Chapter 3: The Refuge Environment and Management

Introduction

Swan Lake NWR includes more than 11,000 acres of bottomland forest, grasslands, wetlands, and open water within Chariton County in northcentral Missouri. Management responsibilities also include 57 smaller parcels totaling more than 2,000 acres scattered across 15 Missouri counties.

Ecological Context

Hydrologic Units, Watersheds, and Ecoregions

In the 1990s the Service adopted an ecosystem approach to management. This shift demanded a spatial framework, some type of mapped unit, which could be identified as an ecosystem. The Service chose to define its ecosystems based largely on hydrologic units as mapped by the U.S. Geological Service (USFWS, 1995). The U.S. Fish and Wildlife Service referred to these hydrologic units as watersheds although the definitions and application of the two terms are different. A watershed is an area delineated by topography such that all surface drainage within the area converges to a single point, usually the point where the collected waters leave the watershed. The hydrologic units that form the basis of the Service's ecosystem units in many cases do not follow the same boundaries as topographic watersheds.

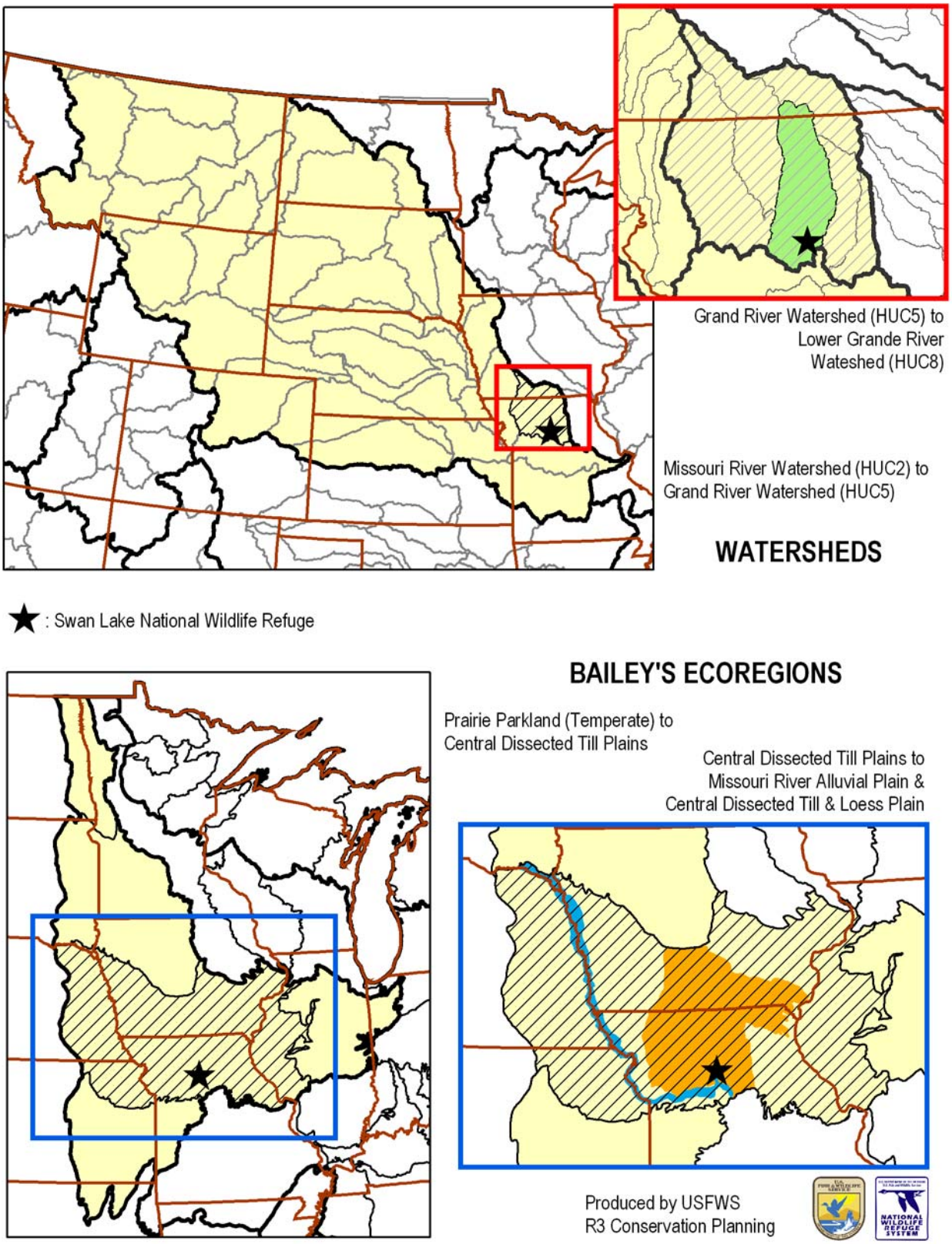
The Service's 53 ecosystem units each typically cover thousands of square miles. However, the hydrologic units, or watersheds as they have come to be known, form a nested hierarchy meaning that smaller watersheds combine to form larger watersheds. Working from a narrow to a broad extent, the Refuge is within the Lower Grand River Watershed which is within the Grand River Watershed which is within the Lower Missouri River Watershed, which the Service recognizes as the Lower Missouri River Ecosystem.

Ecoregions are a different concept also used as a basis for describing ecosystems. Ecoregion boundaries are based on a number of components including climate, geology, physiography, soils, and land cover. The intent of ecoregions is to depict areas within which the mosaic of these components is different than that of adjacent areas. An interagency effort derived a common set of ecological units for Missouri based on the National Hierarchical Framework of Ecological Units (Cleland et al. 1997). Ecoregion boundaries do not coincide with watershed boundaries, but like watersheds ecoregions occur within a nested hierarchy. Working from a narrow to a broad extent, the Refuge is within the Missouri-Grand River Alluvial Plain Land Type Association which is within the Missouri River Alluvial Plain Subsection which is in the Central Dissected Till Plains Section.

Great Egret at Swan Lake NWR. Photo credit: USFWS

Watershed boundaries are helpful in determining the source of surface water flowing into the Refuge and assessing factors that affect water quantity and quality. Ecoregion boundaries are helpful in discovering relationships with other areas that have similar habitats and other features (see Figure 2 on page 10).

Figure 2: Watersheds and Habitats, Swan Lake NWR



Historic Vegetation

The following description of historic vegetation within the Grand River watershed is excerpted from the Grand River Inventory and Assessment (MDC undated).

> The presettlement Grand River Watershed was characterized by long narrow prairies generally oriented north-south and divided by timbered ridge tops and stream valleys (Schroeder 1982). Only in the southwest part of the basin did prairies open up to wide expanses averaging 1 or 2 miles across.
>
> Schroeder (1982) describes the riparian areas common to the watershed:
>
> "In addition to the upland prairies, bottomland prairies occurred regularly on the flood plains of streams, sometimes becoming so extensive that timber was restricted to the river bank and rougher valley slopes.
>
> "Large areas of the broad flood plains of streams in the Grand-Chariton region supported a `luxuriant growth of coarse wild grass' (Watkins et al. 1921). Sometimes these wet prairies occupied the entire bottomland, except for a timber strip fringing the banks of streams. Clay or gumbo soils prevented good drainage, and marshes and ponds abounded.
>
> "Survey notes reveal a complex pattern of small lakes or ponds, wet prairie, intensively meandering creeks with and without river bank timber, and dense timber only along the Grand River channel in northwest Chariton County in what is now the Swan Lake area. There was nothing but wet prairie at the present Swan Lake site."

Land Use/Cover

The Grand River Watershed extends across more than 5 million acres and was once covered by a mosaic of prairies and forests. Extensive land use conversion over the past century produced the current landscape dominated by agriculture. Table 1 on page 12 shows the distribution of current land cover as well as the potential natural vegetation based on county soil survey data for the Grand River Watershed and several of its sub-basins.

Migratory Bird Conservation Initiatives

Several migratory bird conservation plans have been published over the last decade that can be used to help guide management decisions on refuges. Bird conservation planning efforts have evolved from a largely local, site-based orientation to a more regional, even inter-continental, landscape-oriented perspective. Several transnational migratory bird conservation initiatives have emerged to help guide the planning and implementation process. The regional plans relevant to Swan Lake NWR are:

- Partners in Flight Bird Conservation Plan – Dissected Till Plains
- Upper Mississippi River and Great Lakes Region Joint Venture of the North American Waterfowl Management Plan
- The Upper Mississippi Valley/Great Lakes Regional Shorebird Conservation Plan
- The Upper Mississippi Valley/Great Lakes Regional Waterbird Conservation Plan

Each of the bird conservation initiatives has a process for designating priority species, modeled to a large extent on the Partners in Flight method of computing scores based on independent assessments of global relative abundance, breeding and wintering distribution, and vulnerability to threats, area importance, and population trends. These scores are often used by agencies in developing lists of priority bird species. The Service based its 2001 list of Non-game Birds of Conservation Concern primarily on the Partners in Flight shorebird and waterbird status assessment scores.

Missouri Comprehensive Wildlife Strategy

Congress asked each state to develop a comprehensive wildlife strategy or, as they have become known, wildlife action plan. These plans examine the health of wildlife and prescribe actions to conserve wildlife and vital habitat before they become more rare and more costly to protect. Using wildlife information gathered over the past 30 years, Missouri's comprehensive wildlife strategy promotes management and benefits all wildlife, rather than targeting single species. The strategy identifies 33 Conservation Opportunity Areas in which management strategies will conserve both wildlife populations and the natural systems on which they depend. For each Conservation Opportunity Area, a team of partners developed a common vision of issues and actions. Swan Lake NWR is part of the Lower Grand River Conservation Opportunity Area, which also includes Fountain Grove Conservation Area, Yellow Creek Conservation Area, Little Compton Lake Conservation Area, Floyd Memorial Conservation Area, Sumner Access, and Pershing State Park. This network of lands and partners is working to fulfill the following strategies:

- Restore riverine habitat abundance and diversity for native plants and animals.
- Restore bottomland forests and woodlands to provide habitat for native plants and animals, with emphasis on species of conservation concern.

Table 1: Current Land Cover and Potential Natural Vegetation in Grand River Watershed and Sub-basins

Potential Natural Vegetation	Current Land Cover	Grand River Watershed	Lower Grand River Watershed	Yellow Creek Watershed	Turkey Creek Watershed
Prairie	Pasture/Hay	1,479,521			
Prairie	Cropland	1,148,901			
Forest	Pasture/Hay	891,699			
Forest	Forest	402,278			
Forest	Wetland	347,450			
Forest	Cropland	215,917			
Forest	Pasture/Hay		459,825		
Prairie	Pasture/Hay		278,183		
Prairie	Cropland		268,057		
Forest	Forest		142,800		
Forest	Cropland		111,289		
Forest	Pasture/Hay			152,029	
Forest	Forest			31,593	
Prairie	Pasture/Hay			20,330	
Prairie	Cropland			19,794	
Forest	Cropland			17,542	
Prairie	Cropland				21,572
Prairie	Pasture/Hay				11,867
Forest	Pasture/Hay				11,401
Forest	Cropland				5,023
Prairie	Wetland				2,433

- Manage wetlands and wet prairie habitats to benefit resident and migratory wildlife.
- Expand wet prairie habitat to allow the connection of eastern massasauga populations at Pershig State Park and Swan Lake NWR.
- Control populations of problematic exotic and invasive plants.
- Educate landowners about the importance of conservation practice.

Region 3 Fish and Wildlife Conservation Priorities

Every species is important; however the number of species in need of attention exceeds the resources of the Service. To focus effort effectively, Region 3 of the Fish and Wildlife Service compiled a list of Resource Conservation Priorities. The list includes:

- All federally listed threatened and endangered species and proposed and candidate species that occur in the Region.
- Migratory bird species derived from Service wide and international conservation planning efforts.
- Rare and declining terrestrial and aquatic plants and animals that represent an abbreviation of the Endangered Species program's preliminary draft "Species of Concern" list for the Region.

Appendix D lists Regional Resource Conservation Priority species relevant to the Refuge.

Swan Lake NWR. Photo credit: USFWS

Other Conservation and Recreation Lands in the Area

The state of Missouri and other federal agencies own and manage lands and recreation access sites within a 50-mile radius of the Refuge (Figure 3 on page 14). There are more than 100 state areas that include public access sites, fish and wildlife areas, including recreation areas, forests, historic sites, and nature preserves. The federal areas include several units of the Big Muddy National Fish and Wildlife Refuge along the Missouri River. Local governments also own and manage community parks in the area. Conservation easements and lands enrolled in the Natural Resources Conservation Service's Wetland Reserve Program contribute thousands of acres to long-term conservation efforts.

Socioeconomic Context

Swan Lake NWR is located in Chariton County. The county is less racially and ethnically diverse than the state of Missouri as a whole. The population in the county has a lower average income and a lower percentage of high school and college graduates than the state's population as a whole.

Population and Demographics

Based on U.S. Census Bureau data, the population estimate for Chariton County was 8,046 in 2006. The population decreased 4.6 percent from 2000 while the population of the state grew 4.4 percent during the same period. The county population was 95.9 percent white in 2006; the state population was 85.1 percent white. In Missouri, 5.1 percent of the people 5 years and older speak a language other than English at home; in Chariton County it is 2.2 percent. The county population is projected to be 6,492 in 2025, a 19.3 percent decrease from 2006. The largest community in Chariton County is Salisbury with a 2006 population of 1,614.

Employment

There were 5,073 jobs in Chariton County in 2006. Farm employment accounted for more than 24.3 percent of the total jobs. Retail trade, local government, and construction are also notable sectors.

Income and Education

Per-capita income in the county was $24,701 in 2005; in Missouri it was $31,231. The median household income in 2004 was $34,315; for Missouri $40,885. In Chariton County, 11.4 percent of persons over 25 years of age hold a bachelor's degree or higher; in Missouri 21.6 percent of persons older than 25 years hold a bachelor's degree or higher.

Demand and Supply for Wildlife-Dependent Recreation

In order to estimate the potential market for visitors to the Refuge, we looked at 2007 consumer behavior data within approximately 30, 60, and 90 mile drives of the Refuge. The data were organized by zip code areas. We used the three driving distances because we thought this was an approximation of reasonable maximum drives to the Refuge for an outing by different groups. From experience we know, for example, that visitors come from the nearby local area to view wildlife in the evening. We also know that people seeking interesting varieties of bird species drive from all over Missouri and eastern Kansas and western Illinois to visit the Refuge. The 30-mile area extended beyond the communities of Chillicothe, Brookfield, and Carrollton. The 60-mile area included Cameron, Trenton, Kirkville, Moberly, Boonville, Lexington and a number of other communities. The 90-mile area included the Kansas City metropolitan area, Columbia, and Jefferson City.

The consumer behavior data that we used in the analysis is derived from Mediamark Research Inc. data. The company collects and analyzes data on consumer demographics, product and brand usage, and exposure to all forms of advertising media. The consumer behavior data were projected by Tetrad Computer Applications Inc. to new populations using Mosaic data. Mosaic is a methodology that classifies neighborhoods into segments based on their demographic and socioeconomic composition. The basic assumption in the analysis is that people in demographically similar neighborhoods will tend to have similar consumption, ownership, and lifestyle preferences. Because of the assumptions made in the analysis, the data should be considered as relative indicators of potential, not actual participation.

Figure 3: Conservation Lands in the Area of Swan Lake NWR

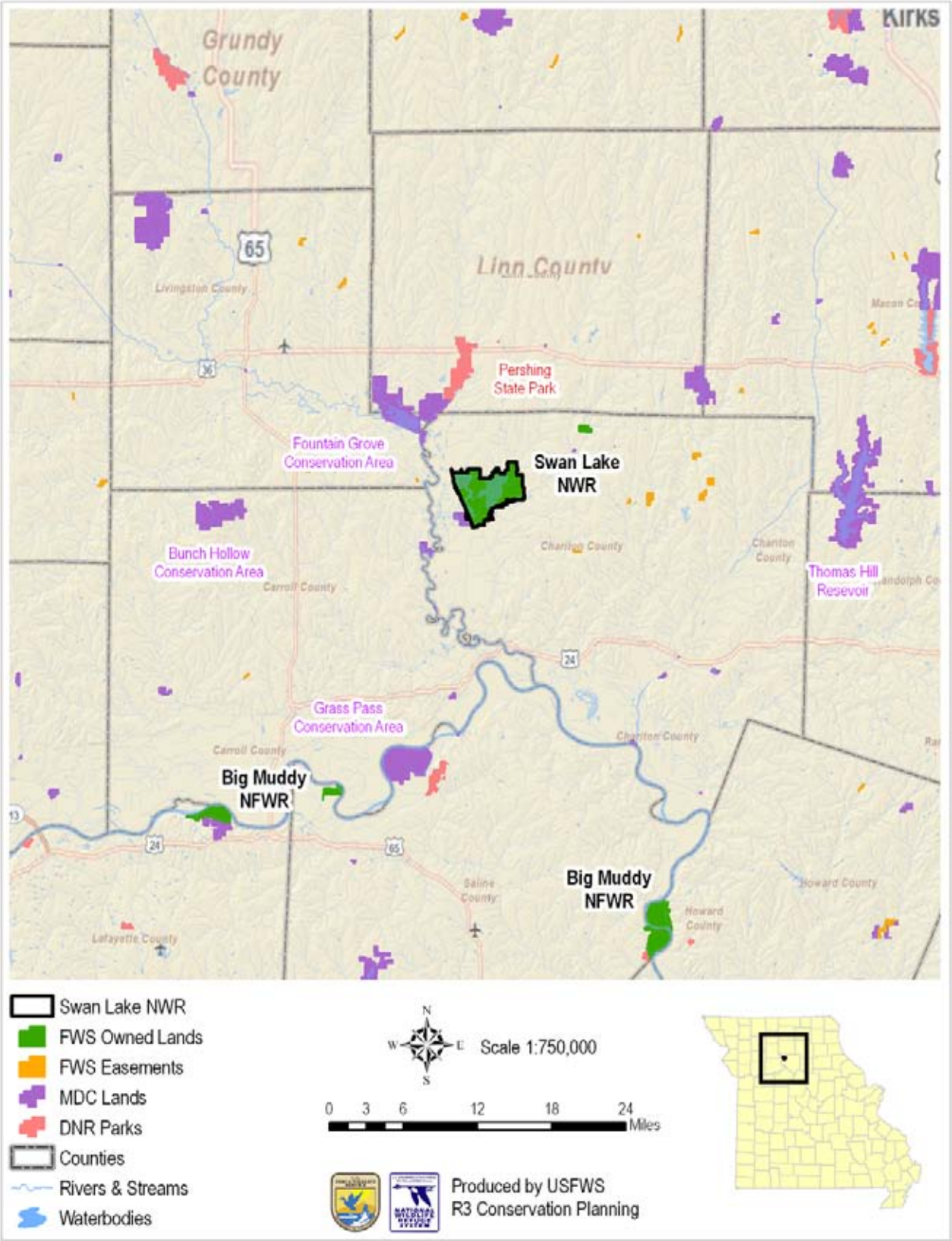


Table 2: Maximum Adult Audiences Within 30, 60, and 90 Miles of Swan Lake NWR for Four Activities

Approximate Driving Distance to Refuge	Total Population	Birdwatching	Fishing	Hunting with shotgun	Contribute to environmental organization
30 miles	108,198	5,143	18,014	5,798	5,009
60 miles	535,531	26,933	84,471	26,939	15,691
90 miles	2,444,707	112,026	331,819	93,772	43,064

We looked at potential participants in birdwatching, fishing, and hunting with shotgun. In order to estimate the general environmental orientation of the population, we also looked at the number of people who might contribute to an environmental organization.

The consumer behavior data apply to persons more than 18 years old. Table 2 displays the consumer behavior numbers for each of the three distances to the Refuge. The projections represent the maximum audience that we might expect to make a trip to the Refuge for approximate drives of half-hour, 1 hour, and 1 and a half hours. Actual visitors will be fewer because the estimate is a maximum, and we expect only a fraction of these people will travel to the Refuge.

We also considered the maximum number of students that might potentially participate in environmental education offered by the Refuge by looking at the school populations in Chariton County and in neighboring Carroll, Livingston, and Linn Counties. For Chariton County the school enrollment in preschool through grade 12 was 1,729 according to the 2000 census. For Carroll, Livingston, and Linn Counties the equivalent enrollments were 2,099, 2,961, and 2,852 respectively. The projected school age (5-19) population for the four counties for 2030 is 7,756.

Climate

The climate of north-central Missouri is characterized by hot, humid summers and mild winters. Spring weather is turbulent and thunderstorms and tornados are fairly common. Average monthly temperatures range from 15 degrees Fahrenheit in January to 80 degrees Fahrenheit in July. Average annual precipitation is 38.27 inches, with the heaviest amounts usually occurring during the months of May, June, and September.

Geology and Soils

The Refuge lies in the glacial till plain of north-central Missouri. Underlying bedrock is primarily shale and coal with occasional limestone. The topography is relatively flat with elevations ranging from 653.91 feet to 741.56 feet.

Soil types of the Refuge are listed in Table 3 on page 16.

Water and Hydrology

The Refuge presently contains three major impoundments containing a combined total of about 4,300 acres and many smaller moist soil units. The largest impoundment, Silver Lake, contains 2,387 acres at full pool and is fed by a drainage area of 110 square miles (70 square miles from Turkey Creek plus 40 square miles from Elk Creek, see Figure 4 on page 17). Silver Lake waters can be drained to South Pool, Swan Lake, or other moist soil units on the Refuge. Additional local drainage adds 13 square miles to the drainage area of South Pool (918 acres at full pool) and approximately 5 square miles to the drainage of Swan Lake (987 acres at full pool).

Flooding is a frequent occurrence at many locations within the Grand River Watershed. The Refuge is subject to flooding from local intermittent streams, the Grand River, and Yellow Creek. Two broad factors affect flood intensity and duration within any watershed: precipitation characteristics and the physical characteristics of the basin or watershed. Precipitation characteristics describe the supply of water to a basin and include the amount, duration, intensity, and distribution. The watershed shape, topography, and soils are determined by geologic factors and are in many cases literally set in stone. Land use is the primary basin characteristic controlled by humans. Modifications to the landscape by practices such as deforestation, mining, and farming, as well as structures such as dams, levees, bridges, channels, and pavement all affect runoff and flooding. There are many such modifications within the Grand River Watershed that both speed and impede surface runoff. All of these factors interact and contribute to flood frequency and duration within the watershed (see Figure 5 on page 18).

Two modifications that are prevalent are channelization and levee construction. Channelization

Table 3: Swan Lake NWR Soil Types by Acreage

Soil Type	Acreage	Percent
Carlow silty clay, 0 to 2 percent slopes, rarely flooded	0	0.0%
Shannondale silt loam, 0 to 2 percent slopes	10	0.1%
Zook silty clay loam, 0 to 2 percent slopes, occasionally flooded	10	0.1%
Gifford silty clay loam, 2 to 9 percent slopes, eroded, rarely flooded	35	0.3%
Grundy silt loam, 2 to 5 percent slopes	38	0.3%
Speed silt loam, 0 to 2 percent slopes, occasionally flooded	151	1.4%
Lagonda silt loam, 2 to 5 percent slopes, eroded	168	1.5%
Blackoar silt loam, 0 to 2 percent slopes, occasionally flooded	217	2.0%
Triplett silt loam, 0 to 2 percent slopes, rarely flooded	367	3.3%
Dockery silt loam, 0 to 2 percent slopes, frequently flooded	419	3.8%
Tice silt loam, 0 to 2 percent slopes, frequently flooded	440	4.0%
Tina silt loam, 0 to 2 percent slopes, rarely flooded	797	7.2%
Carlow silty clay, 0 to 2 percent slopes, occasionally flooded	1125	10.2%
Water	3137	28.5%
Tuskeego silty clay loam, 0 to 2 percent slopes, occasionally flooded	4110	37.3%
	11,025	100.0%

includes straightening natural stream meanders, clearing the banks, and widening and deepening the channel (Funk and Ruhr 1971). This results in a loss of stream habitat, increased bank erosion, and lower ground water levels (Funk and Ruhr 1971). Levee construction separates the stream from its floodplain. Flood water can no longer spread out and is concentrated within the channel, causing further streambank erosion. Many landowners consider channelization and levee construction legitimate stream management practices. Several streams within the basin have been channelized for over one-half their length. A substantial portion of the streams in the basin are confined by levees.

Refuge Habitats and Wildlife

All wildlife requires some combination of food, water, cover, and space. Together these elements are commonly referred to as habitat. Cover types, also referred to as habitat types, are one method of describing habitat. Cover types are discrete areas delineated by differences in dominant vegetative cover. Although cover typing does not fully describe all of the components of habitat it is a useful concept to assist in management. Cover types are derived from aerial photographs that show the variation of Refuge habitats. The boundaries of each cover type are digitally outlined forming a mosaic of polygons that are individually labeled. The resulting map seen in Figure 6 on page 19 depicts the existing cover types found on the Refuge.

The cover types shown in Figure 6 were developed based on the National Vegetation Classification System (NVCS), the Federal Standard for vegetative classification. A number of the NVCS categories were combined to form the eight cover types depicted.

Bottomland Forest

There are more than 3,100 acres of bottomland forest on the Refuge with the largest contiguous block found within the Research Natural Area along Yellow Creek. This cover type consists of bottomland closed-canopy hardwood forest generally occurring on wet soil and in floodplains. It is dominated by pin oak, silver maple, swamp white oak, and shagbark hickory with green ash, elm, black willow, river birch, and honey locust. The understory varies from open areas dominated with sedges and woodland forbs to denser areas with a shrub layer composed of Missouri gooseberry (*Ribes missouriense*), Western snowberry (*Symphoricarpos occidentalis*), and common pricklyash (*Zanthoxylum americanum*). These areas are subject to seasonal flooding.

Figure 4: Lower Grand River Watershed, Swan Lake NWR

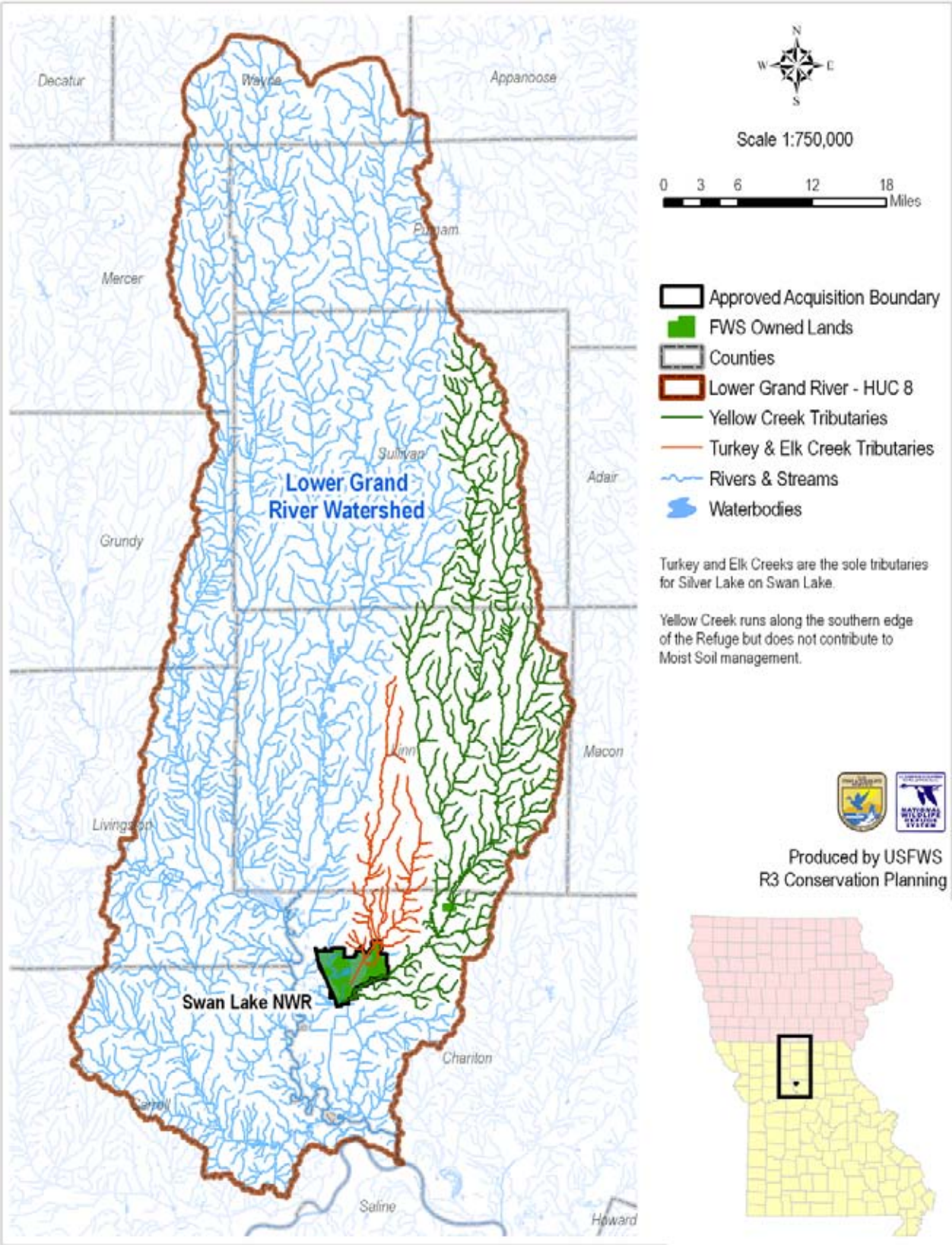


Figure 5: Watershed Comparison, Swan Lake NWR

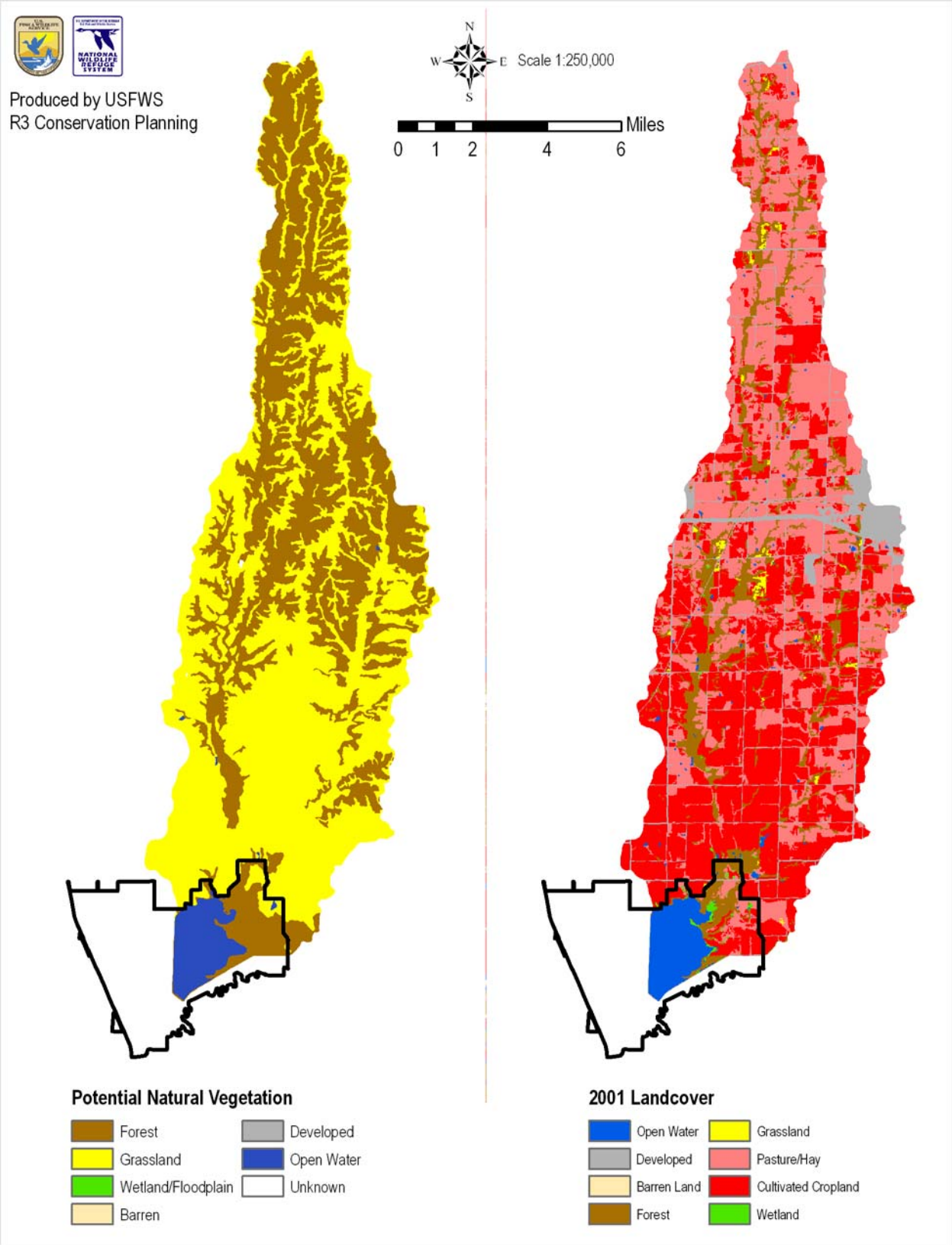
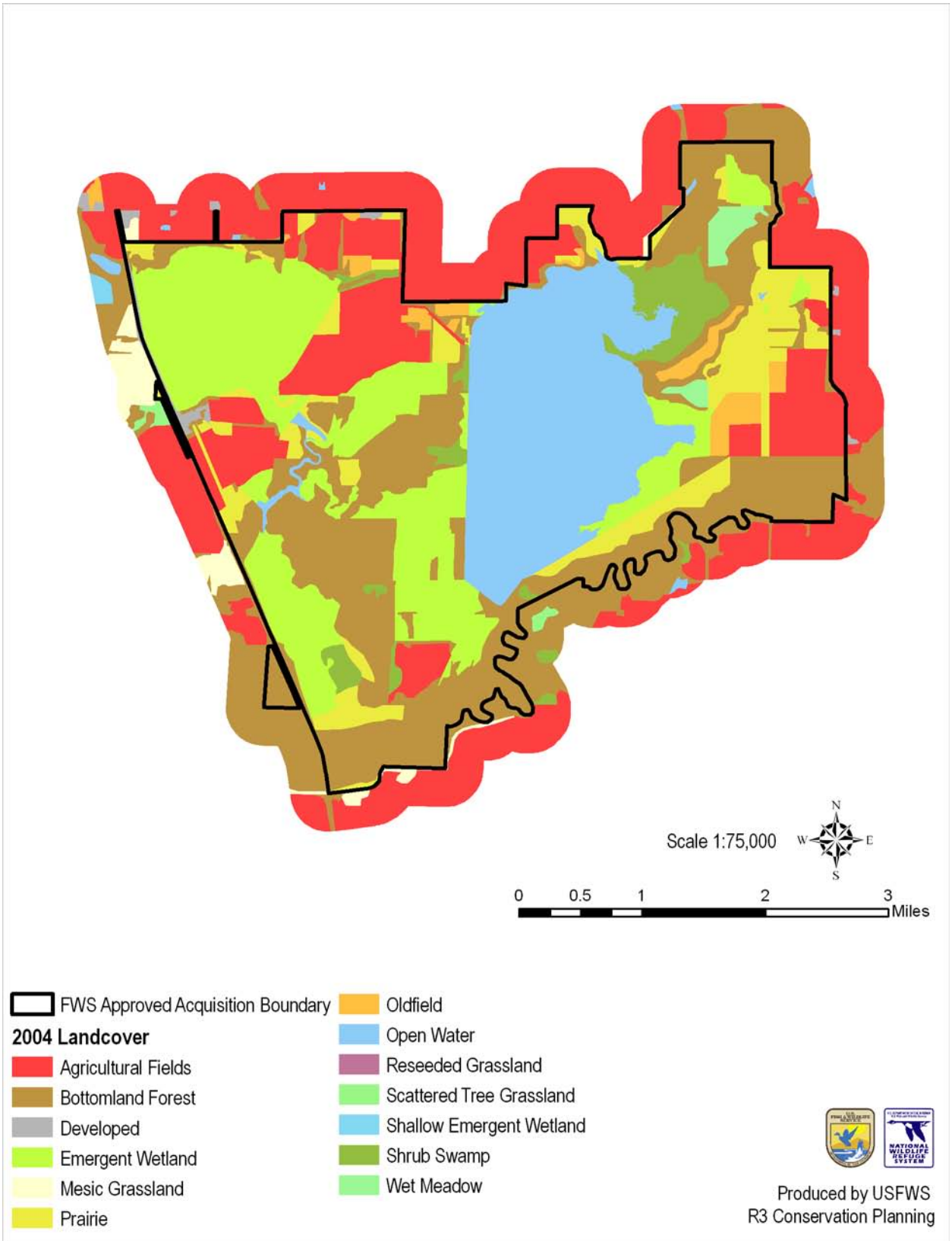


Figure 6: Current Land Cover, Swan Lake NWR



Emergent Wetland

There are over 2,000 acres of emergent wetland habitat on the Refuge. Emergent wetlands, commonly referred to as marshes and sloughs, are characterized by erect, rooted water plants that are present for most of the growing season in most years. These wetlands normally contain standing water, though at times they will dry up. Common perennial plants found in emergent wetlands include cattail, bulrushes, arrowheads, and sedges. Presently more than 800 acres of this habitat are managed using moist soil practices in which water levels are manipulated to create optimum wetland habitat conditions for migratory birds.

Open Water

Silver Lake contains nearly all of the more than 2,100 acres of open water on the Refuge. This cover type is defined as having less than 4 percent visible vegetation, which is either floating or submerged.

Agricultural Fields

There are 1,365 acres of agricultural fields on the Refuge. These are cultivated areas that consist of a variety of grasses and forbs or row crops such as wheat, corn or annual/perennial mixtures mowed for hay. Some of these areas are subject to occasional flooding.

Native Prairie

The Refuge contains approximately 1,000 acres of native prairie. These areas were either rarely or never cultivated in the past. Flooding and surface water is often present during much of the year. Native prairie sites are grassy fields dominated by reed canary grass, sedges and native grasses with a small number of scattered shrubs and small trees.

Wet Meadow

Wet meadow habitat occurs on about 110 acres of the Refuge. It is a type of wetland that commonly occurs in poorly drained areas such as shallow lake basins, low-lying farmland, and the land between shallow marshes and upland areas. Wet meadows often resemble grasslands, but are typically drier than other marshes except during periods of seasonal high water. For most of the year wet meadows are without standing water, though the high water table allows the soil to remain saturated. A variety of water-loving grasses, sedges, rushes, and wetland wildflowers proliferate in the highly fertile soil of wet meadows.

Shrub Swamp

There are approximately 410 acres of shrub swamp habitat on the Refuge, most of which occurs along the perimeter of open water and emergent wetland habitats. Shrub swamp is dominated by deciduous woody vegetation less than 20 feet in height. Dominant species are mostly buttonbush *(Cephalanthus occidentalis)* and willow *Salix* spp. with an underlying mix of sedges and grasses and/or emergent vegetation, depending on water depth. The shrub layer varies from mostly open (25 percent) to closed (80 percent) and may contain scattered trees.

Old Field

The 240 acres of old field habitat occurs on disturbed soils and is dominated by reed canary, smooth brome, quack grass and weedy herbaceous species. These areas are usually drier than those of wet meadow habitat and were once regularly cultivated for crops but now are left fallow. They are subject to occasional flooding.

Wildlife

Birds

A variety of birds are year-around residents of Swan Lake NWR, including many waterfowl. During the spring and fall migrations, there is a great diversity of migrants due to its location between two major migratory bird corridors, the Central Flyway and the Mississippi Flyway. It is not uncommon for the Refuge to host up to 100,000 ducks, comprised mostly of dabblers, during the fall migration. The Eastern Prairie Population (EPP) of Canada Geese used Swan Lake NWR as their main wintering grounds until the late 1980s. In recent years winter distribution of the EPP flock has shifted farther north, but thousands of geese still winter on the Refuge. Wintering waterfowl also attract Bald Eagles. The Refuge also provides habitat for thousands of migratory shorebirds and is designated as a regionally important site under the Western Hemisphere Shorebird Reserve Network. The shallow water wetlands and moist soil units on the Refuge provide critical habitat for many species of waterfowl, shore birds, and marsh birds while the grasslands, forested wetlands, and farmland provide habitat for a variety of passerine birds. A complete list of bird species and a general guide to their seasonal occurrence and status on the Refuge can be found in Appendix C.

Mammals

There are 46 mammals documented as occurring on the Refuge. The mammals include the federally listed endangered Indiana bat as well as the white-tailed deer, a species popular for hunting and wildlife viewing. The presence of a reproductively active female Indiana bat was documented in 2003. The bats appear to be finding summer roosts within the

Eastern massasauga rattlesnake. Photo credit: USFWS

bottomland forest of the Yellow Creek Research Natural Area. Seven mammal species: plains pocket gopher, Franklin's ground squirrel, Eastern chipmunk, hispid cotton rat, Norway rat, Eastern spotted skunk, and gray fox are known to have occurred but have not been documented in recent years. A complete list of mammal species that occur on the Refuge can be found in Appendix C.

Amphibians and Reptiles

A variety of salamanders, toads, turtles, lizards, frogs, and snakes inhabit the Refuge including the eastern massasauga rattlesnake, a candidate for listing under the Endangered Species Act. Candidate species are plants and animals for which the U.S. Fish and Wildlife Service has sufficient information on their biological status and threats to propose them as endangered or threatened under the Endangered Species Act, but for which development of a proposed listing regulation is precluded by other higher priority listing activities. Swan Lake NWR is one of only three sites left in the state of Missouri where the rattlesnakes are known to be present.

Fish and Other Aquatic Species

A 2007 fisheries survey of Silver Lake found 15 species including white crappie, freshwater drum, flathead catfish, and shortnose gar. Flood events dramatically affect the number and composition of the Silver Lake fishery. An earlier survey of Silver Lake conducted in 1996 identifed 16 fish species, but only 9 of these were reported again in the 2007 survey. No fisheries surveys have been conducted on other Refuge waters.

Eleven mussel species have been documented within Refuge waters including the Flat Floater (*Anodonta suborbiculata*), a species listed as imperiled within Missouri.

Invertebrates

No comprehensive survey of invertebrates has been completed on the Refuge, but 20 species of butterflies and 24 species of dragonflies are documented as occuring on the Refuge. A list of these species is included in Appendix C.

Threatened and Endangered Species

State-listed Species

A number of species of concern within the state of Missouri are documented within the Refuge including: Least Bittern, Sora, Common Moorhen, and Franklin's ground squirrel.

Federally Listed Threatened/Endangered/Candidate Species

Presently, two species listed as federally endangered, Interior Least Tern and Indiana bat, have been documented as occurring on the Refuge. The Interior Least Tern uses the Refuge as migratory stop-over habitat and the Indiana bat uses the bottomland hardwoods of the Yellow Creek Research Natural Area as breeding habitat. The Refuge is also one of the few places where the eastern massasauga rattlesnake, a candidate for federal listing, is known to occur.

Threats to Resources

Invasive Species

Exotic/Pest Species

Some exotic (also known as non-native or alien) plants greatly alter the plant communities of natural areas while others more commonly affect already disturbed or agricultural areas. Left unchecked, noxious plant species can seriously degrade the productivity and wildlife value of invaded habitats.

Fortunately, most Refuge wetlands are relatively free of noxious plants. Those in the area possessing the greatest potential for serious impacts include reed canary grass. Monitoring will be necessary to assure prompt action is taken to control these plants before they become a problem in the future.

On upland sites and agricultural communities, the most troublesome noxious plant is *Sericia Lespedeza*. Owing to its hardiness, growth and reproductive mechanisms, this introduced species is difficult to control and located in various areas of the Refuge. Currently little is known of what areas are infested, monitoring will need to be completed to determine the extent of infestation on the Refuge.

Siltation

With its 7,900-square-mile watershed extending into Iowa, the Grand River has been a constant source of floodwater and debris entering Swan Lake NWR. Hundreds of levees have increased velocity and frequency of flooding, impacting Refuge water management, facilities, and habitat. This alteration of hydrology is of major concern.

Contaminants

A Contaminant Assessment Process (CAP) was conducted for this Refuge in 1993 and updated in 2005. A CAP is an information gathering process and initial assessment of a national wildlife refuge in relation to environmental contaminants.

The Refuge is surrounded by an agricultural landscape. Agricultural runoff flows into the streams of the Grand River Watershed, four of which flow through or adjacent to the Refuge. This agricultural runoff contains whatever residue from pesticides and fertilizers that have been used on the fields in the watershed.

Pesticide re-deposition is a phenomenon that has been documented throughout the Midwest, including Missouri. Pesticides become airborne through volatilization and wind erosion of particles both during and after the application process. Once airborne, the pesticide can be carried by wind and deposited onto unintended areas by dry (gas and particle) and wet (fog and precipitation by rain and snow) depositional processes. These deposited residues can revolatilize, re-enter the atmosphere, and be transported and redeposited downwind repeatedly until they are transformed and accumulated, usually in areas with cooler climates. For example, atrazine, a commonly used herbicide, is frequently found in rivers, streams, and groundwater. It is also often found in air and rain. The U.S. Geological Survey found that atrazine was detected in rain at nearly every location tested. Atrazine in air or rain can travel long distances from application sites. The effects of nonpoint source pollution and pesticide re-deposition on the resident and migratory communities of the Swan Lake NWR have not been determined.

The 1993 Swan Lake NWR Contaminants Survey documented potential contamination problems from dieldrin, chlordane, copper, chromium, manganese, and zinc on the Refuge. The major source of these compounds was speculated to be agricultural runoff from the area surrounding the Refuge. It was recommended that if there was concern that populations of fish and wildlife using the Refuge were decreasing or did not seem healthy, there should be further investigations into the abovementioned compounds.

Since that 1993 CAP survey, there may have been changes in agricultural practices in the watershed. Confined animal facility operations have become more prevalent in the watershed. The effects of these changes should be monitored. Eutrophication from increased nutrients from nonpoint source pollution has become a cause for concern on many natural areas throughout the nation (Molitor, 2006).

Climate Change Impacts

The U.S. Department of the Interior issued an order in January 2001 requiring federal agencies under its direction that have land management responsibilities to consider potential climate change impacts as part of long range planning endeavors.

The increase of carbon dioxide (CO_2) within the earth's atmosphere has been linked to the gradual rise in surface temperature commonly referred to as global warming. In relation to comprehensive conservation planning for national wildlife refuges, carbon sequestration constitutes the primary climate-related impact that refuges can affect in a small way. The U.S. Department of Energy's "Carbon Sequestration Research and Development" defines carbon sequestration as "...the capture and secure storage of carbon that would otherwise be emitted to or remain in the atmosphere."

Vegetated land is a tremendous factor in carbon sequestration. Terrestrial biomes of all sorts – grasslands, forests, wetlands, tundra, and desert – are effective both in preventing carbon emission and acting as a biological "scrubber" of atmospheric CO_2. The Department of Energy report's conclusions noted that ecosystem protection is important to carbon sequestration and may reduce or prevent loss of carbon currently stored in the terrestrial biosphere.

Conserving natural habitat for wildlife is the heart of any long-range plan for national wildlife refuges and management areas. The actions proposed in this CCP would conserve or restore land and habitat, and would thus retain existing carbon sequestration on the WMA. This in turn contributes positively to efforts to mitigate human-induced global climate change.

One Service activity in particular – prescribed burning – releases CO_2 directly to the atmosphere from the biomass consumed during combustion. However, there is actually no net loss of carbon, since new vegetation quickly germinates and sprouts to replace the burned-up biomass and sequesters or assimilates an approximately equal amount of carbon as was lost to the air (Boutton et al. 2006). Overall, there should be little or no net change in the amount of carbon sequestered at

Swan Lake NWR from any of the proposed management alternatives.

Several impacts of climate change have been identified that may need to be considered and addressed in the future:

- Habitat available for cold water fish such as trout and salmon in lakes and streams could be reduced.
- Forests may change, with some species shifting their range northward or dying out, and other trees moving in to take their place.
- Ducks and other waterfowl could lose breeding habitat due to stronger and more frequent droughts.
- Changes in the timing of migration and nesting could put some birds out of sync with the life cycles of their prey species.
- Animal and insect species historically found farther south may colonize new areas to the north as winter climatic conditions moderate.

The managers and resource specialists responsible for the WMA need to be aware of the possibility of change due to global warming. When feasible, documenting long-term vegetation, species, and hydrologic changes should become a part of research and monitoring programs on the WMA. Adjustments in land management direction may be necessary over the course of time to adapt to a changing climate.

The following paragraphs are excerpts from the 2000 report: *Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change*, produced by the National Assessment Synthesis Team, an advisory committee chartered under the Federal Advisory Committee Act to help the US Global Change Research Program fulfill its mandate under the Global Change Research Act of 1990. These excerpts are from the section of the report focused upon the eight-state Midwest Region.

Observed Climate Trends

Over the 20th century, the northern portion of the Midwest, including the upper Great Lakes, has warmed by almost 4 degrees Fahrenheit (2 degrees Celsius), while the southern portion, along the Ohio River valley, has cooled by about 1 degree Fahrenheit (0.5 degrees Celsius). Annual precipitation has increased, with many of the changes quite substantial, including as much as 10 to 20 percent increases over the 20th century. Much of the precipitation has resulted from an increased rise in the number of days with heavy and very heavy precipitation events. There have been moderate to very large increases in the number of days with excessive moisture in the eastern portion of the Great Lakes basin.

Scenarios of Future Climate

During the 21st century, models project that temperatures will increase throughout the Midwest, and at a greater rate than has been observed in the 20th century. Even over the northern portion of the region, where warming has been the largest, an accelerated warming trend is projected for the 21st century, with temperatures increasing by 5 to 10 degrees Fahrenheit (3 to 6 degrees Celsius). The average minimum temperature is likely to increase as much as 1 to 2 degrees Fahrenheit (0.5 to 1 degree Celsius) more than the maximum temperature. Precipitation is likely to continue its upward trend, at a slightly accelerated rate; 10 to 30 percent increases are projected across much of the region. Despite the increases in precipitation, increases in temperature and other meteorological factors are likely to lead to a substantial increase in evaporation, causing a soil moisture deficit, reduction in lake and river levels, and more drought-like conditions in much of the region. In addition, increases in the proportion of precipitation coming from heavy and extreme precipitation are very likely.

Midwest Key Issues:

1. Reduction in Lake and River Levels

Water levels, supply, quality, and water-based transportation and recreation are all climate-sensitive issues affecting the region. Despite the projected increase in precipitation, increased evaporation due to higher summer air temperatures is likely to lead to reduced levels in the Great Lakes. Of 12 models used to assess this question, 11 suggest significant decreases in lake levels while one suggests a small increase. The total range of the 11 models' projections is less than a 1-foot increase to more than a 5-foot decrease. A 5-foot (1.5- meter) reduction would lead to a 20 to 40 percent reduction in outflow to the St. Lawrence Seaway. Lower lake levels cause reduced hydropower generation downstream, with reductions of up to 15 percent by 2050. An increase in demand for water across the region at the same time as net flows decrease is of particular concern. There is a possibility of increased national and international tension related to increased pressure for water diversions from the Lakes as demands for water increase. For smaller lakes and rivers, reduced flows are likely to cause water quality issues to become more acute. In addition, the projected

increase in very heavy precipitation events will likely lead to increased flash flooding and worsen agricultural and other non-point source pollution as more frequent heavy rains wash pollutants into rivers and lakes. Lower water levels are likely to make water-based transportation more difficult with increases in the costs of navigation of 5 to 40 percent. Some of this increase will likely be offset as reduced ice cover extends the navigation season. Shoreline damage due to high lake levels is likely to decrease 40 to 80 percent due to reduced water levels.

Adaptations: A reduction in lake and river levels would require adaptations such as re-engineering of ship docks and locks for transportation and recreation. If flows decrease while demand increases, international commissions focusing on Great Lakes water issues are likely to become even more important in the future. Improved forecasts and warnings of extreme precipitation events could help reduce some related impacts.

2. Agricultural Shifts

Agriculture is of vital importance to this region, the nation, and the world. It has exhibited a capacity to adapt to moderate differences in growing season climate, and it is likely that agriculture would be able to continue to adapt. With an increase in the length of the growing season, double cropping, the practice of planting a second crop after the first is harvested, is likely to become more prevalent. The CO_2 fertilization effect is likely to enhance plant growth and contribute to generally higher yields. The largest increases are projected to occur in the northern areas of the region, where crop yields are currently temperature limited. However, yields are not likely to increase in all parts of the region. For example, in the southern portions of Indiana and Illinois, corn yields are likely to decline, with 10-20 percent decreases projected in some locations. Consumers are likely to pay lower prices due to generally increased yields, while most producers are likely to suffer reduced profits due to declining prices. Increased use of pesticides and herbicides are very likely to be required and to present new challenges.

Adaptations: Plant breeding programs can use skilled climate predictions to aid in breeding new varieties for the new growing conditions. Farmers can then choose varieties that are better attuned to the expected climate. It is likely that plant breeders will need to use all the tools of plant breeding, including genetic engineering, in adapting to climate change. Changing planting and harvest dates and planting densities, and using integrated pest management, conservation tillage, and new farm technologies are additional options. There is also the potential for shifting or expanding the area where certain crops are grown if climate conditions become more favorable. Weather conditions during the growing season are the primary factor in year-to-year differences in corn and soybean yields. Droughts and floods result in large yield reductions; severe droughts, like the drought of 1988, cause yield reductions of over 30 percent. Reliable seasonal forecasts are likely to help farmers adjust their practices from year to year to respond to such events.

3. Changes in Semi-natural and Natural Ecosystems

The Upper Midwest has a unique combination of soil and climate that allows for abundant coniferous tree growth. Higher temperatures and increased evaporation will likely reduce boreal forest acreage, and make current forestlands more susceptible to pests and diseases. It is likely that the southern transition zone of the boreal forest will be susceptible to expansion of temperate forests, which in turn will have to compete with other land use pressures. However, warmer weather (coupled with beneficial effects of increased CO_2), are likely to lead to an increase in tree growth rates on marginal forestlands that are currently temperature-limited. Most climate models indicate that higher air temperatures will cause greater evaporation and hence reduced soil moisture, a situation conducive to forest fires. As the 21st century progresses, there will be an increased likelihood of greater environmental stress on both deciduous and coniferous trees, making them susceptible to disease and pest infestation, likely resulting in increased tree mortality.

As water temperatures in lakes increase, major changes in freshwater ecosystems will very likely occur, such as a shift from cold water fish species, such as trout, to warmer water species, such as bass and catfish. Warmer water is also likely to create an environment more susceptible to invasions by non-native species. Runoff of excess nutrients (such as nitrogen and phosphorus from fertilizer) into lakes and rivers is likely to increase due to the increase in heavy precipitation events. This, coupled with warmer lake temperatures, is likely to stimulate the growth of algae, depleting the water of oxygen to the detriment of other living things. Declining lake levels are likely to cause large impacts to the current distribution of wetlands. There is some chance that some wetlands could gradually

migrate, but in areas where their migration is limited by the topography, they would disappear. Changes in bird populations and other native wildlife have already been linked to increasing temperatures and more changes are likely in the future. Wildlife populations are particularly susceptible to climate extremes due to the effects of drought on their food sources.

Administrative Facilities

Administrative facilities consist of roads and developed sites for administration of the Refuge and public use activities. The administrative area of the Refuge currently consists of a maintenance shop, carpentry shop, three cold storage buildings for vehicle and equipment parking and a couple of outbuildings for storage, the Refuge Visitor Center/ Headquarters building, Refuge quarters and a public toilet.

There are 13 pit blinds located on the Refuge available for goose hunters, a short nature trail, boat ramp, 5 small fishing platforms, a kiosk and viewing area on the main entrance road overlooking Swan Lake, and approximately 20 miles of auto tour route. There is also the old hunting headquarters site which was previously occupied by MDC personnel. That site consists of two buildings, one is closed and no longer used, the other is a half-finished garage/storage area where goose draws and hunter check-in are conducted during the hunting season. There are also two vault toilets at the site which still belong to MDC.

Cultural Resources and Historic Preservation

North-central Missouri contains archeological evidence for the earliest suspected human presence in the Americas, the Early Man cultural period prior to 12,000 B.C.; and extending through the PaleoIndian, Archaic, Woodland, Mississippian, and historic Western cultures. Although a complete cultural survey of the Refuge has not been performed, earlier partial surveys have located 30 historical and archeological sites.

Section 106 of the National Historic Preservation Act provides the framework for federal review and consideration of cultural resources during federal project planning and execution. The implementing regulations for the Section 106 process (36 CFR Part 800) have been promulgated by the Advisory Council on Historic Preservation (ACHP). The Secretary of the Interior maintains the National Register of Historic Places (NRHP) and sets forth significance criteria (36 CFR Part 60) for inclusion in the register. Cultural resources may be consid-

Swan Lake NWR Visitor Center. Photo credit: FWS

ered "historic properties" for the purpose of consideration by a federal undertaking if they meet NRHP criteria. The implementing regulations at 36 CFR 800.16(v) define an undertaking as "a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a federal agency, including those carried out by or on behalf of a federal agency; those carried out with federal financial assistance; those requiring a federal permit, license or approval; and those subject to state or local regulation administered pursuant to a delegation or approval by a federal agency." Historic properties are those that are formally placed in the NRHP by the Secretary of the Interior, and those that meet the criteria and are determined eligible for inclusion.

Like all federal agencies, the Service must abide by Section 106 of the NHPA. Cultural resources management in the Service is the responsibility of the Regional Director and is not delegated for the Section 106 process when historic properties could be affected by Service undertakings, for issuing archeological permits, and for Indian tribal involvement. The Regional Historic Preservation Officer (RHPO) advises the Regional Director about procedures, compliance, and implementation of the several cultural resources laws. The Refuge Manager assists the RHPO by informing the RHPO (early in the process) about Service undertakings, by protecting archeological sites and historic properties on Service managed and administered lands, by monitoring archeological investigations by contractors and permittees, and by reporting violations.

Swan Lake NWR follows these procedures to protect the public's interest in preserving any cultural legacy that may potentially occur on the Refuge. Whenever construction work is undertaken that involves any excavation with heavy earth-moving equipment like tractors, graders, and bulldoz-

ers, the Refuge contracts with a qualified archaeologist/cultural resources expert to conduct an archaeological survey of the subject property. The results of this survey are submitted to the RHPO as well as the Missouri State Historic Preservation Officer (SHPO). The SHPO reviews the surveys and determines whether cultural resources will be impacted, that is whether any properties listed in or eligible for listing in the NRHP will be affected. If cultural resources are actually encountered during construction activities, the Refuge is to notify the SHPO immediately.

Visitation

Swan Lake NWR is open Refuge-wide sunrise to sunset from March through October, amounting to about 240 days a year. There are three entrances to the Refuge including the main entrance, north entrance and the west entrance. The Refuge is open to goose hunting during the goose season, which is usually mid November through the end of February. The Visitor Center is opened during weekdays and occasionally opened during special events and staffed by the local Audubon group.

The Refuge annual visitation was estimated at approximately 25,000 in 2008. The number of visitors per year is obtained through estimates derived in large part from traffic counters at the three Refuge entrances.

We do not have an accurate breakdown of visitor numbers per activity but we believe the largest segment of our visitors come for wildlife viewing, followed by fishing, education, and hunting.

Current Management

Habitat Management

Current habitat management activities consist of water level manipulation, farming, moist soil management, prescribed burning, mowing, and deer population control through public hunting programs. (Figure 7)

Environmental education program. Photo credit: USFWS

Wetland Management

Most wetland management activities on the Refuge are carried out through moist soil management described in the following section. Other wetlands are typically held in emergent marsh with natural fluctuations of water through natural flooding and drought cycles.

Moist Soil Units

Approximately 800 acres are under moist soil management to produce food for migrating waterfowl and shorebirds. Moist soil units are developed to impound water through construction of dikes and water control structures. Moist soil management entails manipulating water levels to encourage the growth of plants occurring naturally in the seed bank. The plants produce seeds that are high energy food for migrating waterfowl.

Flooding of moist soil units begins in September and proceeds in stages. Progressive flooding concentrates feeding waterfowl, more fully utilizing moist soil foods. Draining begins in March to exposes mud flats and attract migrating shorebirds that feed on invertebrates. The moist soil units remain dry throughout the growing season to produce food for the following year. Periodically, the units are disturbed to disturb the soil and retard invasion of woody vegetation.

Grasslands

The Refuge's 19 management units include a total of 920 acres of grassland. These units are burned every 3-5 years to reduce the amount of woody vegetation and organic matter (litter) and encourage growth of grass and forbs.

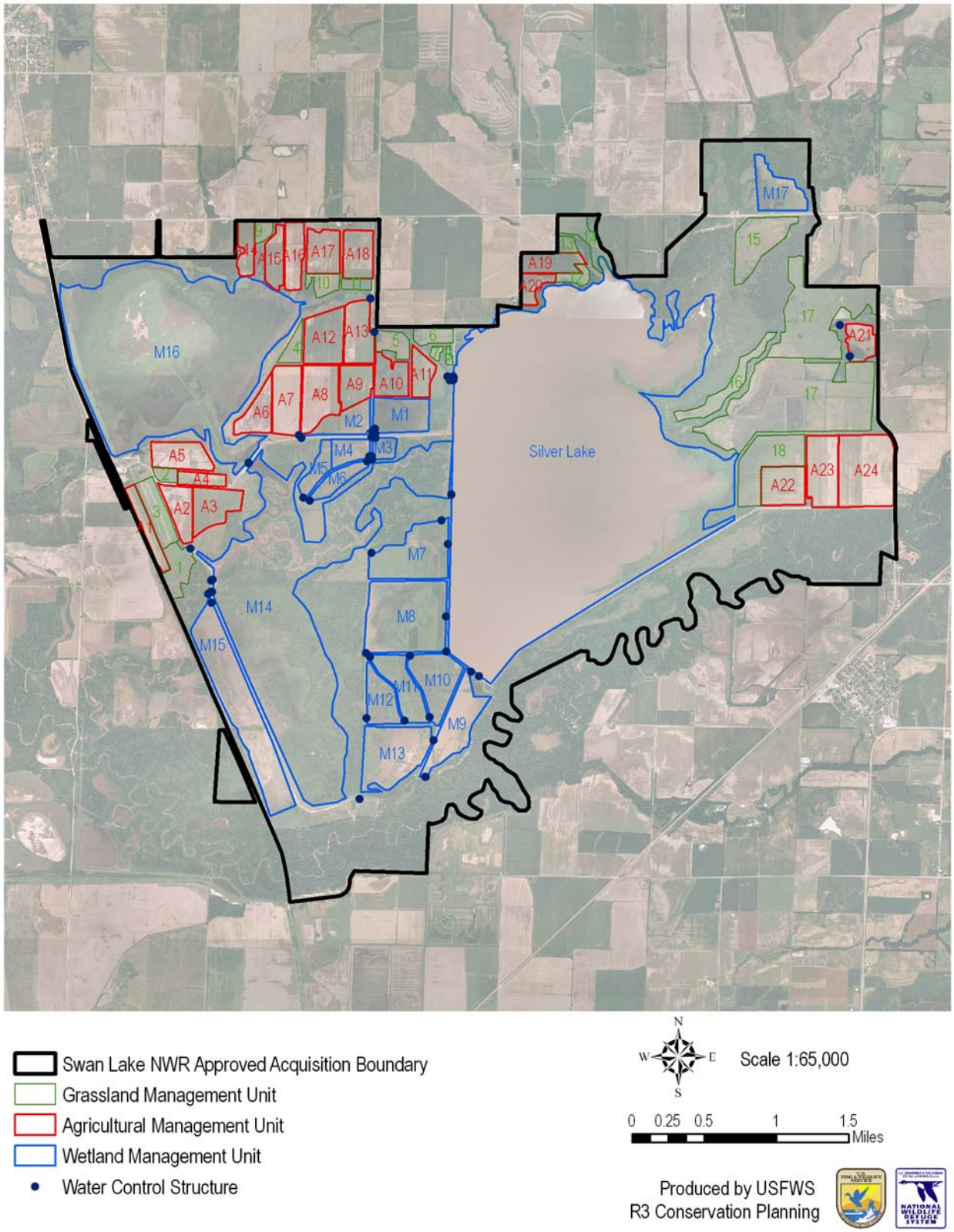
Forests

Presently, the forests on the Refuge are not actively managed.

Cropland

The Refuge crops 1,365 acres through cooperative farming agreements, an arrangement where local farmers plant and harvest the crops but must leave a portion of the crop as food for wildlife. The location of the portion left is determined by the Refuge. Crops, usually corn, soybeans, wheat, clover, or buckwheat, are planted in the spring and harvested anywhere from mid-September to the end of October, but may occur later if conditions are too wet in the fall to allow harvesting. Winter wheat is generally planted in October and left through the winter and harvested in June or July. On some areas, clover is frost seeded in February. Frost seeding

Figure 7: Management Units, Swan Lake NWR



Cooperative farming is a management tool on Swan Lake NWR. Photo credit: USFWS

entails broadcast seeding clover over existing winter wheat and allowing the freeze thaw action to work the seed into the ground. The clover fixes nitrogen into the soil and is either ploughed under in the fall or left through the winter.

The Refuge encourages the use of no-till farming, also known as conservation tillage. This method is practiced on about half of the sites annually. It is a way of growing crops from year to year without disturbing the soil through tillage. In no-till farming the soil is left intact and crop residues – stalks, stubble, leaves, and seed pods left after harvesting – are left in the fields. Despite the advantages to soils, no-till farming usually requires planting herbicide-resistant crop plants and then chemically weeding with herbicides. Herbicide-resistant crops are genetically modified organisms and their use on the Refuge is governed by regional policy.

Monitoring

Bald Eagle

Bald Eagles are monitored in conjunction with waterfowl counts.

Waterfowl

Waterfowl are monitored weekly in the spring and fall; however, it is difficult to get an accurate count of waterfowl use in the moist soil units during periods of heavy use because the birds are readily flushed from one unit to settle in an adjacent unit as the observer moves through the area.

Shorebirds, Marsh Birds and Other Waterbirds

Spring and fall shorebird surveys are conducted by Refuge staff. Marsh birds and other waterbirds are typically counted during shorebird surveys. Although there is much variation and many missing species in these counts due to the secretive nature of many of these birds, documentation of species occurrence is still considered important.

Vegetation

Vegetation surveys are usually conducted in late August or early September. Species variety is noted in the moist soil units as well as the presence of invasive plants.

Public Use

The National Wildlife Refuge System Improvement Act established six priority uses of the Refuge System. These priority uses all depend on the presence of, or expectation of the presence, of wildlife, and are thus called wildlife-dependent uses. These uses are hunting, fishing, wildlife observation, photography, environmental education, and interpretation. Swan Lake NWR provides opportunities in all of the six priority uses of the Refuge System.

Hunting

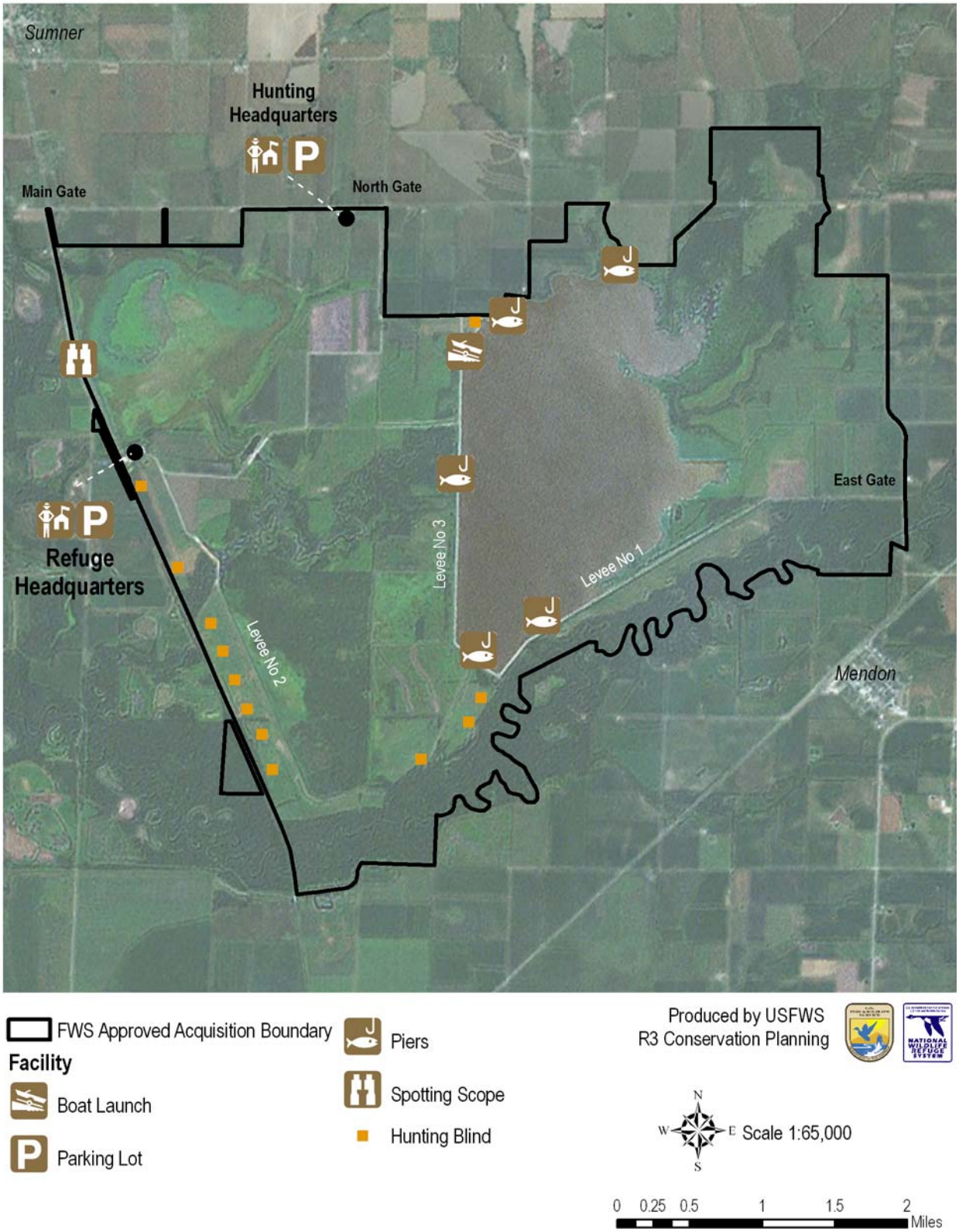
Currently goose and white-tailed deer hunting are permitted on the Refuge. The goose hunting season typically begins in November and ends in January. It occurs at 21 designated units allocated to hunters with a daily drawing on each day of the hunt (see Figure 8). No fees are charged for the goose hunt program. At the conclusion of the regular goose season a special season established through the Service's Conservation Order to reduce Snow Goose numbers begins and continues until March 1.

There are three white-tailed deer hunts. Two of the hunts are considered managed hunts and are listed as such in the Missouri Department of Conservation hunting season regulations and usually occur on successive weekends in November and December. One of the public hunts is a youth hunt open to modern firearms and the other hunt is a regular public hunt open to muzzleloaders only. The Refuge also offers a hunt for disabled hunters that is not part of the MDC managed deer hunt program.

Fishing

The Refuge has a boat ramp and three paved bank fishing platforms on Silver Lake (Figure 8). Fishing activity also includes archery fishing and trotlines. The most common species in the Refuge are channel catfish, bullhead, carp, buffalo, and crappie. Fishing platforms are universally accessible. No special permit is required for fishing on the Refuge, and all state and Refuge regulations apply. The Refuge is open to fishing from March 1 until October 15 with the exception of the area of the Refuge that is accessed by the Taylor Point Road, which allows fishing access along Elk Creek and the north shore of Silver Lake.

Figure 8: Current Visitor Services Facilities, Swan Lake NWR



Wildlife Observation, and Photography

Opportunities for wildlife observation and photography are found along the Refuge roads, at the overlook, and along the nature trail (Figure 8). The benches provided at the fishing platforms on Silver Lake and the universally accessible hunting blind can also be used for wildlife observation.

From 10,000 to 80,000 Canada Geese, up to 150,000 Snow Geese, and over 100,000 ducks can commonly be seen. In addition, more than 240 other species of birds are found here. Appendix C includes the Refuge's bird checklist.

Environmental Education and Interpretation

The Refuge is located in a rural setting in North-central Missouri that requires long commutes from most schools. Nonetheless, the Refuge is an attractive environmental education opportunity because of its unique wildlife resources and its location near a state park that also attracts school groups. Self-guided interpretation is available at the Refuge visitor center and along a nearby trail.

Non Wildlife-dependent Recreation

Visitors are allowed to gather nuts, berries, and mushrooms as well as to collect shed antlers in accordance with Refuge regulations.

Species Management

Animal Species

High densities of species like white-tailed deer, beaver, and raccoons can severely affect habitat quality and/or other species. Our primary goal in managing these populations is to provide complex habitat structures to meet the nesting, feeding, and resting requirements of migratory birds, listed species, and other wildlife. We continue to monitor deer herd size and health and attempt to manage density through a public hunt. Beaver are trapped when a management problem is identified.

Information kiosk on the Refuge. Photo credit: FWS

Plant Species

Invasive or pest plants can affect many habitat types found at the Refuge. Reed canary grass and American lotus can invade wetlands, and *Sericia lespedeza*, Johnson grass, black locust, and honey locust can invade grasslands. To reduce encroachment by these species, we use several management techniques, such as hand pulling individual plants, mowing, burning, water level manipulation, plowing, and chemical applications. The technique we select is influenced by management objectives, intensity of encroachment, best land use practices, cost, and timing of application.

Archaeological and Cultural Resources

Cultural resources are important parts of the nation's heritage. The Service is committed to protecting valuable evidence of human interactions with each other and the landscape. Protection is accomplished in conjunction with the Service's mandate to protect fish, wildlife, and plant resources.

Other Management Areas

Research Natural Area

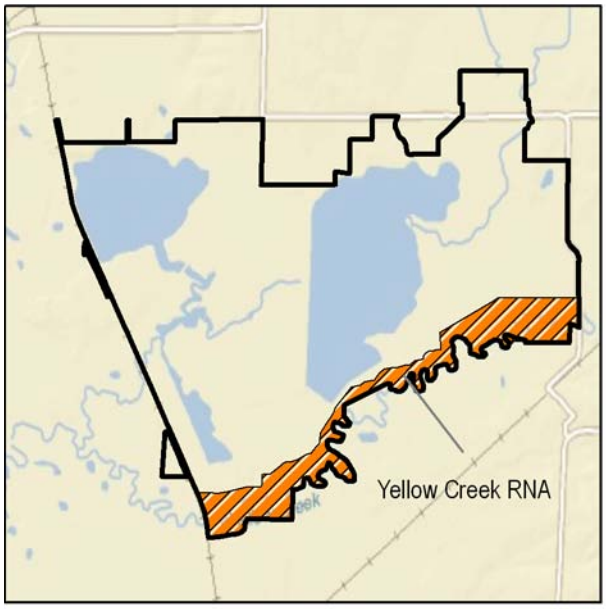
The 1,000-acre Yellow Creek Research Natural Area (Figure 9) was established in 1973 and includes mature bottomland hardwood forest. No management activities occur in the Research Natural Area. Research Natural Areas are part of a national network of reserved areas under various ownerships. Research Natural Areas are intended to represent the full array of North American ecosystems with their biological communities, habitats, natural phenomena, and geological and hydrological formations.

In research natural areas, as in designated wilderness, natural processes are allowed to predominate without human intervention. Under certain circumstances, deliberate manipulation may be used to maintain the unique features for which the research natural area was established. Activities such as hiking, bird watching, hunting, fishing, wildlife observation, and photography are permissible, but not mandated, in research natural areas.

Farm Service Agency Conservation Easements and Fee Title Tracts

Swan Lake NWR manages 46 easements and outlying fee title tracts scattered across 15 Missouri counties (see Figure 10 on page 32). Little active

Figure 9: Yellow Creek Research Natural Area



management occurs on these sites. The Farm Services Agency, formerly known as the Farm Services Administration, is an agency within the U.S. Department of Agriculture. The FSA makes loans to farmers and ranchers temporarily unable to obtain credit from commercial lending institutions. The FSA sometimes obtains title to real property when a borrower defaults on a loan secured by the property and holds such properties in inventory until sale or other disposal.

The Service is involved in the inventory disposal program because some FSA inventory properties contain or support significant fish and wildlife resources or have healthy restorable wetlands or other unique habitats. Some qualifying properties are transferred to the Service and become part of the National Wildlife Refuge System. Others are sold with restrictions known as conservation easements, which protect wetlands or other habitats. In most cases, the Service is responsible for the management and administration of properties with conservation easements.

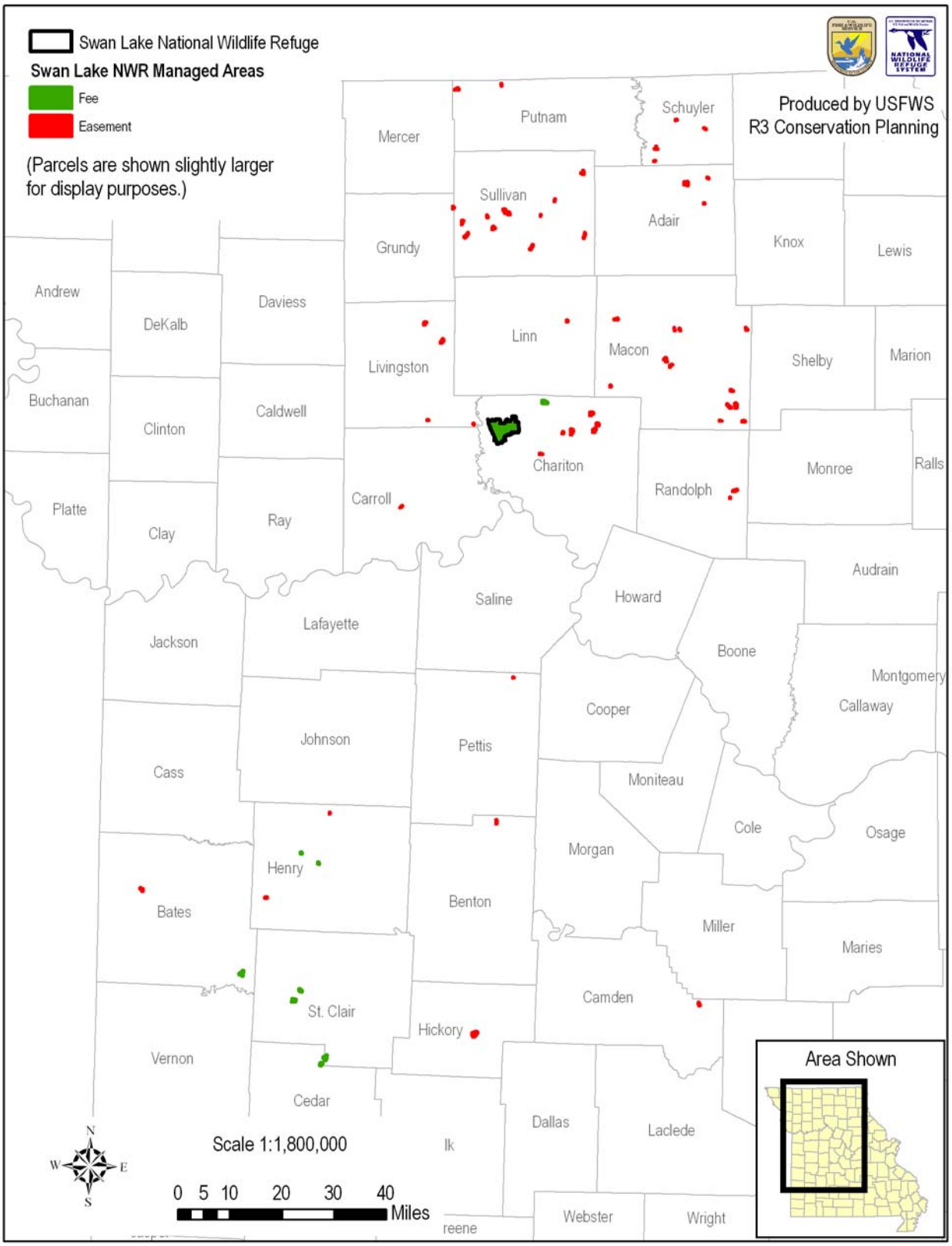



Figure 10: FSA Parcels Managed by Swan Lake NWR