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**ENVIRONMENTAL
RESTORATION
PROGRAM**

**Survey of Protected Terrestrial
Vertebrates on the Oak Ridge
Reservation**

Final Report

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ENERGY SYSTEMS



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**JAYCOR, the Tennessee Wildlife Resources Agency,
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PREFACE

This technical report was prepared as the final report on work performed as part of the Threatened and Endangered Terrestrial Vertebrates Project, Environmentally Sensitive Areas Surveys Program. This work was conducted under Work Breakdown Structure 1.4.12.2.3.04.03.02 (Activity Data Sheet 8304) and the milestone titled "Final Report of Baseline Threatened and Endangered Vertebrate Animal Species Conditions on the Oak Ridge Reservation."

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* Figures 2, 4, and 5 are provided in Appendix E in 11 x 17 size.

ABBREVIATIONS

DOE	U.S. Department of Energy
Energy Systems	Lockheed Martin Energy Systems, Inc.
FE	Federally endangered
FWS	U.S. Fish and Wildlife Service
INM	In need of management
NAs	Natural areas
NR	No historical record on the ORR
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
RA	Reference Area
SC	Federally designated species of concern
SE	State endangered
ST	State threatened
T&E	Threatened and endangered
TWRA	Tennessee Wildlife Resources Agency
TWRC	Tennessee Wildlife Resources Commission

EXECUTIVE SUMMARY

This document is the final report on surveys of protected terrestrial vertebrates on the Oak Ridge Reservation (ORR) conducted from October 1994 through May 1996. The surveys were undertaken to gain information that could help prevent or minimize the potential impacts of projects on the ORR to species listed by the state or federal government as endangered, threatened, or in need of management; federal species of concern were also included. The results of the survey will assist in the effective management of the natural resources of the ORR.

Currently, there are 69 species of federal or state listed terrestrial vertebrates (20 reptiles and amphibians, 20 mammals, and 29 birds) that may occur in Tennessee. Listed animal species that might be present on the ORR were targeted for survey using a prioritization system based on historical and recent sightings, known species distributions, presence of suitable habitat, literature reviews, and personal communications. Survey methods included trapping, seining, monitoring of artificial covers, active searching, and avian surveys. Surveys were conducted during the time of year when each targeted species was most likely to be encountered.

The surveys confirmed the presence of 20 threatened and endangered species on the ORR. Species recorded included 1 federal endangered species (the gray bat); 2 federal threatened species (the bald eagle and peregrine falcon); 2 federal species of concern (the migrant loggerhead shrike and cerulean warbler); 1 state threatened species (the osprey); and 14 state species deemed in need of management (the four-toed salamander, sharp-shinned hawk, Cooper's hawk, northern harrier, sandhill crane, little blue heron, double-crested cormorant, anhinga, great egret, snowy egret, yellow-bellied sapsucker, olive-sided flycatcher, grasshopper sparrow, and southeastern shrew). All but five (i.e., the four-toed salamander, anhinga, sandhill crane, snowy egret, and gray bat) of these species were recorded more than once.

This report also includes some ancillary information. Records are provided for nonlisted species (44 species of reptiles and amphibians, 155 species of birds, and 28 species of mammals). Categorization of survey sites into 1 or more of 19 habitat types, which are briefly described, is presented. Notes are summarized on the occurrence of threatened and endangered species on the ORR. Finally, this report also lists threatened and endangered species not found that might be located by additional surveys, recommends three survey areas for natural-area status due to wildlife value, and suggests several avenues for future work.

1. INTRODUCTION

Environmental management activities on the Oak Ridge Reservation (ORR) are managed by Lockheed Martin Energy Systems, Inc. (Energy Systems), for the U.S. Department of Energy (DOE). The ORR is an approximately 14,000-ha (33,000-acre) block of federal land in the Ridge and Valley Province of eastern Tennessee. Approximately 10,000 ha (25,000 acres) of this land have remained undeveloped in a relatively natural state since the land was acquired by the federal government in the 1940s. The value of the ORR as a nationally and regionally significant source of natural biological diversity is widely recognized (e.g., Mann et al. 1996).

Essential components of responsible stewardship of any land, regardless of the land's purpose, are the protection and enhancement of biodiversity, of which terrestrial vertebrates are a key part. Land managers, therefore, need to consider their legal, intellectual, and ethical responsibilities in maintaining or enhancing lands for native animals, particularly those that are rare and declining. This report on rare terrestrial vertebrates on the ORR addresses this component of responsible land stewardship.

The importance of rare species in effective stewardship has been recognized in state and federal laws that protect certain animal species in Tennessee. The federal Endangered Species Act confers protection on species listed as either endangered or threatened; other species may be proposed for listing, designated as candidates for proposal, or listed as species of concern (about which more information is needed to ascertain whether they are suitable candidates). Federal agencies may not undertake actions that might harm federally threatened or endangered species without first assessing the impacts of the actions on these species, and, under appropriate circumstances, consulting with the U.S. Fish and Wildlife Service (FWS). Following consultation, the FWS may specify additional requirements or prohibit actions. Also, it is advisable for agencies to consider species that may be listed in the future: those species that are proposed, are candidates for listing, or are species of concern. The state of Tennessee lists those species that it considers endangered, threatened, or in need of management (INM) in the state (TWRC 1994 a,b). The state listing includes federally listed species, other species that are rare or declining in Tennessee, and species about which more information is needed. State law prohibits knowingly harming these species or their habitats without a permit, which when granted may include restrictions or mitigative measures. All such state and federally listed species are referred to collectively in this report as threatened and endangered (T&E) species. Species in the main text are referred to by an accepted common name. Scientific names of T&E animals are listed in Appendix A.

Recognizing the legal and institutional importance of T&E terrestrial vertebrate species, the Energy Systems Environmental Restoration Program undertook a study of such species from 1994 through 1996, in cooperation with Oak Ridge National Laboratory (ORNL), which has overall responsibility for managing the National Environmental Research Park including coordination of wildlife management activities on the ORR. The major goal of the study was to develop a preliminary inventory of the occurrence of these species on the ORR. This information will be valuable in managing the natural resources of the ORR and in contributing to sound planning and decision making, particularly with regard to current hazardous waste site remedial decisions and future land development. The findings of this preliminary survey so clearly demonstrated the value

of the ORR for biodiversity, wildlife and ecosystem research, and protection of T&E species that discussion of, and recommendations for, habitat management, species and habitat protection, and future work are included in the final chapter of this report. Useful ancillary information collected during the study and reported herein includes the occurrence of nonlisted animal species and brief habitat characterizations of survey sites. This report also cites historical information on T&E species on the ORR.

2. MATERIALS AND METHODS

2.1 HISTORICAL ACCOUNTS

Literature searches were conducted to locate historical records of T&E species on the ORR. Previous studies had provided some indication of which listed species might currently occur. Although numerous studies had dealt with ORR fauna, only a few contained documentation on T&E animals. Some historical survey areas had been substantially altered since the original studies were conducted, T&E listings had changed, and not all currently listed species had been searched for. Therefore, one objective of this study was to validate and expand on these earlier efforts. Some specimens from historical studies were housed in the ORR plant and animal reference collection; these specimens were catalogued to further document records. In addition, individuals familiar with ORR fauna were interviewed to obtain unpublished information.

2.2 PRIORITIZATION

Sixty-nine species of federally or state listed terrestrial vertebrates may occur in Tennessee (20 reptiles and amphibians, 20 mammals, and 29 birds). Not all of these are expected to occur on the ORR. To ensure effective use of limited resources, listed animal species that might be present were targeted, and a prioritization system was used that took into account historical and recent sightings, species distributions, presence of suitable habitat, literature reviews, and personal communications.

For reptiles, amphibians, and mammals (Tables 1 and 2) the priorities were as follows:

- Priority 1: federal or state listed species that have a range that includes the ORR;
- Priority 2: federal or state listed species that have been recorded in counties adjacent to the ORR; and
- Priority 3: other federal or state listed species that have been recorded elsewhere in eastern Tennessee [(i.e, within 160 km (100 miles) of the ORR].

For birds (Table 3), prioritization was slightly different because these animals are particularly mobile and wide ranging and are frequently migratory over long distances. The two priority categories established for birds were as follows:

- Priority 1: federal or state listed species most likely to be found on the ORR based on their current range and habitat requirements and
- Priority 2: federal or state listed species that have adequate existing habitats on the ORR but that are currently uncommon in eastern Tennessee.

Survey efforts were focused on these species according to priority.

Table 1. Reptile and amphibian species targeted for surveys, optimal survey season, their typical habitat, and recommended survey technique

Species ^a	Survey season	Habitat	Survey technique
Priority 1			
Tennessee cave salamander	Year-round	Cave systems with permanent streams and pools in limestone	Cave surveys
Four-toed salamander	September–March	Hardwood forest wetlands with sphagnum moss	Pitfall traps, active searches, and artificial cover
Hellbender	Year-round	Small rivers or large streams with clear cool running water with flat rocks	Electro-shocking, seining, potato rake, and active searches
Eastern slender glass lizard	April–September	Dry upland areas, brushy cut-over woodlands, and grassy fields	Artificial cover and active searches
Northern pine snake	April–September	Sandy pine woods, dry mountain ridges, old fields with loose soils, and asphalt	Artificial cover and active searches
Priority 2			
Black Mountain dusky salamander	April–October	Under stones in association with mountain brooks	Pitfall traps, funnel traps, active searches, and artificial cover
Mole salamander	January–March	Moist low-lying woodland areas with ponds. Adults live in subterranean tunnels and under rotten logs and debris or leaf-litter	Seining, minnow traps, pitfall traps, and artificial pools and cover
Priority 3			
Bog Turtle	May–September	Sphagnum wetlands and swamps or meadows with clear slow moving streams with muddy bottoms	Turtle traps and seining
Green anole	April–September	Trees, shrubs, vines, and low vegetation. Nesting occurs in dry rotting wood, leaf-litter, and rocky bluffs	Pitfall traps and active searches

^aThis list excludes species that are found only in the high elevations of the Smoky Mountains.

Table 2. Mammal species targeted for surveys, optimal survey season, their typical habitat, and recommended survey technique

Species ^a	Survey season	Habitat	Survey technique
<u>Priority 1</u>			
Gray bat	Year-round	Caves	Cave surveys and mist nets
Smoky shrew	March–September	Moist woodlands with rocks, decaying logs, and leaf-litter	Pitfall traps
Southeastern shrew	March–September	Floodplains, pine woods with rocks, decaying logs, and leaf-litter	Pitfall traps
<u>Priority 2</u>			
Small-footed bat	Year-round	Caves	Cave surveys and mist nets
Indiana bat	Year-round	Caves	Cave surveys and mist nets
Rafinesque's big-eared bat	Year-round	Unoccupied man-made structures and caves	Cave and abandoned building surveys and mist nets
Woodland jumping mouse	August–September	Spruce/fir, hemlock, and hardwood forests and damp, rocky, swampy areas	Sherman traps and pitfall traps
Meadow jumping mouse	August–September	Open grassy areas with thick vegetation near ponds and streams or marshes	Sherman traps and pitfall traps
Southern bog lemming	Year-round	Open grassy areas with thick vegetation near ponds, rocky edges of streams, and marshes	Sherman traps, pitfall traps, and cave surveys
Eastern woodrat	Year-round	Wooded, damp, rocky, swampy areas	Sherman traps and pitfall traps
Masked shrew	March–October	Moist woodlands with rocks, decaying logs, and leaf-litter	Pitfall traps
<u>Priority 3</u>			
Water shrew	March–October	Moist woodlands with rocks, decaying logs, leaf-litter, and rocky over-hangs near streams	Pitfall traps
Yellow-nosed vole	March–October	Moist woodlands with rocks, decaying logs, and leaf-litter	Sherman traps and pitfall traps

^aThis list excludes species that are found only in the high elevations of the Smoky Mountains.

Table 3. Selected bird species targeted for surveys, optimal survey season, their typical habitat, and recommended survey technique

Species ^a	Survey season	Habitat	Survey technique
Priority 1			
Yellow-bellied sapsucker	August–May	Open deciduous woods	Searches for tree markings
Cooper’s hawk	Year-round	Mixed woods with openings	Searches for nests
Sharp-shinned hawk	Year-round	Mixture of woods and open country	Searches for nests
Great egret	July–September	Shorelines and wetlands	Specific habitat surveys
Northern harrier	April–May and October–November	Marsh, open country, and weedy fields	Specific habitat surveys
Bald eagle	August–September and January–March	Open water and tall trees	Clinch River and Melton Hill Reservoir surveys
Osprey	May–October	Open water and platforms	Clinch River and Melton Hill Reservoir surveys
Grasshopper sparrow	April–September	Grassy fields and farmland	Flushing and song identification
Priority 2			
Snowy egret	July–September	Marshes, lake margins, and wetlands	Specific habitat surveys
Vesper sparrow	April–May and October–November	Pastures and grasslands	Flushing and song identification
Common barn-owl	Year-round	Open country, marshes, and sheltered cavities	Building searches and calls
Little blue heron	July–September	Shorelines and wetlands	Specific habitat surveys
Double-crested cormorant	May–July	Open water	Clinch River and Melton Hill Reservoir surveys
Olive-sided flycatcher	Spring and Fall	Openings and dead trees	Specific habitat surveys
Sandhill crane	Spring and Fall	Open shallow water and fields	Specific habitat surveys
King rail	April–October	Marshes	Specific habitat surveys
Least bittern	April–October	Marshes with tall cover	Specific habitat surveys

^aSurvey seasons are taken from Hamel 1992.

2.3 SELECTION OF SURVEY SITES

2.3.1 Reptiles, Amphibians, and Mammals

The selection of survey sites for reptiles, amphibians, and mammals involved first dividing the ORR into 10 compartments (Fig. 1). In each compartment, 5 wetlands were selected from Cunningham and Pounds (1991) based on size and accessibility. Two wetland sites were then chosen at random from the original five. Because no acceptable wetlands could be found in the Tower Shielding area and only 1 accessible wetland occurred near the Central Training Facility, only 17 sites were surveyed. Additional survey sites were later selected in locations of special interest based on historical and recent sightings or presence of unique habitat (e.g., grasslands). The resulting survey sites are shown in Fig. 2. Seven caves were selected for surveying, giving priority to those that had been previously explored and mapped. The locations of surveyed caves (Copper Ridge, Flashlight Heaven, Walker Branch, Big Turtle, Little Turtle, Pinnacle, and Bull Bluff) are shown in Fig. 3.

2.3.2 Birds

Bird surveys were conducted in suitable habitat and/or where the species had been previously reported. Eleven routes were selected for breeding bird surveys in order to survey as many habitat types as possible across the ORR. Breeding bird survey routes are shown in Fig. 4. Not all sites where birds were sighted are shown because some observations were made opportunistically in conjunction with other activities.

2.4 TRAPPING AND SURVEY METHODS

Survey methods were chosen based on their appropriateness for targeted species, efficiency, and the time required to complete them. Sampling was conducted during the time of year each species was most likely to be encountered (e.g., breeding season and migration).

2.4.1 Pitfall Traps

The most effective way of capturing shrews and many amphibians is with pitfall or can traps (Karns 1986). Pitfall traps were used for some amphibian, reptile, and mammal species from all priority groupings.

Traps were installed in a grid pattern, surrounding the wetland with traps at 10-m (33-ft) intervals. At all but 4 survey sites, traps were unbaited #10 cans buried in the ground with the tops flush with the surface. All cans had holes for drainage. The total number of traps at each site varied with wetland size but was generally from 20 to 40. When traps were not in use, they were deactivated by placing a stake into the can, thus allowing any captured animals to escape. One week was allowed before trapping began for animals to adjust to habitat disturbances. During the trapping season (April–August), the traps were left open 24 h a day for 3 consecutive days and checked daily. At 4 sites, buried 5-gal buckets and drift fences were used. Only five to eight buckets were used at each site. These traps were not closed and were checked year-round. Sites with pitfall traps are listed in Table 4.

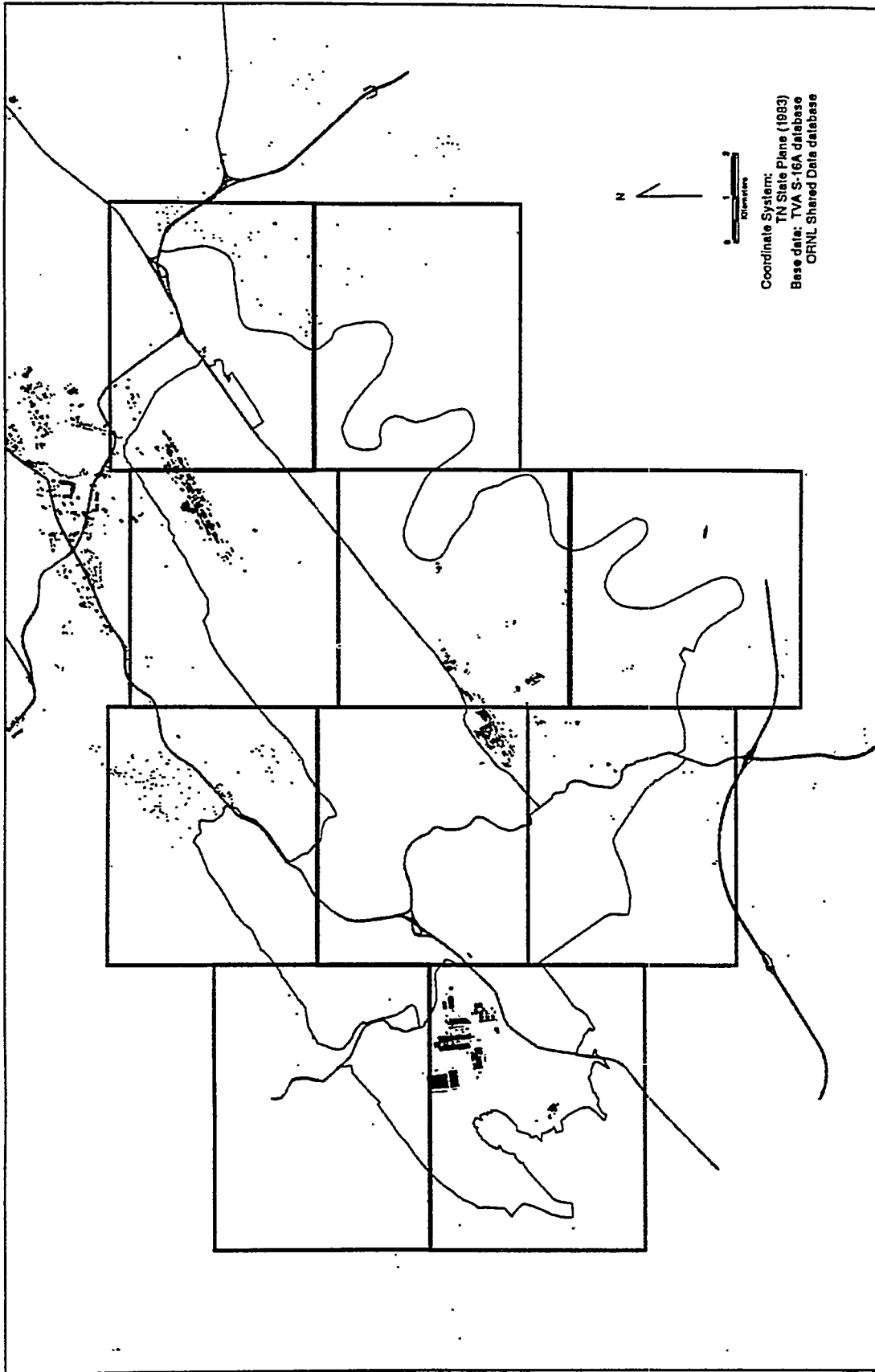


Fig. 1. Sampling compartments for reptiles, amphibians, and mammals on the Oak Ridge Reservation.

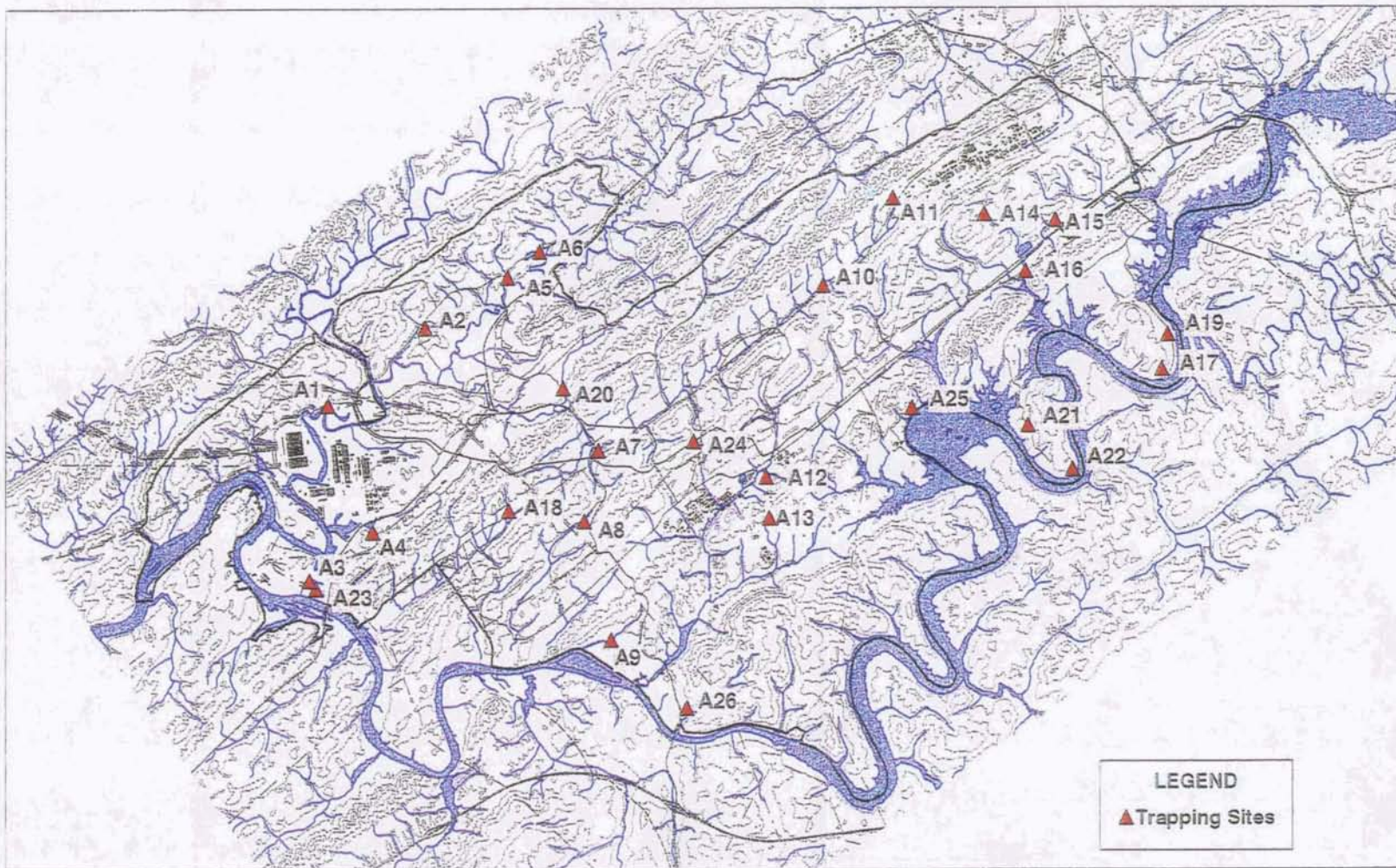


Fig. 2. Reptile, amphibian, and mammal survey sites on the Oak Ridge Reservation.

Figure 3. has been removed from this document as the location of caves on the Oak Ridge Reservation is environmentally sensitive information.

Contact [Pat Parr](#) for questions and assistance.

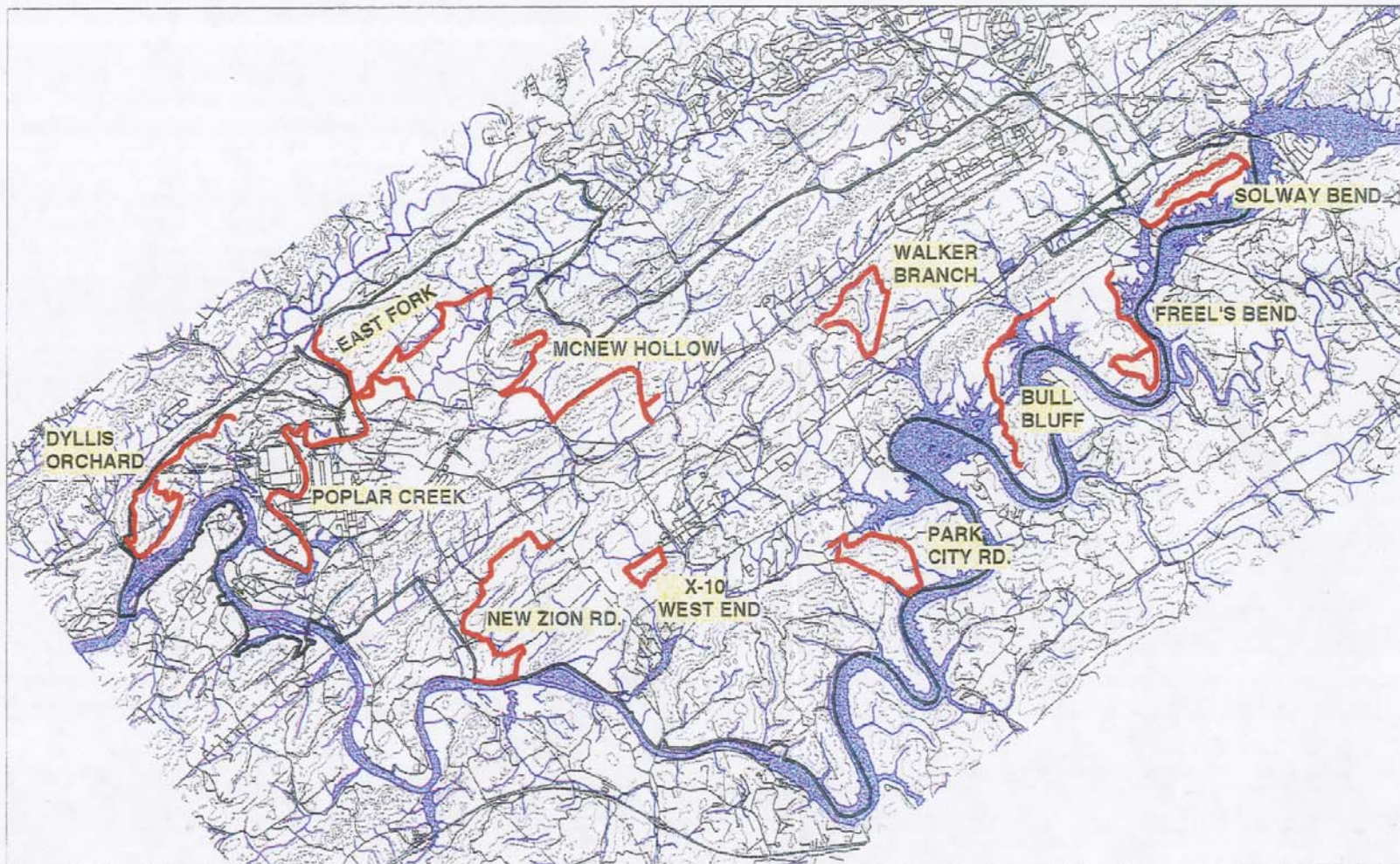


Fig. 4. Routes for breeding bird surveys on the Oak Ridge Reservation.

Coordinate System:
 TN State Plane (1983)
 Base data: TVA S-16A database
 ORNL Shared Data database

Map layout by: B. A. Rosensteel
 - JAYCOR Environmental -
 May 1996

Table 4. Capture methods used at survey sites

Survey site ^a	Site name	Artificial covers	Pitfalls traps	Sherman traps
A1	Perimeter Road		*	*
A2	East Fork Poplar Creek		*	*
A3	K-25 Salvage (wetland)		*	*
A4	K-25 Visitor Overlook		*	*
A5	Gaging Station		*	*
A6	Quarry-Gallaher Cemetery		*	*
A7	Bear Creek Weir "Y"		*	*
A8	Burns Cemetery		*	*
A9	Muskrat Marsh	*	*	*
A10	Bear Creek (wetland)		*	*
A11	Y-12 Meteorological Tower		*	*
A12	X-10		*	*
A13	Melton Valley Drive		*	*
A14	Roger's Quarry		*	*
A15	Wood Duck Pond		*	*
A16	McCoy Branch	*	*	*
A17	Turtle Pond		*	*
A18	Bear Creek Road	*	*	*
A19	Freels Bend	*	*	*
A20	McNew Hollow	*	*	*
A21	Bull Bluff		*	
A22	Bull Bluff (field)	*		*
A23	K-25 Salvage (field)			*
A24	Gasline Road	*		*
A25	Shepherd's Cemetery	*		*
A26	Flashlight Heaven Cave	*		*

^aSurvey site numbers A1–A26 correspond to mapped locations in Fig. 2.

2.4.2 Sherman Traps

Sites where Sherman traps were used are also summarized in Table 4. Three to five sites were trapped per week. Traps were placed near rocks, fallen logs, and animal runways. The total number of traps per site varied with wetland size but was generally from 40 to 50. Traps were placed at 10-m (33-ft) intervals in a grid pattern. Where pitfall traps were present, one trap was placed adjacent to each can. Traps were baited with peanut butter and rolled oats and were set on the afternoon of the first day, checked for 3 consecutive days, and then closed.

2.4.3 Seining

Seining is a quick and effective method of surveying amphibians in small ponds, wetlands, and streams (Heyer et al. 1994). This method was used to search for the mole salamander.

Semipermanent to permanent ponds within or near hardwood forests on the ORR were selected from Cunningham and Pounds (1991). Most ponds were abandoned cattle ponds surrounded by mixed pine/hardwood forest and old fields. A 1.2 m × 2.4 m (4 ft × 8 ft) seine with a 0.3-cm (1/8-in)

mesh net was used. Transects were established in ponds out to a depth of 1.2 m (4 ft) and parallel to the shoreline (Cooperrider et al. 1986). Twenty ponds were seined to sample for adult mole salamanders from January through March 1995. Information collected at each pond included transect length, water and air temperature, weather conditions, and gender and total number of each species collected.

2.4.4 Minnow Traps

Standard conventional minnow traps were used to capture ambystomid salamanders, particularly targeting the mole salamander. Unbaited traps were placed in ponds and slack water from January through March 1996. The number of traps per area varied with the size and depth of the water, with as many as 10 traps used in a 1-ha plot. Traps were checked daily when possible.

2.4.5 Artificial Covers

Artificial covers provided micro-habitats for a variety of animals that could be subsequently captured or identified. Dry upland brushy habitats (e.g., power line rights-of-way and old fields) were selected to survey for the eastern slender glass lizard. Areas with pine stands or dry ridges were selected for the northern pine snake. Artificial covers were constructed from scrap wood, approximately 1 m x 1 m (3 ft x 3 ft). The wood was labeled, numbered, and monitored bimonthly during the appropriate seasons (April–September). Artificial covers were placed at appropriate sites (Table 4) in groups of 20.

2.4.6 Active Searches

Active searches were used extensively to survey for a variety of T&E animals. Suitable or preferred habitats for each species were searched during the time of year the animal was most likely to be encountered. The method involved traveling in an area (walking or driving permanent transects) while recording all animals seen or heard. Most bird surveys were accomplished using this approach; the preferred habitat of each species was searched visually (using optics) and auditorially for their presence.

Night driving was an active search technique used to locate reptile and amphibians. This method involved driving on spring and fall nights (usually rainy) along primary and secondary roads through various suitable habitat. Abandoned buildings, caves (Fig. 3), and rocky slopes were also areas where active searching was performed.

2.4.7 Avian Surveys

Birds were surveyed by performing active searches (Sect. 2.4.6) and by conducting a point count census of breeding birds. Point counts were conducted in various habitats across the ORR. The counts were conducted along old roads, trails, and in the middle of specified habitats. As many habitat types as possible were covered. Each of the 11 routes (Fig. 4) was 3–6 km (2–4 miles) long with stopping points located every 0.3 km (1/6 mile). All birds seen or heard at these points within a 50-m (164-ft) radius and a 5-min time interval were recorded (Hamel 1992). The routes were surveyed in June, the prime nesting season for many species.

2.4.8 Turtle Trapping

Commercial nylon hoop nets baited with watermelon or dog food were used to capture turtles. Nets were made of a mesh cylinder supported by metal hoops and with a funnel opening at one end. Traps were placed in embayments or near turtle basking sites along the Clinch River. As many as five traps were set at a time and checked daily. In 1994, hoop nets were used to capture the Cumberland slider, a species then listed by the state of Tennessee. The turtle was located in several areas along the Clinch River; however, in 1995 the animal was delisted and trapping ceased. The only other listed turtle targeted by this study (Table 1) was the bog turtle. Although marginal habitat occurs for the bog turtle on the ORR, sampling for this animal was not conducted due to time constraints.

2.5 HABITAT ANALYSIS

Habitat analysis was conducted on sites where pitfall and Sherman traps and artificial covers were placed. This analysis was conducted to allow changes over time to be seen in the event that future surveys were conducted. This general information also provides some habitat characterization for areas where T&E species are located. Information recorded for each site included the following variables: latitude; longitude; cover type; basal area and litter depth; tree diameter; dominant plant in ground; under story and over story layers and height of each stage; special features (e.g., log debris, rock outcrops, and disturbances); topography (including slope and aspect); and presence of water. Survey sites were photographed.

2.6 DOCUMENTATION

Information on trapped or observed animals, both listed and nonlisted, was recorded on data sheets and in logbooks. This information was subsequently logged into a computerized data base maintained in the Excel[®] format. The data base provides records for the monitoring of biodiversity on the ORR. (A complete list of animals observed during this survey is provided in Appendix B.) In cases where field identification could not be made, the specimen was taken to the laboratory for further study. When possible, specimens were photographed.

Periodic reports on T&E species located during this survey were given to the Tennessee Department of Environment and Conservation and the Tennessee Wildlife Resources Agency (TWRA). Records for federally listed species were provided to the FWS, where appropriate.

¹Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof.

3. RESULTS

3.1 PROTECTED TERRESTRIAL VERTEBRATES ON THE ORR

Protected animals identified on the ORR from 1994 through 1996 are summarized in Table 5. Each entry provides the common name, survey site number, site name, date of sighting, and number of individuals observed. Survey site numbers begin with A (amphibian and mammal) and B (birds) and correspond to mapped locations of the T&E animal in Figs. 2 and 5, respectively. Further explanations for each species identified can be found in Sect. 4.1.2. Detailed information on each sighting (including latitude, longitude, and individuals who observed the animal) is recorded in the data base.

The following listed species were located in 1994: double-crested cormorant, osprey, bald eagle, Cooper's hawk, northern harrier, and great egret. All of these species were observed again in 1995–1996. T&E species found in 1994 that were subsequently delisted included the black-crowned night heron, red-shouldered hawk, black vulture, and Cumberland slider.

The surveys confirmed the presence of 20 threatened and endangered species on the ORR. Species recorded included 1 federal endangered species (the gray bat); 2 federal threatened species (the bald eagle and peregrine falcon); 2 federal species of concern (the migrant loggerhead shrike and cerulean warbler); 1 state threatened species (the osprey); and 14 state species deemed in need of management (the four-toed salamander, sharp-shinned hawk, Cooper's hawk, northern harrier, sandhill crane, little blue heron, double-crested cormorant, anhinga, great egret, snowy egret, yellow-bellied sapsucker, olive-sided flycatcher, grasshopper sparrow, and southeastern shrew). All but five (i.e., the four-toed salamander, anhinga, sandhill crane, snowy egret, and gray bat) of these species were recorded more than once.

Table 5. Protected terrestrial vertebrates on the Oak Ridge Reservation

Common name	Survey site	Site name	Date	# Observed
Four-toed salamander ^{a,b}	A20	McNew Hollow	12/4/95	1
Sharp-shinned hawk	B1	K-25 Visitors Overlook	5/25/95	1
Sharp-shinned hawk	B2	Duck Island	6/13/95	1
Sharp-shinned hawk	B3	Herrell Road	6/16/95	1
Sharp-shinned hawk ^c	B4	Clark Park	6/19/95	1
Sharp-shinned hawk	B1	K-25 Visitors Overlook	6/19/95	1
Sharp-shinned hawk	B3	Herrell Road	6/29/95	1
Sharp-shinned hawk	B5	Freels Bend Near Cabin	8/14/95	1
Sharp-shinned hawk	B6	Walker Branch Road South	8/15/95	1
Sharp-shinned hawk	B7	East Quarry Road	8/29/95	1
Sharp-shinned hawk	B8	Freels Bend Cabin	9/5/95	1
Sharp-shinned hawk	B44	Park City Patrol Road	1/29/96	1
Cooper's hawk	B9	K-25 Portal 4	8/22/94	1
Cooper's hawk ^c	B10	Bethel Valley Road	2/22/95	1
Cooper's hawk	B11	Gasline Road	3/12/95	1

Table 5 (continued)

Common name	Survey site	Site name	Date	# Observed
Cooper's hawk	B9	K-25 Portal 4	5/19/95	1
Cooper's hawk	B12	K-25 1330 Area	3/7/95	1
Cooper's hawk	B12	K-25 1330 Area	8/8/95	1
Cooper's hawk	B13	Y-12 Lake Reality	8/11/95	1
Cooper's hawk	B10	Bethel Valley Road	10/19/95	1
Cooper's hawk	B14	Freels Bend Road South	11/8/95	1
Cooper's hawk	B26	Freels Bend North	1/2/96	1
Cooper's hawk	B22	K-25 K901-A Pond	1/11/96	1
Cooper's hawk ^c	B45	ORNL Building 2518	2/1/96	1
Cooper's hawk	B52	Walker Branch Powerline	4/25/96	1
Grasshopper sparrow ^a	B15	Freels Bend South	5/8-8/30/95	8+
Anhinga	B16	ORNL Swan Pond	6/20/94	1
Great egret	B17	Poplar Creek	6/11/94	1
Great egret	B18	Poplar Creek	6/28/95	1
Great egret	B19	K-25 Beaver Pond Complex	7/6/95	1
Great egret	B16	ORNL Swan Pond	7/10-9/26/95	5
Great egret	B20	White Oak Lake Upper	7/29-10/12/95	7
Great egret	B21	Freels Bend Land Bridge	7/31-8/14/95	1
Great egret	B22	K-25 K901-A Pond	8/11-8/15/95	1
Great egret	B51	White Oak Lake Lower	4/22/96	1
Northern harrier	B23	McNew Hollow/Hembree Marsh	9/7/94	1
Northern harrier	B24	Raccoon Creek	9/9/94	1
Northern harrier	B25	0800 Area Along Clinch River	9/20/94	2
Northern harrier	B26	Freels Bend North	11/2/95	1
Northern harrier	B26	Freels Bend North	11/6/95	1
Northern harrier	B26	Freels Bend North	11/7/95	1
Olive-sided flycatcher	B26	Freels Bend North	5/12/95	1
Olive-sided flycatcher	B26	Freels Bend North	5/15/95	1
Little Blue heron	B19	K-25 Beaver Pond Complex	7/6/95	1
Little Blue heron	B22	K-25 K901-A Pond	7/17/95	1
Little Blue heron	B22	K-25 K901-A Pond	7/18/95	1
Little Blue heron	B20	White Oak Lake	7/29-9/14/95	1
Snowy egret	B19	K-25 Beaver Pond Complex	4/16/96	1

Table 5 (continued)

Common name	Survey site	Site name	Date	# Observed
Sandhill crane	B18	Poplar Creek	3/5/95	1
Double-crested cormorant	B16	ORNL Swan Pond	6/1/94	1
Double-crested cormorant	B27	Melton Hill Lake	5/5/95	20+
Double-crested cormorant	B27	Melton Hill Lake	5/12/95	20+
Double-crested cormorant	B28	Clinch River Near K-25	7/5/95	1
Double-crested cormorant	B29	Poplar Creek West End	8/31/95	2
Double-crested cormorant	B30	K-25 Near Hwy 58	10/26/95	2
Double-crested cormorant	B50	Walker Branch Embayment	4/12/96	6+
Yellow-bellied sapsucker	B31	Walker Branch	2/23/95	1
Yellow-bellied sapsucker	B32	Walker Branch Road	3/27/95	1
Yellow-bellied sapsucker	B33	Freels Bend Road South	11/8/95	2
Yellow-bellied sapsucker	B34	Walker Branch Road North	11/10/95	1
Yellow-bellied sapsucker	B42	Freels Bend North	11/21/95	1
Yellow-bellied sapsucker	B46	Park City Road	1/24/96	1
Yellow-bellied sapsucker	B6	Walker Branch Road South	2/5/96	1
Peregrine falcon	N/A	Flyover—East ORR	5/15/95	1
Peregrine falcon	B52	Walker Branch Powerline	4/25/96	1
Bald eagle	B35	Jones Island Road	8/9/94	1
Bald eagle	B35	Jones Island Road	8/11/94	1
Bald eagle	B47	Solway Bend Farm	1/11/96	1
Bald eagle	B48	Bearden Creek (Clinch River)	1/15/96	2
Bald eagle	B49	Hickory Creek Bend (Clinch River)	1/15/96	1
Bald eagle	B8	Freels Bend Cabin	1/15/96	2
Bald eagle	B54	Solway Bridge	1/10/96	1
Osprey	B36	K-25 1515 Lagoon	6/7/94	1
Osprey	B29	Poplar Creek West End	6/11/94	1
Osprey	B20	White Oak Lake	5/24/95	1
Osprey	B37	Freels Bend South	5/31/95	1
Osprey	B37	Freels Bend South	6/27/95	1
Osprey	B29	Poplar Creek West End	6/29/95	4
Osprey	B29	Poplar Creek West End	7/18/95	4
Osprey	B29	Poplar Creek West End	3/15/96	2
Osprey	B55	Clinch River Near K-25	4/17/96	2
Osprey	B30	K-25 Near Hwy 58	4/16/96	1
Loggerhead shrike	B38	Scarboro Creek	8/11/94	1
Loggerhead shrike	B39	Freels Bend Road North	11/8/95	1
Loggerhead shrike	B40	Freels Bend Road South	11/9/95	1

Table 5 (continued)

Common name	Survey site	Site name	Date	# Observed
Loggerhead shrike	B41	Freels Bend South	11/13/95	1
Loggerhead shrike	B43	Freels Bend North	11/15/95	1
Loggerhead shrike	B40	Freels Bend Road South	4/24/96	1
Cerulean warbler	B53	East Herrell Road	4/24/96	2
Cerulean warbler	B31	Walker Branch	4/22/96	4
Cerulean warbler	B32	Walker Branch Road	4/22/96	1
Southeastern shrew ^c	A9	Muskrat Marsh	5/10/95	2
Southeastern shrew ^b	A13	Melton Valley Drive	5/10/95	1
Southeastern shrew ^c	A15	Wood Duck Pond	5/10/95	1
Southeastern shrew ^c	A15	Wood Duck Pond	5/12/95	2
Southeastern shrew ^c	A16	McCoy Branch	6/6/95	1
Southeastern shrew ^c	A16	McCoy Branch	6/28/95	1
Southeastern shrew ^b	A12	X-10	7/12/95	1
Southeastern shrew ^c	A2	East Fork Poplar Creek	7/20/95	1
Southeastern shrew ^c	A16	McCoy Branch	7/31/95	1
Southeastern shrew ^c	A18	Bear Creek Road	9/26/95	1
Southeastern shrew ^c	A20	McNew Hollow	9/26/95	1
Southeastern shrew ^c	A19	Freels Bend	10/2/95	1
Southeastern shrew ^c	A18	Bear Creek Road	11/7/95	1
Southeastern shrew ^c	A19	Freels Bend	11/15/95	1
Gray bat ^d	N/A	Y-12 Plant, Building 9204-3	10/31/94	1

^aPhotograph taken.

^bSpecimen caught and released.

^cSpecimen retained in museum.

^dDead specimen sent to FWS in Cookeville, Tennessee.

N/A— not available.

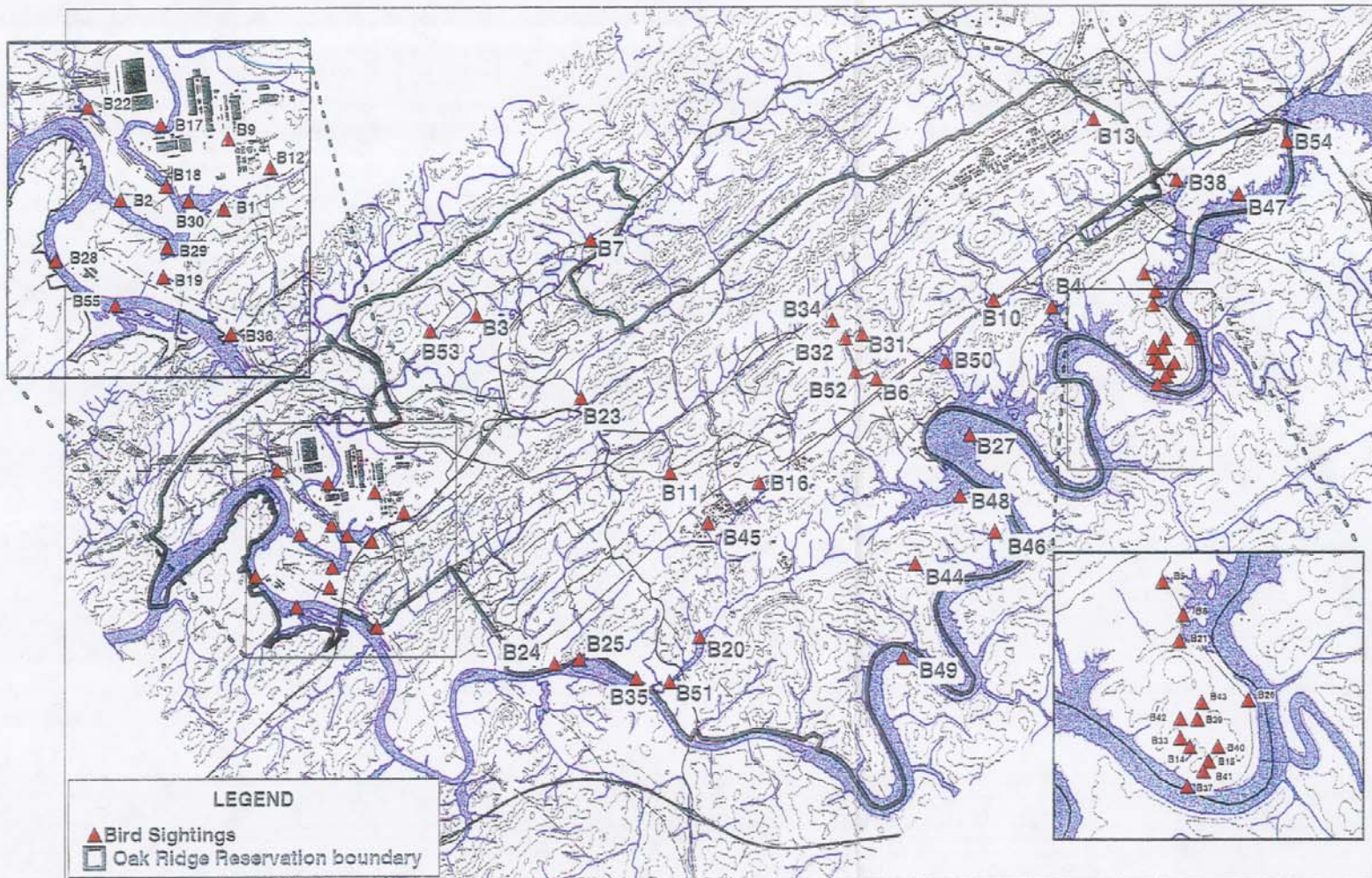


Fig. 5. Locations of sightings of protected bird species on the Oak Ridge Reservation.

Coordinate System:
 TN State Plane (1983)
 Base data: TVA S-16A database
 ORNL Shared Data database

Map layout by: B. A. Rosensteel
 - JAYCOR Environmental -
 May 1996

3.2 HABITAT DESCRIPTIONS OF SURVEY SITES

Habitat descriptions of nonavian survey sites are shown in Table 6. Habitat categories (Appendix C) were created to establish a standard method of reporting. Habitat categories matched with survey sites (the "habitat" heading in Table 6) and areas within 50 m (164 ft) of the sites (the "association" heading in Table 6) are shown in Table 6. Some sites did not have an associated habitat.

Table 6. Habitat descriptions of reptile, amphibian, and mammal survey sites

Survey site ^a	Site name	Habitat	Association
A1	Perimeter Road	8, 13	1, 16
A2	East Fork Poplar Creek	4, 7, 11	14, 15
A3	K-25 Salvage (wetland)	7, 14, 16	
A4	K-25 Visitor Overlook	3, 12	7
A5	Gaging Station	2, 11	14, 15
A6	Quarry-Gallaher Cemetery	9, 12	3, 19
A7	Bear Creek Weir "Y"	2, 11	7
A8	Burns Cemetery	3, 7, 10	14, 16
A9	Muskrat Marsh	5, 11	14
A10	Bear Creek (wetland)	15	2
A11	Y-12 Meteorological Tower	3, 12	6
A12	X-10	7, 9, 13	
A13	Melton Valley Drive	3, 8, 10	
A14	Roger's Quarry	8, 18	
A15	Wood Duck Pond	6, 12, 16	
A16	McCoy Branch	3, 16, 17	1, 13
A17	Turtle Pond	6, 16	17
A18	Bear Creek Road	3, 12	14
A19	Freels Bend	17	6
A20	McNew Hollow	3, 10	8
A21	Bull Bluff	13	12
A22	Bull Bluff (field)	16	12, 13
A23	K-25 Salvage (field)	16	14
A24	Gasline Road	16, 14	12
A25	Shepherd's Cemetery	10	1, 19
A26	Flashlight Heaven Cave	12	

^aSurvey site numbers A1–A26 correspond to mapped locations in Fig. 2.

4. RELATED FINDINGS

The ORR provides important, largely unfragmented habitats for many animal species, both listed and nonlisted. This chapter provides information on four topics that were of interest during the survey of protected terrestrial vertebrates on the ORR and their habitat. Specifically, Sect. 4.1 discusses the status of animal species on the ORR, including both T&E species that might be identified in future surveys of the ORR (Sect. 4.1.1) and protected species recorded during this survey (Sect. 4.1.2). Section 4.2 provides recommendations for enhancing species protection on the ORR. Section 4.3 recommends three survey areas for natural-area status due to wildlife value, and Sect. 4.4 outlines tasks proposed for the future that would support the management of T&E species on the ORR.

4.1 STATUS OF PROTECTED TERRESTRIAL ANIMAL SPECIES ON THE ORR

4.1.1 T&E Species That Might Be Identified in Future Surveys of the ORR

New species continue to be discovered on the ORR; for example, two new county records for salamanders were established in 1995. Some T&E species that were recorded in past surveys were not observed in this project; others were not observed but are expected to occur based on their range, recent records near the ORR, and habitat requirements. Table 7 lists these species, along with references to historical records on the ORR, if any; current protection status of the species; and regional occurrence.

4.1.2 Protected Species Found on the ORR

The ORR provides important habitat for the T&E species that were recorded during this survey. For this reason, additional information on their occurrence may be useful in the future. The accounts below provide the frequency of occurrence on the ORR, state and/or federal status, nesting records, historical records, and other notes for each T&E species found during this survey. Actual records and locations for each species are summarized in Table 5.

4.1.2.1 Four-toed salamander

Rare resident. In need of management. One four-toed salamander was located during the survey and is a new record for Roane county. Although this salamander may be found in bogs and wetlands, it is usually associated with sphagnum moss, which is scarce on the ORR. Nevertheless, this salamander will probably be found in other areas on the ORR if surveys are continued.

4.1.2.2 Southeastern shrew

Common resident. In need of management. Southeastern shrews were trapped at several sites during 1995. This animal may be more common than regional records suggest. Animal activity was discovered in conjunction with rainfall, and typically only one animal was captured at a time. Record(s): Dunaway and Kaye (1961), Howell and Dunaway (1958), and Smith (1976).

Table 7. T&E species that might be located in future surveys of the Oak Ridge Reservation

Species	Reference	Status	Regional occurrence
Hellbender	M. Ryon, personal communication	INM	Rare
Northern pine snake	Krumholz 1954	SC	Very rare
Northern saw-whet owl	Krumholz 1954	INM	Very rare
Vesper sparrow	Krumholz 1954	INM	Uncommon migrant
Bachman's sparrow	Howell 1958	SE, SC	Very rare
Bachman's sparrow	Nicholson 1976	SE, SC	Very rare
Bachman's sparrow	Kroodsma 1987	SE, SC	Very rare
Bewick's wren	Krumholz 1954	ST, SC	Very rare
Bewick's wren	Howell 1958	ST, SC	Very rare
Henslow's sparrow	Howell 1958	SC	Rare migrant
Kirtland's warbler	Krumholz 1954	FE	Very rare transient
Mole salamander	NR	INM	Rare in region
Tennessee cave salamander	NR	ST, SC	Uncommon in region
Eastern slender glass lizard	NR	INM	Uncommon in region
Eastern woodrat	NR	INM	Uncommon in region
Rafinesque's big-eared bat	NR	INM	Uncommon in region
Swainson's warbler	NR	INM	Uncommon in region
Common barn owl	NR	INM	Uncommon in region

INM—In need of management.

SC—Federally designated species of concern.

SE—State endangered.

ST—State threatened.

FE—Federally endangered.

NR—No historical record on the ORR.

4.1.2.3 Gray bat

Rare. Federal endangered. One dead specimen was found in a display cabinet in building 9204-3 at the Y-12 facility. The bat was sent to FWS in Cookeville, Tennessee. The gray bat may forage over the Clinch River and larger creeks on the ORR. Use of ORR caves by this bat is unlikely but possible.

4.1.2.4 Sharp-shinned hawk

Uncommon resident. In need of management. The sharp-shinned hawk is a permanent resident of the ORR. Male and female birds were sighted reservation wide during the 1995 breeding season. One previous nest location was reported in 1994 near the Jones Island area of Clinch River. The nest was located near Raccoon Creek on the TVA boundary line/Gasline (Kroodsma 1995). Record(s): Krumholz (1954), Howell (1958), and Hardy (1991).

4.1.2.5 Cooper's hawk

Uncommon resident. In need of management. The cooper's hawk is a permanent resident of the reservation. Juvenile birds were sighted during the 1994 and 1995 breeding seasons. Record(s): Krumholz (1954).

4.1.2.6 Grasshopper sparrow

Uncommon to rare summer resident. In need of management and declining regionally. The grasshopper sparrow was found in one location on the ORR. Eight to ten birds were presumed nesting in the Freels Bend area. This bird is likely to be found in other areas of the ORR where suitable habitat is maintained. Record(s): Howell (1958) and Kroodsma (1987).

4.1.2.7 Anhinga

Rare transient. In need of management. There is one recent record for the anhinga on the ORR: at the ORNL Swan Pond. This species is more often found in west Tennessee (Robinson 1990).

4.1.2.8 Great egret

Uncommon spring and fall migrant. In need of management. The great egret can be found in several areas across the ORR during post-breeding dispersal. Record(s): Krumholz (1954).

4.1.2.9 Northern harrier

Common spring and fall migrant. In need of management. The northern harrier has been sighted in four locations on the ORR. This hawk is probably more common than records suggest but is not known to nest in this area. Record(s): Krumholz (1954).

4.1.2.10 Olive-sided flycatcher

Rare spring and fall migrant. In need of management. There were two sightings of probably the same olive-sided flycatcher.

4.1.2.11 Little blue heron

Uncommon to rare migrant. In need of management. Several sightings of probably one individual were recorded in 1995. This bird was spotted in several wetlands across the ORR. Record(s): Krumholz (1954).

4.1.2.12 Snowy egret

Uncommon spring and fall migrant. In need of management. The snowy egret, like other wading birds, may become more common as populations recover.

4.1.2.13 Sandhill crane

Uncommon spring and fall migrant. In need of management. One current record exists for the sandhill crane on the ORR. The bird landed in Poplar Creek, probably migrating north.

4.1.2.14 Double-crested cormorant

Common migrant. In need of management. Double-crested cormorants have been observed on Melton Hill Reservoir (bordering the ORR). A group of 20 to 25 individuals used the islands south of the Walker Branch embayment for several weeks. One juvenile was observed on the Clinch River near the K-25, and a group of six was seen in Spring 1996.

4.1.2.15 Yellow-bellied sapsucker

Common winter resident. In need of management. Abundant habitat exists for this species on the ORR, and "sapsucker holes" can be observed in many locations across the ORR. Record(s): Krumholz (1954) and Hardy (1991).

4.1.2.16 Peregrine falcon

Rare migrant. Federal threatened. Two sightings exist for this species. A bird was observed flying over the east end of the ORR (Kroodsma 1995); another was seen near Walker Branch in the spring of 1996.

4.1.2.17 Bald eagle

Uncommon winter resident and possible summer resident. Federal threatened. The bald eagle has been sighted on the ORR. Suitable habitat for this species exists on the ORR side of the Clinch River. Given the expansion of the eagle breeding population in Tennessee and the introduction efforts in eastern Tennessee, a breeding population may become established on the ORR, even without proactive management (Buehler 1994). Record(s): Krumholz (1954).

4.1.2.18 Osprey

Common nester. State threatened. Osprey nesting records have existed on the ORR for several years. The establishment of platforms in the Clinch River and Melton Hill Lake areas have been successful in providing nesting sites. Active platforms are located on Poplar Creek, Melton Hill Reservoir, and the Clinch River. Record(s): Krumholz (1954).

4.1.2.19 Migrant loggerhead shrike

Uncommon spring and fall migrant. Federally designated species of concern. The regional distribution is spotty based on habitat requirements or other limiting factors. Record(s): Krumholz (1954), Howell (1958), and Clark (1989).

4.1.2.20 Cerulean warbler

Uncommon spring and fall migrant; possible nester. Federally designated species of concern. The regional distribution of this species is spotty, and breeding records are uncommon outside of the Cumberland Mountains. Record(s): Anderson and Shugart (1974) and Howell (1958).

4.2 RECOMMENDATIONS FOR ENHANCING SPECIES PROTECTION

Protecting T&E species and their habitats is an important element of wildlife management, which in turn is part of effective ecosystem management. Ecosystem management is a management objective for the ORR; the wildlife management portion of this approach is currently under development by ORNL and TWRA, which manages the ORR for wildlife under a cooperative agreement with the DOE. A key element of ecosystem management is to maintain and increase biodiversity. Attention to T&E species contributes to this objective for several reasons:

- T&E species are often umbrella species (i.e., the protection of these species helps to protect many other species).
- T&E species are usually limited because their habitats are limited; hence, their protection maintains and increases structural and biotic diversity, regionally and nationally.
- T&E species are frequently sensitive to habitat changes and, therefore, can serve as indicators of ecosystem status.

To support contributions, the following are recommended:

- continuing and expanding surveys for T&E species where information gaps exist;
- designating appropriate T&E species as umbrella or indicator species;
- developing management plans for appropriate T&E species (e.g., see Appendix D);
- identifying important habitats on the ORR for T&E species; and
- protecting, maintaining, creating, and enhancing important habitats for T&E species. (See the remainder of Sect. 4.2.)

Several broad habitat categories are particularly important in the management of T&E species on the ORR. These include, but are not limited to, the habitats discussed below.

- **Grasslands**—Native grasslands, as opposed to lawns and planted pastures, are limited both on the ORR and in the region. Yet both pre-colonially and historically, naturally or man-induced wildfires created grassland habitats in the region, thereby increasing wildlife diversity. T&E species associated with grasslands on the ORR include, among others, the grasshopper sparrow, migrant loggerhead shrike, and common barn owl. The ORR provides an opportunity for creation and enhancement of such wildlife habitats.
- **Wetlands**—Large undisturbed wetlands are limited on the ORR and regionally. Recently, natural beaver activity has begun to increase the incidence of wetlands, which provide habitat for T&E species such as the great and snowy egret, little blue heron, and sandhill crane. It is important that such developing habitats be protected on the ORR.
- **Mature Forest**—The ORR provides some of the best unfragmented forested habitat in the region (Mann et al. 1996). Protection and enhancement of such habitat would help protect

interior forest species such as bats (e.g., Rafinesque's big-eared bat and the Indiana bat) and neotropical migrant songbirds (e.g., the cerulean warbler).

- **Caves**—Although more than 20 caves have been identified on the ORR, none has been completely and systematically surveyed for animals. The limited cave surveys reported herein indicate that significant habitat may exist for listed species, such as the Tennessee cave salamander, as well as currently unlisted but rare species (e.g., various invertebrates), which may be in need of protection and may be listed in the future. Caves are particularly fragile environments requiring special protection.

Several management tools are available for maintaining and enhancing T&E species and their habitats. These include the following: (1) establishing natural areas (NAs) (e.g., see Sect. 4.3); (2) avoiding or limiting such threats to the survival of T&E species as invasion of non-native flora and fauna, human expansion and development, and habitat fragmentation; and (3) instituting focused management procedures such as the following:

- **Forest Management**—Forested habitats predominate on the ORR and several methods could be instituted to enhance their value for T&E and other species. Examples include selective thinning of hardwood stands, minimization and elimination of non-native species such as loblolly pine, and prescribed burning.
- **Field Maintenance**—The value of existing hay fields to native wildlife could be increased by instituting programs to increase the incidence of native grasses through mowing, planting, and prescribed burning.
- **Habitat Preservation**—T&E species can often be significantly maintained and enhanced by preserving important habitats (see recommendations below for NAs). Such areas include those broad habitat categories discussed above.

4.3 PROPOSED NATURAL AREAS

Listed species on the ORR are provided protection through the Oak Ridge National Environmental Research Park NA designations. NAs are incorporated into ORR site planning documents. This leads to more informed decision making in relation to proposed land uses. The following areas were submitted (in May 1996) to the ORNL area manager as proposed changes or additions to the ORR NAs.

4.3.1 Freels Bend Proposed Extension of Natural Area 21 (NA21)

The Freels Bend site is a relatively large, undisturbed tract of maintained grasslands with interspersed woodlots. The site consists of a wooded northern section (Rainy Knob) and a southern section containing several ponds and large hayfields. Abundant water bodies on the site provide unusual habitat. The Melton Hill Reservoir borders most of the site and forms embayments at both the northeast and northwest ends of the proposed extension area. Wetlands occur on the site although they have not been formally delineated. Six ponds occur across the site, and a cave with a large sinkhole is located in NA21a at Rainy Knob. Several abandoned buildings, a silo, and grape arbors provide ecological requirements for some protected animal species. The northern section contains the present NA21a and NA21b, and the southern section contains reference area (RA) 26 (RA26). These areas were previously selected as NAs due to the presence of rare plants and unusual habitat types (Pounds et al. 1993).

The proposed extension encompasses most of the area found on the peninsula of the Freels Bend site and combines the existing NAs and reference area. This extension creates an integrated area with a variety of habitats suitable for several protected plants and animals.

Several listed animals species have been observed or trapped multiple times at Freels Bend, due largely to its diverse and unique habitats. Animals that are permanent (year-round) residents of the site included the sharp-shinned hawk, Cooper's hawk, and southeastern shrew. The grasshopper sparrow is the only species currently known to nest on the site. The yellow-bellied sapsucker and bald eagle have been observed wintering on the site. Migrants that use the area while traveling to and from breeding sites include the great egret, northern harrier, olive-sided flycatcher, and loggerhead shrike. T&E animals found on the Melton Hill Reservoir (bordering the site) are the osprey and the double-crested cormorant.

The Freels Bend site requires annual maintenance to maintain optimum habitat for many of the species just mentioned. Appendix D is a specific management plan for the grasshopper sparrow on the Freels Bend site; it presents general information on maintenance requirements for the site that would help protect other species also.

4.3.2 Hembree Marsh Proposed Extension of Natural Area 24 (NA24)

Hembree Marsh (NA24) is comprised of the marsh and its watershed, including a small amount of adjacent mixed woodlands. The proposal is to extend NA24 to encompass approximately 2 ha (5 acres) of stream and hillside north of the area currently delineated. NA26 was originally selected as an NA due to its diversity of flora (including protected plants) and unusual hydrology. The permanent wet conditions found within the marsh are not affected by Tennessee Valley Authority dams (Pounds et al. 1993). The extension would combine areas of wildlife significance and would provide greater protection for listed plants and animals. Protected animals have been documented on both the current NAs list and the proposed extension. Permanent residents on the site include the four-toed salamander and southeastern shrew. The migrant northern harrier has been seen at the site.

This is the only location in Roane County where the four-toed salamander has been found (Scott, personal communication) and the only known location for the animal on the ORR. This specialist species is found in boggy areas and is often associated with sphagnum moss. The low-level permanent wet conditions of the Hembree Marsh site provide valuable habitat for the four-toed salamander.

4.3.3 K-25 Beaver Pond Complex Proposed Natural Area

This wetland is located southwest of the K-25 Site and is bordered by small woodlots and loblolly pines to the south and west. Currently, the value of the wetland is enhanced by the presence of beaver, which increases the extent and depth of water and provides conditions for a variety of wildlife species. The proposed NA is approximately 2 ha (5 acres) and would include all of the area covered with water and a small portion of wooded area. This wetland provides valuable habitat for T&E wading birds. The following wading birds use this area as an important stop-over when migrating to and from wintering and breeding sites: great egret, snowy egret, and little blue heron.

4.4 RECOMMENDATIONS FOR FUTURE WORK

Based on the results of the survey and information just discussed, completion of the following tasks would support the management of T&E species:

- Implement recommendations in Sect. 4.2, "Recommendations for Enhancing Species Protection."
- Prepare and implement cave guidelines and access protocols to prevent unnecessary ecological damage.
- Survey areas of potential development or construction for T&E animals during National Environmental Policy Act documentation before sites are selected.
- Maintain and update the T&E animal data base for quick determination of information available for a site.
- Cross-reference T&E animal records with wetland sites and T&E plant locations using Geographic Information Systems to quickly locate and further identify sensitive communities.
- Conduct surveys for T&E invertebrates that may occur on the ORR (e.g., spiders and insects).

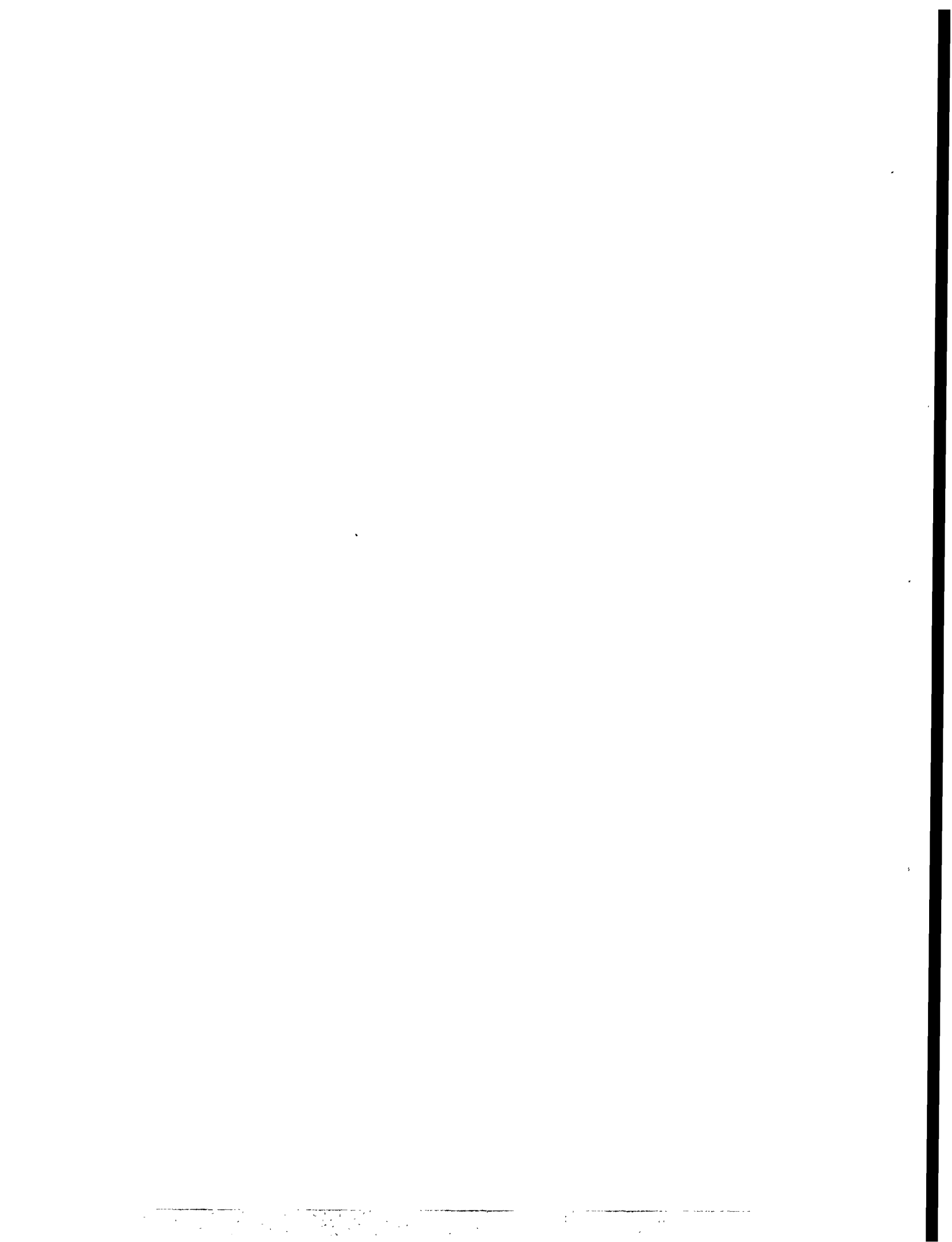
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Appendix A

SCIENTIFIC NAMES OF PROTECTED ANIMALS



Common name	Scientific name
<i>Reptiles and Amphibians</i>	
Black Mountain dusky salamander	<i>Desmognathus welteri</i>
Bog turtle	<i>Clemmys muhlenbergi</i>
Cumberland slider ^a	<i>Trachemys scripta troosti</i>
Eastern slender glass lizard	<i>Ophisaurus attenuatus longicaudus</i>
Four-toed salamander	<i>Hemidactylium scutatum</i>
Green anole	<i>Anolis carolinensis</i>
Hellbender	<i>Cryptobranchus a. alleganiensis</i>
Mole salamander	<i>Ambystoma talpoideum</i>
Northern pine snake	<i>Pituophis m. melanoleucus</i>
Tennessee cave salamander	<i>Gyrinophilus palleucus</i>
<i>Mammals</i>	
Eastern woodrat	<i>Neotoma floridana</i>
Gray bat	<i>Myotis grisescens</i>
Indiana bat	<i>Myotis sodalis</i>
Masked shrew	<i>Sorex cinereus</i>
Meadow jumping mouse	<i>Zapus hudsonius</i>
Rafinesque's big-eared bat	<i>Plecotus rafinesquii</i>
Small-footed bat	<i>Myotis leibii</i>
Smoky shrew	<i>Sorex fumeus</i>
Southeastern shrew	<i>Sorex longirostris</i>
Southern bog lemming	<i>Synaptomys cooperi</i>
Water shrew	<i>Sorex fumeus</i>
Woodland jumping mouse	<i>Napaeozapus insignis</i>
Yellow-nosed vole	<i>Microtus chrotorrhinus</i>
<i>Birds</i>	
Anhinga	<i>Anhinga anhinga</i>
Bachman's sparrow	<i>Aimophila aestivalis</i>
Bald eagle	<i>Haliaeetus leucocephalus</i>
Bewick's wren	<i>Thryomanes bewickii</i>
Black-crowned night heron ^a	<i>Nycticorax nycticorax</i>
Black vulture ^a	<i>Coragyps atratus</i>
Cerulean warbler	<i>Dendroica cerulea</i>
Common barn owl	<i>Tyto alba</i>
Cooper's hawk	<i>Accipiter cooperii</i>
Double-crested cormorant	<i>Phalacrocorax auritus</i>
Grasshopper sparrow	<i>Ammodramus savannarum</i>
Great egret	<i>Casmerodius albus</i>

Common name	Scientific name
<i>Birds (continued)</i>	
Henslow's sparrow	<i>Ammodramus henslowii</i>
King rail	<i>Rallus elegans</i>
Kirtland's warbler	<i>Dendroica kirtlandii</i>
Least bittern	<i>Ixobrychus exilis</i>
Little blue heron	<i>Egretta caerulea</i>
Loggerhead shrike	<i>Lanius ludovicianus migrans</i>
Northern harrier	<i>Circus cyaneus</i>
Northern saw-whet owl	<i>Aegolius acadicus</i>
Olive-sided flycatcher	<i>Contopus borealis</i>
Osprey	<i>Pandion haliaetus</i>
Peregrine falcon	<i>Falco peregrinus</i>
Red-shouldered hawk ^a	<i>Buteo lineatus</i>
Sandhill crane	<i>Grus canadensis</i>
Sharp-shinned hawk	<i>Accipiter striatus</i>
Snowy egret	<i>Egretta thula</i>
Swainson's warbler	<i>Limnothlypis swainsonii</i>
Vesper sparrow	<i>Pooecetes gramineus</i>
Yellow-bellied sapsucker	<i>Sphyrapicus varius</i>

^aA threatened and endangered animal that was delisted in 1994.

Appendix B

ANIMAL RECORDS FOR 1994–1996

The following is a list of terrestrial vertebrates that were encountered during the survey of protected terrestrial vertebrates on the ORR. Additional species are undoubtedly present; thus, this listing should not be considered a complete inventory of ORR terrestrial vertebrate fauna.

Common name	Scientific name
<i>Reptiles and Amphibians</i>	
Spotted salamander	<i>Ambystoma maculatum</i>
Marbled salamander	<i>Ambystoma opacum</i>
Eastern tiger salamander	<i>Ambystoma tigrinum</i>
Red spotted newt	<i>Notophthalmus viridescens</i>
Dusky salamander	<i>Desmognathus fuscus</i>
Two-lined salamander	<i>Eurycea bislineata</i>
Longtail salamander	<i>Eurycea longicauda</i>
Cave salamander	<i>Eurycea lucifuga</i>
Spring salamander	<i>Gyrinophilus porphyriticus</i>
Slimy salamander	<i>Plethodon glutinosus</i>
Four-toed salamander ^a	<i>Hemidactylium scutatum</i>
Red salamander	<i>Pseudotriton ruber</i>
Eastern spadefoot toad	<i>Scaphiopus holbrookii</i>
American toad	<i>Bufo americanus</i>
Spring peeper	<i>Pseudacris crucifer</i>
Gray treefrog	<i>Hyla versicolor</i>
Eastern narrow mouth toad	<i>Gastrophryne carolinensis</i>
Chorus frog	<i>Pseudacris triseriata</i>
Bull frog	<i>Rana catesbeiana</i>
Green frog	<i>Rana clamitans</i>
Southern leopard frog	<i>Rana utricularia</i>
Snapping turtle	<i>Chelydra serpentina</i>
Stripeneck musk turtle	<i>Sternotherus minor</i>
Stinkpot	<i>Sternotherus odoratus</i>
Eastern box turtle	<i>Terrapene carolina</i>
Map turtle	<i>Graptemys geographica</i>
Painted turtle	<i>Chrysemys picta</i>
Red-eared slider	<i>Trachemys scripta elegans</i>
Cumberland slider	<i>Trachemys scripta troosti</i>
Spinny softshell	<i>Apalone spinifera</i>
Fence lizard	<i>Sceloporus undulatus</i>
Six-lined racerunner	<i>Cnemidophorus sexlineatus</i>
Ground skink	<i>Scincella lateralis</i>
Five-lined skink	<i>Eumeces fasciatus</i>
Worm snake	<i>Carphophis amoenus</i>
Black racer	<i>Coluber constrictor</i>
Ringneck snake	<i>Diadophis punctatus</i>
Corn snake	<i>Elaphe guttata</i>

Common name	Scientific name
<i>Reptiles and Amphibians (continued)</i>	
Rat snake	<i>Elaphe obsoleta</i>
Black king snake	<i>Lampropeltis getula</i>
Northern water snake	<i>Nerodia sipedon</i>
Brown snake	<i>Storeria dekayi</i>
Eastern garter snake	<i>Thamnophis sirtalis</i>
Smooth earth snake	<i>Virginia valeriae</i>
Copperhead	<i>Agkistrodon contortrix</i>
<i>Mammals</i>	
Opposum	<i>Didelphis virginian</i>
Southeastern shrew ^a	<i>Sorex longirostris</i>
Shorttailed shrew	<i>Blarina brevicauda</i>
Least shrew	<i>Cryptotis parva</i>
Eastern mole	<i>Scalopus aquaticus</i>
Gray bat ^b	<i>Myotis grisescens</i>
Eastern pipistrel	<i>Pipistrellus subflavus</i>
Eastern cottontail	<i>Sylvilagus floridanus</i>
Eastern chipmunk	<i>Tamias striatus</i>
Groundhog	<i>Marmota monax</i>
Eastern gray squirrel	<i>Sciurus carolinensis</i>
Southern flying squirrel	<i>Glaucomys volans</i>
Beaver	<i>Castor canadensis</i>
Eastern harvest mouse	<i>Reithrodontomys humulis</i>
White-footed mouse	<i>Peromyscus leucopus</i>
Golden mouse	<i>Peromyscus nuttalli</i>
Deer mouse	<i>Peromyscus maniculatus</i>
Hispid cotton rat	<i>Sigmodon hispidus</i>
Pine vole	<i>Pitymys pinetorum</i>
Meadow vole	<i>Microtus pennsylvanicus</i>
Muskrat	<i>Ondatra zibethica</i>
Norway rat	<i>Rattus norvegicus</i>
House mouse	<i>Mus musculus</i>
Coyote	<i>Canis latrans</i>
Red fox	<i>Vulpes vulpes</i>
Gray fox	<i>Urocyon cinereoargenteus</i>
Raccoon	<i>Procyon lotor</i>
Mink	<i>Mustela vison</i>
Striped skunk	<i>Mephitis mephitis</i>
Whitetailed deer	<i>Odocoileus virginianus</i>

^aA state listed in need of management species.

^bA federally listed endangered species.

Common name	Season(s) of occurrence			
<i>Birds</i>				
Common loon	Sp			
Pied-billed grebe	Sp		F	W
Horned grebe				W
Double-crested cormorant	Sp	Su	F	
American anhinga		Su		
Great blue heron	Sp	Su	F	W
Great egret	Sp	Su	F	
Snowy egret	Sp			
Little blue heron		Su	F	
Green heron	Sp	Su	F	
Black-crowned night heron	Sp	Su	F	
Canada goose	Sp	Su	F	W
Wood duck	Sp	Su	F	W
Green-winged teal				W
American black duck	Sp		F	W
Mallard	Sp	S	F	W
Northern pintail			F	W
Blue-winged teal	Sp			
Gadwall	Sp		F	W
American widgeon	Sp		F	W
Canvasback				W
Ringed-necked duck	Sp		F	W
Greater scaup			F	
Bufflehead				W
Hooded merganser			F	W
Red-breasted merganser				W
Ruddy duck				W
Black vulture	Sp	Su	F	W
Turkey vulture	Sp	Su	F	W
Osprey	Sp	Su	F	W
Bald eagle			F	W
Northern harrier	Sp		F	
Sharp-shinned hawk	Sp	Su	F	W
Cooper's hawk	Sp	Su	F	W
Red-shouldered hawk	Sp	Su	F	W
Broad-winged hawk	Sp	Su	F	W
Red-tailed hawk	Sp	Su	F	W

Common name	Season(s) of occurrence			
	Sp	Su	F	W
American kestrel	Sp	Su	F	W
Peregrine falcon	Sp			
Ruffed grouse	Sp			W
Wild turkey	Sp	Su	F	W
Northern bobwhite	Sp	Su	F	W
Sandhill crane	Sp			
American coot	Sp	Su	F	W
Sandhill crane			F	W
Killdeer	Sp	Su	F	W
Greater yellowlegs	Sp			
Solitary sandpiper	Sp			
Spotted sandpiper	Sp	S		
Common snipe	Sp			
American woodcock	Sp	Su	F	W
Bonaparte's gull			F	
Ring-billed gull	Sp			W
Caspian tern			F	
Rock dove	Sp	Su	F	W
Mourning dove	Sp	Su	F	W
Yellow-billed cuckoo	Sp	Su	F	
Eastern screech owl	Sp	Su	F	W
Great horned owl	Sp	Su	F	W
Barred owl	Sp	Su	F	W
Common nighthawk	Sp	Su	F	
Chuck-will's-widow	Sp	Su	F	
Whip-poor-will	Sp	Su	F	
Chimney swift	Sp	Su	F	
Ruby-throated hummingbird	Sp	Su	F	
Belted kingfisher	Sp	Su	F	W
Red-bellied woodpecker	Sp	Su	F	W
Yellow-bellied sapsucker	Sp		F	W
Downy woodpecker	Sp	Su	F	W
Hairy woodpecker	Sp	Su	F	W
Northern flicker	Sp	Su	F	W
Pileated woodpecker	Sp	Su	F	W
Olive-sided flycatcher	Sp			
Eastern wood-pewee	Sp	Su	F	
Acadian flycatcher	Sp	Su	F	

Common name	Season(s) of occurrence			
Eastern phoebe	Sp	Su	F	W
Great crested flycatcher	Sp	Su	F	
Eastern kingbird	Sp	Su	F	
Horned lark				W
Purple martin	Sp	Su	F	
Tree swallow	Sp	Su	F	
Northern rough-winged swallow	Sp	Su	F	
Cliff swallow	Sp	Su	F	
Barn swallow	Sp	Su	F	
Blue jay	Sp	Su	F	W
American crow	Sp	Su	F	W
Carolina chickadee	Sp	Su	F	W
Tufted titmouse	Sp	Su	F	W
Red-breasted nuthatch			F	W
White-breasted nuthatch	Sp	Su	F	W
Brown creeper				W
Carolina wren	Sp	Su	F	W
House wren	Sp	Su	F	
Winter wren	Sp		F	W
Golden-crowned kinglet				W
Ruby-crowned kinglet	Sp			W
Blue-gray gnatcatcher	Sp	Su	F	
Eastern bluebird	Sp	Su	F	W
Veery	Sp			
Swainson's thrush	Sp			
Hermit thrush	Sp		F	W
Wood thrush	Sp	Su	F	
American robin	Sp	Su	F	W
Gray catbird	Sp			
Northern mockingbird	Sp	Su	F	W
Brown thrasher	Sp	Su	F	
Cedar waxwing	Sp	Su	F	W
Loggerhead shrike	Sp	Su		W
European starling	Sp	Su	F	W
White-eyed vireo	Sp	Su	F	
Solitary vireo	Sp			
Yellow-throated vireo	Sp			
Red-eyed vireo	Sp	Su	F	W

Common name	Season(s) of occurrence			
Blue-winged warbler	Sp			
Tennessee warbler	Sp			
Northern parula	Sp	Su	F	
Yellow warbler	Sp			
Magnolia warbler			F	
Cape May warbler	Sp			
Black-throated blue warbler	Sp		F	
Yellow-rumped warbler	Sp		F	W
Black-throated green warbler	Sp			
Blackburnian warbler	Sp			
Yellow-throated warbler	Sp	Su	F	
Pine warbler	Sp	Su	F	W
Prairie warbler	Sp	Su	F	
Palm warbler	Sp		F	
Bay-breasted warbler	Sp			
Cerulean warbler	Sp			
Black-and-white warbler	Sp	Su	F	
American redstart	Sp			
Prothonotary warbler	Sp	Su	F	
Worm-eating warbler	Sp	Su	F	
Ovenbird	Sp	Su	F	
Northern waterthrush	Sp			
Louisiana waterthrush	Sp	Su	F	
Kentucky warbler	Sp	Su	F	
Common yellowthroat	Sp	Su	F	
Hooded warbler	Sp	Su	F	
Wilson's warbler	Sp			
Yellow-breasted chat	Sp	Su	F	
Summer tanager	Sp	Su	F	
Scarlet tanager	Sp	Su	F	
Northern cardinal	Sp	Su	F	W
Rose-breasted grosbeak	Sp			
Blue grosbeak	Sp	Su	F	
Indigo bunting	Sp	Su	F	
Dickcissel	Sp			
Rufous-sided towhee	Sp	Su	F	W
Chipping sparrow	Sp	Su	F	
Field sparrow	Sp	Su	F	W

Common name	Season(s) of occurrence			
Savannah sparrow	Sp			W
Grasshopper sparrow	Sp	Su	F	
Fox sparrow				W
Song sparrow	Sp	Su	F	W
Swamp sparrow				W
White-throated sparrow	Sp		F	W
White-crowned sparrow	Sp			W
Dark-eyed junco				W
Bobolink	Sp			
Red-winged blackbird	Sp	Su	F	W
Eastern meadowlark	Sp	Su	F	W
Common grackle	Sp	Su	F	W
Brown-headed cowbird	Sp	Su	F	W
Orchard oriole	Sp	Su	F	
Northern oriole	Sp			
Purple finch	Sp			W
House finch	Sp	Su	F	W
Pine siskin				W
American goldfinch	Sp	Su	F	W
Evening grosbeak	Sp			
House sparrow	Sp	Su	F	W

Appendix C

HABITAT CATEGORIES

The following habitat descriptions were adapted from Johnson 1964 and Burgess 1975.

1. **Riparian.** Major flowing water systems (e.g., the Clinch River below Melton Hill Dam, Poplar Creek, and East Fork Poplar Creek to about the 800-ft contour line). Characteristics of this habitat are (a) generally steep exposed banks of bare soil or rock cliffs and ledges; (b) moderate-to-deep channel; (c) continuous current, although variable in rate of flow even in a 24-h period; and (d) usually turbid water.
2. **Stream.** Water courses such as Bear Creek and East Fork Poplar Creek above the 800-ft contour line. Characteristics of this habitat are (a) silt, sand, and gravel bottom in level portions and gravel-and-rock bottom where the fall is more precipitous; (b) depth varying from a few inches to several feet and frequent scour holes; (c) gravel and sand-and-mud bars occurring in level portions; (d) continuous current affected by precipitation or lack of it; (e) shoreline steep or low, in the latter case with a sparse-to-dense cover of emergent herbaceous or woody vegetation or both; and (f) width varying from 4 ft to as broad as 20 ft.
3. **Spring Branch.** A habitat characterized by (a) clear water derived from one or more springs; (b) relatively constant temperature; (c) bottom varying from silt to gravel and rock, depending upon the substrate and slope; (d) clearly defined channel; (e) current continuous except during dry periods; (f) water depth usually shallow, seldom exceeding 1 ft; and (g) freedom from aquatic vegetation in heavily wooded, well drained, or precipitous areas or dense attached, emergent and submergent vegetation in low, poorly drained areas.
4. **Spring.** A "boil" area where groundwater issues from the substrate. This is a smaller system than the spring branch; it is similar to a seep, but pooling water and flow are nonexistent. Vegetation is highly variable.
5. **Embayment.** Impounded water lateral to the main channel of the Clinch River. Embayments are characterized by (a) turbid water (sometimes more so than the river); (b) a periodic rise and fall of water level, often several feet in a 24-h period (water levels controlled by Tennessee Valley Authority dams and culvert pipes); (c) usually gently sloping shoreline covered with herbaceous or woody vegetation or both, which may be emergent or submergent depending on water level; (d) reversible current, if present, affected by the rise and fall of the river level; and (e) possibility of becoming fluvial habitats in time of low water if they are drowned streams or river mouths.
6. **Pond.** A small water body, permanent except during prolonged drought. It is characterized by (a) zonal stratification of shoreline vegetation; (b) abundant algal growth, both floating and attached; (c) shoreline of grasses, sedges, and rushes, which may include woody plants; (d) no current; and (e) high temperatures (over 30°C) in late spring and summer.
7. **Pool.** A semi-permanent body of standing water, seldom lasting for more than a few weeks after being formed by rainfall or flooding from an adjacent river or stream. Some small pools may last year-round except during periods of prolonged drought. These areas are smaller than most ponds and usually seasonal or ephemeral. The bottom and the vegetation occurring in it depend upon the site. Roadside ditches are the smallest type of pool; floodplain pools resulting from river overflow are among the largest.

8. **Marsh.** A continually wet area characterized by (a) saturated organic substrate; (b) dense vegetation of sedges, grasses, and rushes; (c) supply of groundwater as well as rainfall; and (d) a surface temperature of the water that may exceed 30°C in late summer. Button bush, willow, and swamp dogwood may occur here.
9. **Seep.** A marsh in miniature, if it occurs in an area that is relatively low, poorly drained and exposed to the sky. In wooded areas, living vegetation is often replaced by a thick deposit of leaves and branches. The substrate—which is composed of organic matter or organic matter, mud, and silt—is saturated. Except in dry weather, there is usually a detectable current. The water temperature remains relatively constant, even in the summer.
10. **Upland Forest.** Mixed deciduous forest on well drained sites. It has at least three strata—canopy, understory or shrub layer, and ground cover. Canopy trees include oaks, hickories, maples, tulip poplar, and American beech in varying combinations depending upon slope and aspect. The understory and shrub layer contain saplings and pole-sized trees of the canopy species, dogwood, oaks, hickories, maple, and beech. The ground cover consists of seedlings of canopy or understory species, ferns, and vernal herbaceous plants. Leaf-litter is usually well developed, and log debris is scattered on the site.
11. **Floodplain Forest.** Deciduous forest in stream valleys and poorly drained sites. It has at least three strata with a varied flora—canopy, understory or shrub layer, and ground cover. Canopy species include sweet gum; sycamore; box elder; elms; ash; willow; and, infrequently, oak and pine. The understory and shrub layer contain saplings and pole-sized trees of the canopy species, ironwood, hop hornbeam, and red maple. The ground cover is often dense and contains grasses, vines, and cane.
12. **Mixed Hardwood and Pine.** A habitat characterized by various species of deciduous trees, depending upon the site, and pine in nearly equal abundance. Pine species include shortleaf and Virginia. This habitat type may be associated with loblolly pine plantations. In upland sites, the deciduous species include those listed for the upland forest; in lowland sites, the deciduous species include those listed for the floodplain forest. Understory or shrub layers or both may be present. Characteristically, the ground cover is composed of grasses and perennial weeds and may have an abundance of flowering plants. The leaf-litter layer, when developed, consists of both hardwood and pine species.
13. **Cedar/Pine.** A habitat consisting mainly of shortleaf and Virginia pine and eastern red cedar. There is very little understory, and ground cover is almost nonexistent, although infrequently redbud and sassafras occur. Ferns, lichens, and mosses are present. Limestone outcrops and loose surface rocks are abundant.
14. **Pine Plantation.** An area composed of planted loblolly pines. The trees are in rows, the canopy is closed, the substrate consists almost entirely of a thick mat of pine needles, and there is scarce understory, shrub layer, or ground-cover vegetation.
15. **Cut-over.** An area of recent timber harvest, usually salvage of a former pine plantation or an area destroyed by pine beetles. Bare ground, piled brush, log, debris, snags, and sparsely scattered hardwoods may occur. Typically, ground vegetation is dense, and honeysuckle, sourwood, sumacs, and brambles may occur.

16. ***Old Field-Transition.*** Abandoned fields in various advanced stages of succession to forest (e.g., powerline rights-of-way). This habitat is continually changing and regenerating into this stage as powerline mowing is conducted. Saplings and pole-sized deciduous and pine trees are numerous. Grasses and perennial weeds are the dominant ground cover, including fescue, broomsedge, and ironweed. Shrubs include sumacs and brambles.
17. ***Cultivated Field.*** A field in which grasses and perennial weeds, especially fescue, are the dominant vegetation. Abandoned fencerows covered with pole-sized deciduous trees and field vegetation are common. Many of these areas are plowed and planted for harvesting hay. These areas would quickly become "old field-transition" if not maintained.
18. ***Disturbed Area.*** A site where nature or human activity has removed most or all of the vegetation (e.g., an ash disposal area). Areas of bare substrate are present. What vegetation does occur consists of bunch grasses, annual weeds, some perennial weeds, and patches of lichens and drought-resistant mosses. Occasional cedars, pines, oak seedlings, and saplings may be present. Other species include Nepal grass, honeysuckle, and kudzu. Wet disturbed areas contain sycamore, box elder, and willow.
19. ***Abandoned Homesite.*** A habitat often characterized by honeysuckle and brambles. The ground cover elsewhere is most often a dense sod of grass or perennial weeds (or both). Collapsing buildings and other rubble may be present. Periwinkle, fescue, Nepal grass, yucca, and day-lilies may occur.

Appendix D

**RECOMMENDATIONS FOR MANAGEMENT
OF THE GRASSHOPPER SPARROW
ON THE FREELS BEND SITE, OAK RIDGE RESERVATION**

(These recommendations were submitted to the ORNL Area Manager in May 1996.)

In May 1995 a small population of grasshopper sparrows (*Ammodramus savannarum*) was found in the Freels Bend area of the Oak Ridge Reservation (ORR). The grasshopper sparrows were seen by several individuals of the Oak Ridge National Laboratory (ORNL), Environmental Sciences Division (Fig. D.1), and were photographed by an ORNL photographer. The sparrows were monitored periodically from May 8 through August 31, 1995, to obtain field data on the population and to evaluate nesting success (Fig. D.2). On May 31, 1995, it was estimated that 10 to 12 were using the Freels Bend area and were preparing to nest.

Freels Bend requires annual maintenance to provide suitable habitat for grasshopper sparrows. Grasshopper sparrows probably exist in other areas on Freels Bend and nearby. Hence, a comprehensive management and monitoring plan should be developed for this species on the ORR. This sparrow appears to be most stable in habitat sizes of 100 acres or larger (J. Herkert, personal communication). With the current maintenance of the Freels Bend area and other grasslands, a sizeable amount of habitat for grassland species will exist on the ORR. An increased number of grasshopper sparrows and other protected grassland birds such as the barn owl, loggerhead shrike, northern harrier, and vesper sparrow could occur on this habitat.

Nationwide this species (and grassland birds in general) has experienced steeper, more consistent declines than any other guild (P. Vickery, personal communication). This species is consistently declining throughout most of its range (B. Peterjohn, personal communication). This decline is not entirely understood but has been attributed to the loss and degradation of suitable grassland habitat and shifts in agricultural practices, resulting in nest failure (Herkert et al. 1993). The grasshopper sparrow is listed as "in need of management" by the state of Tennessee, and this protection prohibits the knowing destruction of its habitat (TWRC 1994).

The grasshopper sparrow nests in open grassy and weedy meadows, pastures, hayfields, and cultivated cover crops (Eagar and Hatcher 1980) approximately 1 m high (F. Alsop, personal communication). June is the peak nesting time for grasshopper sparrows in Tennessee and is also prime time for hay harvesting. If mowing occurs during nesting season, it could result in decreased nest success and/or increased adult mortality. [Note: Grasshopper sparrows may exhibit strong site fidelity. "...despite loss of cover, birds stay and then suffer increased losses from predators" (Ehrlich et al. 1988) or grasshopper sparrows may move to other suitable areas to renest when adverse habitat changes occur (P. Vickery, personal communication)]. However, birds decline in number or are not found in areas where woody vegetation has begun to develop (J. Herkert, personal communication). Thus, annual maintenance at the proper time is necessary to provide suitable conditions for the sparrows.

In 1995, a hay contract was let for the Freels Bend site. To avoid detrimental effects from haying on the grasshopper sparrow population, steps were taken for their protection. On June 2, 1995, the mowing schedule at Freels Bends was assessed. After consideration, it was recommended that mowing be delayed on the field with the sparrows until after August 1, 1995, giving the birds time to nest with minimal disturbance (Fig. D.3).

On July 3, 1995, the haying contractor had completed haying in the area and requested permission to mow the remaining field (which contained grasshopper sparrows). After consultation with the representative of the Tennessee Wildlife Resources Agency, ORNL wildlife coordinator, lands manager, haying contracts personnel, and biologists monitoring the grasshopper sparrows, it was decided that the contractor could proceed with mowing.

On May 12, 1995, two grasshopper sparrows (*Ammodramus savannarum*) were observed in the Freels Bend area on the Oak Ridge Reservation, Anderson County, Tennessee, USA. The birds were located on the south end of Freels Bend along the Clinch River across from Hewitt Bluff. These birds were identified by sight and song by the following members of the Environmental Sciences Division at the Oak Ridge National Laboratory.

Michael G. Ryon Date
Michael G. Ryon 5/18/95

Elizabeth M. Schilling Date
Elizabeth M. Schilling 5/18/95

General location is marked below. Map clip is taken from S-16A. TVA 1987.

W. Kelly Roy Date
W Kelly Roy 5/18/95

Brian A. Carrico Date
Brian A. Carrico 5/18/95

Jason M. Mitchell Date
Jason M. Mitchell 5/18/95

J. Warren Webb Date
J. Warren Webb 5/19/95



Fig. D.1. Documentation of grasshopper sparrows at Freels Bend.

5/08/95	Grasshopper sparrows seen at Freels Bend for the first time in 1995.
5/09/95	Two grasshopper sparrows located at Freels Bend.
5/10/95	One grasshopper sparrow identified.
5/12/95	Grasshopper sparrows at Freels Bend observed by several individuals.
5/16/95	One grasshopper sparrow observed singing.
5/17/95	Steve Eberhardt (ORNL photographer) taken to Freels Bend to get photographs of the grasshopper sparrow. Two birds were observed mating. Most photographs were apparently of the male.
5/30/95	Five to six grasshopper sparrows seen at Freels Bend. Birds were pairing. Birds dispersed from original staging area and scattered throughout several fields.
5/31/95	Six to nine grasshopper sparrows counted. An estimated 10 to 12 birds were using the Freels Bend area. Six transects were walked in the field where most birds had been sighted.
6/02/95	Mowing schedule assessed at Freels Bend, nesting areas noted, and areas delineated that could be mowed.
6/05/95	Three grasshopper sparrows observed; birds became quiet and were presumed nesting.
6/06/95	Two grasshopper sparrows seen during a breeding bird census; no singing.
6/14/95	No grasshopper sparrows heard or seen at Freels Bend.
6/20/95	Two grasshopper sparrows flushed; fields near large barn were mowed.
6/22/95	No grasshopper sparrows seen or heard at Freels Bend.
6/27/95	One grasshopper sparrow observed singing and three grasshopper sparrows sighted (total 4).
7/03/95	Field of grasshopper sparrows mowed for hay.
7/06/95	Mowed area in nesting field assessed. Grass was 3 to 4 inches high. Many perches and edge were mowed. Three to four grasshopper sparrows were observed singing atop hay bales. Four posts were erected for singing perches.
7/10/95	Three to four grasshopper sparrows seen, no juveniles. Grasshopper sparrows were using artificial perches.
7/18/95	Two grasshopper sparrows seen; birds were using artificial perches.
7/24/95	Two grasshopper sparrows observed singing; birds were singing from the ground.
8/09/95	No grasshopper sparrows seen or heard at Freels Bend.
8/31/95	No grasshopper sparrows seen or heard at Freels Bend.
Late August or early September	Birds apparently departed.
Mid-October	Several of the surrounding fields plowed.

Fig. D.2. Grasshopper sparrow observations at Freels Bend.

To: Bill Teer
From: Pat Parr

Date: May 26, 1995
Subject: Grasshopper sparrow at Freels Bend

A population of grasshopper sparrows was found in a recent survey of Freels Bend for Threatened and Endangered species. The grasshopper sparrow is listed by the state as "in need of management". The population was seen using a hayfield at the southern end of the area (see map). Because the grasshopper sparrow is nesting we are requesting that **NO MOWING** be done in that area until after August 1995. This will provide protection of the habitat during the summer months and allow wildlife personnel time to evaluate habitat needs in more detail. Mowing (at particular times of the year) will be required in the area to maintain a field condition.

I believe that area is under a new hay contract for mowing. Please advise me on how to proceed to ensure the area is not mowed this summer. Thank you.



c: Frank Kornegay, Warren Webb, Jim Evans, Dennis Bradburn

Fig. D.3. Recommendation to delay mowing on grasshopper sparrow nesting sites.

This decision was based on the following criteria:

1. The field required mowing in order to maintain optimum habitat for the grasshopper sparrow.
2. The birds had apparently completed their first nesting cycle and were preparing to renest. (Note: This observation is based on their decreased activity and presumed nest fidelity.) This 10- to 12-day period appeared to be the most suitable time for mowing, if it was to be done before August 1, 1995.
3. It was desirable to allow the mower to complete his work in a timely manner without inconvenience in anticipation of working cooperatively with him in the future.

A follow-up assessment of the population was conducted after the mowing was completed in the week of July 3, 1995. Grasshopper sparrows remained in the field and were sighted on at least four occasions. On July 6 and 10, 3 to 4 grasshopper sparrows were observed; on July 18 and 24, only 2 birds were observed. No juvenile birds or nests were observed during the 1995 season. However, juveniles and nests may have been present. (They are very difficult to locate and observe.) Although it is unclear, an apparent decline and/or nest failure could be attributed to one or more of the following factors:

1. Birds and offspring survived undetected, remained on their nest, and suffered increased predation by foxes, skunks, or other predators due to loss of cover.
2. Some birds were killed by machinery while on the nest. Evidence was found (a carcass) that this occurred with other birds at the site (e.g., indigo bunting and eastern meadowlark).
3. Nests were destroyed. The birds dispersed and established new nest sites.
4. The birds were unaffected by mowing and successfully produced offspring but were undetected by our surveys.

Management Recommendations for 1996

1. To minimize the loss of adult grasshopper sparrows and fledglings, the mowing of the nesting field should be delayed until *August 1, 1996*; however, the field *should be* mowed in late summer or the fall of 1996.
2. If possible, a crop mutually beneficial to the farmer and the sparrows should be planted. The ideal crop should be mowed once a year in late summer or fall (possibly summer warm-season grasses).

Long-term Management Recommendations

1. Any work (including hay harvesting, planting, plowing, fertilizing, clearing, bush-hogging) conducted on the nesting site should be approved by the ORNL wildlife coordinator.
2. Off-road driving on the site should be prohibited from April through August.
3. Prescribed burning should be considered on the site every 5–10 years to maintain suitable conditions for the sparrows (J. Herkert, personal communication). Critical habitat factors include shrub encroachment and litter. Burning can reduce both of these problems (P. Vickery, personal communication).

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Appendix E

FIGURES

(11 x 17)

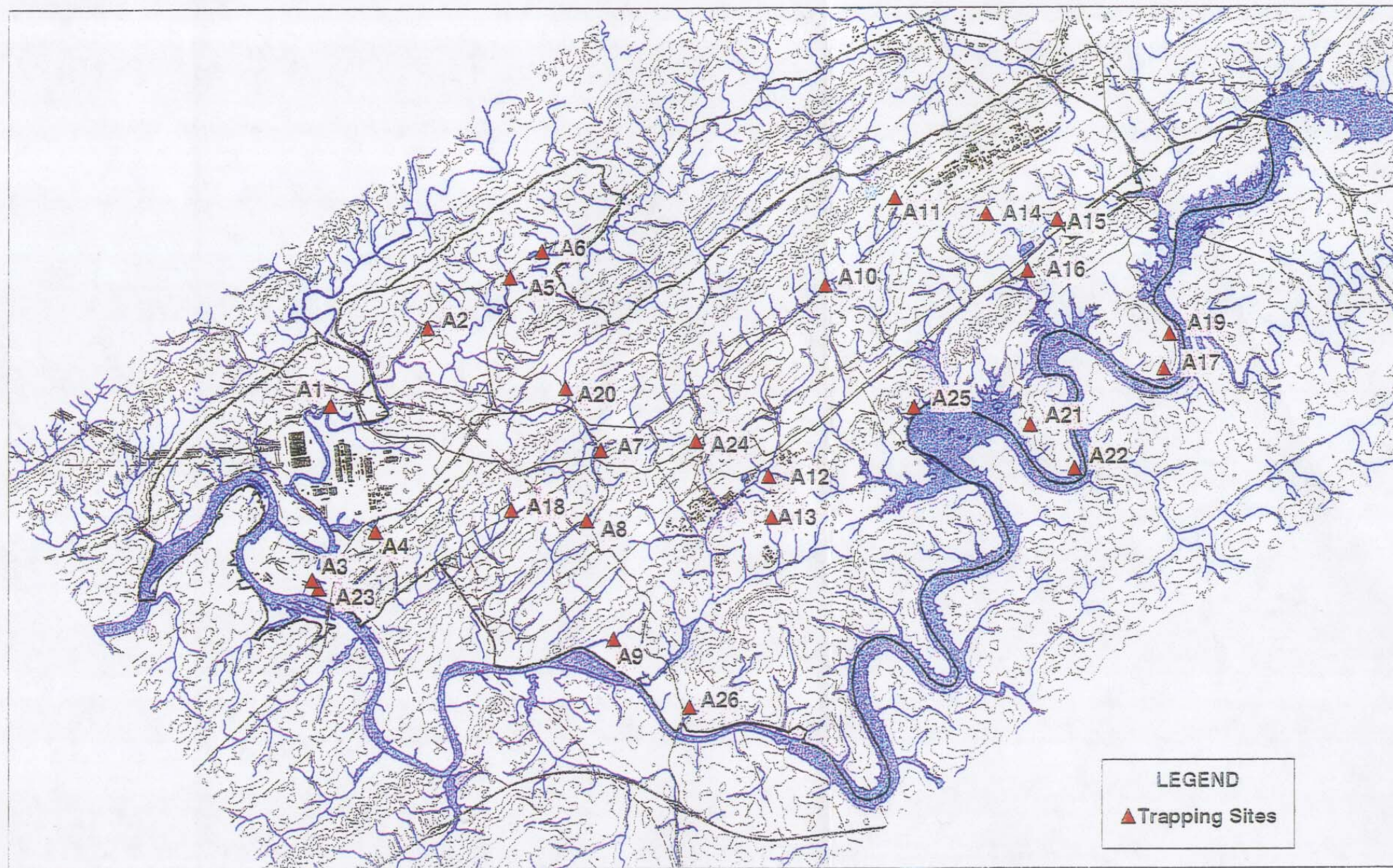


Fig. 2. Reptile, amphibian, and mammal survey sites on the Oak Ridge Reservation.

Coordinate System:
 TN State Plane (1983)
 Base data: TVA S-16A database
 ORNL Shared Data database

Map layout by: B. A. Rosensteel
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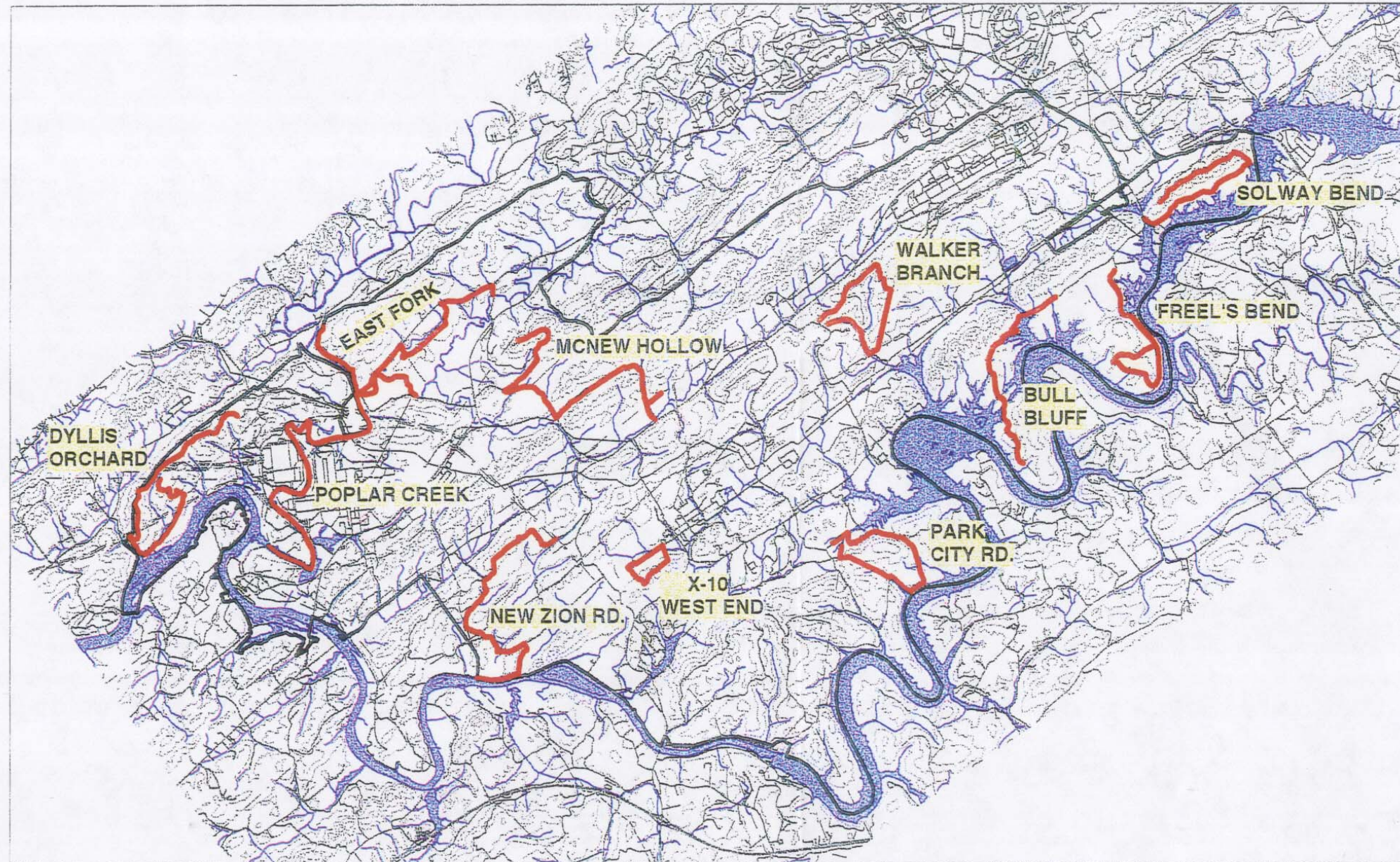


Fig. 4. Routes for breeding bird surveys on the Oak Ridge Reservation.

Coordinate System:
 TN State Plane (1983)
 Base data: TVA S-16A database
 ORNL Shared Data database

Map layout by: B. A. Rosensteel
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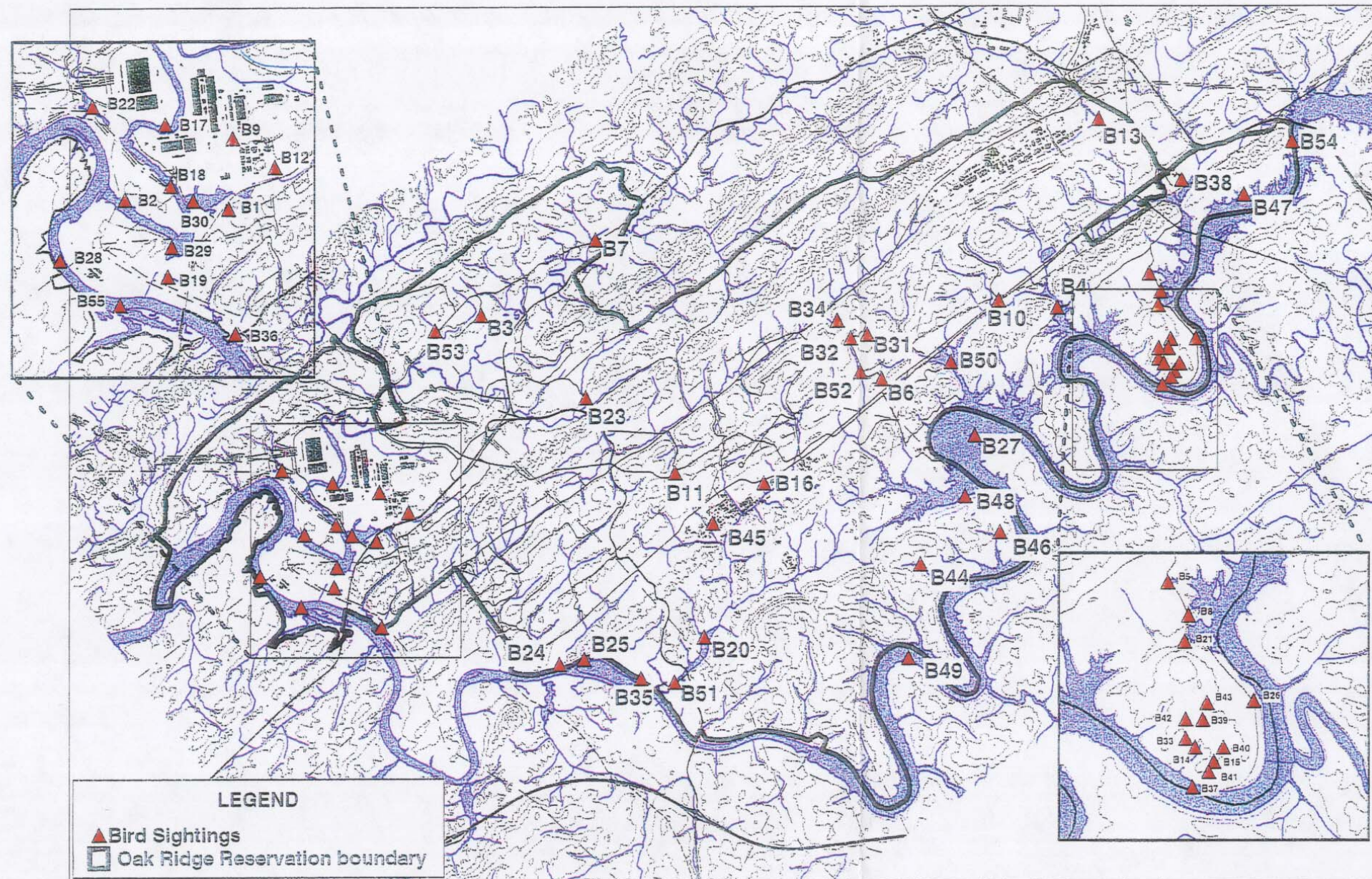


Fig. 5. Locations of sightings of protected bird species on the Oak Ridge Reservation.

Coordinate System:
TN State Plane (1983)
Base data: TVA S-16A database
ORNL Shared Data database

Map layout by: B. A. Rosensteel
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