Chapter 3: Affected Environment

3.1 Introduction

Chapter 3 provides an overview of Crab Orchard National Wildlife Refuge and the resources it provides in terms of habitat, wildlife and people.

3.2 Physical Environment

3.2.1 Physiography

The physiography of the northern and southern portions of the Refuge is quite different. The terrain of the northern portion of the Refuge is characterized by low relief, broad valleys, and relatively well-developed drainage systems while the southern portion of the Refuge is uplands with narrow ridges dissected by deep, narrow valleys with steep slopes and numerous sandstone outcrops.

The northern portion of the Refuge is covered with a heterogeneous mixture of rock fragments ranging in size from clay to boulders deposited by glaciers on bedrock. Generally the slopes in the area are less than 3 percent. The southern portion of the Refuge is part of a continuous ridge extending from Battery Rock on the Ohio River to Horseshoe Bluff overlooking the Mississippi River. The hills are highly dissected uplands with little flat land and nearly all of the area has steep slopes, most in excess of 10 percent slope.

The Refuge's elevation ranges from less than 380 feet above mean sea level at Crab Orchard Creek in Jackson County to over 740 feet at the southeast corner of the Refuge in Union County.

The most prominent features of the Refuge landscape are three artificial impoundments: Crab Orchard Lake, Little Grassy Lake, and Devils Kitchen Lake. Together these lakes total about 8,720 surface acres.

Prairie restoration, Crab Orchard NWR

3.2.2 Geology

The bedrock underlying the Refuge is of Pennsylvanian age. In the northern part of the Refuge, the bedrock is covered by a thin layer of glacial till of Illinoian age. During the Wisconsin glacial age, the weathered Illinoian glacial till was covered by the Farmdale and the Peorian loess sheets. The present upland soils developed from these loess sheets. The Loveland loess sheet underlies the Peorian and Farmdale sheets in the unglaciated areas in the southern portion of the Refuge. The Mississippi River valley is the main source of the loess.

Although mining for bituminous coal has occurred over extensive areas to the north of the Refuge, no coal has been mined on Refuge lands. In 1940, an exploratory oil well was drilled in the central portion of the Refuge, but apparently it never produced any oil. The federal government owns the mineral estate on all lands originally transferred to the Department of the Interior in 1947, except for a one-half interest in oil and gas minerals on one 40-acre tract. The government does not own the subsurface rights on several parcels of land acquired since that time. These parcels amount to about 1,350 acres.

3.2.3 Soils

Information on soils is essential for their conservation, development, and productive use. The various soil types have characteristic properties that determine their potential and limitations for specific land uses. Knowledge of soils is important in managing the Refuge's agriculture and wildlife habitat programs, as well as recreational and industrial facilities and activities.

Since the existing soil surveys were published for Williamson County (Fehrenbacher and Odell, 1959) and Jackson County (Herman et al., 1977), many changes and dramatic improvements have been made in soil classification and mapping techniques. The Heartland Geographic Information System Project will create an updated, digitized soil survey of Williamson, Jackson, and Perry counties. The Refuge is co-sponsoring the new soil survey of Williamson County. The soil survey, which will meet current National Cooperative Soil Survey standards, will be completed in December 2005.

3.2.4 Climate

The climate of the area is typical of the mid-western region of the United States in which frequent weather changes occur from day-to-day and season-to-season. The weather is governed by cold air moving southward across the plains from Canada, warm, moisture-laden air moving up from the Gulf of Mexico, and dry air from the west and southwest.

Summers are generally hot and humid, with July normally the hottest month. Winters are normally mild with the coldest temperatures recorded in January. The average frost-free dates in spring and fall for the area are April 15 and October 22. The mean annual temperature of the area is about 57 degrees Fahrenheit with mean monthly temperatures ranging from about 35 degrees Fahrenheit in January to 79 degrees Fahrenheit in July. Lake evaporation in the area averages nearly 36 inches a year varying from about 0.7 inch in December to 5.6 in July.

The average annual rainfall for the area is approximately 44 inches. Precipitation is usually highest March through June. Annual snowfall averages from 10 to 15 inches.

3.2.5 Hydrology and Water Quality

The entire Refuge lies within the Crab Orchard Creek watershed. Crab Orchard Creek is a tributary of the Big Muddy River, which drains into the Mississippi River. Major tributaries of Crab Orchard Creek include Drury Creek, Grassy Creek, Little Grassy Creek and Wolf Creek; other tributaries include Prairie Creek, Pin Oak Creek, Pigeon Creek, Rocky Comfort Creek, and numerous smaller, unnamed streams (Figure 19). Surface water on the Refuge exists almost exclusively as man-made reservoirs and ponds. Three large reservoirs cover nearly 9,000 acres of the Refuge (Table 5 on page 82). There are about 60 smaller impoundments covering about 300 acres (range 0.5-100 acres, average = 6 acres). The only natural lake on the Refuge is a 42-acre oxbow of Crab Orchard Creek. The hydrology of this oxbow has been modified by drainage ditches and impoundment of Crab Orchard Lake.

Water quality, drainage modification, shoreline erosion and sedimentation remain ongoing concerns for water bodies on the Refuge. Refuge waters are impacted by agricultural runoff, wastewater treatment effluent, urban runoff, stream channelization, and industrial contaminants. Pollutants from agriculture include sediment, nutrients and pesticides.

3.2.5.1. Crab Orchard Lake

Crab Orchard Lake is the oldest (1940), largest, and most heavily used lake on the Refuge. Although created for water supply and recreation purposes, it is no longer used as a source for industrial or drinking water. Crab Orchard Lake is eutrophic (high nutrient levels, low oxygen levels) and rarely exhibits thermal stratification. Turbidity can be quite high, especially following rain storms, and the lake supports moderate plankton blooms during warm months. Water surface temperatures reach 88 degrees Fahrenheit in August. The land cover of the Crab Orchard Lake watershed consists of grasslands (34 percent), forests (31 percent), row crops (15 percent), open water (12 percent), urban development (7 percent), and wetlands (2 percent).

Figure 19: Streams and Watersheds of Crab Orchard NWR

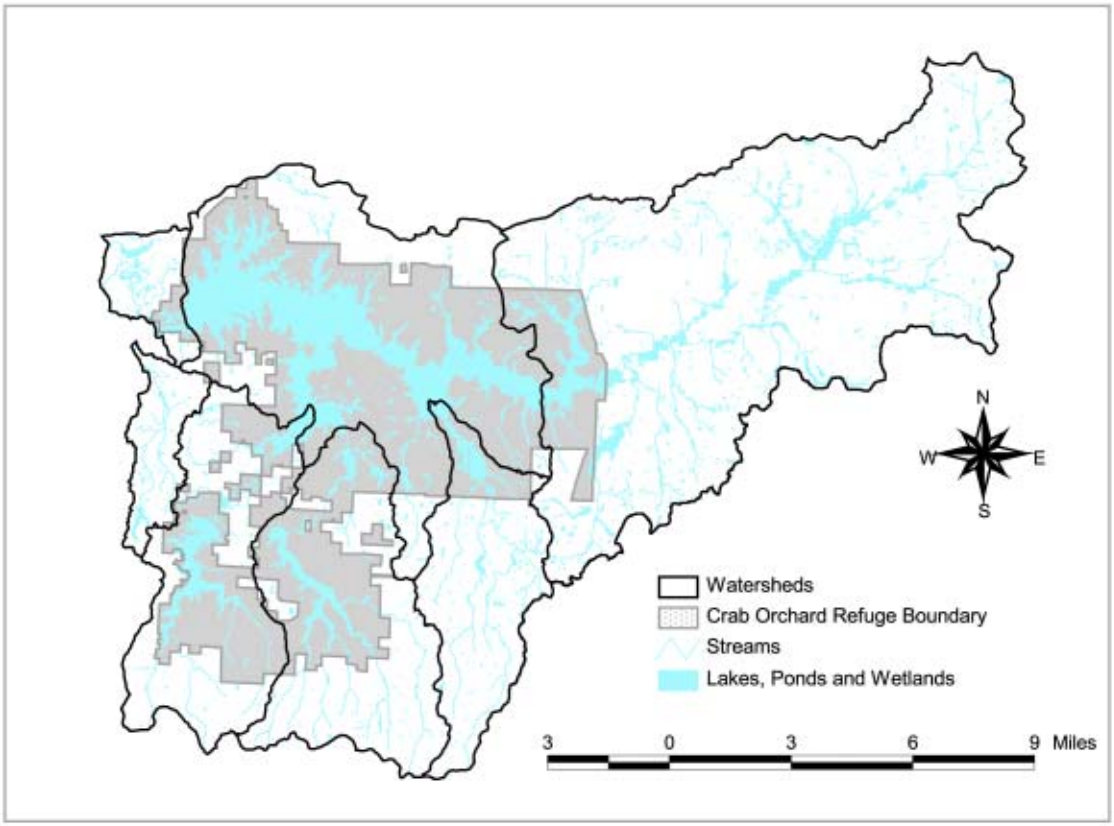


Table 5: Crab Orchard NWR Lake Details

Name	Crab Orchard	Little Grassy	Devils Kitchen
Surface Area (acres)	6,910	1,000	810
Capacity (acre feet)	72,525	27,000	29,200
Average Depth (feet)	10.7	27.0	36.0
Shoreline Length (miles)	125	28.3	24.0
Watershed Area (square miles)	215	15	18.3
Creek Dammed	Crab Orchard Creek	Little Grassy Creek	Grassy Creek
Spillway Elevation	405.0	500.0	510.0
Maximum Depth (feet)	24.6	77.0	90.0

3.2.5.2. Little Grassy Lake

Little Grassy Lake was impounded in 1950 as a recreation resource and today is most commonly used for sport fishing. Little Grassy Lake is relatively clear, has low nutrient levels, and supports light plankton blooms during warm months. The land cover of the Little Grassy Lake watershed consists of forests (65 percent), grasslands (18 percent), row crops (10 percent), open water (6 percent) and wetlands (1 percent).

3.2.5.3. Devils Kitchen Lake

Devils Kitchen Lake was impounded in 1959 as a recreation resource and today is most commonly used for sport fishing. Devils Kitchen is one of the deepest and clearest lakes in Illinois, has low nutrient levels, and supports minimal plankton blooms

during warm months. Except for the dam area, the lake shoreline consists primarily of oak-hickory forest. The land cover of the Devils Kitchen Lake watershed consists of forests (62 percent), grasslands (25 percent), row crops (7 percent), open water (5 percent), and wetlands (1 percent).

3.2.6 Contaminants

3.2.6.1. Comprehensive Environmental Response Compensation and Liability Act (CERCLA)

Following World War II and the transfer of the War Department's Illinois Ordnance Plant to the Department of the Interior, explosives production continued to be the principal industry on the property. In addition, new industries moved into buildings formerly used by the wartime contractor. Over the years, approximately 200 tenants have operated a variety of manufacturing plants under lease from the Refuge. In addition to munitions, manufactured products included plated metal parts, ink, electrical components, machined parts, various painted products, and boats.

A number of locations on the Refuge were contaminated with hazardous substances as a result of handling and disposal methods that were once considered acceptable. These methods included placing waste materials in unlined landfills and discharging liquids into surface water bodies and impoundments. These practices contaminated soils, aquatic sediments, and water, which eventually led to the Refuge's designation by the U.S. Environmental Protection Agency (USEPA) in 1987 as a national priority for hazardous waste investigation and cleanup under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA).

In the 1970s, the State of Illinois identified polychlorinated biphenyl (PCB) and cadmium contamination at the Refuge. A fish consumption advisory has been in effect for Crab Orchard Lake since 1988. In 1989, a Refuge-wide investigation was completed on 33 sites. Several sites were remediated and other sites are in different phases of clean-up. A subsequent investigation was conducted in 2001. This investigation identified additional areas of significant contamination where efforts will fully characterize the nature and extent of contamination, evaluate potential cleanup alternatives, and select and implement protective cleanup measures.

The Department of the Interior, the Department of Army, the USEPA, and the Illinois Environmental Protection Agency (IEPA) are actively involved in the site remediation process. The agencies entered into a Federal Facilities Agreement (FFA) in 1991 that defined roles and responsibilities for the contaminants investigations and remediation.

Approximately $85 million has been spent so far for investigation and clean up of contaminated sites. In one cleanup project, approximately 117,000 cubic yards of hazardous PCB contaminated soils were safely treated. The soils, along with other PCB contaminated soils and incinerator ash, were placed in a repository on the site. Other cleanup projects addressed contamination problems associated with unexploded ordnance and lead-contaminated soils around water towers.

Investigation and cleanup are continuing at several sites in existing and former industrial areas within the restricted use portion of the Refuge. These activities are expected to continue into the foreseeable future.

3.2.7 Administrative Facilities

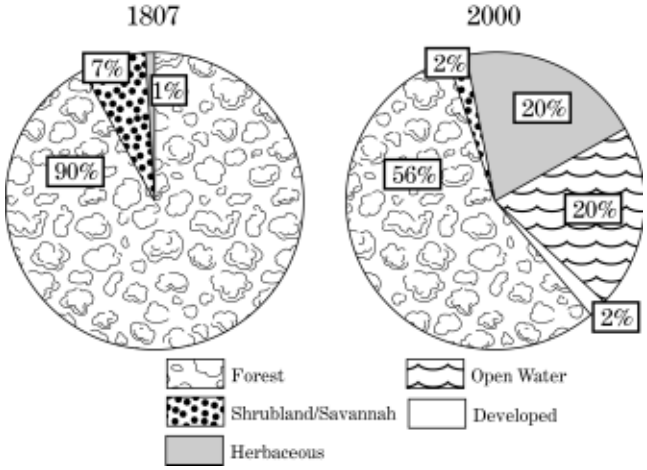
The Service is responsible for maintaining the Refuge headquarters building, visitor information center, maintenance building, a small office building, and three high hazard dams. The visitor information center is described in the discussion of public use in Section 3.6 on page 97.

The headquarters building consists primarily of office space for four offices – Refuge administrative staff, Ecological Services Marion Field Office, Ecological Services Crab Orchard Superfund Office, and U.S. Environmental Protection Agency. The building has 10,000 square feet and was completed in 1981.

The Refuge maintenance building consists of office areas, supply and equipment storage areas, and a large bay area for various equipment and

Crab Orchard NWR Headquarters, Bot Etzel

Figure 20: Land Cover of Crab Orchard NWR



vehicle maintenance and repair functions. This building has 10,000 square feet and was completed in 1981.

The office building houses the Carterville Fishery Resource Office and the Illinois Department of Natural Resources. This building, built in 1941, has 3,420 square feet.

The three major dams on the Refuge are the Crab Orchard Lake Dam, Devils Kitchen Lake Dam, and Little Grassy Lake Dam.

The Crab Orchard Lake Dam was constructed to provide a reservoir for an industrial and municipal water supply, recreation, and work relief. Construction was authorized in 1936 and completed in 1939, with extensive modifications completed in 1991. The dam is a zoned earth fill embankment dam with a service spillway.

Devils Kitchen Lake Dam was constructed to provide recreation, water storage, habitat and breeding grounds for migratory birds and other wildlife, and conservation. The dam was designed in 1940. Construction began in 1941, but was suspended in 1943 because of World War II. In 1955, the U.S. Army Corps of Engineers reviewed and modified the original designs. Construction was completed in 1959. The dam is concrete with a concrete spillway.

Little Grassy Lake Dam was constructed to provide recreation. Construction was authorized in 1936 and completed in 1942, with modifications in 1991, 1994 and 2003. The dam is a homogeneous earth fill embankment dam with a concrete spillway near the center of the embankment.

3.3 Habitat Overview

The purpose of this section is to broadly describe the existing habitats and the changes that have occurred in the last 200 years. The discussion helps us understand and evaluate the management alternatives discussed in this document. The historic framework helps us implement the Fish and Wildlife Service's policy on maintaining the biological integrity, diversity, and environmental health of the National Wildlife Refuge System. The historic perspective is useful to us as a starting point for assessing the condition of the landscape, the potential for restoration of habitats where appropriate, and the recognition of irreversible changes that may preclude or greatly limit restoration.

3.3.1 Background

The habitats of the Refuge area have changed dramatically in the last 200 years. The area that is now the Refuge was 90-95 percent forest prior to European settlement (Anderson and Anderson 1975) (Figure 20). European settlement of southern Illinois began in the early 1800s and by the mid 1800s Native Americans had been pushed out and villages and primitive roads established. Change in the area was greatest in the late 1800s and the first half of the 1900s. Nearly all of the area was either logged for timber or cleared and converted to other uses, particularly agriculture. By the 1930s, the soils in the area were depleted and severely eroded. Starting in 1938, the Resettlement Administration acquired 32,000 acres of the land along Crab Orchard Creek in an effort to prevent further deg-

radation. However, additional clearing and development ensued with the establishment of the Illinois Ordnance Plant during World War II.

The changes in Refuge habitats since 1807 can be summarized as follows: the original hardwood forest (92 percent of aboriginal area) was converted to largely open habitats (agricultural fields and open water) by the 1930s, where forests now exist the mature hardwood forest has been changed to a forest in an earlier seral stage and pine plantations. Savannah (7 percent of aboriginal area) and native prairie (1 percent of aboriginal area) have been completely converted to other habitats. The overall result has been the fragmentation of the hardwood forest and an increase in aquatic habitats with the construction of the lakes. The current land cover for the Refuge is displayed in Figure 21; changes in land cover are displayed in Table 6.

3.3.2 Forests

Before European settlement, the area that is now the Refuge was 92 percent forest. Essentially, all of the original forest was either converted to other habitats, harvested for timber, or otherwise disturbed. The amount of forest reached the lowest point in the first half of the 1900s. Since that time, forests have gradually become reestablished in abandoned farm fields and industrial areas, and some areas were actively replanted with trees. Presently, 56 percent of the Refuge is covered by forest. Examples of wildlife that use Refuge forests are deer, squirrels, raccoons, hawks, owls, and a variety of forest song bird species. A Refuge goal has been to manage for productive oak-hickory forest dominated by native species. Management activities have included tree planting, prescribed burning, thinning, and control of exotic and invasive plants.

3.3.3 Shrubland

Before European settlement, the area that is now the Refuge was about 7 percent savannah. Savannah was probably dominated by prairie grasses interspersed with trees, but some of it was dominated by shrubs. Presently, about 2 percent of the Refuge is covered by shrubland. Examples of wildlife that use shrubland are deer, rabbit, loggerhead shrike, Bell's vireo, and field sparrow. Most Refuge shrubland is the result of abandoning farm fields and industrial areas.

3.3.4 Grassland

Before European settlement, the area that is now the Refuge was 1 percent prairie. All of the prairie was converted to other habitats. Presently, about 4 percent of the Refuge is covered by grassland. Examples of wildlife that use grassland are deer, rabbit, northern bobwhite, grasshopper sparrow, loggerhead shrike, dickcissel, and eastern meadowlark. The majority of Refuge grassland is managed pasture (55 percent) and hay (35 percent) with the remainder (10 percent) represented by planted, native warm-season grasses. Management activities have included planting agricultural and native grasses, prescribed burning, grazing, mowing, control of exotic and invasive plants, and fertilizing.

3.3.5 Wetlands

Before European settlement, there was relatively little wetland habitat on the area that is now the Refuge. Presently, most wetland habitat on the Refuge consists of man-made ponds and lakes, which are discussed in the following paragraphs. Wetlands cover about 6 percent of the Refuge. Examples of wildlife that use wetlands are Canada goose, other waterfowl, herons, raccoons, turtles, frogs, and other amphibians and reptiles. The majority of these wetlands are bottomland hardwood forests (1,900 acres) and moist-soil units (450 acres). During normal years, water levels in moist-soil units are lowered during the summer to encourage the establishment of moist-soil vegetation. Water levels are then raised during the fall to make the seeds produced by moist-soil plants available to waterfowl. Management activities include maintenance of levees and water control structures, water level manipulation, mowing, disking, planting, and control of exotic and invasive plants.

3.3.6 Open Water

Before European settlement, the area that is now the Refuge had little, if any, open water habitat. Presently, about 20 percent of the Refuge is covered by open water, almost all of it in man-made reservoirs. Open water serves as habitat for warm-water sport fish, waterfowl and other waterbirds. Management activities include maintenance of dams, levees, and water control structures, and manipulation of water levels.

3.3.7 Cropland

Row croplands are farmed through cooperative farming agreements with eight farmers. The objectives of the cooperative farming program have been

Figure 21: Land Cover of Crab Orchard NWR, 2000

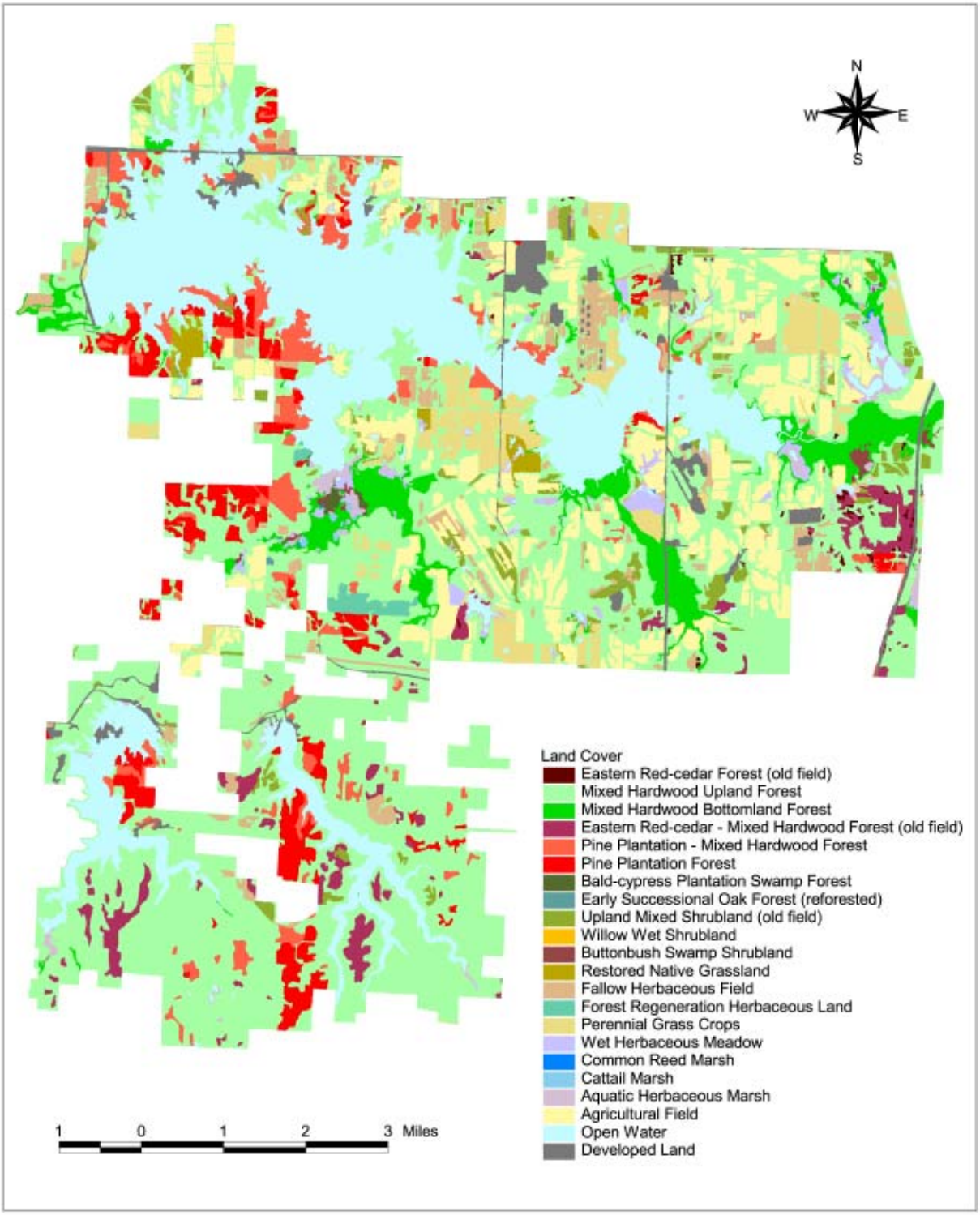


Table 6: Area and Percent Cover of Habitats on Crab Orchard NWR, 1807 and 2000

Habitat Type	Acres in 2000	Percent Cover in 2000	Acres in 1807	Percent Cover in 1807
Forest	**25,254**	**56**	**41,820**	**92**
Eastern Red-cedar Forest (old field)	71	<1		
Mixed Hardwood Upland Forest	18,923	42		
Mixed Hardwood Bottomland Forest	1,908	4		
Eastern Red-cedar Mixed Hardwood Forest (old field)	1,006	2		
Pine Plantation/Mixed Hardwood Forest	1,633	4		
Pine Plantation Forest	1,665	4		
Bald-cypress Plantation Swamp Forest	44	<1		
Early Successional Oak Forest (reforested)	5	<1		
Shrubland	**956**	**2**	**3,182**	**7**
Upland Mixed Shrubland (old field)	872	2		
Willow Wet Shrubland	3	<1		
Buttonbush Swamp Shrubland	81	<1		
Herbaceous	**9,026**	**20**	**455**	**1**
Restored Native Grassland	198	<1		
Fallow Herbaceous Field	1,542	3		
Forest Regeneration Herbaceous Land	168	<1		
Perennial Grass Crops	1,752	4		
Wet Herbaceous Meadow	389	1		
Common Reed Marsh	7	<1		
Cattail Marsh	25	<1		
Aquatic Herbaceous Marsh	365	1		
Agricultural Field	4,580	10		
Other Land Cover	**10,220**	**22**	**0**	**0**
Open Water	9,082	20		
Developed Land	1,138	2		
Totals	45,456	100	45,456	100

to provide food for wintering Canada geese and other waterfowl, protect and improve Refuge soils, and fulfill the agricultural purpose of the Refuge. Presently, about 10 percent of the Refuge is covered by cropland. Examples of wildlife that use cropland are deer, Canada goose, northern bobwhite, and wild turkey. Management activities include mowing, disking, planting, herbicide and fertilizer application, and harvesting.

3.3.8 Developed Land

Presently, about 2 percent of the Refuge is covered by developed land. These include: roads and adjacent rights-of-way, and industrial, administrative, and recreational facilities.

3.3.9 Invasive Species

Three categories of undesirable species (invasive, exotic, noxious) are found on the Refuge.

Invasive species are alien species whose introduction causes or is likely to cause economic or environmental harm or harm to human health. Executive Order 13112 requires the Refuge to monitor, prevent, and control the presence of invasive species.

Exotic species are species that are not native to a particular ecosystem. Service policy directs the Refuge to try to maintain habitats free of exotic species.

Table 7: Principal Weed Species in Agricultural Fields, Crab Orchard NWR

Common Name	Scientific Name
crab grass	*Digitaria sp.*
fall panicum grass	*Panicum sp.*
foxtail grass	*Setaria sp.*
cocklebur	*Xanthium strumarium*
smartweed	*Polygonum sp.*
shattercane	*Sorghum bicolor*
ragweed	*Ambrosia sp.*
pigweed	*Amaranthus sp.*
lamb's quarters	*Chenopodium album*
trumpet-creeper	*Campsis radicans*
morning-glory	*Ipomoea sp.*
nutsedge	*Cyperus esculentus*

Noxious weeds are designated by the U.S. Department of Agriculture or the Illinois Department of Agriculture as species which, when established, are destructive, competitive or difficult to control. Principal weed species are shown in Table 7.

Invasive, exotic and noxious weed species are relatively abundant on the Refuge. These species are quite diverse and are found in most Refuge habitats, although some are typically found in agricultural fields or lakes and ponds. Johnsongrass, Canada thistle and giant ragweed are Illinois state-listed noxious weeds that occur on the Refuge. Currently, most Refuge control efforts focus on Johnsongrass, autumn olive, kudzu, garlic mustard and common reed. The principal invasive and exotic species on Crab Orchard NWR are shown in Table 8.

Exotic and invasive plant species pose one of the greatest threats to the maintenance and restoration of the diverse habitats found on the Refuge. They threaten biological diversity by causing population declines of native species and by altering key ecosystem processes like hydrology, nitrogen fixation, and fire regimes. Left unchecked, these plants have come to dominate many areas on the Refuge and reduced the value of the land as wildlife habitat. There is a bountiful seed source of many of these exotic/invasive species on the lands surrounding the Refuge, thus in order to be effective in our management plans, we must bring together a complex set of interests including private landowner, commercial, and public agencies.

Table 8: Principal Invasive and Exotic Species, Crab Orchard NWR

Common Name	Scientific Name
autumn olive	*Elaeagnus umbellata*
multiflora rose	*Rosa multiflora*
kudzu	*Pueraria montana*
purple loosestrife	*Lythrum salicaria*
common reed	*Phragmites australis*
Johnsongrass	*Sorghum halepense*
reed canary grass	*Phalaris arundinacea*
fescue grass	*Festuca pratensis*
tall fescue	*Festuca arundinacea*
garlic mustard	*Alliaria petiolata*
Japanese honeysuckle	*Lonicera japonica*
Amur honeysuckle	*Lonicera maackii*
Oriental bittersweet	*Celastrus orbiculatus*
Canada thistle	*Cirsium arvense*
bull thistle	*Cirsium vulgare lanceolatum*
black-locust	*Robinia pseudoacacia*
white poplar	*Populus alba*
mimosa	*Albizia julibrissin*
tree-of-heaven	*Ailanthus altissima*
wintercreeper	*Euonymus fortunei*
Chinese yam	*Dioscorea oppositifolia*
crown vetch	*Coronilla varia*
white sweet clover	*Melilotus alba*
yellow sweet clover	*Melilotus officinalis*
sericea lespedeza	*Lespedeza cuneata*
bush clover	*Lespedeza bicolor*
Japanese stiltgrass	*Microstegium vimineum*
dodder	*Cuscuta spp.*
shortleaf pine	*Pinus echinata*
loblolly pine	*Pinus taeda*
Virginia pine	*Pinus virginiana*
ponderosa pine	*Pinus ponderosa*
coontail	*Ceratophyllum demersum (aquatic)*
Eurasian watermilfoil	*Myriophyllum spicatum (aquatic)*
common teasel	*Dipsacus fullonum*
cut-leaved teasel	*Dipsacus laciniatus*

Prescribed burn on a national wildlife refuge, Bernie Angus

3.3.10 Natural and Current Role of Fire

Prior to European settlement, fire assuredly was an influence on the structure and function of the small patches of prairie and savannah in the area that is now the Refuge. Fire was less of a factor in open forests, and even less in closed forests. Now, the natural process of fire has been replaced by fire management that includes suppression and prescribed burning.

We have fire records for the Refuge from 1947 to the present, but information prior to 1986 is incomplete. Records indicate that the area has an average of 2.3 wildland fires annually, with a total of 127 wildland fires recorded from 1947 to 2001. Fires are most likely to occur in the spring from March 1 to May 15 and in the fall from October 15 to December 1.

We use prescribed fire to manipulate vegetation in a safe and cost-effective manner. Our principal purpose is to improve the wildlife habitat conditions in the southern pine plantations. Prescribed burning also reduces hazardous fuels, encourages oak and hickory and discourages sugar maple. Burning improves the condition of the understory. And, although burning is not specifically undertaken for these purposes, burning enhances the aesthetics of the forest by making the understory more open and improves access for both habitat management and recreation.

Southern pine plantations are burned to reduce fuels on the forest floor and to keep understory low to better provide for wildlife. By burning, we keep the understory vegetation in a young, vigorous condition, increasing seeds and fruit that are available to wildlife near the ground. As a result of fire, more light reaches the ground, which favors less shade-tolerant species. We conduct inventories to determine if there are enough young hardwoods in the understory of pine stands to permit succession to a native hardwood forest. If succession is likely, we will terminate prescribed burning.

Areas identified as "fallow herbaceous fields" (Figure 20, page 97) are old fields that have been invaded by low, woody vegetation and vines. If we want to maintain these lands in an early seral stage, fire helps maintain the openings and habitat diversity. Burning also enhances conditions for deer and upland game hunting and wildlife observation and photography.

Fire is essential for proper management of native, warm-season grasses and associated forbs. Prescribed fire stimulates growth of the grasses, increases seed germination and growth of forbs, creates open ground for wildlife, retards encroachment of woody vegetation, and reduces the fuel load. Tallgrass prairie has been established on several areas on the Refuge. Fire will play a significant role in maintaining this habitat type, which benefits prairie bird species.

3.4 Wildlife

Information on wildlife in the area before European settlement is limited. We do know that some mammals that were in the area are no longer found in Illinois (Hoffmeister 1989): bison (*Bison bison*), elk (*Cervus elaphus*), black bear (*Ursus americanus*), and mountain lion (*Felis concolor*). The Passenger Pigeon (*Ectopistes migratorius*) and Carolina Parakeet (*Conuropsis carolinensis*) inhabited the area but are now extinct. The Greater Prairie Chicken (*Tympanuchus cupido*) has a greatly reduced range (Bohlen 1989). We know little about how amphibians, reptiles, and invertebrates in the area may have changed through the years.

The Refuge provides habitat for many species that occur in Illinois (Table 9). See Appendix D for a complete list of wildlife species known to inhabit the Refuge.

3.4.1 Mammals

Forty-three species of mammals have been recorded in or near the Refuge (Appendix D). White-tailed deer, Virginia opossum, raccoon, rabbits, squirrels, beaver, and coyote are commonly observed species on the Refuge.

Table 9: Number of Wildlife Species Found in Illinois and at Crab Orchard NWR

Taxonomic Group	Number of Species Found in Illinois	Number of Species Found at Crab Orchard NWR	Percent of Illinois Species Found at Crab Orchard NWR
Amphibians	41	22	54
Reptiles	61	28	46
Mammals	62	43	69
Birds	327	269	82
Terrestrial Vertebrates	491	362	74

White-tailed deer numbers on the Refuge have shown a pattern similar to the rest of Illinois. By the early 1900s, deer had either been extirpated from the Refuge, or occurred in very low numbers. Refuge records mention a release of deer in 1942, but no numbers are provided. The number of deer on the Refuge is estimated at 10 in 1947, 30 in 1949 and 70 in 1950. By 1953, deer were no longer an oddity on the Refuge. The population increased and attained such high levels that deer damage to crops and forest began to become an issue in the early 1960s. The first Refuge deer hunt in the restricted use area occurred in 1966. The average annual harvest in the restricted use area since then has been about 600 per year.

3.4.2 Birds

Two-hundred sixty-nine species of birds have been recorded in or near the Refuge (Appendix D). Herons, Canada goose and other waterfowl, raptors, wild turkey, and songbirds are commonly observed species on the Refuge.

Canada Goose

Prior to European settlement, Canada geese probably rarely used the Refuge area. The Refuge was dominated by forest (more than 90 percent) and had little habitat to attract geese. Refuge records indicate that there were only about 2,200 Canada geese on the Refuge in 1947. Establishing a large, wintering population was a Refuge priority. Refuge staff kept pinioned or penned geese as a decoy flock to attract migrating geese and emphasized production of corn and other grains in the Refuge farm program to provide food for wintering geese. The response by Canada geese was relatively quick; in 1948 the peak count on the Refuge was 24,000 and peak counts generally increased through the middle 1990s (Figure 22). The average peak count (1947-2001) is 82,000.

Overall, Canada goose use of the Refuge, as measured in goose-use-days, has been more variable and shows less of a trend than peak counts (Figure 23). The average (1952-2002) has been 5.4 million goose-use-days. The Refuge goal is to provide food for 6.4 million goose-use-days each year.

Since the Refuge was created in 1947, attracting and providing food for migratory Canada Geese has been a primary focus of activities on the Refuge. Early efforts to attract geese included maintaining a captive flock of pinioned geese, increasing the production of desirable agricultural crops, and, sometimes, directly feeding geese by placing large quantities of grain in open areas of the Refuge. Current efforts to supply food for geese emphasize providing sufficient quantities of diverse food-producing habitats. Much of this food is provided by the Refuge agriculture program. Row crops provide corn, winter wheat, and clover. Hay fields and pastures provide grasses and legumes. Food is also provided in natural wetlands, managed moist soil wetlands, lakes and ponds, and miscellaneous sites such as mowed industrial areas and rights-of-way. Other goose management activities include seasonal closure to boating on the east end of Crab Orchard Lake and fall mowing around selected ponds.

In 1998, Service and Illinois DNR biologists completed a report that set a specific Refuge goal of providing food for 6.4 million goose-use days annually. This goal was derived using over 40 years of Refuge Canada Goose data (unpublished Crab Orchard NWR report, 1998). This report also calculated that the minimum amount of agricultural row crops required topotentially provide for 6.4 million GUDs is 1,500 acres, but this requires several critical assumptions. These assumptions are: 1) geese have unrestricted use of all fields, 2) average crop yields, 3) average winter temperatures, 4) average snow fall, and 5) crops are not consumed by other animals. In practice, we know these assumptions are not met

Figure 22: Peak Counts of Wintering Canada Geese on Crab Orchard NWR, 1947 to 2001

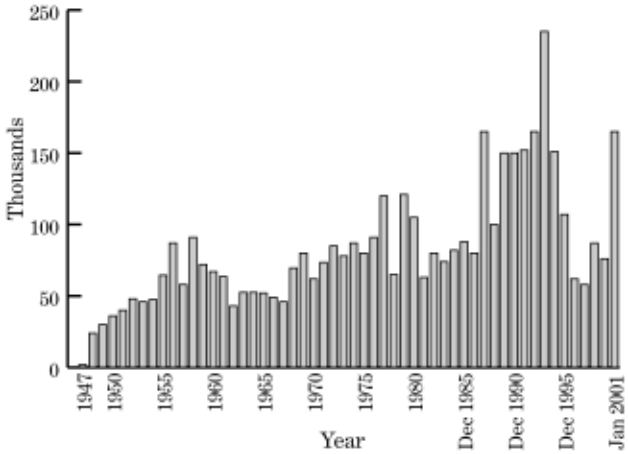
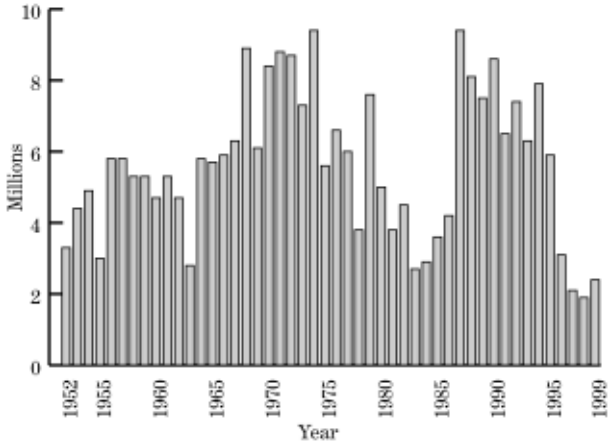


Figure 23: Canada Goose-use Days on Crab Orchard NWR, 1952 to 1999



and goose food availability is influenced by the following factors: 1) geese do not use some fields because they are too small to fly into or they are in the portion of the Refuge open to the public and disturbance levels are higher, 2) crop yields can vary substantially (winter wheat production was low in fall 2001 because of late and wet planting conditions, corn and clover production in 2002 was low because of drought conditions, etc.), 3) lower than average winter temperatures result in greater calorie demand by Canada Geese, 4) some crops are unavailable because of occasionally heavy snow cover, and 5) other animals (deer, raccoons, blackbirds, etc.) also consume crops. In order to compensate for factors that regularly decrease food availability (ex., consumption by other species and non-use of certain fields) and factors that occasionally decrease food availability (ex., low crop production due to drought, deep snow conditions) more than 1,500 acres of crops are required. For example, if each of these five factors reduced food availability by just 10 percent, over 2,500 acres of row crops would be required to provide 6.4 million goose-use-days. However, we know that in some instances these factors can cause larger reductions. For example, in 2002 corn production was reduced by 50 percent or more.

Wild Turkey

Wild turkeys were not known to occur on the Refuge until 122 were released by the Illinois Department of Conservation in 1958. Occasional turkey

Table 10: Nongame Species of Management Concern, Crab Orchard NWR

Common Name	Scientific Name
Common Loon	*Gavia immer*
Northern Harrier	*Circus cyaneus*
Red-shouldered Hawk	*Buteo lineatus*
Greater Yellowlegs	*Tringa flavipes*
Black-billed Cuckoo	*Coccyzus erythropthalmus*
Chuck-will's-widow	*Caprimulgus carolinensis*
Whip-poor-will	*Caprimulgus vociferus*
Red-headed Woodpecker	*Melanerpes erythrocepalus*
Northern Flicker	*Colaptes auratus*
Acadian Flycatcher	*Empidonax virescens*
Loggerhead Shrike	*Lanius ludovicianus*
Bell's Vireo	*Vireo belli*
Wood Thrush	*Hylocichla mustelina*
Blue-winged Warbler	*Vermivora pinus*
Prairie Warbler	*Dendroica discolor*
Prothonotary Warbler	*Protonotaria citrea*
Worm-eating Warbler	*Helmitheros vermivorus*
Louisiana Waterthrush	*Seiurus motacilla*
Kentucky Warbler	*Oporomis formosus*
Field Sparrow	*Spizella pusilla*
Grasshopper Sparrow	*Ammordramus savannarum*
Dickcissel	*Spiza americana*
Eastern Meadowlark	*Sturnella neglecta*
Orchard Oriole	*Icterus spurius*

sightings were made on the Refuge through 1965. In 1966, Refuge records estimate a population of seven wild turkeys and state that several observations were made during the year. Wild turkey numbers continued to increase enough that by 1989, the Illinois DNR trapped 14 hen turkeys for stocking off the Refuge. The Refuge held its first wild turkey hunting season in the restricted use area in the spring of 2001, when 39 wild turkeys were harvested by 52 hunters.

USFWS Nongame Bird Species of Management Concern

The Fish and Wildlife Conservation Act, 1980, requires that the Service identify "all migratory nongame birds that, without additional conservation action, are likely to become candidates for listing under the Endangered Species Act of 1973." Additionally, the Act further underscores the need to develop actions to assure the conservation of these species with the underlying philosophy that "an ounce of prevention is worth a pound of cure." Species of management concern in Region 3 have been identified in a Resource Conservation Priorities report (USFWS 2002). Nongame species of management concern known to regularly occur on the Refuge are shown in Table 10.

3.4.3 Amphibians and Reptiles

Twenty species of amphibians and 28 species of reptiles have been recorded on the Refuge (Appendix D). Cricket frog, Fowler's toad, bullfrog, painted turtle, eastern box turtle, racer, and diamondback water snake are commonly observed species on the Refuge.

3.4.4 Fish[1]

Prior to dam construction, fish habitat in the area consisted primarily of the larger, named streams. No fish community survey data from streams from before dam construction exists, and only one cursory survey has been completed since. Over the last 50-60 years, most fish habitat has been provided by the three large lakes and eight smaller impoundments. Fish management on the Refuge has emphasized mixed-species, warm-water sport fish. Since 1998, the fisheries on the Refuge have been managed cooperatively by IDNR and the Refuge. Table 11 lists fish species found in Crab Orchard Lake.

3.4.4.1. Crab Orchard Lake

The fish community of Crab Orchard Lake is dominated by carp and gizzard shad, which comprise 75 percent of the biomass. However, a popular recreational fishery exists for largemouth bass, bluegill, crappie, channel catfish and white bass. The Lake's aquatic habitat has been affected by shoreline erosion, sedimentation, excessive nutrient loading from discharges of municipal wastewater and nonpoint source pollution, and contamination by PCBs and other contaminants. Sediments contaminated by PCBs were dredged from a bay of the lake in 1996.

1. *Information for this section comes primarily from: 1) Refuge records; 2) IDNR records and 3) an unpublished report by the Carterville Fisheries Resource Office (Surprenant 1994).*

Table 11: Crab Orchard NWR Fish Species List

Common Name	Scientific Name	Common Name	Scientific Name
Bowfin		**Poeciliidae**	
Bowfin	*Amia calva* (N)	Mosquitofish	*Gambusia affinis*
Herrings		**Pikes**	
Gizzard shad	*Dorosoma cepedianum* (N)	Grass pickerel	*Esox americanus* (N)
Threadfin shad	*D. petenense* (I)*	Northern pike	*E. lucius* (I)
Minnows		**Silversides**	
Carp	*Cyprinus carpio* (I)	Brook silversides	*Labidesthes sicculus* (N)
Bluntnose minnow	*Pimephales notatus* (N)	**Sunfishes**	
Fathead minnow	*P. promelas*	Largemouth bass	*Micropterus salmoides* (N)
Golden shiner	*Notemigonus crysoleucas* (N)	Green sunfish	*Lepomis cyanellus* (N)
Suckers		Warmouth	*Chaenobryttus. gulosus* (N)
Bigmouth buffalo	*Ictiobus cyprinellus* (N)	Orangespotted sunfish	*L. humilus* (N)
Perches		Redear sunfish	*L. microlophus* (N)
Yellow perch	*Perca flavescens* (I)	Bluegill	*L. macrochirus* (N)
Log perch	*Percina caprodes* (N)	White crappie	*Pomoxis annularis* (N)
Slough darter	*Etheostoma gracile*	Black crappie	*P. nigromaculatus* (N)
Killifishes		Flier	*Centrarchus macropterus* (N)
Blackstripe topminnow		**Sea basses**	
Catfishes		White bass	*Morone chrysops* (N)
Black bullhead	*Ameiurus melas* (N)	Yellow bass	*M. mississippiensis* (N)
Yellow bullhead	*A. natalis* (N)	Striped bass	*M. saxatilis* (I)
Channel catfish	*I. punctatus* (N)	Hybrid striped bass	*M. chrysops X M. saxatilis* (I)
Flathead catfish	*Pylodictus olivaris* (N)	**Aphredoderidae**	
Tadpole madtom	*Noturus gyrinus* (N)	Pirate perch	*Aphredoderus sayanus*
Drums		* Periodically stocked (I) introduced species (N) native species	
Freshwater drum	*Aplodinotus grunniens* (N)		

The fish management goals for Crab Orchard Lake are to:

maintain and/or improve the existing bluegill and redear fisheries,
maintain and/or improve the existing largemouth bass fishery,
maintain the existing channel catfish fishery,
maintain the existing white bass and hybrid striped bass fishery,
maintain the existing white and black crappie fishery, and
monitor PCB concentrations in fish flesh.

Species abundance and body condition, which are monitored by annual surveys, determine population objectives for bluegill, redear, largemouth bass, black and white crappie, white and hybrid striped bass, and channel catfish.

Although initial stocking records are not available, if USDA Soil Conservation Service recommendations were followed, largemouth bass, bluegill, channel catfish, and bullheads were stocked. Other species now occurring were present in the watershed or have since been introduced. Following the pattern of large impoundments in the 1940s and 1950s, the largemouth bass fishery flourished initially then declined through the late 1940s as carp, gizzard shad, white crappie and yellow bass became dominant. Supplemental stocking of game species

began with 1.5 million largemouth bass 2-inch fingerlings in the 1950s. Since then, millions of fry and fingerlings of several species have been released into Crab Orchard Lake.

Commercial fishing was permitted on Crab Orchard Lake during the 1960s and 1970s and discontinued in 1979. There are no plans to resume commercial fishing on Crab Orchard Lake.

Contaminant levels in Crab Orchard Lake fish have been studied by the Illinois Environmental Protection Agency, Fish and Wildlife Service and Illinois Department of Natural Resources since 1975. PCBs in fish flesh have exceeded FDA safety levels, especially in fish east of Route 148 (Hite and King 1977, Ruelle 1983, Kohler and Heidinger 1990, Kohler and Heidinger 1994).

Based on analysis of PCB data, the first fish consumption advisory was issued in 1988. People were advised that certain fish had high contamination and should not be eaten. This advisory applied to channel catfish longer than 15 inches and to carp longer than 15 inches caught east of Route 148. People were advised that bluegill and largemouth bass caught east of Route 148 had moderate contamination and should not be eaten by children and nursing mothers. This advisory has since been modified and covers largemouth bass, channel catfish, and carp. Consumption advisory information is published annually by IDNR in the Illinois Fishing Information booklet.

3.4.4.2. Devils Kitchen Lake

Devils Kitchen Lake is most commonly used for sport fishing and is known for its quality-sized bluegill and redear, occasional trophy bass, and year-round rainbow trout. The fish management goals for Devils Kitchen Lake are to: 1) maintain and/or improve the existing bluegill and redear fisheries, 2) maintain and/or improve the existing largemouth bass fishery, and 3) maintain the existing rainbow trout fishery through annual stockings.

The forage base at Devils Kitchen Lake is augmented with annual stockings of threadfin shad, if available. Population objectives for bluegill, redear, and largemouth bass are based on species abundance and body condition, which are monitored by annual surveys. Low lake fertility results in minimal plankton blooms and limited food for fish leading to lower fish numbers and growth rates. In 2004, the Illinois Department of Public Health issued a fish consumption advisory for largemouth bass caught in Devils Kitchen Lake because of elevated levels of methyl mercury.

Table 12: Small Fishing Ponds on Crab Orchard NWR

Name	Surface Area (Acres)	Shoreline Length (miles)
A-41 Pond	37	2.0
Bluegill Pond	6	0.6
Blue Heron Pond	10	0.6
Honker's Corner Pond	6	0.5
Mann's Pond	9	0.7
Manager's Pond	2	0.3
North Prairie Pond	6	0.6
Visitor's Center Pond	40	2.3

3.4.4.3. Little Grassy Lake

Little Grassy Lake is most commonly used for sport fishing and is known for quality-sized bluegill, redear, and largemouth bass. The fish management goals for Little Grassy Lake are to: 1) maintain and/or improve the existing bluegill and redear fisheries, 2) maintain and/or improve the existing largemouth bass fishery, and 3) maintain the existing channel catfish fishery through annual stockings.

The forage base at Little Grassy Lake is augmented with annual stockings of threadfin shad, when available. Population objectives for bluegill, redear, and largemouth bass are based on species abundance and body condition, which are monitored by annual surveys. Like Devils Kitchen Lake, low fertility limits fish management. Light plankton blooms and limited food leads to lower fish numbers and growth rates.

3.4.4.4. Small Impoundments

Sport fisheries management also occurs on eight small impoundments (Table 12). The IDNR attempts to control algae blooms in some of the smaller impoundments. Two ponds were treated in 1999 and 2001 with an aquatic herbicide. These impoundments are managed for warm-water, mixed species sport fisheries.

3.4.5 Monitoring

Refuge staff, staff from the IDNR, and volunteers survey wildlife use. The surveys provide information for Refuge management and support state and national conservation efforts. The following paragraphs describe current monitoring programs.

Canada Goose Surveys: Aerial surveys of Canada Geese are conducted by the IDNR, generally from mid-October to mid-March. The data are used to estimate goose-use-days. Refuge biologists also conduct an informal survey of goose use of agricultural fields.

Weekly Waterfowl Survey: Refuge biologists survey waterfowl weekly from mid-August through mid-April, traveling over 70 miles and covering 50 points to view large areas of Crab Orchard Lake and several smaller impoundments and moist-soil units. Survey data are entered into a database, which can produce 16 types of reports. Gulls, shore, wading, and predacious birds are also counted throughout the route. Goose collar observations are also recorded and reported to the Office of Migratory Bird Management.

Bald Eagle Monitoring: Biologists monitor Bald Eagle nests for use and productivity. As part of a nation-wide effort, the Refuge has participated in the mid-winter Bald Eagle survey since 1961.

Heron Rookeries: Biologists periodically check the known heron rookeries for use and productivity.

Wild Turkeys: Biologists monitor wild turkeys to keep track of their population. The data are used in establishing harvest permits.

Bluebirds: Since 1992, a group of volunteers has maintained and monitored bluebird boxes. In 2000, nine volunteers monitored 220 boxes.

Christmas Bird Count: The Refuge participates in the Christmas Bird Count, a national survey organized by the National Audubon Society.

Spring Bird Count: The Refuge participates in the Spring Bird Count, another national survey organized by the National Audubon Society.

Mourning Dove Count: The Mourning Dove Count is conducted off the Refuge as part of a nation-wide survey coordinated by the Office of Migratory Bird Management. The survey has been conducted every year since 1964.

American Woodcock Singing Ground Survey: The North American Woodcock Singing Ground Survey is a cooperative effort conducted on and off the Refuge in conjunction with the Office of Migratory Bird Management.

White-tailed Deer: The Refuge uses a fall deer count to establish a deer population index. The population index is used, in turn, to determine the number of available hunting permits. A 20-mile survey route was developed by Southern Illinois University in 1966 and the Refuge has conducted the survey every year since then.

Indiana Bat Surveys: The Indiana bat is a federally listed endangered species. Biologists have conducted limited mist-netting to determine if and where the Indiana bat might be using the Refuge.

Amphibian Surveys: Biologists have used a variety of techniques (searching, song counts and drift fences) to determine what species of amphibians, and to a lesser extent reptiles, inhabit the Refuge. In a one-time effort, biologists surveyed for deformed frogs as part of a nation-wide cooperative effort. In an effort to evaluate certain CERCLA sites, surveys for the absence or presence of amphibians and deformed frogs are ongoing.

Gypsy Moth: The Refuge cooperates with the U.S. Forest Service by installing gypsy moth traps each summer as part of a nation-wide effort to monitor this pest's distribution and population.

Exotic and Invasive Plants: Biologists informally monitor exotic and invasive plants. Some of the species monitored are autumn-olive, Johnsongrass, common reed, purple loosestrife, Canada thistle, musk thistle, kudzu, and reed canary grass.

Forest Watch: Forest Watch is a volunteer cooperative effort organized by the Illinois DNR. Volunteers conduct biological monitoring in order to identify long-term changes in the health of forest ecosystems. Two permanent monitoring plots are located on the Refuge.

River Watch: River Watch, like Forest Watch, is a volunteer cooperative effort organized by the Illinois Department of Natural Resources. Each spring

Barn Owl, U.S. Fish & Wildlife Service

Figure 24: Bald Eagle Winter Survey Counts on Crab Orchard NWR, 1993-2002

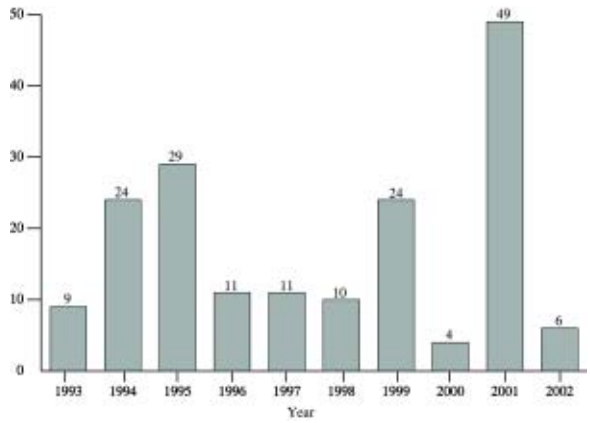
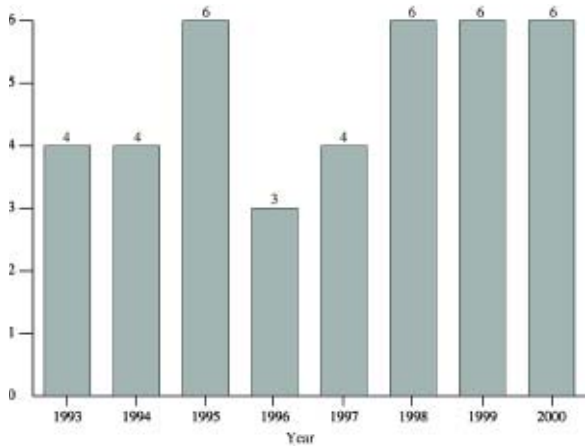


Figure 25: Bald Eagle Fledgling Counts on Crab Orchard NWR, 1993-2000



citizen scientists evaluate two streams on the Refuge. The data and results are reported to the state for an evaluation of stream quality.

Fish Surveys: Refuge fish management is conducted by IDNR in conjunction with the Service's Carterville Fishery Resource Office. The IDNR uses electrofishing on the lakes and several of the smaller ponds each year to determine population diversity, structure and overall health. The IDNR also collects fish for contaminant analysis as dictated by the State fish consumption advisory group and studies delayed bass mortality associated with fishing tournaments as appropriate. Creel surveys were conducted in 1976, 1978 and 2000.

Lotus Surveys: The American lotus (Nelumbo lutea) that grows in Grassy Bay is in apparent decline and is being studied. The IDNR has done some seeding and planting in the bay. The Refuge is monitoring several new patches of lotus in Crab Orchard Lake east of Route 148.

Shoreline Surveys: Shoreline and island erosion has been shown to be a contributor of sediment to the lakes, especially Crab Orchard Lake. Over the years various surveys and control efforts have been tried. The last effort was in 2001.

3.5 Federal Threatened and Endangered Species

3.5.1 Mammals

The endangered Indiana bat (*Myotis sodalis*) is not known to occur on the Refuge, but it has been observed in areas nearby. In winter, Indiana bats hibernate in caves and mines. There are no known caves or mines on the Refuge, but Indiana bats are known to hibernate in caves in Jackson County adjacent to the Refuge. Summer maternity roosts and colonies are found in well-developed riparian woods and upland forests.

The first surveys for Indiana bats on the Refuge occurred in 1989. During two nights of netting, none were captured. However, Illinois DNR biologists thought that some of the Refuge habitat looked suitable. There have been several attempts to capture Indiana bats on the Refuge to determine if the species is present. A 1999 survey was unsuccessful in capturing any Indiana bats.

3.5.2 Birds

The Bald Eagle (*Haliaeetus leucocephalus*) occurs as a winter migrant and a summer breeder on the Refuge (Figure 24). The Bald Eagle is currently listed as a threatened species that has been proposed to be delisted. Bald Eagles are probably much more common in the area than they were before construction of Crab Orchard Lake in 1940. The Refuge estimated 10-14 wintering birds in 1961. The history of eagles nesting can be summarized as: 1974-construction of the first nest; 1979-the first nesting attempt; 1980-first nestling; 1981-first fledglings. Generally, each year 10 to 30 bald eagles winter on the Refuge; there are two or three active nests and two to six fledglings (Figure 25).

3.5.3 Plants

There are no known federally listed threatened or endangered plants on the Refuge.

3.6 Public Use Resources and Trends

Swimming, boating, picnicking, dog field trials, camping, hunting and fishing were a part of the Crab Orchard Creek Project before the establishment of Crab Orchard National Wildlife Refuge. When Congress transferred the lands to the Department of the Interior, they directed the Secretary to classify the lands for the most beneficial use. Subsequently, the Secretary designated Area I and Area III of the Refuge for recreational use, including hunting, fishing, picnicking, boating, swimming and similar activities. In Area III group recreation and camps were to take precedence over other public uses. Area II was classified as "closed refuge." (Figure 26)

When the Department of the Interior assumed management of the lands, Area I was under a single concession permit issued by the Soil Conservation Service. The concessionaire operated two government owned bathing beaches, a boat docking concession (Playport) and a skeet and trap facility. The Crab Orchard Boat & Yacht Club, an incorporated group of individuals, leased property and paid concession royalties to the main concessionaire.

In 1956, the Refuge reached a milestone of 1 million annual visitors. Nine years later visitation surpassed 2 million annual visits. Visitation fell as additional State and federal recreational areas were constructed in Southern Illinois. Today the annual visitation averages 1 million.

A wide spectrum of recreational activities continues to occur on and around Crab Orchard, Devils Kitchen and Little Grassy lakes. The activities include boating, water-skiing, swimming, camping, picnicking, hunting, fishing, wildlife observation, environmental education, environmental interpretation, horseback riding, and photography. Public use facilities include campgrounds, marinas, boat ramps, fishing piers, beaches, picnic areas, hiking trails, auto tour, visitor center, environmental education complex, observation decks, and photo blinds.

3.6.1 Hunting

Several species of small game, big game, and migratory waterfowl are hunted on the Refuge. Federal and State hunting regulations apply. Recreational trapping requires a special use permit. Refuge records show only a few trappers setting traps on the Refuge in the last few years.

Most hunting occurs outside the restricted use area. The public use area of the Refuge makes up approximately 23,000 acres and is open to all hunting activities in accordance with State hunting seasons. Hunting includes muzzleloader, archery, shotgun and pistol deer hunting, waterfowl hunting, archery and shotgun wild turkey hunting, small game hunting (rabbit, squirrel, quail, and woodchuck), game bird hunting (dove, woodcock, snipe and crow) and furbearer hunting (raccoon, opossum, fox and coyote).

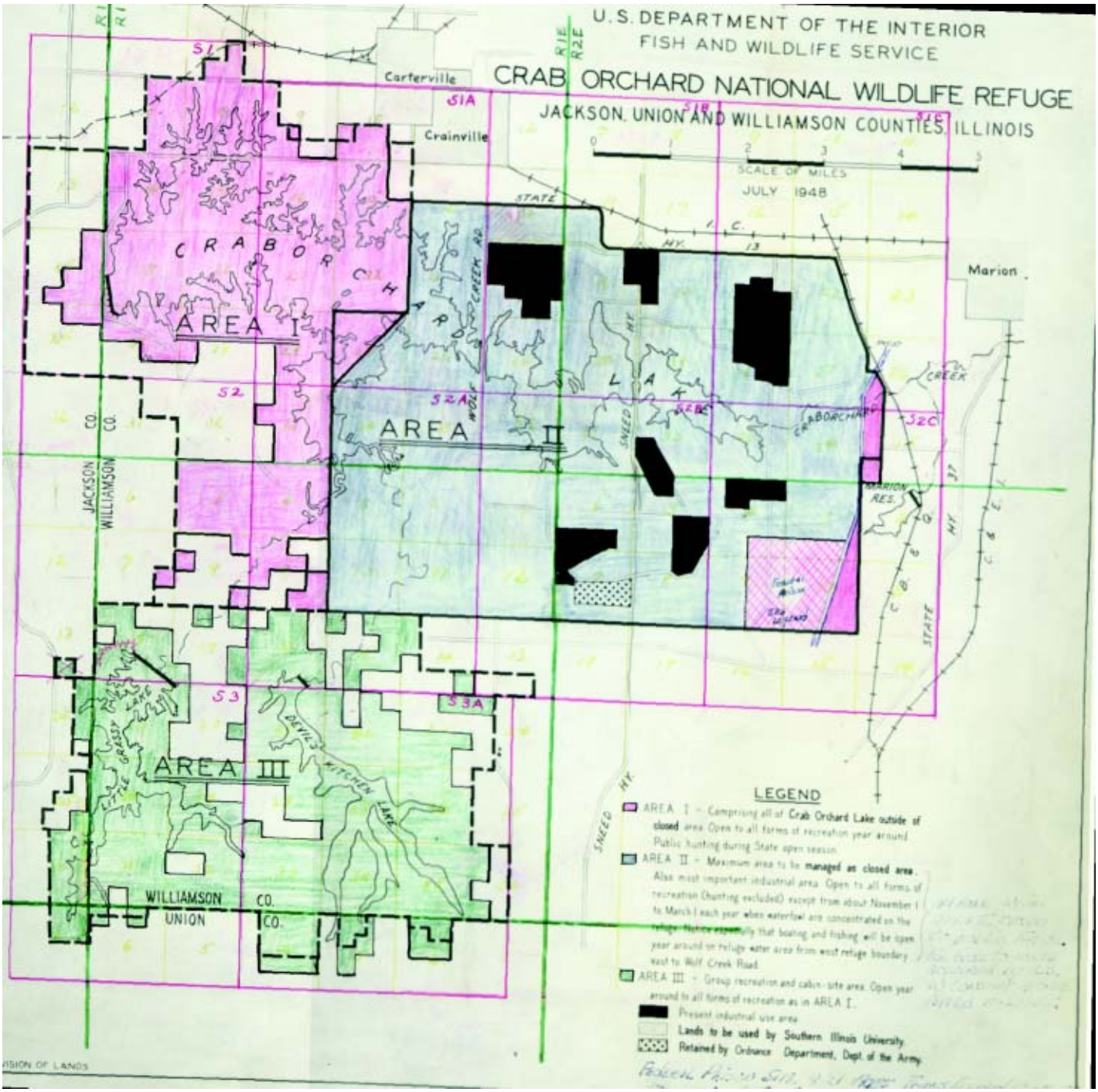
A controlled white-tailed deer and wild turkey hunt occur in the restricted use area. Other hunting programs include controlled goose hunting, youth deer hunting and deer hunting for people with physical disabilities. Hunting is prohibited in zones around the youth camps on Little Grassy Lake and industrial areas in the restricted use area.

Restricted Use Area Deer Hunt: Since 1973, white-tailed deer hunting in the restricted use area has been an important management tool and a popular recreational activity. The Refuge conducts two hunts that coincide with State seasons. Five hundred permits are issued each season for a total of 1,000 permits.

From 1973 through 1994, hunters could take either sex of deer. They were encouraged to take antlerless deer with the intent of keeping the Refuge's deer population strong and healthy by limiting the herd size and balancing the sex ratio. However,

Marion Boat Club, 1945

Figure 26: 1948 Area Designations, Crab Orchard NWR



the Refuge did not achieve this goal. Therefore, in 1995, the first gun deer hunting season was designated antlerless only.

Restricted Use Area Spring Wild Turkey Hunt: In the spring of 2001, the Refuge implemented a spring turkey hunt in the Restricted Use Area. The Refuge requested 15 State-issued permits for each of four seasons for a total of 60 permits. When the State went to five seasons in 2002, the Refuge chose to keep the same total number of permits (60) so 12 permits were issued for each season. The State also added a youth season, so 12 additional Restricted Use Area permits were added in 2002. A total of 72 permits are currently offered. The public use area portion of the Refuge is open to all turkey hunters who have an appropriate permit from the State. This can result in hunter competition for prime hunting areas and lower success rates. The Refuge goal for the Restricted Use Area hunt has been to offer an experience that focuses on lower numbers of hunters and higher success rates. Hunter success rates in the Restricted Use Area during 2001-2004 have been 75 percent, 43 percent, 52 percent, and 35 percent, respectively. The State-wide hunter success rate is about 20 percent.

Controlled Goose Hunting: The area for this hunt is within the portion of the Refuge open to public hunting. The controlled goose hunting areas, contain 18 land blinds and 15 water blinds. Two of the blinds are accessible to people with disabilities and can be reserved daily.

Youth and Disabled Persons Deer Hunt: In 1991, volunteers constructed blinds and implemented the hunts, which have been very successful. The hunts coincide with the first shotgun deer hunt season. The Refuge reserves permits for 25 disabled hunters and 25 youth hunters and a portion of the Restricted Use Area is designated for these hunts. Hunters are required to have an aide or adult with them in the field.

3.6.2 Fishing

Fishing is one of the more popular visitor pastimes on the Refuge. Crab Orchard, Little Grassy and Devils Kitchen Lakes are available for fishing year-round with one exception. The eastern portion of Crab Orchard Lake is closed to boating from October 1 to March 14 to provide resting area for wintering waterfowl. The main species of fish sought by the anglers are largemouth bass, crappie, bluegill and channel catfish.

There are several bank fishing areas on the Refuge (see Figure 27). Although there are many other good fishing areas, the areas described in the following paragraphs receive the highest visitation and the most noticeable resource impacts.

Visitor's Pond is a popular fishing site on the Refuge. It is located in the restricted use area behind the visitor information center. The pond is open from March 15 to September 30. A universally accessible asphalt trail leading to a fishing pier allows easy access to the pond.

Wolf Creek Recreation Area consists of a causeway and a peninsula where pan fishing is popular year-round. There are two gravel parking areas, a restroom, fish attractors, and six accessible fishing platforms along the causeway. Picnic tables and benches are provided for day use.

Blue Heron Pond is located in the restricted use area. The pond is open from March 15 to September 30. Because it is out of the way, the pond receives far fewer visits than other ponds in the restricted use area.

A-41 Pond is located in the restricted use area. People walk from a gravel parking area approximately one-half mile to the pond. The pond is open from March 15 to September 30. The opening coincides with cattle pasturing in the same area.

Manager's Pond is accessible from Old Route 13 near Carterville. The pond receives light use, possibly due to the scarcity of parking facilities and the heavy algae growth covering the pond during most of the summer.

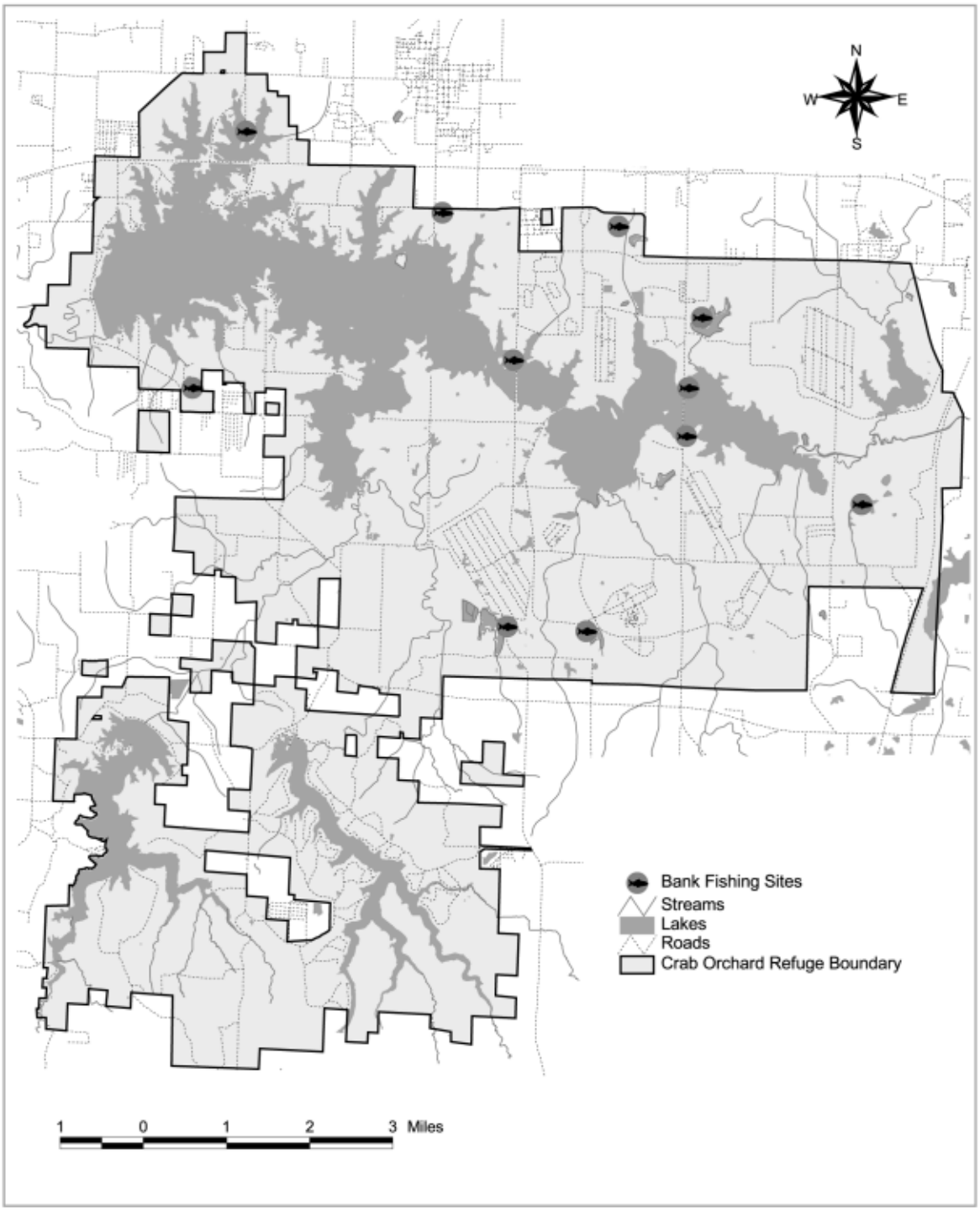
Honker's Corner Pond is located on Old Route 13 approximately 1 mile west of Route 148. There is ample roadside parking. The pond is used consistently in early spring, but slows as algae growth covers the pond during most of the summer months.

Route 148 North is located on the northeast end of the Route 148 causeway. There is a large gravel parking lot and kiosk. The area receives moderate use from spring to fall. Mostly anglers fish for pan fish and channel catfish in Crab Orchard Lake.

Route 148 South is located on the southeast end of the Route 148 causeway. There is a small gravel parking lot. The area usually has one or more cars in the parking lot during fishing season.

Cambria Neck Area is located on a peninsula off Cambria Road. The area is used by anglers often during the height of fishing season. There are picnic

Figure 27: Bank Fishing Sites on Crab Orchard NWR



facilities, a restroom, a parking lot and a grassy recreation area. The area is visible from New Route 13, which may account for a lot of first-time visitors.

Ann Manns Pond is located on Spillway Road, 2 miles south of the Crab Orchard Lake Dam. Bank fishing and fishing from non-motorized boats is permitted year around. There is a small parking area.

Bluegill Pond is located along the southern boundary of the Restricted Use Area. People walk from a gravel parking area approximately one-half mile to the pond. The pond is open from March 15 to September 30. The opening coincides with cattle pasturing in the same area.

Fishing Tournaments

Five fishing tournaments are held annually on the Refuge's three lakes under special use permits. The tournaments are well established and require minimal assistance from Refuge staff, although the Refuge's law enforcement staff and Illinois DNR officers do run spot checks during the tournaments. Approximately 500 anglers participate in these events. Anglers and biologists have expressed concern over the lack of vegetation for spawning bass and, with respect to tournaments, to post-release mortality.

Fish-Offs

The three major lakes receive many visits from fishing clubs hosting club events called "fish-offs." A fish-off is defined as an organized club fishing event of 20 boats or fewer. The Refuge registered over 130 fish-offs in 2001 and more occur without being registered. The Refuge recently instituted new rules restricting fish-offs to one per club, per lake, per year. All fish caught must be returned to the lake and aerated live wells are required for all boats.

3.6.3 Camping

At one time camping was allowed throughout open areas of the Refuge. Because of litter and trash problems, camping was restricted to a concession-operated campground on each of the three major lakes. Campground locations are shown in Figure 1 on page 2.

Crab Orchard Campground began operation in 1964 under a concession contract. In 1969, the Refuge assumed operation of the campground and upgraded electric service, restrooms and showers. The campground returned to a concession contract in 1972.

Today Crab Orchard Campground is the largest of the four campgrounds with 250 electric and non-electric sites. Restroom and shower facilities are located on each of the six loops. In addition, there is a fish cleaning area, a store and a swimming beach. The campground is open from April 1 through October 31. With management approval, campsites may be made available during the off-season. There is no limit on campground stays.

Little Grassy Campground is a concession-operated campground and marina that has 130 electric and non-electric campsites. There is a restroom and shower facility. A store offers bait, food items and boat rental. The campground is open from April 1 through October 31 with limited campsites available during the off season.

Devils Kitchen Campground is a concession-operated campground and marina that has 45 electric and non-electric campsites. The campsites are tiered, because they are located on a steep hill. There is a restroom and shower facility. A store offers bait, food items and boat rental. The campground is open from April 1 through October 31 with limited campsites during the off season.

Crab Orchard Boat & Yacht Club, a private organization, operates a marina and a campground with 40 electric campsites under a lease contract. Membership is required to use any part the facility. Camping is permitted with an annual membership.

Figure 28 summarizes campground visits to the Refuge.

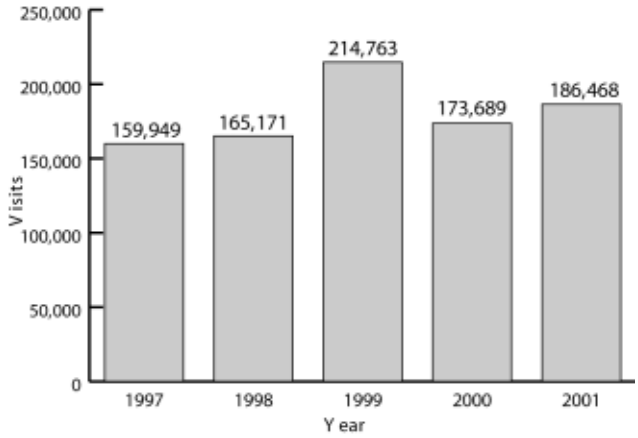
3.6.4 Wildlife Observation

Wildlife observation is the most popular activity occurring on the Refuge, and there are many good observation areas on the Refuge. Points of interest, trails, auto tours and viewing blinds have been developed in an effort to encourage and enhance wildlife viewing. Figure 29 identifies existing observation blinds and decks.

The Route 148 observation platform is located approximately 2 miles south of the Visitor Center. The platform has interpretive signs and offers a good view of an open field, but only adequate viewing of a pond area. There is a large, paved parking lot.

Wolf Creek Causeway is a very popular location when wintering waterfowl are present. The parking lot is used to view birds from automobiles.

Figure 28: Crab Orchard NWR Campground Visits Per Year



Waterfowl Display Pond is located on Wolf Creek Road about one-half mile north of the causeway. There is a roadside pull-off area from which visitors can view waterfowl at the 1-acre pond, which is about 100 yards west of the road.

Bald Eagle Lane is located off Spillway Road and offers a view of Grassy Bay and an occasional Bald Eagle sighting. There is a Bald Eagle's nest not too far from this site.

The Devils Kitchen Dam observation area offers good viewing of the lake. The area has a restroom, parking lot, picnic table, grassy area and trail leading to the bottom of the dam.

Devils Kitchen Line No. 11 offers a good view of the lake.

Little Grassy Lake Dam overlook offers an excellent view of the lake. The area has enough room for a few automobiles and is occasionally congested when anglers use it as a parking lot.

3.6.5 Hiking Trails

Hiking is permitted throughout the public use area of the Refuge. Refuge volunteers maintain seven trails that are open to the general public and one trail that is provided for educational purposes only. Numerous fire trails have served as hiking trails on the Refuge. The following is a list of maintained trails.

Harmony Trail: The trail is about 1 mile long and is a self-guided, non-interpretive trail. The trail has an A-frame structure with interpretive panels at the trailhead. The trail receives heavy use, especially during the spring and fall.

Prairie Trail: Located across from the Harmony Trail, this trail makes a circle through a 7-acre prairie restoration area. Currently the trail is used very little, because it is not well defined or interpreted.

Wild Turkey Trail: Located across from Devils Kitchen Line No. 12 on Tacoma Lake Road, the 2-mile trail zigzags through a pine plantation and continues along a ridge top, ending at a gravel parking lot on Grassy Road. The trail has been signed at the trailheads and throughout the trail.

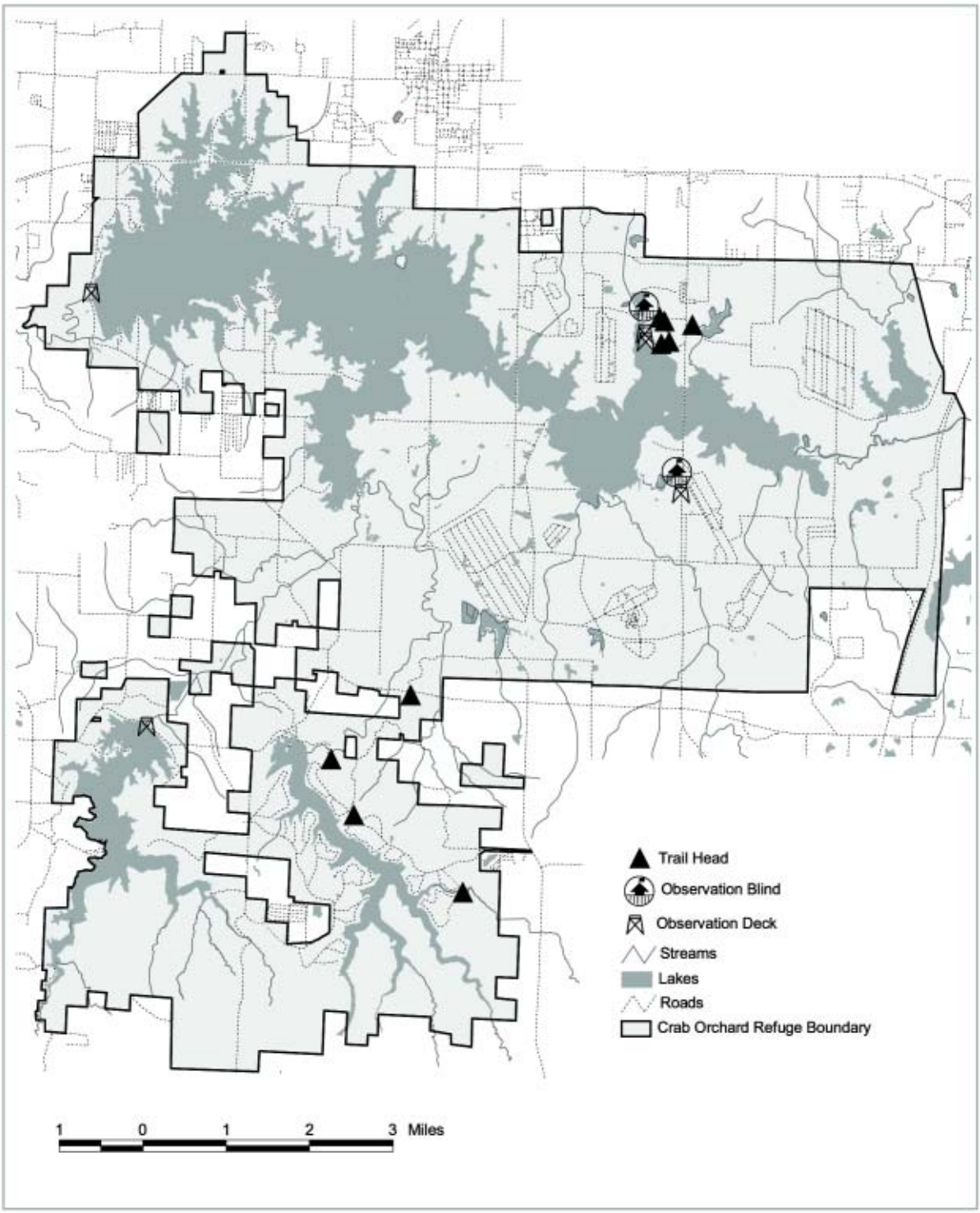
Devils Kitchen Line No. 17: This loop trail is an asphalt road that has been closed to automobile traffic. It borders and offers access to the Crab Orchard Wilderness. There is a large, paved parking lot at the trailhead.

Visitor Center Trail: The trail is located next to the Visitor Center. The first quarter mile is universally accessible and has three benches and four interpretive signs. A new half-mile section completes the loop trail. The new section awaits an asphalt surface.

Homestead Trail: The gravel, 1-mile loop trail next to Refuge Headquarters is designed as an environmental education trail. It has an observation deck and a study platform.

Rocky Bluff Trail: The trail is the most popular trail on the Refuge. Located across from Devils Kitchen Line No. 11, the trail offers a magnificent view of the unglaciated part of the Refuge. The 1.5 mile loop trail crosses the Wild Turkey Trail at midpoint. During the spring, volunteers lead wildflower walks along the trail.

Figure 29: Observation Areas on Crab Orchard NWR



The National Trail System Act of 1968 (Public Law 90-543) authorized creation of a national trail system comprised of National Recreation Trails, National Scenic Trails and National Historic Trails. Legislation is pending in Congress to add National Discovery Trails as a new category of long-distance trails and designate the American Discovery Trail as the first National Discovery Trail. The proposed American Discovery Trail covers more than 6,000 miles from Delaware to California. The Southern Midwest Route of the American Discovery Trail crossing Illinois would overlay most of the River to River Trail, which runs about 146 miles from Battery Rock on the Ohio River to Grand Tower on the Mississippi River for a distance of about 176 miles (River to River Trail Society, 1995).

In late 1997, the Shawnee National Forest drafted a memorandum of understanding (MOU) between the Shawnee National Forest, the Refuge, and the River to River Trail Society to formalize maintenance responsibilities and alignment of the River to River Trail along a tentative route through the Crab Orchard Wilderness. The parties have not agreed to or signed the MOU.

3.6.6 Boating

Boating has long been a popular activity on the Refuge. When Crab Orchard Lake was completed in 1940, it was the largest man-made lake in Illinois. Crab Orchard Lake hosted professional outboard motor races in 1947. In 1953, the Southern Illinois Sailing Club moved from St. Louis to Crab Orchard Lake. Over the past 50 years boating on Crab Orchard Lake has changed with the times, from 25 hp outboards in the 1940s to jet skis and house boats today.

The Refuge offers boating on Crab Orchard, Devils Kitchen, and Little Grassy lakes. Crab Orchard Lake has 13 improved boat launching facilities; three ramps are provided on Devils Kitchen Lake; four are provided at Little Grassy Lake (see Figure 30). The lakes and boating facilities are described in the following paragraphs.

3.6.6.1. Crab Orchard Lake

Crab Orchard Lake is the largest of the three main lakes and covers approximately 7,000 acres. The area west of Wolf Creek Road is open all year and serves as a multi-recreation area for pleasure boating of all types (jet skis, house boats, runabouts, sail boats, and pontoons) and fishing. The area east of Wolf Creek Road is open March 15 to September 30. Thirteen boat ramps offer access to the lake.

Three marinas are operated on Crab Orchard Lake. The Refuge operates Playport Marina and the former Images Marina. Crab Orchard Boat & Yacht Club offers docks, slips, a picnic area and campsites to members only.

3.6.6.2. Devils Kitchen Lake

The smallest and most scenic of the three lakes, Devils Kitchen Lake covers approximately 800 acres. Care must be used when boating in the lake because numerous trees lie just under the water's surface. The lake is used for boating, canoeing, and fishing. Outboard motors on the lake are limited to 10 horsepower. There are three public boat ramps and one marina on the lake.

3.6.6.3. Little Grassy Lake

Little Grassy Lake covers approximately 1,000 acres. The lake is heavily used by the public, four group camps and Southern Illinois University's Touch of Nature Environmental Center for fishing, boating, swimming and canoeing. The lake is scenic and has some underwater hazards from trees. Outboard motors on the lake are limited to 10 horsepower. There are four public boat ramps and one marina on the lake.

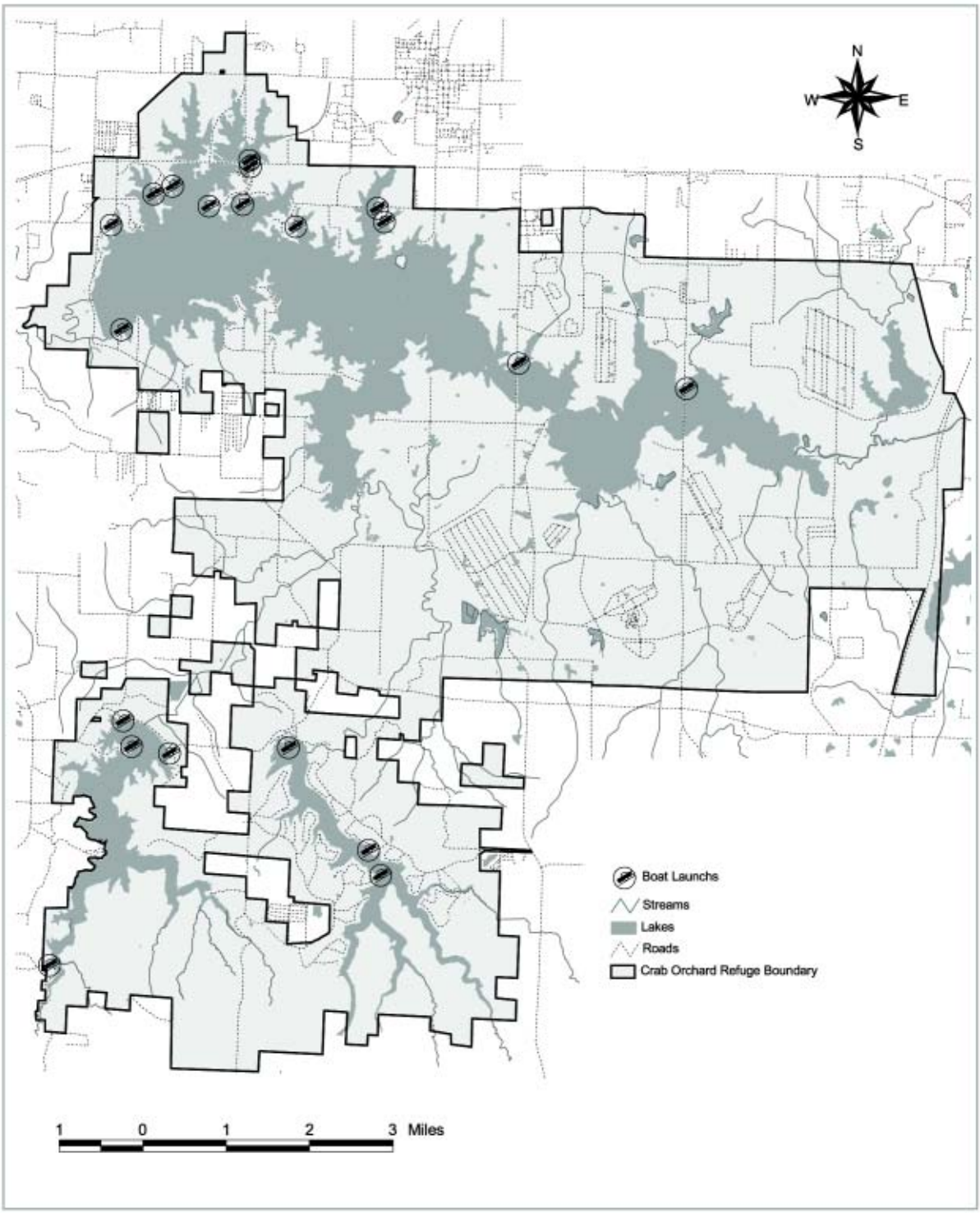
3.6.7 Swimming

Swimming has long been a popular activity on the Refuge. At one time the Refuge supported six public beaches – four on Crab Orchard Lake and one each on Devils Kitchen Lake and Little Grassy Lake.

The Soil Conservation Service ran two concession-operated beaches on Crab Orchard Lake at the time the area was transferred to the Department of the Interior. Each beach had a beach house with showers, changing area, and vending area. Subsequently, the Fish and Wildlife Service ran these beaches (Hogan's Point and Crab Orchard) as fee areas. The Service also created beaches at Carterville and Lookout Point. In 1973, the Crab Orchard Beach and Hogan's Point Beach were closed and Carterville and Lookout Point were placed under concession contracts.

Today swimming is allowed in Crab Orchard and Little Grassy lakes and prohibited in Devils Kitchen Lake. In 1994, Carterville and Lookout Point beaches were removed from concession contract. The Service then ran Carterville Beach as a recreational area and Lookout Point was closed. Because the Refuge was not able to meet public health standards at Carterville Beach, the beach was closed in 1998. The Refuge expanded the beach at the Crab Orchard Campground and the concessionaire

Figure 30: Boat Launches on Crab Orchard NWR



Beach on Crab Orchard Lake

opened the beach to the general public. The Little Grassy Campground also operates a beach that is open only to campers.

3.6.8 Picnicking

From the late 1940s through the 1960s, picnicking was a very popular activity on the Refuge. In 1961 there were 20 designated picnic areas with more than 200 picnic tables. When the Refuge experienced a $75,000 budget cut in non-program uses in 1973, several picnic areas were closed. Today picnicking is encouraged in four locations on the Refuge. The areas vary in size, character and type of use (see Figure 31).

Cambria Neck: This is the largest of the picnic areas. The area has several picnic tables with grills, a restroom, a gravel boat ramp and parking lot. The area is open during warm season months for picknicking and fishing.

Greenbriar: This area has a parking lot, a restroom, an accessible fishing dock and three picnic tables and grills. The area is used mostly by anglers fishing along the bank.

Harmony Trail: The area has a heated restroom, a large parking lot and two concrete picnic tables. The area is used mainly by school groups and trail visitors.

Wolf Creek Recreation Area: This area is mostly used by anglers fishing from the bank. The area has five picnic tables and grills, a restroom, and fishing access.

3.6.9 Horseback Riding

Regulations controlling horseback riding on Crab Orchard NWR have seen several changes over the years. During the 1960s and up to 1979, horseback riding was permitted only in areas designated by signs or on marked horseback trails. In 1979, the regulation permitted horseback riding only on existing paved or graveled roads in the open area (public use area) of the Refuge. In 1984, the regulation prohibited horses in concession, agriculture and grazing areas.

Even though the 1984 regulation allowed horseback riding in most of the public use area, this activity is concentrated in the more wild and scenic southern portion of the Refuge. In 1976, much of this southern portion was designated as the Crab Orchard Wilderness and horseback riding was not allowed. In the past two decades, probably as a result of lax enforcement, horseback riding in the Wilderness has become increasingly common. Equestrians typically ride on old abandoned roads and user-defined trails within the Wilderness and adjacent lands. Recently there has been a marked increase in the development of unauthorized trails in the Wilderness.

Several organizations have proposed developing trails in the Wilderness for hiking and horseback riding. In 1980 the Shawnee Trails Conference, Inc. proposed the 130-mile MISHIO trail traversing southern Illinois from Grand Tower on the Mississippi River to Cave-in-Rock on the Ohio River. The Refuge Manager decided not to authorize any trail construction in the Wilderness based on the unsuitable soil and steep slopes. The Refuge's Master Plan, finalized in 1979, also recommended that no trails be developed for these same reasons. The Crab Orchard Wilderness Management Plan (1985) states: "No trail construction will be undertaken in the future …" In 1993 The River to River Trail Society sought permission to realign the River to River Trail from public, paved roads to a route through the Wilderness. The Refuge Manager requested more details from the Society regarding design criteria, layout, construction and maintenance, as well as modes of travel and expected levels of public use, to assess the impacts on the Wilderness and the Refuge in general. In 1997 volunteers laid out and cleared a tentative route, but the proposal has not been formally evaluated. Later that year a formal Memorandum of Understanding between the Society, the Refuge and the U.S. Forest Service was drafted to define trail alignment and maintenance responsibilities, but it has not been signed.

3.6.10 Group Camps

Four group camps are located on Little Grassy Lake. The camps operate under a cooperative agreement with the Refuge.

Figure 31: Picnic Areas on Crab Orchard NWR

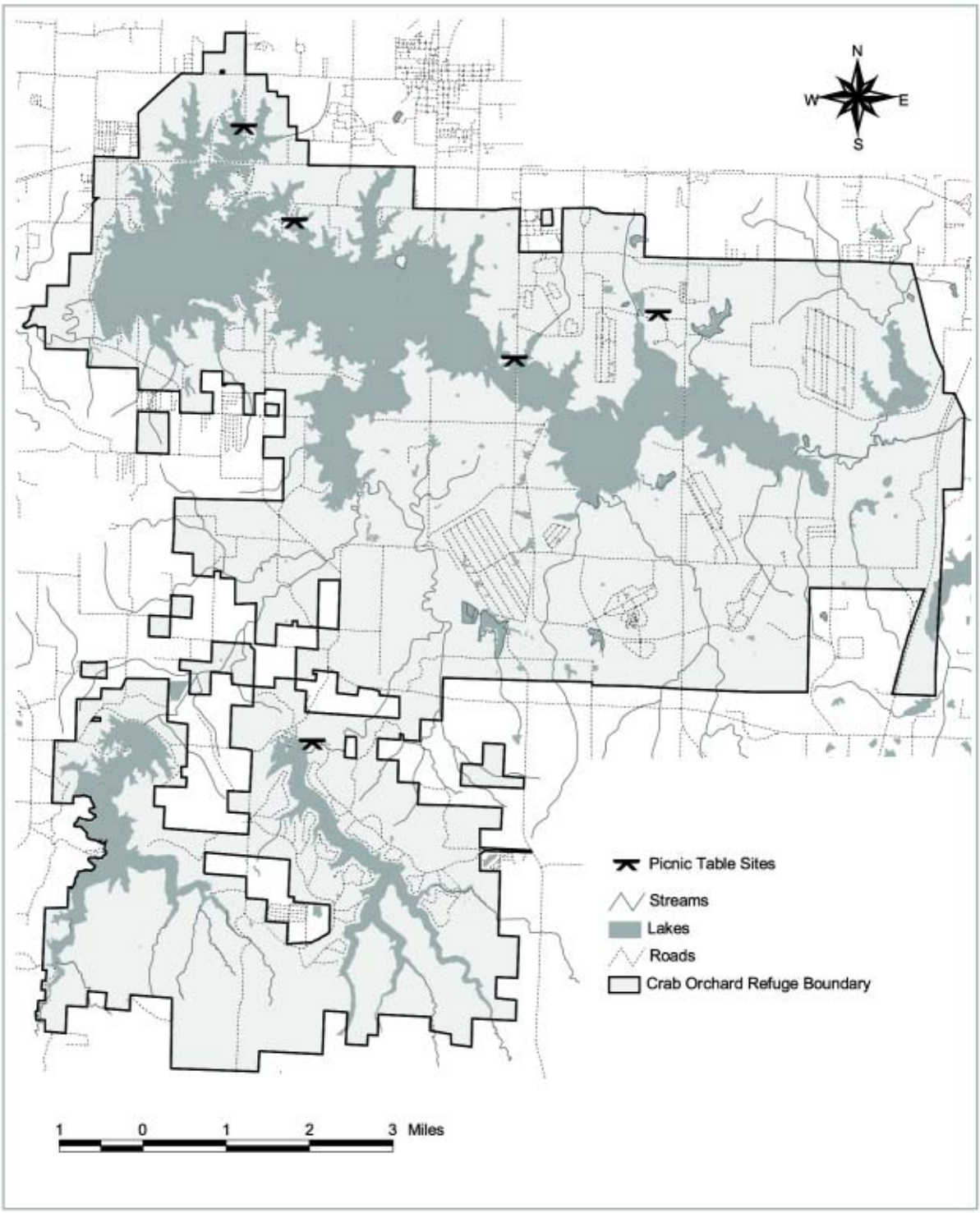
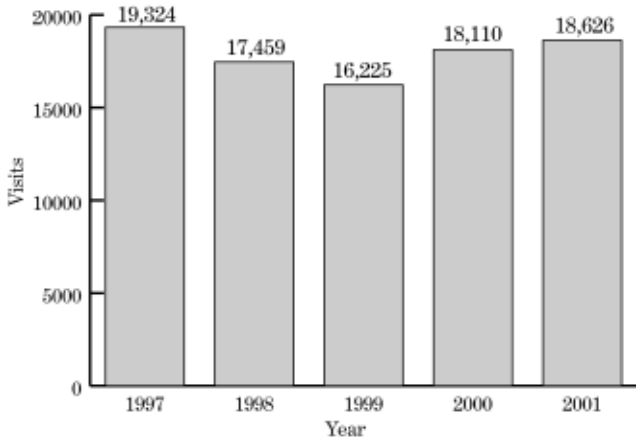


Figure 32: Annual Group Camp Attendance at Crab Orchard NWR, 1997-2001



Annually, approximately 5,700 people attend the United Methodist Church Camp and 1,200 attend Camp Carew, a Presbyterian Church camp.

The Boy Scouts of America camp, Pine Ridge, is primarily a day use facility that is active throughout the year. Approximately 6,000 Scouts attend the camp each year.

The Girl Scouts camp, Camp Cedar Point, is recognized as one of the oldest Girl Scout camps in the nation. The camp is active throughout the year. Approximately 7,000 Scouts attend this camp.

Almost 20,000 campers participate in group camping activities on the Refuge every year (Figure 32).

3.6.11 Environmental Education

The Refuge provides educational assistance to area teachers, educators, and Refuge group camps. Refuge staff, interns, and volunteers present both on-site and off-site educational programs to area school groups, Boy Scout groups, and other organizations upon request. In addition, each group camp is required to provide a minimum of 1 hour of environmental education each day to campers. The Refuge provides camp instructors with workshops and lesson plans prior to each camping season.

Educational materials (books, posters, videos, and other supplies) are maintained by the Refuge and are available for loan to area educators. Educational kits focusing on key concepts and resources are also available for loan. In addition, Refuge staff provide assistance with curriculum development and with special event programs conducted by other agencies and organizations.

3.6.12 Interpretation

Interpretive programs are given by Refuge staff and volunteers to school, civic and other groups. The programs are presented through automobile tours, talks and walks. Some of the better attended programs include Bald Eagle tours, wildflower walks and owl prowls. The Refuge also presents its interpretive message through bulletin boards, signs and wayside exhibits. Visitor services staff presented 114 programs to more than 3,400 individuals in 2001.

3.6.13 Visitor Center

The Visitor Center contains an information and exhibit area, auditorium/conference room, book store and office space for visitor services staff. Built in 1941, the building originally housed a fire station. The building was renovated in 1993 and has 3,455 square feet. Approximately 1 million people visit the Refuge every year, and the Center receives approximately 40,000 of those visitors. Visitor Center staff answer questions, issue user passes, host workshops and conferences, present interpretive programs, and check-in deer and turkey hunters.

3.6.14 Existing Transportation Patterns and Visitor Facilities

Crab Orchard NWR is located in southern Illinois relatively close to Arkansas, Indiana, Kentucky, Missouri and Tennessee. Interstate highways 24, 55, 57, and 64 provide high speed routes to southern Illinois. Several state and county roads provide access to and within Refuge boundaries.

State Route 148 passes through the Refuge from north to south, passes the Visitor Center and has an average daily traffic count of 5,800. New State

Route 13 crosses the northern portion of the Refuge and has an average daily traffic count of 25,000. New State Route 13 provides the primary access to the developed recreation sites in the northwestern portion of the Refuge. Interstate 57 passes through the eastern portion of the Refuge and has an average daily traffic count of 26,900.

The Refuge also maintains an extensive system of roads within its boundaries. According to a 2001 survey of Refuge roads completed by the U.S. Department of Transportation, Crab Orchard National Wildlife Refuge maintains 38 miles of paved surface roads and 17 miles of gravel roadway for a total of 56 roadway miles. And additionally, 1.1 million square feet of parking area, 21 boat launch ramps, and three universally accessible areas are also maintained by Refuge personnel.

3.7 Special Management Areas

3.7.1 Wilderness

Congress designated the Crab Orchard Wilderness as a unit of the National Wilderness Preservation System on October 19, 1976, when it enacted Public Law 94-557. The 4,050-acre Wilderness was the first in the State of Illinois; seven additional wilderness areas have since been established on the Shawnee National Forest. The Crab Orchard Wilderness is located in the extreme southern portion of the Refuge bordering the shores of Devils Kitchen and Little Grassy lakes. (See Figure 1 on page 2.) A Wilderness Management Plan was approved for the Crab Orchard Wilderness in 1985.

The rugged terrain of this unglaciated land is interlaced with numerous creeks. The vegetation cover in the Crab Orchard Wilderness is predominantly second growth deciduous forest on slopes and typical old-fields with scattered trees, brush and small grassy openings along ridges. There are more than 700 acres of plantations, including 400 acres of hardwood (mostly black-locust) and 325 acres of non-native pine and pine-hardwood. Invasive species, such as autumn-olive, multiflora rose, Japanese honeysuckle, Amur honeysuckle and Oriental bittersweet, are common throughout the Wilderness, and likely to become more problematic. The Wilderness contains numerous old house sites with relic exotic ornamental plants, sandstone pillars, open wells, ponds and trash. There is one known cemetery (Baker) located in the north central portion. Rocky Comfort Road, which is maintained by Williamson County, runs north and south through the area.

Crab Orchard Wilderness Area

The Wilderness Act of 1964 permits certain activities within designated wilderness areas that do not alter natural processes. Wilderness values are preserved through a "minimum tool" approach that requires the Refuge to use the least intrusive methods, equipment and facilities necessary for administering the areas. The Refuge staff maintains boundary signs and barricades to prevent vehicle trespass and occasionally patrols in the area. There are no research projects presently being conducted within the Wilderness.

Visitor activities in the Crab Orchard Wilderness include hunting, hiking, horseback riding, nature study, and mushroom picking. Although horseback riding was prohibited when the Wilderness was designated, this use has become increasingly common in the years since then, likely as a result of lax enforcement. Hikers and horseback riders generally follow old roads and user-defined trails, which have become eroded in some places especially on the steeper slopes. Horse traffic, though generally light, has disturbed the fragile soils along the trails. Most damage occurs during winter and spring when the ground is wet and soft.

The Crab Orchard Wilderness is located near the population center of southern Illinois and is readily accessible to visitors who seek solitude in a natural

setting. The primary access points are along Rocky Comfort Road, Devils Kitchen Lines #9 and #17, Antioch Cemetery Road, and West Liberty Cemetery Road. The Wilderness is also accessible by boat from Little Grassy and Devils Kitchen lakes. The number and distribution of visitors in the Wilderness are not well documented. A study was conducted by Reeder (1977) soon after Wilderness designation to characterize public use by surveying 128 visitors. A more detailed study by McCurdy and others (1994) described the demographics and recreation use patterns of visitors to five wilderness areas on the Shawnee National Forest, one of which was Panther Den Wilderness which is adjacent to the Crab Orchard Wilderness.

3.7.1.1. Inholdings and Lands Contiguous to the Crab Orchard Wilderness

The entire northern boundary and almost all of the western boundary of the Wilderness border other Refuge land (see Figure 5 on page 27). Much of the northern boundary is formed by the Little Grassy and Devils Kitchen lakes, which are man-made reservoirs. At the time of designation, the Wilderness designation excluded an inholding and another parcel surrounded by Wilderness on three sides, both owned by Southern Illinois University. Through a land exchange in 1979, the Refuge acquired these tracts, which together constitute about 120 acres. An additional 558-acre tract contiguous with the southern boundary of the Crab Orchard Wilderness was acquired in the same land exchange. Rocky Comfort Road runs north-south through this tract.

Lands on the southern boundary of the Wilderness include the 779-acre Panther Den Wilderness, managed by the USDA Forest Service. Additional lands are owned by Southern Illinois University and private individuals. Neighboring lands are primarily second growth forest with a few fields making up the rest of the boundary. Lands adjacent to the eastern boundary of the Wilderness are primarily fields in private ownership.

3.7.2 Research Natural Areas

The Service administratively designates research natural areas (RNA), which are part of a national network of reserved areas under various ownerships. RNAs are intended to assist in the preservation of examples of all significant natural ecosystems for comparison with those influenced by man, to provide educational and research areas for scientists to study the ecology, successional trends, and other aspects of the natural environment, and to serve as gene pools and preserves for rare and endangered species of plants and animals. In RNAs, 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 RNA was established. Activities such as hiking, bird watching, hunting, fishing, wildlife observation, and photography are permissible, but not mandated, in RNAs. Thirteen RNAs totaling 1,353 acres have been established on the Refuge (Figure 33 and Table 13).

3.7.3 Conservation Easements

When the Farm Services Agency (FSA), formerly the Farmers Home Administration (FmHA), acquires property through default of loans, it is required to protect wetland and floodplain resources on the property prior to resale to the public. The Service assists the FSA in identifying important wetland and floodplain resources on the property. Once those resources have been identified, FSA protects the areas through a perpetual conservation easement and transfers management responsibility to the Service. The authority and direction comes from the Consolidated Farm and Rural Development Act (7 U.S.C. 1981 and 1985, as amended); Executive Order 11990 providing for the protection of wetlands; and Executive Order 11988 providing for the management of floodplain resources. The Service administers the easements as part of the National Wildlife Refuge System.

The Refuge manages 24 conservation easement areas totaling 490 acres located within the Crab Orchard Fish and Wildlife Management District, a 21-county area in southern Illinois (see Figure 34). Inadequate staffing levels have impeded proper management of the widely dispersed easements. Some of the easements have not been surveyed or marked on the ground. The easements should be inspected regularly, but some have not been inspected in over ten years. Without appropriate monitoring the easements and their resources can not be protected from the myriad forms of encroachment.

3.8 Industrial Use Status and Trends

In 1942, the eastern portion of the Crab Orchard Creek Project was transferred to the War Department for construction of the Illinois Ordnance Plant.

Figure 33: Research Natural Areas on Crab Orchard NWR

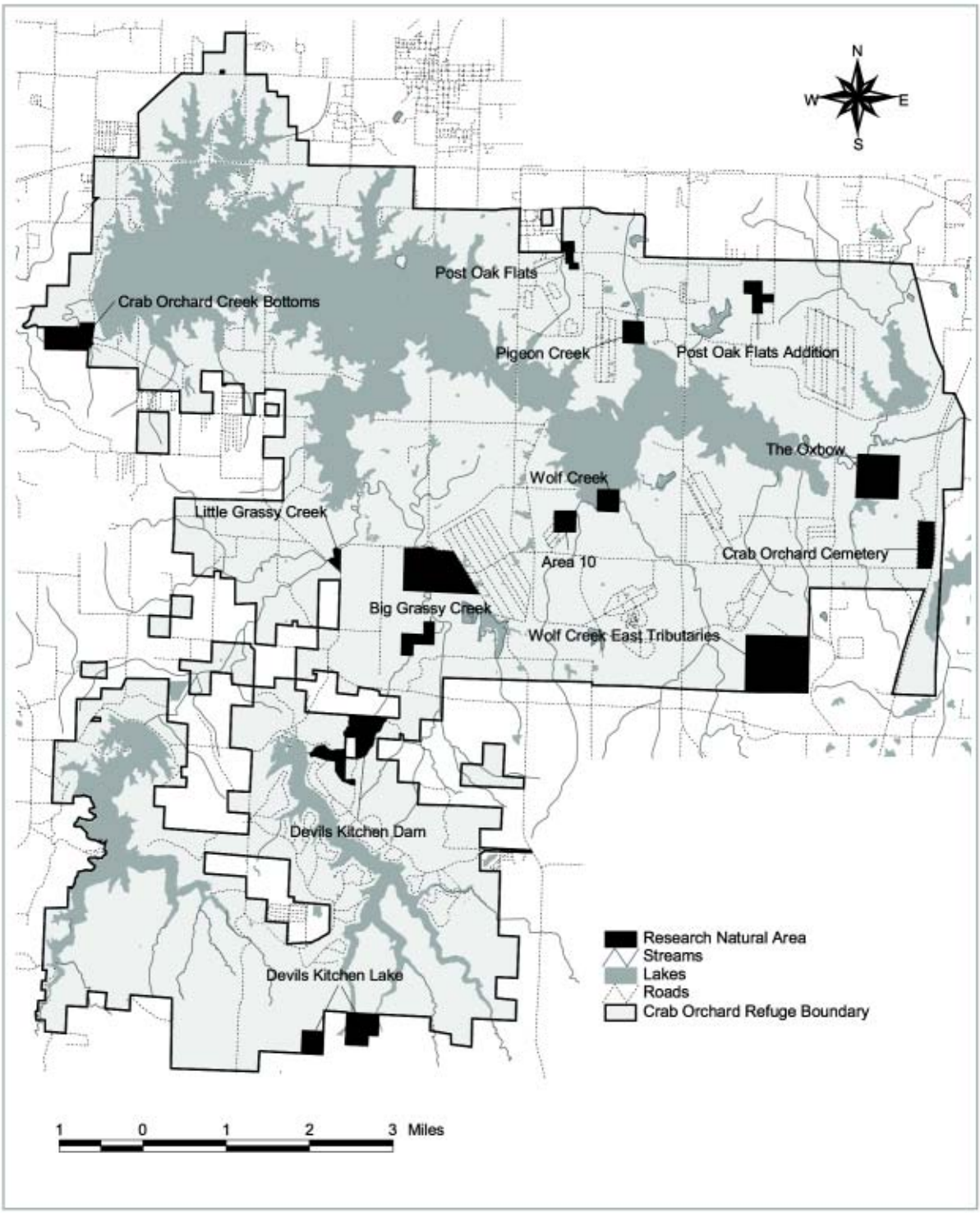


Table 13: Research Natural Areas on Crab Orchard NWR

Name	Area (Acres)	Date Established
Crab Orchard Creek Bottoms	105	1970
Devils Kitchen Dam	130	1970
Post Oak Flats	22	1970
Area 10	40	1972
Big Grassy Creek	210	1972
Crab Orchard Cemetery	70	1972
Devils Kitchen Lake	136	1972
Little Grassy Creek	20	1972
Pigeon Creek	40	1972
Post Oak Flats Addition	50	1972
The Oxbow	160	1972
Wolf Creek Bay	40	1972
Wolf Creek East Tributaries	330	1972
Total	1,353	

The War Department acquired additional lands for its purposes. The Illinois Ordnance Plant was built during 1942 as a loading site for high explosive shells, land mines, bombs and components.

Initially, the Illinois Ordnance Plant contained 536 buildings with approximately 2.3 million square feet of space, water and sewage treatment plants and distribution systems, power and telephone utility systems, 88 miles of railroad track, 93 miles of access and service roads, parking for 6,900 vehicles, nine steam generating plants and a peak wartime employment of approximately 10,000 workers. The Illinois Ordnance Plant ceased ordnance operations in 1945 with the end of World War II.

When the War Department and Soil Conservation Service lands were transferred to the Department of the Interior in 1947, approximately 1.6 million square feet of space suitable for industrial leasing were included in the transfer.

From 1947 to 1978, the Refuge leased buildings to a variety of tenants. Conventional buildings were used for the manufacture of munitions, boats, stencil board, marking machines, mobile homes, inks and brushes. A vocational training school also operated in the buildings. Cold storage warehouses were used for washer/dryer parts storage, beverage distributorship, freight terminal and office space, among other things. Igloo type buildings were leased primarily by munitions manufacturers, fireworks distributors, and coal mining companies for storage of explosives or explosive components.

In 1978, in a master planning process, the Service considered divesting the industrial operations on the Refuge. A 250-acre tract of land was identified on the north boundary of the Refuge as an industrial park for the relocation of existing industrial tenants. The industrial park concept failed due to distance requirements of munitions manufacturing, costs related to relocation of industrial operations, and the industrial purpose specified in the public law that created the Refuge.

In 1981, in a cooperative effort with the Industrial Tenant Association, the Service implemented a new industrial policy and new lease contracts. The policy and leases have served as guidelines in the administration of the industrial complex since 1981. The industrial complex currently consists of about 1.2 million square feet. The Refuge collects about $500,000 in rental receipts each year. Rental receipts are returned to the Refuge and are used as part of its operation and maintenance budget.

3.9 Agriculture

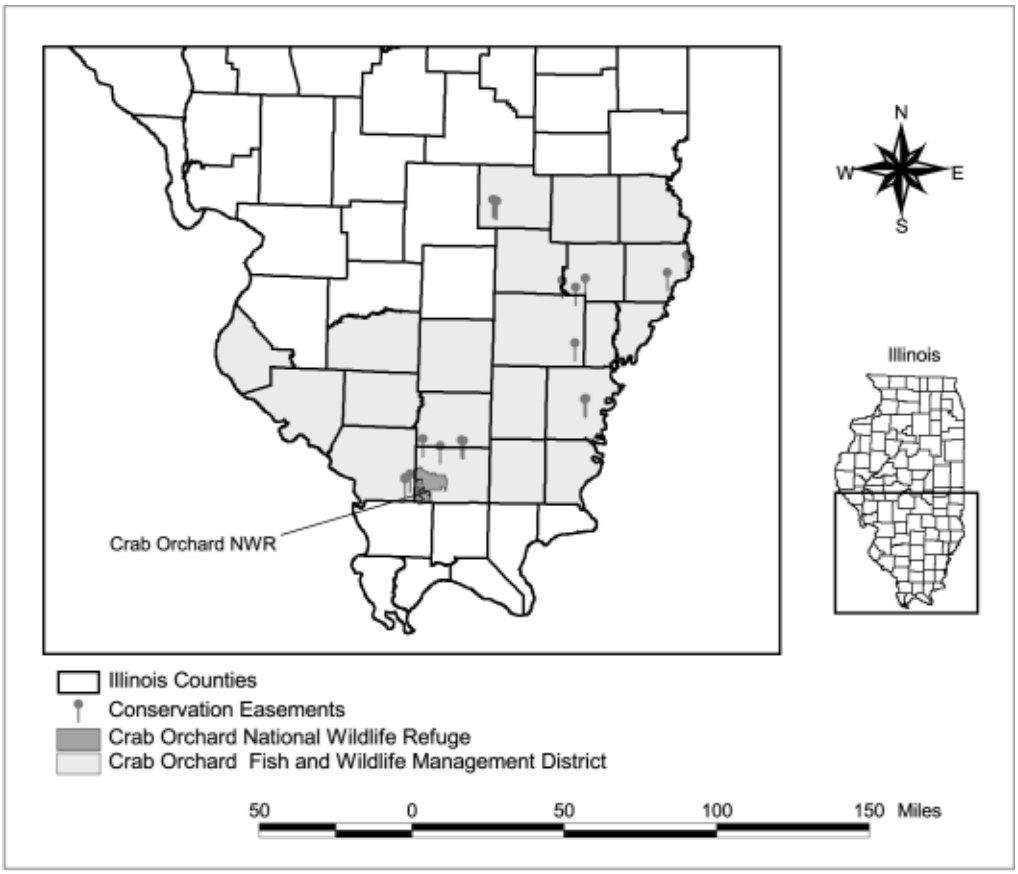
The Refuge began farm management in 1948. The original focus of management was to:

reclaim farmland that had been fallow during ordnance plant operations,
improve soil fertility,
improve farm practices,
emphasize establishment of pasture, and
use crops to help establish a wintering flock of Canada Geese.

The Refuge started with 35 cooperative and 18 cash farmers in 1948. By 1952, there were 60 cooperative farmers and no cash farmers. .Common crops included corn, soybeans, wheat, sudan grass, oats, rye, and barley. Crop fields were in a 5-year rotation that included 2-3 years of grass or legumes. Pastures of cheat (*Bromus tectorum*) and bluegrass (*Poa* sp.) were grazed by cattle along with some horses and sheep. There were no permanent hay fields.

Hay crops were red clover (*Trifolium pratense*), lespedeza, red top (*Agrostis alba*), and timothy (*Phleum pratense*). The number of cooperators was high and the number of acres allocated to each cooperator was relatively small. In 1953, there were 99

Figure 34: Conservation Easements Administered by Crab Orchard NWR



cooperators with an average of 110 acres per cooperator (Figure 35). By 1979, there were 28 cooperators with an average of 280 acres per cooperator. In 2001, there were 20 cooperators with an average of 315 acres per cooperator

Efforts to reclaim farmland continued through the 1950s and 1960s (Figure 36). Some bottomland forest was converted to farmland. In 1963, for example, 170 acres of bottomland forest were cleared and converted to crop production. During this period, the common rotation was: corn, soybeans, winter grain, hay, hay. In 1966, 2,500 geese died from impaction of soybeans in their crops. In 1967, soybeans were dropped from the rotation and replaced with milo, and 1967 was the first year in 10 with no impaction mortality of geese on the Refuge. Soybeans were added back into the rotation in 1992. More has been learned about crop impaction in geese and there has been no subsequent impaction-related mortality.

Current row crop management emphasizes soil protection and integrated pest management. Management consists of crop rotation, no-till planting, higher weed tolerance, restricted use of herbicides, and no insecticide use.

The current rotation, which was implemented in 1994, is:

Year 1 – corn followed by rye
Year 2 – soybeans (drilled) followed by winter wheat (drilled)
Year 3 – corn
Year 4 – clover
Year 5 – clover

Approximately 300 acres are in a continuous rotation of corn and soybeans, because these areas are too wet to produce clover.

Until recently, cooperators signed 5-year agreements. In anticipation of comprehensive conservation planning, the agreements were changed to 1-year agreements until a management direction for

Figure 35: Number of Agricultural Cooperators at Crab Orchard NWR, 1953, 1979, and 2001

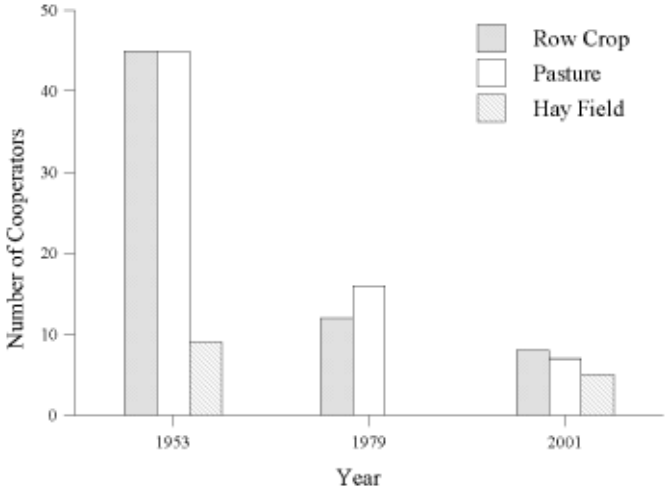
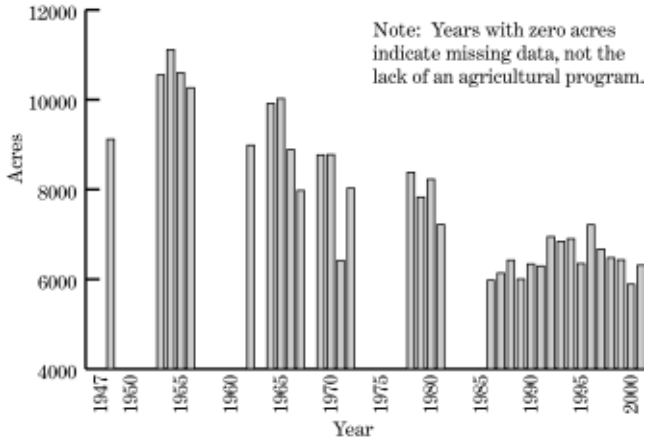


Figure 36: Total Area of Agricultural Fields on Crab Orchard NWR, 1947-2001

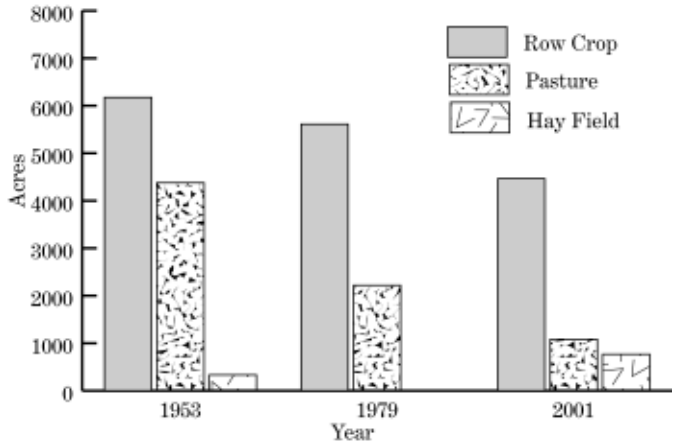


the Refuge is specified within a plan. Cooperators bear the expense of all planting and harvesting costs. Cooperators receive 75 percent of the corn, 100 percent of the soybean harvest, and 100 percent of any second year clover they cut for hay. Crab Orchard NWR receives 25 percent of the corn and 100 percent of the winter wheat. The Refuge's share of corn and wheat are left unharvested to be used by geese and other wildlife. In 2001, approximately 4,464 acres were planted in corn, beans or clover (Figure 37). There were 244 fields with an average size of 18 acres.

The current grazing program consists exclusively of cattle grazing on fescue pastures. The grazing period runs from April 15 to September 30. To make pastures more attractive to geese, cooperators are required to have their pastures grazed or mowed to 6 inches or lower in height by October. The Refuge's pastures are in relatively poor condition with low soil fertility. Cooperators currently sign a 1-year special use permit. The grazing fee is $8.95 per animal unit month (AUM). Cooperators pay the fee through a mowing credit of $2.53/AUM and by fertilizing the pasture. In 2001, there were 10 pastures with an average size of 108 acres – approximately 863 acres were grazed and 220 acres were cut for hay.

The current hay program consists of improved timothy fields and unimproved fields that are mostly old fescue pastures. Cooperators are allowed as

Figure 37: Area of Row Crop Fields, Pastures and Hay Fields in 1953, 1979, and 2001



many cuttings as a field will produce each year, and they are required to cut their field to 6 inches or shorter by October. The Refuge's hay fields currently have low soil fertility. In 2001, cooperators paid $8.50 per ton of hay. Payment is made by fertilizing their field. In 2001, approximately 767 acres were cut for hay. There were 22 fields with an average size of 34 acres.

3.10 Archaeological and Cultural Values[2]

Several investigations have shown that humans have exploited southern Illinois, with its great variations in topography, geology, and vegetation, for over 10,000 years. People of the nomadic hunter-gatherer PaleoIndian (10,000 to 8,000 BC) and Archaic (8000 to 600 BC) cultures found rich lithic resources for tools, rock overhangs for shelter, and animals and plants from both forests and prairies for subsistence. Late Archaic people began farming the prairies to supplement their hunting and gathering procurement. People of the Woodland culture (600 BC to AD 1000) acquired pottery and the bow and arrow and increased reliance on farming, with cultural influences that came from the west via the Mississippi River and from the east via the Ohio and Illinois rivers. The Refuge area was the center for the Woodland Crab Orchard Tradition, the archeological site type now flooded by Crab Orchard Lake. Woodland people were further influenced by the flowering of the Hopewellian and Mississippian culture (AD 1000 to 1500), resulting in the establishment of small agricultural communities in the Refuge area. Southern Illinois essentially became depopulated from about AD 1500 until after the first European contact in AD 1673, although groups of displaced eastern tribes intermittently settled the area.

Euro-American settlers began arriving in the early 19th century, primarily from Kentucky, Tennessee, and the Carolinas. Even earlier, George Rogers Clark passed through Williamson County and possibly the Refuge area in 1788 while taking Illinois from British control. Subsequent settlers constructed fortifications for protection; three blockhouses were located on or near the Refuge.

Settlements established before the mid-1800s near what is now the Refuge were Russell Corners on Eight Mile Prairie, Bainbridge and Phelps Prairie on Phelps Prairie, Cottage Home and Fredonia. One settlement located on what is now Refuge land was the village of Chamnesstown (later known as Mousertown), which became a center for agricultural trade.

By the 1930s farmsteads and small towns covered the Refuge area. Documents indicate at least 28 farmsteads and habitations, 34 cemeteries, three churches, 12 schools, and two towns within the Refuge boundaries.

2. *This section of the Final EIS is derived from the report, "Cultural Resource Management Plan for Cultural Resources Within the Crab Orchard NWR" (3 vols.) by Anthony Godfrey and Donna Stubbs, dated August 2001, as well as other cultural resources reports of studies at the Refuge from 1951 to the present.*

Peithman Collection, Crab Orchard NWR

About 1,000 acres of the Refuge have been subjected to controlled and reported archeological survey and investigation. One hundred and thirty-six prehistoric sites have been reported on the Refuge, and human remains have been identified for at least 98 persons. Moreau Maxwell conducted the important excavation of the Sugar Camp Hill site 11-WM-1 in 1939 and identified the Crab Orchard Tradition before the site was covered by Crab Orchard Lake. The artifacts from this work have been dispersed to various museums; many artifacts can no longer be located.

Some subsequent investigations at the Refuge in the 1950s and 1960s have had similar or worse problems. Reyman reported a survey from which artifacts, field notes and other documents have all been lost. The Refuge contracted, as part of its 1978 master planning, for an inventory of 28 recorded and reported sites on the Refuge, but documentation was still incomplete. During the 1980s and 1990s several investigations have occurred on the Refuge for which reports have been completed and collections are curated at appropriate repositories. Recent studies indicate settlement patterns in the Crab Orchard Creek basin may be more complex than previously thought.

As of October 1, 2001, there were no National Register properties on or in the vicinity of the Refuge.

The area of the Refuge having been vacated of most human occupancy from approximately 1500 and resettled by historic period tribes from the 17th to 19th centuries, modern descendants of prehistoric cultures have not been identified. Three historic period tribes have legal or occupancy claims to the Refuge area. The Kaskaskia (part of the Illiniwek or Illinois, now part of the Peoria Tribe) were declared by the Indian Claims Commission as having jurisdiction over most of southern Illinois. The Piankashaw, a sub-group of the Miami tribe, historically were in southern Indiana, then in southeastern Illinois with a short-term reservation 75 miles northeast of the Refuge, but actual occupation there was historically late, brief, and tenuous. The Indian Claims Commission determined the Piankashaw to be legally part of the Peoria tribe and later became the United Peoria and Miami. The third tribe was the Shawnee, who had homes in Ohio and Missouri and used southern Illinois as transient travelers. The Indian Claims Commission identified Shawnee villages in the 18th century in Illinois south of the Kaskaskia on the Mississippi, south of Grayville on the Wabash, and along the Ohio River.

Although Indian tribes are generally considered to have concerns about traditional cultural properties, the several church groups (and possibly other groups) formerly within the Refuge boundaries could also have similar concerns.

The Refuge archeological collections contain prehistoric artifacts currently not associated with any modern tribe. Furthermore, the collections contain human remains but no funerary objects, sacred objects or objects of cultural patrimony as defined in the Native American Graves Protection and Repatriation Act. Although sites of historic period Indian occupation have not been identified on the Refuge, they may exist and contain cultural items.

3.11 Law Enforcement

Enforcement of Federal wildlife laws, regulations specific to the Refuge System, and State laws is an essential part of Refuge operation. Law enforcement plays a crucial role in ensuring that natural and cultural resources are protected and that visitors have a safe environment. The Refuge currently has five employees, three full-time and two collateral duty, who conduct law enforcement duties on the Refuge. Cooperative relationships exist with state conservation officers and all county sheriff departments in the area. Table 14 displays the most frequently cited offences between 1997 and 2001.

Table 14: Most Frequently Cited Offences on Crab Orchard NWR, 1997-2001

Offence	1997	1998	1999	2000	2001	Totals
Trespass	73	109	118	93	68	461
No Entrance Pass	57	103	91	73	49	373
State Vehicle Code	9	15	11	10	9	54
State Hunting Law	8	10	13	9	6	48
No Fishing License	25	21	14	19	17	96
Underage Drinking	16	21	29	20	10	96
Under Influence	3	11	14	8	5	41
Unauthorized Fire	7	5	12	9	6	39
Violate Posted Sign	4	6	9	7	8	34
Illegal Transport Alcohol	33	41	54	19	21	168
Special Regulations	17	15	29	12	28	101
Public Indecency	15	11	7	14	6	53
Possession of Controlled Substance	43	52	39	31	24	189
Off-road Vehicle	6	9	6	10	4	35
Total	316	429	446	334	261	1,788

3.12 Socioeconomic Environment

3.12.1 Economic Setting

The study area for estimating the economic effects of the recreational, agricultural and commercial use of the Refuge is defined as Williamson and Jackson counties. Most visitors to the Refuge (about 89 percent) come from within a 50-mile radius of the Refuge, and about 90 percent of these visitors come from Williamson and Jackson counties. Since most visitors come from these two counties, most of the economic impact of Refuge visitation occurs within these counties. All of the commercial activities that take place on the Refuge are within these counties.

Williamson County contains almost all of the Refuge lands. Williamson County was established in 1839 with Marion as the county seat. Major communities include Marion, Herrin, Carterville, Johnston City, Pittsburg and Creal Springs.

Jackson County contains portions of Little Grassy Lake. The county was established in 1816. Most of the county's residents live in one of three cities: Carbondale, DeSoto, and Murphysboro, which is the county seat.

3.12.1.1. Population

Table 16 compares the population growth of Williamson and Jackson counties, Illinois, and the United States from 1980 to 2000. Williamson County population grew at a slower rate than the state but substantially less than the U.S. from 1980 to 2000. The 1990s was a period of significantly increased growth for both Williamson County and the state, but both lagged behind national population growth.

Jackson County population declined while the State and U.S. population grew from 1980 to 2000. From 1990 to 2000, Jackson County lost population compared with significant increases in the state and U.S. population.

Demographic information for Williamson and Jackson counties is provided in Table 17.

3.12.1.2. Employment

Table 18 shows full- and part-time employment by major business sector in Williamson County in 1980 and 2000. The majority (68 percent) of county employment in 1980 was in four sectors: services, retail trade, government and manufacturing. These four sectors accounted for 75 percent of county employment in 2000.

Employment growth in Williamson County generally outpaced state growth from 1980 to 2000. Williamson County has had a substantially higher unemployment rate than either the state or the U.S. However, since 1983, Williamson County unemployment rates have slowly declined so that they more closely resemble state and national unemployment rates.

Table 15: Employment by Major Business Sector, Jackson County, 1980 and 2000

Sector	1980	Percent of Total Employment	2000	Percent of Total Employment	Percent Change in Employment 1980-2000
Farming	1,061[1]	3.50	973	2.50	-12.70
Mining	662	2.20	89	0.20	-86.60
Construction	1,119	3.70	1,729	4.50	54.50
Manufacturing	1,742	5.70	1,469	3.80	-15.70
Transportation/Public Utilities	1,473	4.90	1,062	2.70	-27.90
Wholesale Trade	488	1.60	460	1.20	-5.70
Retail Trade	5,548	18.30	7,285	18.80	31.30
Finance, Insurance and Real Estate	1,663	5.50	2,056	5.30	23.60
Services	5,828	19.20	9,920	25.50	70.20
Government	10,783	35.50	13,784	35.50	27.80
Total Employment	30,367	100.00	38,827	100.00	27.90
Illinois Total Employment	5,688,054	100.00	7,442,406	100.00	30.80

1.Equals 5-year average 1980-84.

Table 16: Williamson County and Jackson County, Illinois and the United States Population, Percentage Change 1980, 1990, 2000

				Percent Change		
	1980	1990	2000	1980-1990	1990-2000	1980-2000
Williamson County	56,846	57,717	61,296	1.5	6.20	7.8
Jackson County	61,846	61,055	59,612	-1.30	-2.40	-3.60
Illinois	11,434,702	11,446,979	12,419,293	0.10	8.50	8.60
United States	227,224,719	249,464,396	281,421,906	9.80	12.80	23.90

Table 17: Demographic Profile of Jackson County, Williamson County, Illinois and the United States

	Jackson County	Williamson County	Illinois	USA
Population, percent change 1990-2000	-2.40	6.20	8.60	13.10
White, percent	80.80	95.30	73.50	75.10
Black or African American, percent	13.00	2.50	15.10	12.30
American Indian and Alaska Native, percent	0.30	0.30	0.20	0.90
Asian, percent	3.00	0.50	3.40	3.60
Hispanic or Latino origin, percent	2.40	1.20	12.30	12.50
Home ownership rate, percent	53.3.	73.60	67.30	66.20
Persons per household	2.21	2.35	2.63	2.59
Persons below poverty level, percent	21.00	14.90	11.30	13.30

Table 18: Employment by Major Business Sector, Williamson County, 1980 and 2000

Sector	1980	Percent of Total Employment	2000	Percent of Total Employment	Percent Change in Employment, 1980-2000
Farming	788	3.80	591	1.90	-25.00
Mining	1,046	5.00	124	0.40	-88.10
Construction	1,443	6.90	2,105	6.80	45.90
Manufacturing	3,440	16.50	3,119	10.10	-9.30
Transportation/Public Utilities	1,293	6.20	1,681	9.50	30.00
Wholesale Trade	942	4.50	837	2.70	-11.10
Retail Trade	3,541	16.90	6,174	20.10	74.40
Finance, Insurance, and Real Estate	1,226	5.90	2,414	7.90	96.90
Services	3,615	17.30	8,166	26.60	125.90
Government	3,488	16.70	5,534	18.00	58.70
Total Employment	20,909	100.00	30,745	100.00	47.00
Illinois Total Employment	5,688,059	100.00	7,442,406	100.00	30.80

Table 15 shows the major employment sectors in Jackson County for 1980 and 2000. In 1980, the major sectors – government, services and retail trade – totaled 73 percent of county employment. In 2000, government, services and retail trade accounted for 80 percent of county employment.

3.12.1.3. Employment Earnings and Personal Income[3]

Employment earnings in Williamson County totaled $604 million in 1980 and $789 million in 2000, an increase of 31 percent. This compares with a 51 percent statewide increase. Table 19 shows employment earnings for Williamson County by major employment sectors for 1980 and 2000.

Employment earnings in Jackson County totaled just under $750 million in 1980 and about $985 million in 2000, an increase of 32 percent. Table 20 shows employment earnings for the major employment sectors in Jackson County.

Table 21 shows per capita personal income (PCPI) for Williamson and Jackson counties, Illinois, and the U.S. for 1980, 1990 and 2000. During the 1980s, PCPI growth in Williamson County was significantly lower than both the state and the U.S. However, in the 1990s county PCPI growth was fairly even with state growth and much higher than national growth. While growth rates were similar for Jackson County and the state, 2000 PCPI is almost 55 percent higher for the state than Jackson County (Table 21). Overall, from 1980 to 2000, Williamson County PCPI grew at a substantially lower rate than the state and national economies.

3.12.2 Impact of the Refuge Budget

Refuge budget expenditures contribute to local and regional economies. Table 22 summarizes the economic impact of both salary and non-salary budget expenditures. Separate input-output models were used to estimate the impacts of local spending, regional (in-state but not local), and out-of-state spending for both salary and non-salary expenditures. These estimates are based on the annual average Refuge budget from 1996 to 2000.

Table 23 shows the tax revenues generated by budget expenditures for each of the three spending areas and by salary and non-salary expenditures.

3.12.3 Economic Impacts of Refuge Recreation

The Refuge has averaged between 1.1 and 1.2 million visits per year during the 1990s. During this period, four major recreational activities – hunting, fishing, boating and wildlife observation – comprised from 37 to 89 percent of total Refuge visits.

3. *All dollar figures have been adjusted for inflation for year 2000 dollars.*

Table 19: Employment Earnings by Major Business Sector, Williamson County, 1980 and 2000

Sector	1980 (thousands)	Percent of Total Employment	2000 (thousands)	Percent of Total Employment	Percent Change in Employment, 1980-2000
Farming	$1,985	0.30	$3,418	0.40	72.20
Mining	$75,082	12.40	$2,655	0.30	-96.50
Construction	$59,209	9.80	$56,674	7.20	-4.30
Manufacturing	$111,770	18.50	$102,425	13.00	-8.40
Transportation/ Public Utilities	$56,286	9.30	$75,755	9.60	34.60
Wholesale Trade	$29,358	4.90	$28,209	3.60	-3.90
Retail Trade	$72,557	12.00	$92,471	11.70	27.40
Finance, Insurance and Real Estate	$16,200	2.70	$41,944	5.30	158.90
Services	$77,965	12.90	$166,231	21.10	113.20
Government	$103,644	17.20	$219,532	27.80	111.80
Total Employment Earnings	$604,056	100.00	$789,314	100.00	30.70
Illinois Total Employment Earnings	$194,155,230	100.00	$293,692,287	100.00	51.30

Table 20: Employment Earnings by Major Business Sector, Jackson County, 1980 and 2000

Sector	1980 (thousands)	Percent of Total Employment	2000 (thousands)	Percent of Total Employment	Percent Change in Employment, 1980-2000
Farming	$5,420	0.70	$12,347	1.30	127.80
Mining	$51,687	6.90	$3,342	0.30	-93.50
Construction	$43,395	5.80	$51,886	5.30	19.60
Manufacturing	$45,965	6.20	$41,334	4.20	-10.10
Transportation/Public Utilities	$57,067	7.60	$47,429	4.80	-16.90
Wholesale Trade	$13,131	1.80	$11,373	1.20	-13.40
Retail Trade	$93,030	12.50	$98,023	9.90	5.40
Finance, Insurance and Real Estate	$23,438	3.10	$30,692	3.10	30.90
Services	$12,253	16.10	$234,441	23.80	95.00
Government	$297,359	39.80	$454,432	46.10	52.80
Total Employment Earnings	$749,284	100.00	$985,299	100.00	32.00
Illinois Total Employment Earnings	$194,155,230	100.00	$293,692,287	100.00	51.30

From 1995 to 2000, these activities averaged about 44 percent of all Refuge visits. Activities making up the remaining Refuge visits include Visitor Center visits, environmental education and tours.

Based on the average annual visitation over the 5-year span between 1996-2000, 66 percent of all visits were made by residents of the study area and 34 percent were made by non-residents (people residing outside the two-county study area). About 80 percent of Refuge visitors reside within 20 miles of

Table 21: Williamson County and Jackson County Per Capita Income, 1980, 1990 and 2000

				Percent Change		
	1980	**1990**	**2000**	**1980-90**	**1990-2000**	**1980-2000**
Williamson County	$18,109	$19,698	$22,641	8.80	14.90	25.00
Jackson County	$15,092	$17,559	$21,676	16.30	23.50	43.80
Illinois	$22,625	$27,419	$31,856	21.20	16.20	40.10
United States	$20,799	$27,127	$29,469	30.40	8.60	41.70

Table 22: Annual Economic Impact of Refuge Budget Expenditures

	Expenditures	**Economic Output**	**Jobs**	**Labor Income**
Salary Impacts				
Two-county Study Area	$1,212,390	$1,625,313	25.2	$547,998
Illinois	$166,888	$288,957	3.4	$106,369
United States	$18,793	$32,539	0.4	$11,978
Total Salary Impacts	$1,398,071	$1,946,809	29	$666,345
Non-salary Impacts				
Two-county Study Area	$525,030	$691,622	7.8	$213,173
Illinois	$61,605	$98,776	0.8	$33,718
United States	$184,302	$295,457	2.5	$100,864
Total Non-salary Impacts	$770,937	$1,085,855	11.1	$347,755
Total Impacts	$2,169,008	$3,032,664	40.1	$1,014,100

the Refuge. A significant portion of non-resident visitors come from the St. Louis and Chicago metropolitan areas.

From 1996 to 2000, hunting visits averaged close to 44,000 annually. Most of the hunting on the Refuge is migratory waterfowl hunting (62 percent), followed by deer hunting (26 percent) and small game hunting (12 percent). Overall, about 74 percent of annual hunting visits are made by non-residents. Annually, non-residents make up about 85 percent of deer hunters, 15 percent of small game hunters and 80 percent of migratory waterfowl hunters.

During the period from 1996 to 2000, annual fishing visits to the Refuge have averaged over 210,000. Residents of the two-county area account for about 70 percent of total Refuge fishing visits.

Boating use on the Refuge has increased from 73,334 visits in 1996 to 109,420 in 2000, an increase of 49 percent. Residents make up about 60 percent of annual boating use on the Refuge.

Wildlife observation has increased from 93,692 annual visits in 1996 to 154,869 visits in 2000, an increase of over 65 percent. Most of the wildlife observation visits come from residents, comprising 80 percent of annual Refuge wildlife observation visitation.

Camping and picnicking on the Refuge averages 193,400 visits annually. Residents comprise about 80 percent of annual camping and picnicking visitation.

Recreation on the Refuge results in significant expenditures for both travel-related goods and services and activity-related equipment purchases. Table 24 shows expenditures by recreational activity along with estimates of the economic output, employment and income associated with these expenditures. The impacts were estimated using regional input-output models[4] for each of the six recreational activities.

4. *The economic impacts of recreational spending were derived using IMPLAN, a regional input-output modeling and software system. For additional information, see MIG, Inc., IMPLAN System and Olson and Lindall, IMPLAN Professional Software, Analysis and Guide.*

Table 23: Annual Tax Impacts of Refuge Expenditures

	Federal Taxes	State and Local Taxes	Total Taxes
Salary Tax Impacts			
Two-county Area	$144,950	$114,805	$259,755
Illinois	$30,631	$19,885	$50,516
United States	$3,449	$2,239	$5,688
Total Salary Tax Impacts	$179,030	$136,929	$315,959
Non-salary Tax Impacts			
Two-county Area	$52,359	$27,325	$79,684
Illinois	$9,352	$4,373	$13,725
United States	$27,376	$13,802	$41,178
Total Non-salary Tax Impacts	$89,087	$45,500	$134,587
Total Tax Impacts	$268,117	$182,429	$450,546

Table 24: Economic Impacts of Refuge Recreation in Two-county Study Area

Activity	Total Expenditures	Economic Output	Employment	Labor Income
Big game hunting	$451,620	$581,414	11	$238,742
Small game hunting	$168,260	$205,545	4	$75,604
Migratory waterfowl hunting	$1,163,229	$1,480,497	27	$624,816
Fishing	$7,347,787	$9,260,444	181	$3,972,468
Boating	$2,757,469	$3,459,091	84	$2,068,264
Wildlife observation	$4,923,785	$6,088,532	118	$2,477,711
Camping	$2,901,000	$3,655,260	72	$1,569,180
Refuge Total	$19,713,150	$24,730,783	497	$11,026,785

Total expenditures shows the total annual expenditures associated with the indicated recreational activity. The figures include spending by both residents and non-residents in the two-county study area.

Economic output shows the total industrial output generated by recreation-related expenditures. Total output is the production value (alternatively, the value of all sales plus or minus inventory) of all output generated by recreation expenditures. Total output includes the direct, indirect and induced effects of these expenditures. Direct effects are simply the initial effects or impacts of spending money; spending money in a grocery store for a fishing trip or purchasing ammunition or a pair of binoculars are examples of direct effects. The purchase of the ammunition by a sporting goods retailer from the manufacturer or the purchase of canned goods by a grocery from a food wholesaler are examples of indirect effects. Finally, induced effects refer to the changes in production associated with changes in household income (and spending) caused by changes in employment related to both direct and indirect effects. More simply, people who are employed by the grocery, by the food wholesaler, and by the ammunition manufacturer spend their income on various goods and services which in turn generate a given level of output. The dollar value of this output is the induced effect of the initial (or direct) recreation expenditures. [5]

5. *More technically, direct effects are production changes associated with the immediate effects ofchanges in final demand (in this case, changes in recreation expenditures); indirect effects are production changes in those industries directly affected by final demand; induced effects are changes in regional household spending patterns caused by changes in regional employment (generated from the direct and indirect effects) Taylor et al. 1993, Appendix E, p. E-1.*

Table 25: Recreation Expenditures and Economic Impacts for Non-resident Visitors to the Refuge

Activity	Total Expenditures	Economic Output	Employment	Labor Income
Big game hunting	$383,877	$494,202	9	$202,931
Small game hunting	$33,652	$41,109	1	$15,121
Migratory waterfowl hunting	$930,583	$1,184,398	21	$499,853
Fishing	$2,204,336	$2,778,133	54	$1,191,740
Boating	$1,102,988	$1,383,636	33	$827,306
Wildlife Observation	$984,757	$1,217,706	24	$495,542
Camping	$580,200	$731,052	14	$313,836
Refuge Total	$6,220,393	$7,830,236	156	$3,546,329

The economic impact of a given level of expenditures depends, in part, on the degree of self-sufficiency of the area under consideration. For example, a county with a high degree of self-sufficiency (out-of-county imports are comparatively small) will generally have a higher level of impact associated with a given level of expenditures than a county with significantly higher imports (a comparatively lower level of self-sufficiency). Consequently, the economic impact of a given level of expenditures will generally be less for rural and other less economically integrated areas compared with other, more economically diverse areas or regions.

Employment and labor income include direct, indirect and induced effects in a manner similar to total industrial output. Employment includes both full-time and part-time jobs, with a job defined as one person working for at least part of the calendar year, whether one day or the entire year. Labor income in the IMPLAN system consists of both employee compensation and proprietor income (Minnesota IMPLAN Group, Inc. 1999).

Table 25 shows recreation expenditures and economic impacts for non-resident visitors to the Refuge.

The economic impacts from recreation expenditures estimated in this report are gross area-wide (two-county area) impacts. Information on where expenditures may occur locally and the magnitude and location of resident and non-resident expenditures is not currently available. Generally speaking, non-resident expenditures bring "outside" money into the area and thus generate increases in real income or wealth. Spending by residents is simply a transfer of expenditures on one set of goods and services to a different set within the same area. In order to calculate "net" economic impacts within a given area derived from resident expenditures, much more detailed information would be necessary on expenditure patterns and visitor characteristics. Since this information is not currently available, the gross area-wide estimates are used as an upper-bound for the net economic impacts of total resident and non-resident spending in the two-county area. The economic impacts of non-resident spending in Table 22 represents a real increase in wealth and income for the two-county area (for additional information, see Loomis p. 191 and U.S. Department of Commerce pp. 7-9).

3.12.4 Tax Impacts of Refuge Recreation Spending

Table 26 shows Federal, state and local tax revenue derived from Refuge-related recreational spending in the two-county area by both residents and non-residents. These estimates are based on tax regulations and policies in effect in 1998.

Table 27 shows tax revenue generated by non-resident recreation spending in the two-county area.

3.12.5 Economic Impacts of Refuge Agriculture, Grazing, Timber Harvesting and Commercial Use

Several different types of commercial activities take place on the Refuge. Commercial uses include: (1) the leasing of Refuge land for an industrial park and storage facilities; (2) the use of lakes within the Refuge for boat docks and marina concessions; (3) timber harvesting; (4) grazing; and (5) farming.

The industrial park currently has 14 firms leasing space. These 14 firms employ 551 people. Annual rental receipts total $506,051. Eleven buildings are currently vacant, which if leased would employ about 20 people and bring in about $55,000 in rental revenue.

Table 26: Federal, State and Local Tax Revenue Derived From Refuge-related Recreational Spending by Residents and Non-residents

	Federal Taxes	State and Local Taxes	Total Tax Revenue
Big game hunting	$46,672	$42,306	$89,043
Small game hunting	$13,013	$11,893	$24,924
Migratory waterfowl hunting	$115,180	$106,828	$222,171
Fishing	$665,325	$604,459	$1,270,722
Boating	$248,213	$175,679	$424,259
Wildlife Observation	$393,536	$375,150	$769,244
Camping	$232,080	$212,785	$444,865
Totals	$1,714,019	$1,529,100	$3,243,119

Table 27: Tax Revenue Generated by Non-resident Refuge Recreation Spending

	Federal Taxes	State and Local Taxes	Total Tax Revenue
Big game hunting	$39,671	$35,960	$75,687
Small game hunting	$2,602	$2,378	$4,984
Migratory waterfowl hunting	$92,144	$85,462	$177,736
Fishing	$199,598	$181,338	$381,217
Boating	$99,285	$70,272	$169,704
Wildlife Observation	$78,707	$75,030	$153,849
Camping	$46,416	$42,557	$88,973
Totals	$558,423	$492,997	$1,051,420

Table 28: Annual Concession Revenue and Fees Paid for Crab Orchard NWR Recreational Facilities

Recreational Facility	Revenue	Fees Paid
Devils Kitchen Marina and Campground	$53,805	$1,076
Boat & Yacht Club	$94,547	$9,454
Crab Orchard Campground	$148,553	$14,682
Little Grassy Marina and Campground	$97,582	$11,210
Playport Marina	$97,625	NA
Images Marina	$43,255	NA
Total	$535,367	$36,422

Table 29: Recreation and Refuge Budget Expenditures Compared with Study Area

Area	Industrial Output	Employment	Employment Income
Williamson County	$2,280 million	30,745	$789 million
Jackson County	$2,070 million	38,827	$985 million
Study Area Total	$4,350 million	69,572	$1,770 million
Refuge Impacts	$27.8 million	537	$12.0 million
Refuge Impacts as Percent of Study Area Total	0.64%	0.77%	0.68%

The Refuge has three boat docks, four campgrounds and two marinas. Table 28 shows annual concession revenue and fees paid for each of these facilities.

The Refuge's forests are managed strictly for wildlife conservation. Forest habitat management activities, such as thinning, sometimes generate merchantable timber as a by-product. Some types of timber the Refuge has sold include pine pulpwood, pine sawtimber, and hardwood pulpwood. Since 1989, there have been about 35 timber sales which produced $264,266 in stumpage receipts. Most of the timber harvested has been pine pulpwood, amounting to over 10,000 tons. About 2,800 tons of pine sawtimber and 425 tons of hardwood pulpwood have been harvested over the same period. On average about 1,927 tons are harvested annually with a value of $6,641.

The Refuge currently allocates 863 acres to support 375 head of cattle and 1,726 animal unit months 3 (AUM) with a value of $172,500. We assume that all cattle are yearlings, and are thus sold at the end of each grazing period. The period for cattle grazing on the fescue pastures runs from April 15 to September 30. Also, the grazing fee is $8.95 per AUM, and is paid through a mowing credit of $2.53 per AUM and by fertilizing the pasture.

In recent years, about 5,200 acres annually have been farmed on the Refuge. Crops include corn (1,877 acres with a market value of $507,000), clover (1,484 acres with a value of $320,000), soybeans (1,179 acres with a value of $212,000) and hay (767 acres with a value of $164,905). Total market value of crops grown on the Refuge is $1.2 million.

3.12.6 Comparison of Refuge-Related Economic Impacts to Study Area Economy

Current recreational and commercial use of the Refuge generates a considerable amount of economic effects. However, compared with either of the two counties individually or in total, the economic effects generated by the Refuge are comparatively minor. This is not to say that businesses in certain sectors in specific locations may not be significantly affected by major changes in Refuge management policy; however, in general the Refuge plays a relatively minor role in the study area economy as whole.

Tables 22 to 28 compare Refuge-related impacts to the study area economy. Table 29 compares the two major sources of Refuge economic impacts, recreation and Refuge budget expenditures, with the two-county study area. Annual industrial output for the study area (based on 1998 data) totals $4.35 billion. Refuge recreation and budget impacts total $27.8 million, 0.64 percent of the study area total. Similarly, Refuge recreation and budget impacts account for 0.77 percent of total study area employment and 0.68 percent of study area employment income.

Table 30 shows the annual number of acres farmed on the Refuge and production value compared with the study area. Farming on the Refuge typically accounts for less than 2 percent of total acres farmed in the study area. If only Williamson County is considered, the Refuge accounts for 5.7 percent of total acres farmed in the county. Farming on the Refuge comprises about 3 percent of total crop value in the study area. Compared with Williamson County only, Refuge crop value is 12 percent of total county crop value.

Table 31 shows Refuge grazing and value compared with the study area. The 375 head of cattle on the Refuge constitute 2.9 percent of all cattle grazed in the study area and 7.2 percent of all cattle grazed in Williamson County. Grazing value on the Refuge is 2.8 percent of the study area total and is 7.8 percent of total grazing value for Williamson County.

Table 32 shows the amount of timber harvested on the Refuge compared with the study area. Average annual tons harvested on the Refuge is 1,927, which is 3.4 percent of total tons harvested in the study area and about 32 percent of total tons harvested in Williamson County. Williamson and Jackson counties harvest approximately 56,000 tons of hardwoods annually, receiving about $900,000 annually. Timber value on the Refuge is 1 percent of the study area total and 7 percent of total timber value for Williamson County.

Currently, the Refuge leases about 1.2 million square feet of commercial and industrial building space. As of March 2001, the Greater Marion, Illinois, area had industrial parks and sites that included 2,231 acres (Regional Economic Development Corporation, 2002).

Table 30: Annual Number of Refuge Acres Farmed and Production Value Compared with the Study Area

Area	Acres[1]	Value[2]
Williamson County	92,289	$10.1 million
Jackson County	202,558	$32.6 million
Study Area Total	294,847	$42.7 million
Refuge Impacts	5,231	$1.2 million
Refuge Impacts as a Percent of Study Area Total	1.8%	3.00%

1. *County data source: U.S. Department of Agriculture, 1999.*
2. *Value is based on statewide average market prices.*

Table 31: Annual Refuge Grazing and Value Compared with the Study Area

Area	Total Head[1]	Value[2]
Williamson County	5,185	$2.2 million
Jackson County	7,900	3.9 million
Study Area Total	13,085	$6.1 million
Refuge Impacts	375	$172,500
Refuge Impacts as Percent of Study Area Total	2.90%	2.80%

1. *County data source: U.S. Department of Agriculture, 1999.*
2. *Value is total county sales based on 1997 Census of Agriculture.*

Table 32: Annual Amount of Timber Harvest on the Refuge Compared with the Study Area[1]

Area	Tons Harvested	Value
Williamson County	6,090	$97,440
Jackson County	49,778	$796,448
Study Area Total	55,868	$893,888
Refuge Impacts	1,927	$6,641
Refuge Impacts as Percent of Study Area Total	3.45%	

1. *Value for Williamson and Jackson counties is based on the average price received for hardwood stumpage ($140/mbf in Illinois, November 1999 to August 2000. Value for the Refuge is based upon average stumpage receipts received by the Refuge.*

3.12.7 Current Staff and Budget

3.12.7.1. Staff

The Refuge's staffing as of January 2003 is illustrated in Figure 38.

3.12.8 Budget

Based on the annual average Refuge budget between 1996 and 2000, the Refuge budget includes $1.4 million in salaries and $770,937 in non-salary expenditures.

3.13 Partnerships

The Refuge has many partnerships with local, state, and national organizations. These partnerships benefit the Refuge in many ways, including fostering good community relations and enhancing Refuge habitats and wildlife populations. The Refuge intends to continue partnerships such as the following:

Southern Illinois Hunting and Fishing Days, Inc. is a non-profit organization that partners with the Refuge to promote hunting and fishing in the area. The Refuge initiated this program in the early 1980s. SI Hunting and Fishing Days assumed the lead for this activity in the early 1990s. Several thousand people now attend an annual weekend event, which is held at John A. Logan College.

Take Pride in America has been organized and worked with the Refuge since 1988. Take Pride in America has built courtesy docks for boat landings at all three lakes. Take Pride in America organized the construction of bass-rearing ponds and maintains Take Pride in America Point (formerly known as Hogan's Point) for fish-offs.

The Crab Orchard Waterfowl Association has provided funds for the construction of moist soil units on the Refuge. Quail Unlimited has provided native grass seed for Refuge prairie restoration.

Southern Illinois University, Touch of Nature, the Friends of Crab Orchard NWR and the Refuge's Visitor Services Program have partnered to provided environmental education opportunities for local schools.

With the help of the following partners, the Refuge has been able to provide one of the most successful Kids Fishing Derby events in the area:

University of Illinois Extension
Illinois DNR
Southern Illinois National Hunting and Fishing Days
Timberline Fisheries
Zimmer Radio Group
WalMart
Silkworm Inc.
Marion Pepsi-Cola
Crab Orchard Boat & Yacht Club

The Refuge has many dedicated groups and volunteers who assist with a variety of tasks. The Friends of Crab Orchard National Wildlife Refuge, John A. Logan College, University of Southern Illinois, Southern Illinois Audubon Society, Williamson County Tourism Bureau, and Marion U.S. Penitentiary are just a few of the organizations that contribute time to the Refuge.

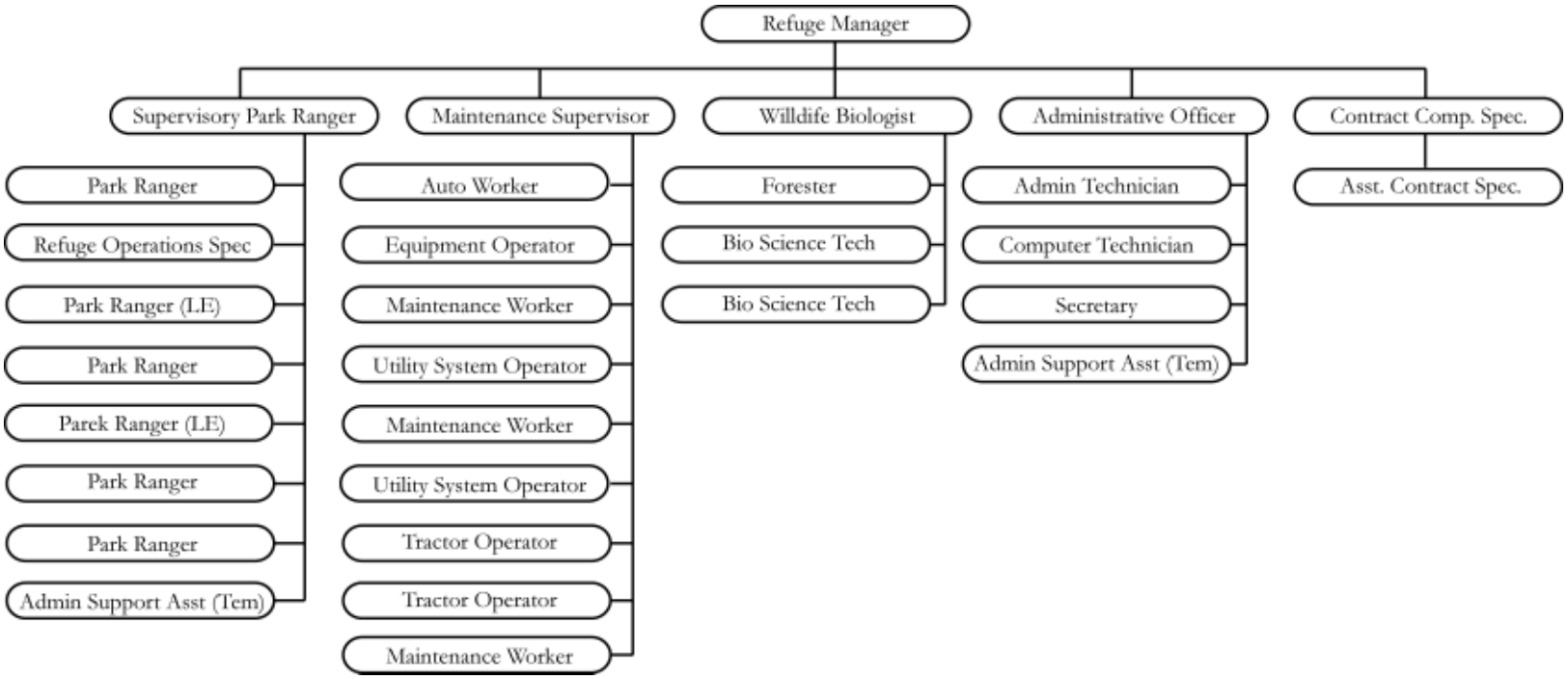



Figure 38: Crab Orchard NWR Current Staffing Chart