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Abstract

In 1994 the University of Arkansas - Little Rock (UALR), in cooperation with the Nature Conservancy and the Arkansas Natural Heritage Commission, began a faunal assessment of Camp Joseph T. Robinson Military Installation in North Little Rock, Arkansas. The purpose of the study was (1) to determine the distribution and the abundance of native fauna on the installation, (2) to survey the installation for rare and endangered species, and (3) to determine the impact of human activities on sensitive habitats and on the fauna. During the fall (1994-1996), winter (1995-1996) and spring (1995-1996) seasons, mammals were located by either live-trapping, mist-netting, scent stations, pitfall trapping, active hunting or spotlighting. Arc/INFO® and ArcView® 2.0 were used to visualize and analyze the data. ERDAS Imagine® was used for satellite imagery interpretation. We recorded 315 individuals representing 29 of the 54 possible mammalian species within central Arkansas. Two additional species were documented from UALR museum records. When habitats were categorized into either Hardwood or Mixed Hardwood/Pine, we found more species occurring in Mixed Hardwood/Pine areas than in Hardwood areas. When the two habitat-associations were compared (techniques by Hutcheson; 1970 and Zar; 1996) there was no significant difference ($P \leq .05$) in species diversity, species richness or species evenness.

Introduction

Worldwide, the United States Army (U.S. Army) manages 186 installations containing over 12 million acres (Tazik et al., 1992). Threatened or endangered species may occur on some of these installations. Protected species and their environments fall under regulations of international, federal and state laws, such as the U.S. Endangered Species Act of 1972 (as amended). To comply with environmental requirements the U.S. Army implemented a management program called "Land Condition Trend Analysis" (LCTA). Under this program, all active U.S. Army and 16 major National Guard installations have an LCTA program. One of the major objectives of the LCTA program is to "delineate the biophysical and regulatory constraints to use of the land" (Tazik et al., 1992).

The State of Arkansas contains one of the 16 major National Guard installations, Camp Joseph T. Robinson (CJTR). The local LCTA program started with vegetation and floral inventories in the fall of 1993. In the spring of 1994 a faunal inventory was initiated. The University of Arkansas - Little Rock undertook the responsibility for surveying herpeto- and mammal faunas. This paper discusses the implementation and current (two-year) status of the mammalian survey.

Methods and Materials

Study Area.--The CJTR study area comprised over 38,000 acres in Pulaski and Faulkner Counties, north of the Arkansas river and the greater North Little Rock - Little Rock metroplex. Located on the eastern boundary of the Ouachita Mountain physiographic province and near the western edge of the Gulf Coastal Plain province, CJTR has a forest cover of 72 percent. The vegetation consists of various grasses in mowed or cleared areas while major tree species include white oak (*Quercus alba*), blackjack oak (*Quercus marilandica*), post oak (*Quercus stellata*), willow oak (*Quercus phellos*), hackberry (*Celtis occidentalis*), sweetgum (*Liquidambar styraciflua*), Eastern redceader (*Juniperus virginiana*), loblolly pine (*Pinus taeda*) and other overstory species.

The installation is used as a training site for the Army National Guard and the U.S. Air Force. Of the acreage on CJTR, 32,000 are used for active training, with 2,000 acres for cantonment areas and 4,000 acres managed by the Arkansas Game and Fish Commission (AG&FC). The area managed by AG&FC was not included in the study area.

Mammalian Collecting Methods.--Between December 1994 and January 1996, small and medium-sized mammals were sampled from both hardwood and mixed hardwood/pine stands. A map of CJTR (Fig. 1) shows the geographic distribution of sample localities.

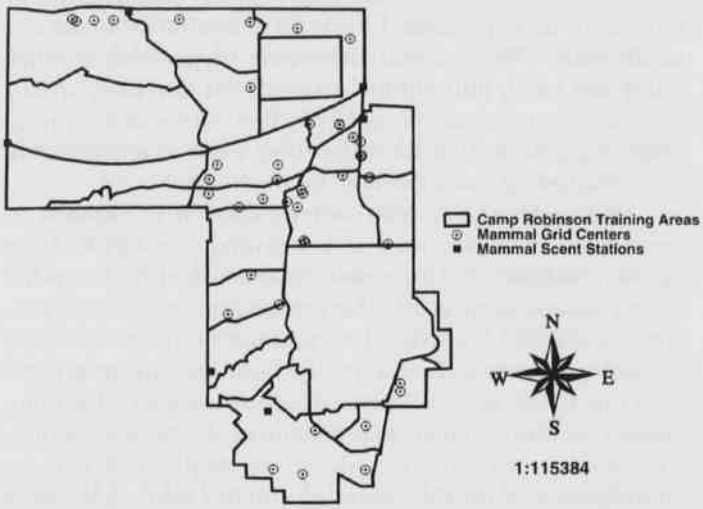

Fig. 1. Map of Camp Joseph T. Robinson Military Installation showing locations of training areas, mammal trapping, and start/end points of mammal scent stations.

Sherman live traps (model LFAG, H.B. Sherman Co., Tallahassee, FL.), Tomahawk live traps (models 102, 105 and 108, Tomahawk live trap Co., Tomahawk, WI), and pitfalls were used to sample small- and medium-sized mammals. Nineteen modified grids (O'Farrell et al., 1977) was used to survey smaller mammals. A center point for each 50m x 50m grid was determined and georeferenced by using a Trimble Global Positioning System receiver. The grid was divided into quarters for sampling. Between 20-40 traps were placed in each quarter. Standard measurements, sex and overall condition of each captured individual was recorded. Voucher specimens were placed in the UALR Vertebrate collections.

For larger mammals such as white-tailed deer (*Odocoileus virginianus*) or coyote (*Canis latrans*) the individual number of observations was recorded, but the animals were not captured. Observations in these cases were performed either directly (simple observation) or indirectly by the use of scent stations or sign. Scent stations were constructed by clearing a 1 m^2 area and sprinkling powdered lime ($CaCO_3$) into the cleared area. Fatty acid scent (FAS), an attractant, was placed in the center (Diefenbach et al., 1994). Searches of abandoned structures, water tanks and mistnets placed over selected water bodies were used to sample bat species.

Computer Methods.--A geographic information system (GIS) was constructed for data storage and spatial analysis. Arc/INFO (Environmental Systems Research, Inc.) was used for GIS data management. The CJTR installation was digitized from Department of Defense (DOD) maps at 1:25,000 scale. Data layers, including roads, streams and lakes, training areas and boundaries, were projected to Universal Transverse Mercator Zone 15 coordinates, North American Datum 83 meters. Soiltypes were obtained from the State Soil Geographic (STATSGO) Data Base (1:250,000 scale) and initial Landuse (LU)/Land Cover (LC) maps were constructed from 1981 Environmental Protection Agency LU/LC data (1:250,000 scale).

Because land cover changes over time, we used recent (1992) LandSat Thematic Mapper (TM) and (1995) Satellite Probatoire pour L'Osservation de la Terre (SPOT) remotely sensed imagery to re-classify canopy types. The images were atmospherically corrected, georeferenced (rectified to 30 ground control points: RMS error <0.5), and classified (unsupervised) using ERDAS - Imagine 8.2. We used a Normalized Difference Vegetative Index (NDVI: Jansen, 1986) for the canopy (land cover) classification. Ground truthing was used to validate the classes. Classified images were used to digitisze polygons into Arc/INFO.

Analytical Methods.--Diversity indices were used to determine the species distribution in Hardwoods and Mixed Hardwood/Pine communities. We used Margelef's richness index, Shannon-Weaver index and Hills Modified index (see Ludwig and Reynolds, 1988). We used the suggestions of Hutcheson (Hutcheson; 1970) and techniques described in Zar (1996) to determine significance of the species diversity indices.

Results and Observations

Out of a possible 54 mammalian species in Central Arkansas (Sealander and Heidt 1990), we recorded a total of 29 species (6 common species, 23 less frequently observed species; see Table 1 for species list). A record of two other species (*Urocyon cinereoargenteus* and *Coryrhinus rafinesquii*) were obtained from museum records. While various methods were used for sampling bat species, we were only successful in obtaining samples from mistnetting riaparian flyways. No endangered species were observed throughout the study.

The most common species belonged in the orders Insectivora and Rodentia, see Table 1. Diversity indices (Table 2) were calculated on the basis of small mammals for which more than five observations were recorded. In the Hardwood community we recorded five common species with 149 observances (H'=1.313; Table 2), while in the Mixed Hardwood/Pine community, six species with 82 observances (H'=1.570; Table 2). Even though we observed many more individuals in the Hardwood community than in the Mixed Hardwood/Pine community (149 vs. 82), there is no significant difference in species diversity between the two areas ($t=0.247 < t_{0.05(2),196}=1.972$). Similarly, these communities were not differentiated on

the basis of species richness (0.79 vs. 1.13; Margalef's Index; Table 2) or evenness (0.79 vs. 0.80; Hill's Index; Table 2).

Discussion and Recommendations

The proximal and immediate goals of this project were (1) to produce a species list of the mammalian fauna on CJTR, and (2) to asses anthropogenic impact on those species. To accomplish the first goal, we initially generated a list of all possible mammalian species in central Arkansas without regard to habitat or other species preferences. After two winters of sampling, we have trapped or otherwise documented the occurrence of approximately half (29 of 54) of those possible species. Of the 25 species which we predicted but did not record on CJTR eight were bats, nine rodents, 5 carnivores, 2 insectivores and 1 lagomorph (Table 3). With more intensive sampling we would expect to find most of these. Although not listed as threatened or endangered, the southeastern shrew (*Sorex longirostris*) and long-tailed weasel (*Mustela frenata*) are of unknown status in the state and in need of further research (Heidt; 1996). In addition, suitable habitat is either absent or very limited for Baird's pocket gopher (*Geomys breviceps*), woodchuck (*Marmota monax*), and Eastern spotted skunk (*Spilogale putorius*).

Due to general interest in conserving diversity and assessing human impact on diversity at the landscape level, we calculated species diversity and species evenness indices for the two major habitat types used for military training exercises. While we recognize difficulties in applying, comparing, and interpreting these values (Magnussed and Boyle, 1995), we present them for comparative purposes. Values that we observed are in close agreement for other species diversity/evennes indices for similar habitats in eastern Texas (Ford et al., 1991), even though they were primarily interested in the herpetofauna.

Our inability to detect diversity/evenness differences etween the two habitat types may have resulted from several causes. First, there may be no underlying differences between the habitat-mammal associations. Given the recent history of the installation, being reclaimed from private ownership (1930's), heavily urbanized (1940's), and restored to a more natural area (1970's), the homogenization of the installation my underlie the lack of regionalization. The alternative hypothesis (i.e. there is a difference between the habitat-mammal associations, but that we have not measured it) presents a more serious issue. The sample size and sampling regime that must be used to obtain the statistical power to differentiate habitat-associations will be a considerable undertaking. As Magnussen and Boyle (1995) indicate, "extensive sample sizes are often needed to allow (powerful) statistical inference and/or hypothesis testing of quantitative measures of diversity". We feel that the former hypothesis is more likely the case, and submit that to test the later would require extensive sampling. Given the results of the initial study, suggesting that no differences exist, extensive additional sampling is not likely to be profitable.

Due to lack of human activity data, it is difficult to asses human impact on species diversity at CJTR. Data needed includes accurate records documenting the number of troops using particular training areas, dates of use, time of use and type, duration and nature of each activity as well as continued sampling in both the disturbed and non-disturbed areas. Potential and unmeasured human impact involves civilian encroachment of the installation. On many occasions we observed deposited refuse, biodegradable and non-biodegradable materials. Such items as discarded sofas, home appliances, and litter were clearly not of military orgin. Finally, as the installation matures, a yearly vegetation/land cover assessment should be made. Remotely sensed data should be obtained on a regular basis to maintain a database for the installation. These data should be combined into a long-term landuse management plan.

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Table 1. Species list of mammals documented at Camp Joseph T. Robinson, North Little Rock, Arkansas, December 1994-March 1996.

Order Didelphimorphia	
Didelphis virginiana	Opossum
Order Insectivora	
*Blarina carolinensis**	Southern short-tailed shrew
Scalopus aquaticus	Eastern mole
Order Edentata	
Dasypus novemcinctus	Nine-banded Armadillo
Order Chiroptera	
Lasiurus borealis	Red bat
Nycticeius humeralis	Evening bat
*Coryrhinus rafinesquii***	Rafinesque's big-eared bat
Order Lagomorpha	
Sylvilagus floridanus	Eastern cottontail
Order Rodentia	
Sciurus carolinensis	Gray squirrel
Sciurus niger	Fox squirrel
Glaucomys volans	Southern flying squirrel
Castor canadensis	Beaver
*Reithrodontomys fulvescens**	Fulvous harvest mouse
*Peromyscus leucopus**	White-footed mouse
*Peromyscus maniculatus**	Deer mouse
*Peromyscus gossypinus**	Cotton mouse
Peromyscus attwateri	Texas mouse
Ochrotomys nutalii	Golden mouse
Sigmodon hispidus	Hispid cotton rat
Neotoma floridana	Eastern woodrat
*Microtus ochrogaster**	Prairie vole
Microtus pinetorum	Woodland vole
Order Carnivora	
Canis latrans	Coyote
*Urocyon cinereoargenteus***	Gray fox
Vulpes vulpes	Red fox
Procyon lotor	Raccoon
Mephitis mephitis	Striped skunk
Felis rufus	Bobcat
Order Artiodactyla	
Odocoileus virginianus	White-tailed deer

*denotes common species
**denotes museum specimens

Table 2. Summary species diversity indices for mammals on Camp Joseph T. Robinson, North Little Rock, Arkansas.

Index	Hardwoods	Mixed/Hardwood Pine
Margalefs' Richness	0.79	1.13
Shannon-Weaver's Diversity	1.31	1.57
Hill's Eveness	0.79	0.80

Table 3. Species list of mammals which were not documented at Camp Joseph T. Robinson, North Little Rock, Arkansas, December 1994-March 1996.

Order Insectivora	
Cryptotis parva	Least shrew
Sorex longirostris	Southeastern shrew
Order Chiroptera	
Myotis lucifugus	Little brown myotis
Mytotis septentrionalis	Keen's myotis
Lasioncyteris noctivagans	Silber-haired bat
Pipistrellus subflavus	Eastern pipistrelle
Eptesicus fuscus	Big brown bat
Lasiurus seminolus	Seminole bat
Lasiurus cinereus	Hoary bat
Tadarida brasiliensis	Brzilian free-tailed bat
Order Lagomorpha	
Sylvilagus aquaticus	Swamp rabbit
Order Rodentia	
Tamias striatus	Eastern chipmunk
Marmota monax	Woodchuck
Geomys breviceps	Baird's pocket gopher
Oryzomys palustris	Marsh rice rat
Ondatra zibethicus	Muskrat
Rattus rattus	Black rat
Rattus norvegicus	Norway rat
Mus musculus	House mouse
Myocastor coypus	Nutria
Order Carnivora	
Ursus americanus	Black bear
Mustela frenata	Long-tailed weasel
Mustela vison	Mink
Spilogale putorius	Eastern spotted skunk
Lutra canadensis	River otter