the meetings and work with the group to determine if it would be appropriate for the refuge to protect some of the sensitive areas and associated cultural resources, while at the same time accomplishing its objectives to protect wildlife and habitat.

Plans resulted to protect approximately 30 acres along Monument Road suspected of harboring cultural resources. The acquisition of that land by the refuge is underway. Additional lands with valuable habitat for migratory birds and Neotropical migratory birds that lie between the 30 acres and the existing refuge boundary are also slated for eventual acquisition and addition to the refuge.

Archaeological artifacts may yield information about the biological community on the refuge in the past. Given sufficient resources, existing archaeological samples could be evaluated for their potential to yield historical information on mussels, turtles, birds, and other wildlife. Therefore, these historical resources could eventually be linked to the refuge biological goals and objectives.

### **Strategies**

#### *Continue:*

- Conduct patrols at all known cultural and historical sites on a regular basis to inspect for and prevent illegal activity
- Continue and enhance communication and cooperation between the refuge manager and the local Abenaki Nation of Missisquoi tribe to share their knowledge of sites that have spiritual or historical importance to the Abenaki Nation of Missisquoi.
- Continue to serve on Monument Road Working Group to protect additional cultural resource sites

#### *Within 5 to 10 years of CCP approval:*

- Complete a cultural resources overview with subsurface survey and a comprehensive literature review of past archaeological, anthropological, and historical investigations within and near the refuge. Utilize the resources of the UVM library, the UVM Department of Archaeology, UMaine to compile the reference material
- Develop and implement a cultural resources management plan to protect identified cultural and historical sites in consultation with Service Archaeologists, the State Historic Preservation Office, Native American tribes, and the professional archeological community
- Train refuge field staff in the requirements of ARPA for implementing the Vermont Archaeological and Historical Resources Protection Protocol (Shattuck 1996).
- Establish a monitoring program to assess bank erosion along the Missisquoi River and document (including mapping) impacts to cultural resources

- Conduct law enforcement patrols at all known archeological sites and any new sites on the refuge
- Engage the Abenaki Nation of Missisquoi in assisting with monitoring some of the sensitive sites on the refuge with assistance from the Regional Office cultural resource staff to train monitors
- Evaluate the feasibility of examining existing unexpended archaeological samples for potential to yield information on past presence of various wildlife species on the refuge.

#### **Objective 5.2 Cultural Resource Interpretation**

Increase recognition and appreciation of the area's cultural heritage resources through education and interpretation at the Visitor Contact Station and with community partners, and by making cultural resources found on the refuge more available to researchers and educators.

#### **Rationale**

Four groups of peoples lived in Vermont prior to European arrival—Paleo-Indians, the Archaic, the Woodland, and the Abenaki Nation of Missisquoi. For thousands of years those native people relied on their surrounding environment for their survival: growing crops, hunting, fishing, and gathering fruits and nuts. The Abenaki Nation of Missisquoi were the people living in Vermont when the Europeans arrived around the year 1600. At that time, the Abenaki population in the Champlain Valley is estimated at 4,000 people. The western Abenaki continue as an important and active part of the Swanton community, home to the Abenaki Tribal Headquarters and Museum and the Missisquoi Refuge.

The new Visitor Contact Station includes an exhibit to promote an appreciation of the value of the cultural heritage resources of the Missisquoi region as a vital aspect of the area's economic and community life. The refuge and surrounding area have a rich human history dating back thousands of years. Pottery shards, arrowheads, and spear points unearthed by archaeologists on the refuge are evidence that indigenous people inhabited today's Missisquoi Refuge lands at least 6,800 years ago. As more archaeological artifacts are discovered and documented and more of the history and pre-history of the area is uncovered, the refuge will continue to update and expand its cultural exhibits.

#### **Strategies**

*Within 5 to 10 years of CCP approval:*

- Enhance cultural resources interpretive display at the Visitor Contact Station as new information becomes available
- Explore opportunities with the Abenaki Nation of Missisquoi in Swanton to lend artifacts found on the refuge to them for interpretation

### **GOAL 6. Foster cooperative partnerships and actions to promote fish and wildlife conservation in the Lake Champlain Basin and Missisquoi River Watershed.**

#### **Objective 6.1 Landscape-Scale Conservation**

Collaborate with conservation partners to advance landscape-scale or watershed-scale projects that benefit the Lake Champlain basin ecosystem and associated fish and wildlife species.

### Rationale

A wealth of local, regional, national, and international organizations and agencies are active in the Lake Champlain Basin. This underscores the breadth and complexity of management issues facing this region and the great interest among people to come together to solve problems and promote benefits. The management issues in the Missisquoi River Watershed and in the Lake Champlain Basin affect the fish, wildlife, and habitats of the Missisquoi Refuge as well and must be addressed in any refuge planning and management decisions.

The refuge is engaged in many partnerships and proposes to expand its collaborations to advance the conservation of fish and wildlife and their habitats. The Service's Lake Champlain Fish and Wildlife Resources Office in Essex Junction, Vermont is a key partner in conducting ecological surveys and monitoring on the refuge and in Missisquoi Bay. Refuge staff are participating in the Missisquoi River Watershed planning initiative, working to improve water quality of the river as it flows through the refuge.

DU is an international organization with projects in the U.S., Canada, and Mexico. Several refuge management issues require international cooperation such as hunting regulations, or management of species such as the spiny softshell turtle that lives in Missisquoi Bay on both side of the international boundary line. The refuge has benefited from DU's assistance with funding and expertise in creating the Stephen Young Marsh impoundment, replacing the Cranberry Pool water control structure, and rehabilitating the Goose Bay Dike.

### Strategies

*Continue:*

- Continue refuge participation in the USFWS Lake Champlain Ecosystem Team

*Within 1 year of CCP implementation:*

- With partners, conduct an analysis of lands along the shore of Lake Champlain and adjacent to the refuge to determine the value for Service trust resources, the need for protection, and the proposed level of Service involvement in a future protection effort. Prepare a Conservation Proposal for consideration by the Director.
- If the Conservation Proposal is approved, develop (with partners) a land protection plan and environmental assessment to propose the level of Service involvement to insure the long term protection of lands in the Lake Champlain Basin near the refuge, that provide outstanding habitats for federal trust resources.
- If the land protection plan and EA propose Service acquisition and are approved, work collaboratively with partners to implement the land protection plan by supporting projects, building public support, providing funding from both the LWCF and the MBCF, and identifying alternative funding sources.

*Within 5 years of CCP implementation:*

- Strengthen partnership (staffing, funding, expertise) between Missisquoi Refuge and the Lake Champlain Fish and Wildlife Resources Office to enhance outreach within the northern Vermont Lake Champlain region
- Utilize the collective knowledge from the Lake Champlain Ecosystem Team, Lake Champlain Basin Program, BCR North American Waterfowl Management Program (NAWMP), and other partners to identify land protection needs in the Lake Champlain Basin

- Work with partners to identify high-priority areas in the watershed and utilize the USFWS Partners for Fish and Wildlife program and other initiatives to contact and work with landowners willing to restore habitats and prevent or minimize runoff and degradation on their lands to protect the Missisquoi River Delta and the Lake Champlain Basin
- Enhance work with partners to foster international cooperation for resource protection

*Within 10 years of CCP implementation:*

Work with partners (Missisquoi River Basin Association, Friends of Missisquoi River, and others) and the Missisquoi River Watershed Planning initiative to identify specific areas in the watershed that contribute heavy sediment and phosphorus loads and work to reduce sedimentation and phosphorus loading into Missisquoi Bay.

## Implementation, Monitoring, and Revision

### Refuge Funding Needs

Successful implementation of the CCP relies on our ability to secure funding, personnel, infrastructure, and other resources to accomplish the actions identified. CCP's detail certain levels of program planning that are sometimes substantially above our current budget allocations and, as such, are primarily for Service strategic planning and program prioritization purposes. The plans do not constitute a commitment for staffing increases, operational and maintenance increases, or funding for future land acquisition. The recommended projects and their recurring costs, such as staff salaries, are listed and prioritized in the Refuge Operations Needs Systems (RONS) database (appendix I). We also identify new projects that we will include in the RONS database with the next annual update. Also, in that appendix, maintenance and equipment needs are prioritized in the Service Asset Maintenance Management System Database (SAMMS). The source of funding for those projects and salaries primarily comes from Refuge Operations dollars.

We will seek funds for refuge public use, parking lots, bridges, restrooms, and trails from the Refuge Roads Program (RRP), a Federal Lands Highway Program that Congress funded through the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) (P.L. 109-59; 119 STAT. 1144). Those funds can also be used for interpretive enhancements associated with the projects, as long as the costs for the interpretive facilities do not exceed 5 percent of the project budget. RRP funds can be used as the non-federal match for FHA funds available through state departments of transportation. Refuges can use appropriated Service funds as the non-federal match for those funds, as well. That matching ability can be used to further city, county, and state transportation and transit funds for projects that benefit the refuge.

### Staffing the Refuge

We will always ensure that visitors have a safe visit, engage in approved, compatible activities, and understand and adhere to refuge regulations. To accomplish that includes maintaining refuge boundary signs and continuing to make visitor contacts and conduct outreach and law enforcement. If RONS funding is not available, we will continue to seek alternate means of accomplishing our projects: for example, through volunteers, challenge cost share grants or other partnership grants, and interns.

**Monitoring and Evaluation** Monitoring and evaluating the implementation of this CCP will occur at two levels. The first level, which we refer to as implementation monitoring, responds to the question, “Did we do what we said we would do, when we said we would do it?”

The second level of monitoring, which we refer to as effectiveness monitoring, responds to the question, “Are actions we proposed effective in achieving the results we had hoped for?” Or, in other words, “Are the actions leading us toward our vision, goals, and objectives?” Effectiveness monitoring evaluates an individual action, a suite of actions, or an entire resource program. This approach is more analytical in evaluating management effects on species, populations, habitats, refuge visitors, ecosystem integrity, or the socioeconomic environment. More often, the criteria to monitor and evaluate these management effects will be established in step-down, individual project, or cooperator plans, or through the research program. The Inventory and Monitoring Plan will be based on the needs and priorities identified in the HMP.

**Adaptive Management** Adaptive management strategies keep the CCP relevant and current through scientific research and management. We acknowledge that our information on species and ecosystems is incomplete, provisional, and subject to change as our knowledge base improves. The need for adaptive management is all the more compelling today.

“The earth’s ecosystems are being modified in new ways and at faster rates than at any other time in their nearly 4 billion year history. These new and rapid changes present significant challenges to our ability to predict the inherently uncertain responses and behaviors of ecosystems.” (Christensen, et al. 1996)

Climate plays a significant role in the geographic distribution of ecosystems and wildlife, and most scientists agree that global climate change is already affecting some ecosystems. “Global temperatures increased by over 1°F in the past century and are projected to increase 2.5–10.4°F by 2100 as a result of human emissions of greenhouse gases” (Parmesan and Galbraith 2004). Some recent shifts in wildlife populations are attributed to changing climate conditions, and those impacts are projected to increase. Changes in temperature and precipitation will affect biological diversity, including national wildlife refuges, and challenge land managers.

Our objectives and strategies must be adaptable in responding to new information and spatial and temporal changes. We will continually evaluate our management actions, both formally and informally, through monitoring or research, to reconsider whether their original assumptions and predictions are still valid. In that way, management becomes an active process of learning what really works. Public understanding and appreciation of the adaptive nature of natural resource management is most important, especially in light of the potential large-scale impacts of global climate change. The refuge manager is responsible for changing management actions if they do not produce the desired conditions. Significant changes may warrant additional NEPA analysis. Minor changes will not, but we will document them in annual monitoring or project evaluation reports or in our Annual Narrative Report.

**Plan Amendment and Revision** The CCP for Missisquoi Refuge is meant to provide guidance to refuge managers and staff over the next 15 years. Periodic review of the CCP will be required

to ensure that objectives are being met and management actions are being implemented. Ongoing monitoring and evaluation will be an important part of this process. The results of that monitoring or new information may indicate the need to change our strategies. Likewise, many of the strategies are dependent upon Service funding for staff and projects. Revisions will be necessary if significant new information becomes available, ecological conditions change, major Refuge expansions occur, or we identify the need to do so during a program review. At a minimum, the CCP will be fully revised every 15 years. We will modify the CCP documents and associated management activities as needed; following the procedures outlined in Service policy and NEPA requirements. Minor revisions that meet the criteria for categorical exclusions (550 FW 3.3 C) will require only an environmental action memorandum.