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Evaluation of the habitat, density, and distribution of a raccoon population in East Tennessee

Edward L. Warr

To the Graduate Council:

I am submitting herewith a thesis written by Edward L. Warr entitled "Evaluation of the habitat, density, and distribution of a raccoon population in East Tennessee." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Wildlife and Fisheries Science.

Michael R. Pelton, Major Professor

We have read this thesis and recommend its acceptance:

Ralph W. Dimmick, Boyd L. Dearden

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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Accepted for the Council:

Vice Chancellor
Graduate Studies and Research

EVALUATION OF THE HABITAT, DENSITY, AND DISTRIBUTION OF A RACCOON POPULATION IN EAST TENNESSEE

A Thesis

Presented for the

Master of Science

Degree

The University of Tennessee, Knoxville

Edward L. Warr

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ABSTRACT

A study on the status of the raccoon in East Tennessee was conducted from July 1975 to November 1976. Objectives were to evaluate the habitat characteristics necessary for raccoon transplant purposes with respect to natural features, land use practices, and cultural attributes, and to determine the population density and distribution of resident raccoons.

A study area within Blount, Loudon, and Monroe counties, Tennessee, covering 52,084 ha (128,602 a), was selected by officials of the Tennessee Wildlife Resources Agency (TWRA) on the recommendations of local raccoon hunter clubs.

Within the study area, forested areas covered approximately 23,697 ha (45.5 percent). In the tri-county area (Blount, Loudon, and Monroe counties), forests account for 201,993 ha (52.9 percent). Twenty-two percent of the total forested area of Loudon County is composed of large sawtimber hardwoods dominated by oak-hickory stands (18.4 percent). Approximately, 378 km (235 mi) of streams drain the study area, and 191 km (119 mi) flow through wooded areas 0.41 ha (1 a) or larger.

The total human population in the study area in 1970 was 17,426; in the tri-county area it was 111,485. The majority of the farming enterprises is for livestock. Much of the land used for these enterprises is pasture. Within the study area, 52.2 percent (27,174 ha, 67.091 a) of the total area is devoted to agriculture. Commercial land use is concentrated mostly in the larger towns.

From 21 September 1975 through 22 November 1976, 24 grids (809 ha each) were trapped on 223 different nights for a total of 3,928 trip-nights. A total of 32 (17 males, 15 females) different raccoons were trapped and tagged for a capture success of one per 83.6 trip-nights (1.2 percent). On numerous occasions free-roaming dogs were observed inside the study area.

From 31 December 1975 through 11 November 1976, a total of 19 simulated hunts was conducted on 18 different nights. The dogs treed 39 times out of 82 "trial strikes." A total of 8 raccoons was sighted. The percentage hunter success per hunt was 42 percent; the percentage hunter success per hour was 11 percent.

Trapping success in the study area indicated a low population density as compared with other studies done in open county and protected areas. The simulated hunts illustrated that hunter success is low when compared state-wide.

There appear to be two general causes for the low raccoon population density in the study and surrounding areas of East Tennessee: (1) agricultural practices and (2) harassment from hunting and free roaming dogs. It is recommended that the dog training season in East Tennessee be sharply curtailed and a special dog licensing law passed to aid in identification between stray and domestic dogs.

TABLE OF CONTENTS

LIST OF TABLES

TABLE PAGE

LIST OF FIGURES

CHAPTER I

INTRODUCTION

The raccoon (Procyon lotor) is a very adaptable mammal with a wide ecological tolerance and has proliferated despite increasing human modification of the environment (Sanderson 1951a, 1951b, 1960, Cabalka et al. 1953). Its adaptability has manifested itself by the extension of its geographical range (Sutton 1964).

The pursuit of this animal for sport is an American tradition which dates back to pioneer days, and through the years its popularity has increased. The problem of maintaining an adequate huntable raccoon population has become acute in many areas of East Tennessee. It has been assumed that the decline in the number of raccoons found in this region is due to hunting pressure and habitat losses (Shultz 1956, Whitehead 1975). Little is known about the quality of the raccoon habitat in East Tennessee or the density and distribution of the resident raccoon populations.

In Appalachia, the number of individuals interested in raccoon hunting rose during the 1960's as well as the amount of money spent to pursue the sport. This is demonstrated by the increased participation in organized licensed events, the high prices paid for raccoon dogs (Canis familiaris) of proven worth, and the inclusion of more professional people among the ranks of raccoon hunters (Clements 1972). Legler (n.d.) reported Tennessee raccoon hunters spent $65,000 on food and transportation in 1961. Stains (1956) estimated that Kansas raccoon hunters

spent $240,000 per year for the maintenance of raccoon hunting dogs.

The total number of raccoon hunters in Tennessee has been declining over the past 30 years, while the number of raccoon hunters in East Tennessee has more than tripled from an estimated 2,630 in 1951 to 9,637 in 1969 (Whitehead 1975). Hunters averaged 2.2 trips per season in 1951 and 17.6 trips per season in 1969. Raccoon hunter success per trip in East Tennessee during this period has generally been low and fluctuated between 13.3 and 76.7 percent; whereas, statewide success has fluctuated between 40.9 and 70 percent. "Bag check" data since 1969 indicate that East Tennessee raccoon hunter success per hour dropped from 16 percent to 8.0 percent in 1974 (Whitehead 1975).

For years local raccoon hunter clubs have stocked favored hunting spots in order to provide animals for hunting. The environmental impact of these introductions on the native raccoon populations and raccoon hunter performance is unknown. It is possible that a raccoon stocking program could increase a huntable population, but an evaluation of stocking is essential (Clements 1972, Frampton and Webb 1973). However, preliminary investigations on the habitat, density, and distribution of resident raccoon populations are needed. In July 1975, the following objectives were established as guidelines for a 1.5 year study.

1. To evaluate the habitat characteristics of an area in East Tennessee selected for raccoon transplant purposes in respect to natural features, land use practices, and cultural attributes.

2. To evaluate the population density and distribution of resident raccoons on the study area.

CHAPTER II

GENERAL STUDY AREA DESCRIPTION

I. STUDY AREA SELECTION

The area selected for study was chosen by officials of the Tennessee Wildlife Resources Agency (TWRA) on the recommendations of local raccoon hunter clubs. This area is representative of typical raccoon habitat in East Tennessee.

II. LOCATION AND SIZE OF AREA

Blount, Loudon, and Monroe counties are located in the Little Tennessee River Valley region within the foothills of the Great Smoky Mountains in the eastern portion of the Tennessee Valley, near metropolitan Knoxville (Figure 1). The tri-county area falls within the Ridge and Valley and the Unaka Mountain physiographic provinces commonly known as the Great Valley of East Tennessee and the Great Smoky Mountains. Collectively, the three counties cover slightly less than 3,813 km^2 (1,472 mi^2).

The study area is situated where Blount, Loudon, and Monroe counties border each other (Figure 2). It has an irregular shape and covers an area of 52,084 ha (128,602 a). The study area is bounded on the southeast by the Foothills Parkway on Chilhowee Mountain, the south and west by the Little Tennessee River, the north by Fort Loudoun Lake on the Tennessee River, and by Federal Aid Secondary (FAS) highways 2424

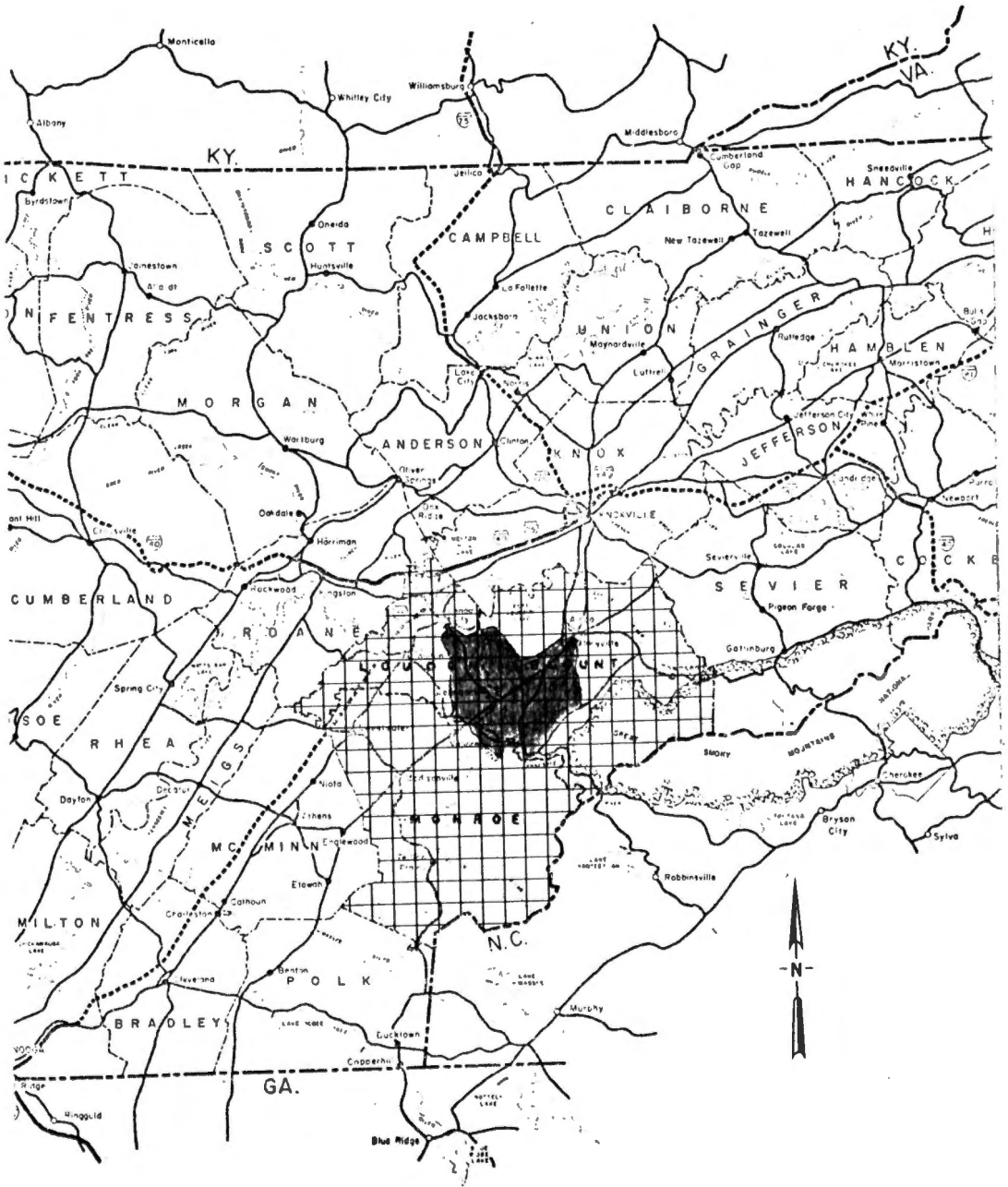

Figure 1. Location of Blount, Loudon, and Monroe counties, Tennessee and the study area.

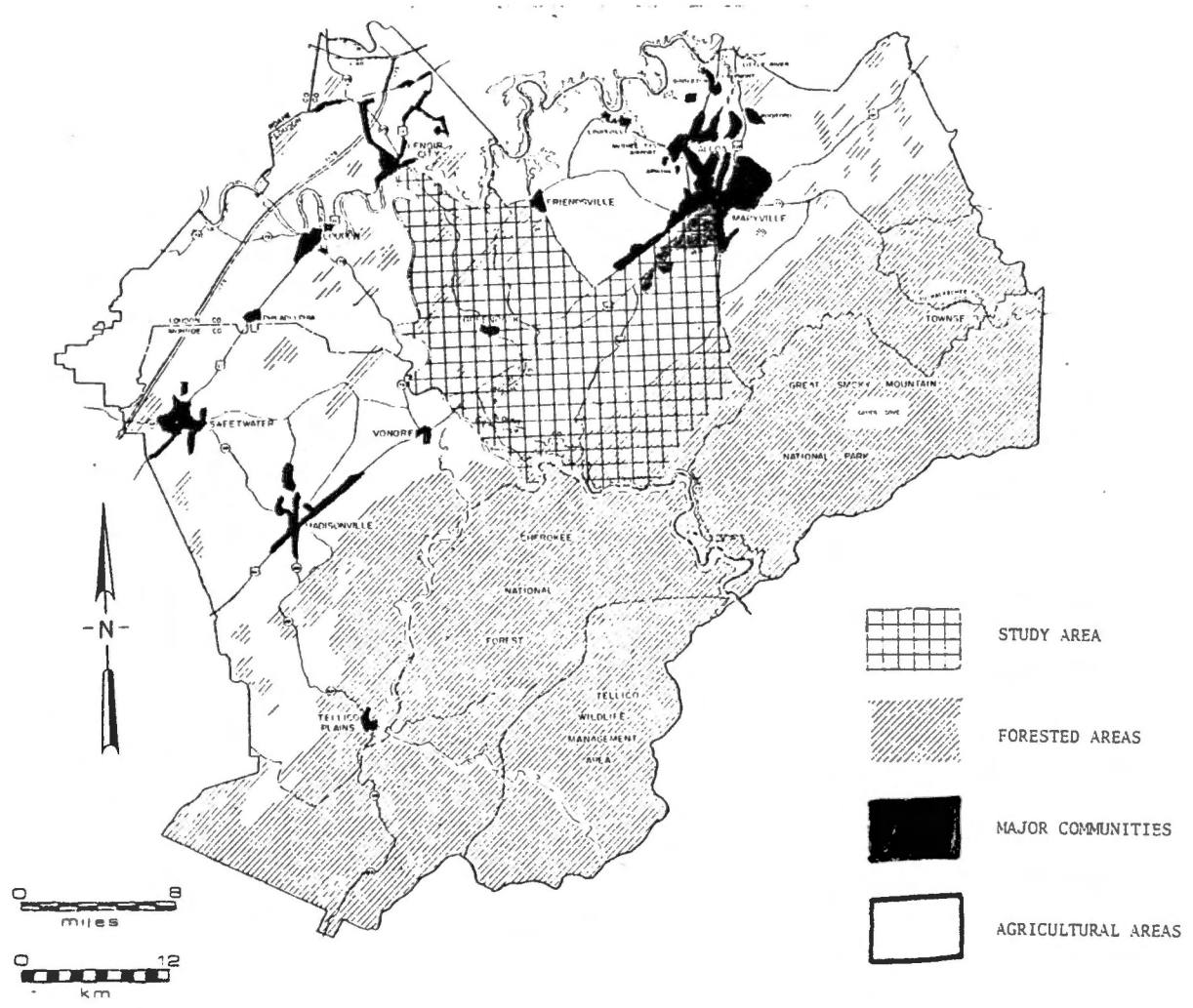

Figure 2. The Tri-County Area and the Study Area within the Borders.

and 2560, and the east by FAS highway 2497. A portion of the eastern boundary of the area falls within the city limits of Maryville, the county seat of Blount County (Figure 2).

For future study, the study area was divided into two parts: the restoration or stocking area (23,740 ha, 48,618 a) and the control area (28,344 ha, 69,984 a). Highway U.S. 411 separates the two areas with the restoration area on the north side and the control area on the south.

III. TOPOGRAPHY

The tri-county area has two strikingly different modes of topographic expression. The western, less mountainous part in the Ridge and Valley physiographic province where Loudon County and the western half of Blount and Monroe counties lie is characterized by low, roughly parallel ridges and gently rolling valleys. These ridges and valleys extend in a southwest-northeast direction, and the relief ranges from level to very steep. This physiographic region constitutes approximately 90 percent of the study area. In this region, elevations in the study area range from 400 m (1,313 ft) above sea level at Alexander Knob in the Red Knobs to 218 m (714 ft) along the junction of the Little Tennessee and Tennessee Rivers.

The eastern section of Blount and Monroe counties, in the Unaka Mountain province, has a rugged, mountainous terrain. Many of the mountain peaks are the highest in the eastern United States, rising over 1,981 m (6,500 ft) in elevation. That part of the study area located on Chilhowee Mountain is a rugged area of steep-walled slopes and narrow winding ridge crests. The highest crests along Chilhowee Mountain are

762 m (2,500 ft) above sea level, with the highest point being 846 m (2,775 ft). The lowest point in this region is 247 m (810 ft) along the Little Tennessee River.

IV. DRAINAGE

The area has been identified as the Little Tennessee River Valley, since parts of all three counties drain into this major tributary of the Tennessee River, the principal stream of this region. The drainage basin of the Little Tennessee River occupies only the center core of the Blount, Loudon, Monroe County area and slightly over half its aggregate territory. Most of Blount County is drained by the neighboring Little River. Parts of Loudon and Monroe counties are drained by Sweetwater and other smaller creeks. The Tennessee River crosses the northern tip of Loudon County and forms the boundary of Blount and Knox counties; the river is impounded through this region by Watts Bar and Fort Loudoun dams.

The Little Tennessee River watershed is situated in two physiographic provinces, the Unaka Mountain and the Ridge and Valley. The river has its origin in northern Georgia, flows across mountainous western North Carolina and through the mid-section of tri-county area to enter the Tennessee River directly opposite Lenoir City in Loudon County. The stream winds through the three counties for approximately 80.5 km (50 mi). The main tributary of the river in this area is the Tellico River. The Tellico has its source in North Carolina and flows into Monroe County, where it joins the Little Tennessee, 30.6 km (19 mi) above its mouth.

The Little Tennessee River constitutes 53.1 km (33 mi) of the study area's border. The Tennessee River on Fort Loudoun Lake has 9.2 km (5.7 mi) of shoreline bordering the study area. Over 378 km (235 mi) of permanent streams are located within the study area (Figure 3). A few of the major creeks are Baker Creek, Nine-mile Creek, Four-mile Creek, and Six-mile Creek, which drain into the Little Tennessee River. Cloyd and Floyd Creeks are the only major streams flowing into Fort Loudoun Lake.

All the major creeks are located in the Ridge and Valley physiographic province of East Tennessee and have relatively slow rates of flow with few rapids and waterfalls. The streams found on Chilhowee Mountain are typical mountain streams with a rapid flow and shallow depth. Water flowing out of the mountains is very clear, but in the Valley of East Tennessee, it becomes turbid.

V. SOIL

The characteristics of the soils of the Little Tennessee River watershed are influenced by the physiography and geology of the region. The soils on the ridges of the Ridge and Valley province of the three counties are developed from low-grade dolomites, sandstones, or shales; and consequently, tend to be generally steep, stoney, and infertile. The Valley soils, on the other hand, are underlain by the more easily soluable limestone and shales. A considerable portion of these valley soils are derived from transported alluvial sediments, resulting in rather productive soils on gentle slopes. Agricultural crop production

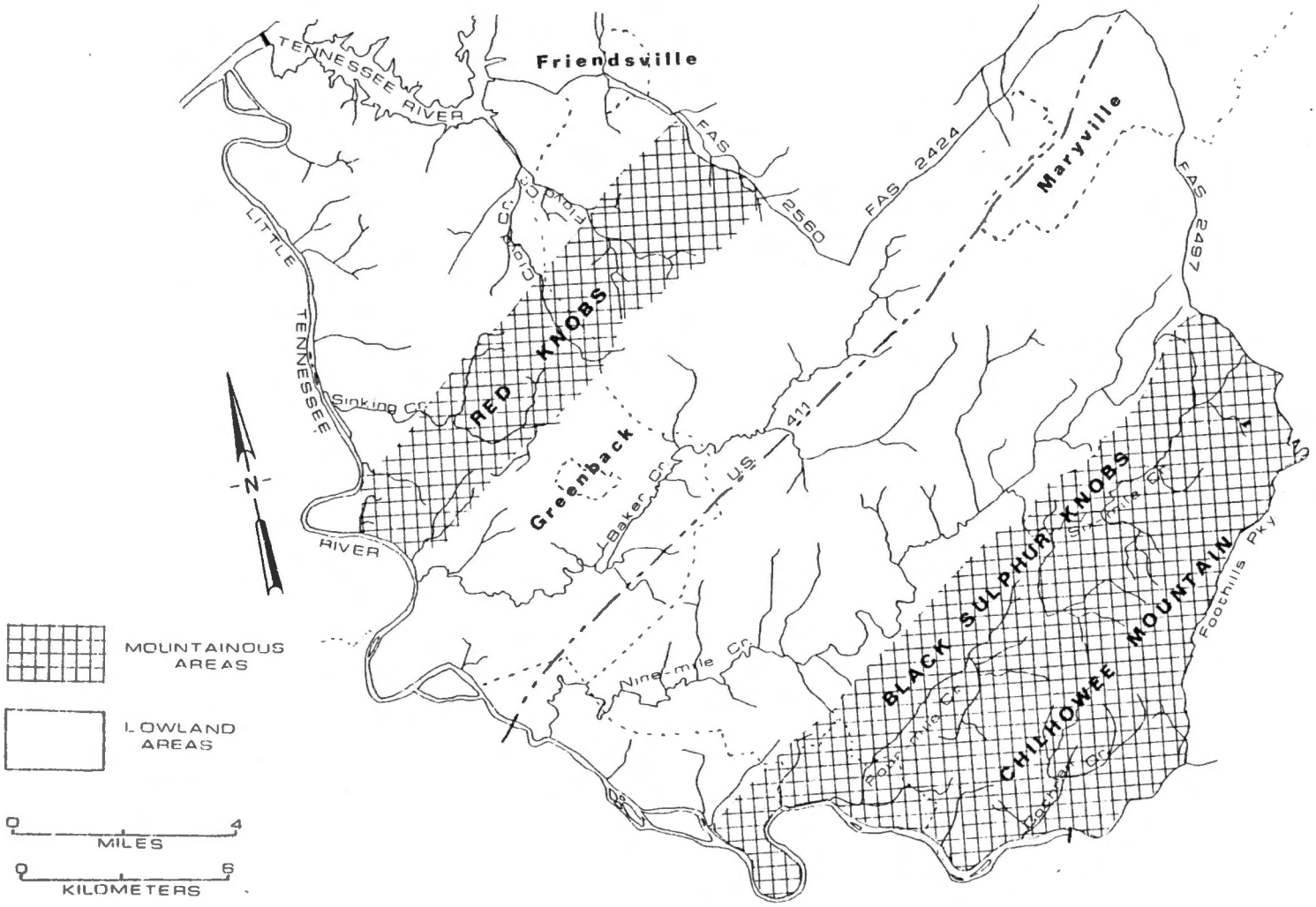

Figure 3. Major landmarks and Drainages within the study area.

in the Ridge and Valley province is limited primarily to the relatively level soils of the valleys and ridge crests (Elder 1959, 1961).

The soils of the Unaka Mountain region of Monroe and Blount counties, including Chilhowee Mountain in the study area, are generally shallow and stoney, being derived mainly from highly resistant rocks such as quartzites, slates, shales, and sandstones. The limited area (estimated at less than 5 percent) of soils suited to agricultural crop production occurs in the small and gentler sloping areas along stream courses and on footslopes. The Unaka Mountain area of the water shed consequently has very little potential for agriculture (Elder 1959, 1961).

VI. CLIMATE

Climatic conditions are typical of the mild climate in the central Tennessee Valley, affording weather conducive to an extended outdoor recreation season. The study area and surrounding areas have a humid-temperate climate. Although short cold periods do occur, winters are not severe, but summers are hot. The difference between the lowest (January and December) and the highest (July) temperature is 21.1° C (38° F). Sudden great changes in temperatures seldom occur and there is a variation between day and night temperatures of about 11.1° C (20° F) (Elder 1959, 1961) (Tables 1 and 2).

The drainage basin of the Little Tennessee area receives the highest rainfall in the United States with the exception of the Pacific Northwest. The Little Tennessee River watershed averages 136 cm (53.5 in) annually (Blount County, Tennessee State Planning Commission 1970). About 32.8 cm (12.9 in) of the average annual precipitation occurs as snowfall. However,

Table 1. Temperature and Precipitation at the Knoxville, Tennessee Airport from September 1975—November 1976.

Month	Temperature—°C					Precipitation—Cm			
	Average Maximum	Average Minimum	Average	Highest	Lowest	Rain Total	Greatest One Day	Snow and Sleet Total	Snow and Sleet Max. Depth
Sept. 1975	25.8	15.2	20.5	35.6	8.9	8.3	3.1	0	0
Oct.	21.2	9.9	15.6	27.8	1.7	10.2	2.8	0	0
Nov.	34.3	21.5	10.1	24.4	-5.0	7.4	4.0	T	0
Dec.	10.6	17.3	5.1	20.6	-11.7	9.1	2.7	T	0
Jan. 1976	6.5	-4.0	1.3	18.3	-13.9	9.8	2.6	0.8	T
Feb.	16.2	1.8	9.0	23.3	-8.9	5.5	3.4	7.1	8.0
Mar.	17.7	5.2	11.4	27.8	-3.3	13.3	2.9	0	0
Apr.	22.9	7.0	14.9	30.6	1.1	1.0	0.4	0	0
May	23.6	11.3	17.4	30.6	3.3	14.0	4.1	0	0
June	29.0	17.5	23.3	32.2	10.0	8.8	4.2	0	0
July	30.2	18.9	24.6	33.9	14.4	9.5	3.9	0	0
Aug.	29.9	17.8	23.8	32.8	13.3	5.0	2.7	0	0
Sept.	25.6	14.1	19.8	31.7	6.7	7.3	2.8	0	0
Oct.	18.2	6.8	12.5	26.7	-2.8	13.5	3.5	0	0
Nov.	11.8	0.6	6.2	21.7	-8.9	8.8	6.2	2.54	T

Source: U.S. Weather Bureau 1975, 1976.

Table 2. Temperature and precipitation at Lenoir City, Tennessee from September 1975—November 1976.

Month	Temperature—°C					Precipitation—Cm			
	Average Maximum	Average Minimum	Average	Highest	Lowest	Rain Total	Greatest One Day	Snow and Sleet Total	Snow and Sleet Max. Depth
Sept. 1975	26.0	13.9	19.9	36.1	8.3	11.5	3.3	0	0
Oct.	21.6	9.0	15.3	27.8	0.6	13.1	4.0	0	0
Nov.	16.3	2.6	9.4	25.0	-5.0	6.4	2.6	T	0
Dec.	10.0	-2.1	4.0	20.0	-12.2	13.0	3.8	T	0
Jan. 1976	6.5	-5.7	0.4	18.9	-15.0	13.1	2.7	2.54	T
Feb.	15.3	-0.7	7.3	23.3	-8.9	7.7	2.9	11.4	7.6
Mar.	18.1	4.1	11.1	27.8	-3.3	13.9	5.3	0	0
Apr.	23.1	5.6	14.4	30.6	-0.6	1.7	0.6	0	0
May	23.3	9.5	16.4	28.9	0.6	21.3	6.2	0	0
June	28.8	15.9	22.4	32.8	8.3	6.0	1.5	0	0
July	30.3	17.2	23.8	34.4	12.2	8.4	3.6	0	0
Aug.	30.3	16.5	23.4	35.0	11.7	5.8	1.5	0	0
Sept.	25.8	12.2	19.0	31.1	4.4	7.7	3.3	0	0
Oct.	18.2	4.8	11.5	26.7	-3.9	13.8	2.7	0	0
Nov.	11.7	-2.5	4.6	21.1	-11.7	6.4	4.0	T	T

Source: U.S. Weather Bureau 1975, 1976.

this usually comes in amounts of less than 10.2 cm (4 in) at one time and usually at higher elevations. It is very uncommon for snow to remain on the ground in measurable amounts longer than one week. In general, precipitation is ample for agricultural purposes and is favorably distributed during the year for most crops. Precipitation is greatest in the wintertime with another peak period occurring during the late spring and early summer. Destructive hailstorms are rare (Deardorff 1976).

Temperatures and precipitation vary from place to place in the study area. These variations are caused by differences in topography. Frosts frequently kill vegetation in the valleys and depressions while the vegetation on the ridges is not injured. Chilhowee Mountain has more precipitation, including more snow, than the rest of the area. It also has a cooler temperature, more fog and cloudiness, and a shorter frost-free period (Elder 1959, 1961).

The average frost-free period for Blount and Loudon counties is 191 days. It extends from 14 April, the average date of the latest killing frost, to 25 October, the average date of the earliest (Elder 1959, 1961).

The mountainous topography also has a pronounced effect upon the prevailing wind directions. Daytime winds are usually from the northeast. The winds are relatively light, and tornados occur infrequently (Deardorff 1976).

CHAPTER III

MATERIALS AND METHODS

I. HABITAT EVALUATION

Forest Cover

Forest cover in the study area was determined by the use of high altitude aerial photography (RB57). Both infra-red and color photographs were used. Three broad cover types were assigned under the U.S. Geologic Survey system for classification for land use and land cover. The three cover types are: deciduous forest land (Hardwood), evergreen forest land (Coniferous), and mixed forest land (Mixed).

Forested areas were traced from photographs onto frosted acetate and later traced on a map. Area for each type was determined by the use of a polar planimeter. Truth data were collected by checking plots that lie in the forested areas either by observations from a trap line or an airplane.

Tennessee Valley Authority (TVA) forest inventory maps and data were also used to give a more detailed description of the forest stand characteristics in the study area and the surrounding tri-county area. The forest area in Blount County was estimated in 1970 (TVA 1971) from USDA-ASCS (United States Department of Agriculture—Agricultural Stabilization and Conservation Service) aerial photograph contact prints dated February-November 1967. Distribution of forest area by various

categories such as forest type was computed from sample plot frequencies as classified in the field.

The forest area and cover types for Loudon County were computed by TVA (1973), using the same methods as for Blount County. The USDA-ASCS aerial photograph contact prints were dated December 1966-February 1967. Adjustments for land use change since date of photography was determined by 1973 field sampling.

In Monroe County, the total area of forest land was determined by making a forest or nonforest classification of points on USDA-SCS (Soil Conservation Service), 1958 and USDA-FS (Forest Service), 1963 aerial photograph contact prints (TVA 1965). Distribution of the forest area by various categories such as forest type was computed from TVA sample plot frequencies as classified in the field.

TVA (1965, 1971, 1973) also classified the timber into stand size classes: large sawtimber, small sawtimber, pole timber, and seedlings and saplings. Large sawtimber stand sizes are stands having a net volume of at least 457 board meters per 0.41 ha (1,500 board ft/a) in live sound trees 38.1 cm (15 in) d.b.h. (diameter at breast height) or larger. Small sawtimber are stands with a net volume of at least 457 board meters per 0.41 ha (1,500 board ft/a) in live sound trees with one-half or less of this volume in trees 38.1 cm (15 in) d.b.h. or larger. Pole timber stands have a net volume less than 457 board meters per 0.41 ha (1,500 board ft/a) having at least 30 sound trees of pole size or larger, 15 of which must be of pole size. Seedlings and saplings are stands not qualifying as either sawtimber or pole timber, but have at least 100 seedlings and saplings per 0.41 ha (1 a).

Four degrees of tree stocking are recognized and are based on the percentage of ground area shaded by the crowns of the growing stock or in areas predominantly seedlings and saplings, on the number of stems per 0.41 ha (1 a). A crown cover of 100 percent or over 700 seedlings and saplings per 0.41 ha (1 a) is classified as overstocked. A well stocked area has at least 70 percent crown cover or 550 well distributed seedlings and saplings per 0.41 ha (1 a) or equivalent combination. Medium stocked is from 40 to 70 percent crown cover or 300 to 550 well distributed seedlings and saplings per 0.41 ha (1 a) or equivalent combination. From 10 to 40 percent crown cover or 75 to 300 seedlings and saplings per 0.41 ha (1 a) is classified as poorly stocked (TVA 1965, 1971, 1973).

Forest Cover Along Streams

Stream courses that passed through wooded areas were noted on TVA quad maps. The distances through these wooded areas was compiled by using a road map distance measurer. Trap site information data along with field observations were used to determine the relative stand characteristics.

Human Population

Census data used to estimate the human population in the study area were obtained from the East Tennessee Development District. Additional information on population trends in the tri-county area was obtained from land use plans for Blount, Loudon, and Monroe counties (Blount County, Tennessee State Planning Commission 1970, Gaylon 1975, Deardorff 1976) and the U.S. Census (1970).

Land Use

Information on the agricultural, commercial, industrial, and public and semipublic land use of the tri-county area was gathered from the Blount, Loudon, and Monroe counties land use plans (Blount County, Tennessee State Planning Commission 1970, Gaylon 1975, Deardorff 1976) and the Tennessee Statistical Abstract (1974). These data were used to give the land use trends affecting raccoon habitat in the study area.

Land use within the study area was determined from high altitude aerial photography (RB57) and ground truth surveys. Since the photographs were taken in early April, agricultural practices could not be distinguished. Areas for the open agricultural land was determined by a polar planimeter.

Transportation

Distribution and distances of roads and railroads were obtained from the Tennessee Department of Transportation (DOT) maps, TVA quad maps, and land use plans for Blount, Loudon, and Monroe counties (Blount County, Tennessee State Planning Commission 1970, Gaylon 1975, Deardorff 1976). A road map distance measurer was used to compute the kilometers and miles of road from TVA quad maps.

TVA Habitat Maps

The TVA Division of Forestry, Fisheries, and Wildlife Development (Dr. Larry E. Beeman, personal communication) judged the wildlife habitat for seven important game species. Habitat ratings based on the presence and quality of several necessary environmental factors, were made at the same time the forest plots were visited. The objectives of the TVA

habitat survey were: (1) to determine the present extent and quality of habitat for several of the common game species, including the raccoon, of the Tennessee Valley region, (2) to identify factors limiting the increase of game populations, (3) to determine the potential for habitat improvements, and (4) to record habitat changes and predict trends.

Eight numbered habitat features are listed on the data sheet. These factors are required vegetation, interspersion of cover types, cover quality, travel lanes, food, water, den trees, and unidentified noncontributing factors. These factors are rated according to quality and importance. The overall description of the 80.9 ha (200 a) of raccoon habitat sampled is listed either good, average, poor, or nonhabitat. From this the general habitat quality for each county is derived.

This information was expanded by the use of aerial photographs and was programmed for computer analysis. The computer compiled these data and printed out a habitat map which illustrates the approximate distribution and quality of a given species' (raccoon) habitat in East Tennessee. The portion of the raccoon habitat map covering the study area was used to evaluate the quality of raccoon habitat within the study area.

II. POPULATION EVALUATION

Stocking

Due to commitments made to local raccoon clubs by the TWRA and to circumstances beyond the researcher's control, the TWRA stocked the restoration portion of the study area with 142 raccoons captured in

West Tennessee. Five stockings were made between the dates 16 July 1975 and 13 August 1975 (Table 3). The effect this had on overall trapping success will probably never be known.

It was also reported that in April or May 1976 a private raccoon hunter stocked 20 to 24 raccoons near Chilhowee Mountain within the control area (William G. Minser III, personal communication). Other possible releases could have occurred during the course of the study, but no reports were made.

Hunting Season

The TWRA closed the raccoon hunting and dog training season in the study area for the duration of the project. Any type of trapping was also prohibited in the area. However, the dog training season in the Loudon County portion of the area was not closed since a private act, passed by the State Legislature, ruled that dog training was open year around. This act was never overruled by the TWRA and resulted in 34.2 percent of the study area having a year-round harassment of raccoons by dog training or illegal hunting.

Trapping Area

A topographic map of the study area was divided into 90 numbered grids (Figure 4), each covering an area of 809 ha (2,000 a). Twenty-four grids having more than 50 percent of the study area within their boundaries were randomly selected for trapping. Grids that were primarily pasture were dropped due to lack of habitat, and another grid with more suitable habitat was randomly chosen. Distributions of raccoons captured were plotted on a map.

Table 3. Number of raccoons stocked in the restoration portion of the study area, 1975.

Date	Male	Female	Untagged	Total
July 16	11	20	0	31
July 25	10	10	0	20
August 1	14	8	3	25
August 7	17	21	0	38
August 13	12	16	0	28
Total	64	75	3	142

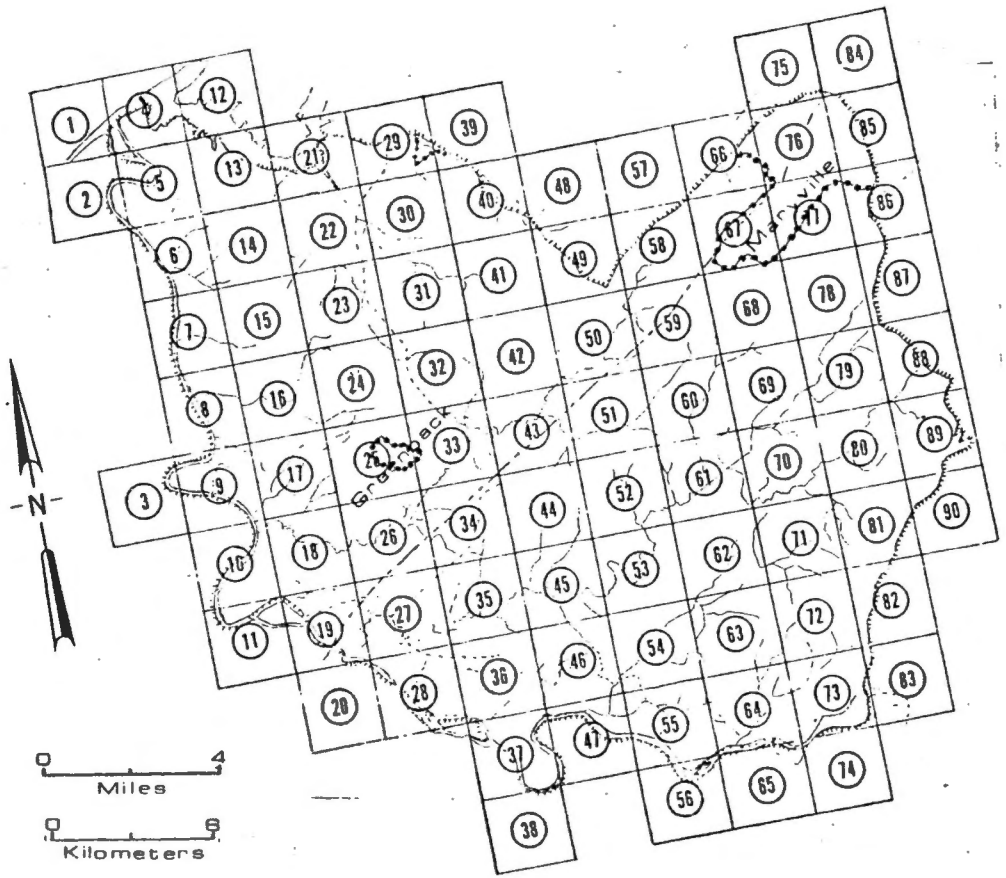

Figure 4. The study area divided into 90 numbered grids, each covering an area of 809 ha (2,000 a). Grids with more than 50 percent of the study area within their boundaries were randomly selected for trapping.

Traps and Bait

Collapsible 1 × 2-12 ga wire live-traps (25.4 × 30.5 × 81.3 cm, 10 × 12 × 32 in) (Tomahawk 207) were the only traps used in this study. Each trap weighed approximately 4.1 kg (9 lbs) and had only one spring activated door. These traps were fairly easy to transport and store.

Sardines were the primary bait used during this study. This bait was easy to use and could be stored for long periods of time. It was not very species-specific, for many opossums (Didelphis virginiana), dogs, and cats (Felis catus) were captured. Stuewer (1943a) considered the odor of smoked herring useful in luring raccoons to traps; it was felt that sardines would also do the same. For maximum effect, one can was used initially to bait each trap. Sardine oil was sprinkled around the entrance of the trap along with some fish. The can was suspended in the rear of the trap, so the reflection of the metal could also be a curiosity lure. When the bait appeared to be getting rancid, the can was removed, and the trap was rebaited with fresh bait.

Trap Site Selection and Activity

The initial purpose of trapping was to tag as many raccoons as possible. The criteria used to select trap sites within a grid were: nearness to streams, stream junctions, adequate cover (Butterfield 1954), suspected den sites, scats, and feeding areas. To trap on private land permission from land owners was obtained. A description of the immediate area around each trap site was kept on file.

Traps were baited and activated for a minimum of four nights. Trap lines were run once a day and records were kept on number of trap nights, species captured, rebaiting, trap disturbances, etc.

Immobilization

Raccoons captured for the first time were immobilized with Phencyclidine hydrochloride (Sernylan) in order to facilitate handling and to prevent stress or injury to raccoon or handler (Montgomery 1964, Harthoorn 1965, Seal and Erickson 1969, Baily 1971, Dean et al. 1973).

The weight of the captured raccoon was estimated by weighing the trap with the raccoon inside it and then subtracting the weight of the trap. Occasionally raccoons gathered dirt into the trap. To prevent overdoses, it was necessary to remove as much dirt as possible from the trap before weighing.

Sernylan is available in 10 cc vials of 100 mg/cc concentration. The drug was administered with a 1 cc tuberculin syringe of the plastic disposable type. Dosages could be accurately measured to 0.01 cc.

When the study began, Sernylan was injected at a dosage of 1.3 mg/kg (0.6 mg/lb). Dosages were later reduced by half to 0.66 mg/kg (0.3 mg/lb). Although this dosage did not immobilize the animal as long, it was sufficient to make the raccoon tractable without having the risk of convulsions.

It was often difficult to determine when a raccoon was sufficiently anesthetized to permit safe handling because small doses (0.66 mg/kg, 0.3 mg/lb) did not always produce complete immobilization. Raccoons

which were unable to right themselves when the trap was rolled over were considered safe to handle.

Recovery from Sernylan was quite variable, ranging from one to 3.5 hours. The ability to walk preceded the ability to recognize or respond to danger. Raccoons recovering from Sernylan were able to walk in a drunken manner. Safe recovery was assured by observing the raccoon until it appeared to have its motor coordination back or by replacing the drugged animal in the trap to be released later in the day.

Aging

Age of captured raccoons was determined by a combination of methods described by Montgomery (1964) and Grau et al. (1970). The tooth wear method described by Grau et al. (1970) permits placing raccoons into 5 broad age classes. This technique was found to be 82.7 percent accurate. Juvenile raccoons captured in the fall were placed into Age Class I, but their age could be further separated into days by using the tooth erruption technique described by Montgomery (1964). These animals usually had some deciduous teeth grouped with some erupting permanent teeth.

Measurements

Weight of raccoons was determined from a spring scale. The animal was suspended from the scale by a string around the body or the hind leg. Weights were measured to the nearest 0.1 kg or to the nearest 0.25 lb. Standard mammal measurements were also recorded in millimeters.

Reproductive Status

Mature and immature males were determined by body weight (Johnson (1970) and by descent of the testes (Keeler 1978. The teats on females showed whether they nursed young previously or was lactating. Stuewer (1943b) stated that teats in an unbred female are 2-3 mm long and are light in color. Teats in a female that has bred and suckled young the previous year are approximately 6 mm long and dark in color. Teats of lactating females are 10-15 mm long and almost black in color, and the hair around the teats shows the circular impression of suckling young.

Physical Condition

A subjective impression of the physical condition of raccoons captured was noted. Raccoons which were fat, vigorous, and had shiny fur were considered to be in excellent condition. Raccoons which were not obviously fat but had a shiny coat and were aggressive were considered to be in good condition. Raccoons which appeared thin and exhibited a dull pelage were considered to be in poor condition. General observations such as scars, deformed limbs, injuries, and other obvious maladies were noted.

Marking

Each captured raccoon was marked with a numbered and labeled Monel ear-tag (National #4) and with a numbered, red, plastic, Standard Rototag (NASCO #C1635N). In males, the Rototag was placed in the right ear while the Monel tag was placed in the left. Females were marked just the opposite with the Rototag in the left ear and the Monel tag in the

right. Optimum placement of tags was found to be at the base of the front of the ear where the cartilage was sufficiently thick to prevent the tag from pulling out. Both tags were found to be quite satisfactory in ease of application and permanence. Both ears were tattooed with red ink with the number corresponding to the Rototag number.

In addition, opossums initially captured were marked by notching or punching a hole in one or both ears. The fur on some individuals was dyed yellow around the head and neck with picric acid.

Simulated Hunts

In order to census raccoons and to determine the relative hunter success in the study area, simulated raccoon hunts were carried out periodically, usually about twice a month. Data were collected on the number of "strikes" and "treeings," and the type and location of refuges. Records were maintained on the number and species of animals treed and on tagged versus untagged raccoons. The distributions of raccoons treed were plotted on a map.

When possible, attempts were made to capture treed raccoons alive by either shaking the animal out of the tree into a dip net or by immobilizing the animal using a CO_2 pistol with a Cap-Chur syringe dart loaded with Sernylan diluted in a saline solution. Methods used were similar to those described by Twichell and Dill (1949).

The dogs used in the hunts were supplied by members of the East Tennessee Coon Hunters Association, Louisville, Tennessee. A minimum of two dogs were taken on each hunt. Efforts were made to use the same two dogs on each hunt, but problems in scheduling the hunts did not always

make this possible. In order to prevent any public misunderstanding on the nature of these hunts, a Wildlife Officer from the TWRA was present.

Areas hunted were grids that had raccoon captures, places recommended by the hunters, or areas where raccoon sign was observed earlier. Areas that showed potential or had previous hunting success were sampled more than once. The researchers acted as observers and did not actively supervise the hunters once the hunt began.

CHAPTER IV

RESULTS

I. HABITAT EVALUATION

Forest Cover

The composition of forested areas varies between conifers and hardwoods. Within the study area, woodlands cover approximately 23,697 ha (58,511 a) (Table 4). The tri-county area forests account for some 201,993 ha (498,748 a): 15.8 percent in The Great Smoky Mountains National Park (GSMNP), 23.8 percent in Cherokee National Forest, and 60.4 percent in private ownership. Approximately 127,258 ha (315,100 a) of the total forested area is in Monroe County. Commercial forest land described here include only the National Forest and privately owned woodlands. Half the commercial forest is hardwood; a third is coniferous. The balance is a mixture of hardwoods and conifers (TVA 1965, 1971, 1973).

Hardwood stands cover 3,571 ha (8,814 a) of the study area (Table 4). The major stands are located near the southern edge of Chilhowee Mountain in the vicinity of Cochran Creek and Harrison Branch, and on the ridges located near the mouth of the Little Tennessee River (Figure 5).

On moderately moist lower slopes of Chilhowee Mountain can be found American beech (Fagus grandifolia), sycamore (Plantanus occidentalis), sweetgum (Liquidambar styricflua), elm (Ulmus sp.), red maple (Acer rubrum), ash (Fraxinus sp.), and hackberry (Celtis occidentalis). At

Table 4. Forest cover types in hectares of Blount, Loudon, and Monroe counties, Tennessee and the study area.

County	Hardwoods	Coniferous	Mixed	Total
Blount	22,023	19,742	9,112	50,877
Loudon	13,145	8,278	2,435	23,858
Monroe	63,181	43,945	20,132	127,258
Total	98,349	71,965	31,679	201,993
Study Area*	3,571	2,257	17,869	23,697

*Forest cover in the study area is not comparable to the tri-county area.

Source: TVA 1965, 1971, 1973.

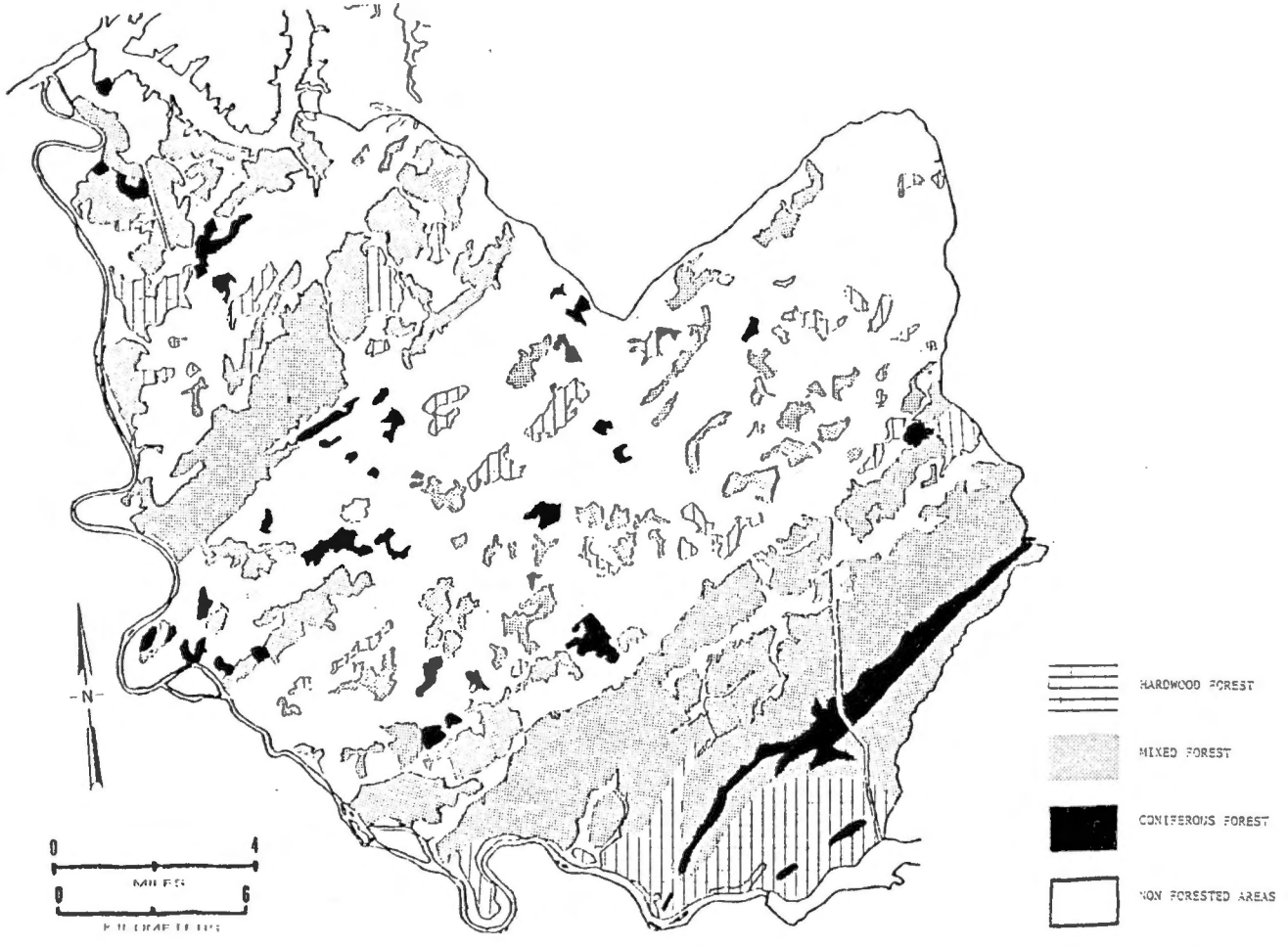

Figure 5. Forest cover types inside the study area.

higher elevations the vegetation changes into typical oak-hickory forest, with white oak (Quercus alba) being the most prominent species.

On the ridges near the mouth of the Little Tennessee River, there are several isolated saw-timber stands of pure hardwoods. These stands are mostly typical oak-hickory forest, with white oak, southern red oak (Q. falcata), black oak (Q. velutina), post oak (Q. stellata), and shagbark hickory (Carya ovata) being the most common. In the poorly drained sites there are stands of yellow poplar (Liriodendron tulipifera), red maple, ash, elm, sweetgum, and hackberry.

Approximately 2,257 ha (5,572 a) of the study area is covered with coniferous stands (Table 4, p. 29). The most common stand in the low land areas is Virginia pine (Pinus virginiana). Because the land is mostly underlain by limestone, eastern redcedar (Juniperus virginiana) is quite common, and in some cases following abandonment of the old fields, almost pure stands of redcedar have become the early successional forest.

In the Red Knobs and on Chilhowee Mountain the pines are more common on the drier, more southerly exposures. These forested areas are made up of stands of pole-sized and small sawtimber-sized trees. Virginia pine and shortleaf pine (P. echinata) are the most prominent pines in the Red Knobs area. Chilhowee Mountain has Virginia and shortleaf pines in the lower elevations, but in the higher elevations pitch pine (P. rigida) and table mountain pine (P. pungens) stands are the most common.

Over 75 percent of the forested area within the study area is of the mixed forest type and covers 17,869 ha (44,122 a) (Table 4). These stands consist predominately of oak-hickory-pine. Because of the hilly

topography on some portions, there was a great deal of difficulty in separating the predominate pine stands on the dry south-facing slopes and the hardwood stands on the moist north-facing slopes, so these were averaged together into the mixed forest classification.

The tree species composition in the mixed stands generally has the same dominate species as found in the other two classifications. White oak, southern red oak, shagbark hickory, shortleaf pine, and Virginia pine are the most common species found in this association, but they tend to vary in compositional proportions. These mixed stands are mainly found in the Red Knobs vicinity and the Black Sulphur Knobs-Chilhowee Mountain area.

Within Blount County, hardwood types covered 22,023 ha (54,375 a), coniferous types 19,742 ha (48,750 a), and mixed types 9,112 ha (22,500 a) (Table 13, Appendix A). Oak-hickory stands made up 32.8 percent (16,694 ha, 41,250 a) of the 50,877 ha (125,625 a) of forested land in Blount County. Virginia pine made up 25.4 percent (12,909 ha, 31,875 a) of the forested land while a mixture of yellow pine-hardwoods covered 6,829 ha (16,875 a) or 13.4 percent.

Within Loudon County, hardwood types covered 13,145 ha (32,454 a), coniferous types 8,278 ha (20,434 a), and mixed types 2,432 ha (6,010 a) (Table 14, Appendix A). Oak-hickory stands covered 11,684 ha (28,848 a) or 49 percent of the 23,858 ha (58,889 a) forested area. Shortleaf pine covered 12.2 percent (7,212 a). Yellow pine-hardwoods occupied only 1,948 ha (4,808 a) or 8.2 percent of the total forest area within the county.

Within Monroe County, hardwood types covered 63,181 ha (156,000 a), coniferous types 43,945 ha (108,500 a), and mixed types 20,132 ha (49,700 a) (Table 15, Appendix A). Virginia pine covered 16 percent or 20,129 ha (49,700 a), while yellow pine-hardwoods made up only 10 percent (12,799 ha, 31,600 a) of the total forest area.

Ninety percent of the forest area has medium or better stocking. Forty-four percent of the timber growing sites are in bottomlands or moist uplands with moderately deep soils (TVA 1965, 1971, 1973). Tables 16, 17, and 18, Appendix A, give the commercial forest area in hectares by type and tree stocking for the three counties.

Blount County (Table 16, Appendix A) has 15,935 ha (39,375 a) or 31.3 percent of the total forest area being medium stocked or higher in oak-hickory. Approximately 20,488 ha (50,625 a) or 40.3 percent of the area is from medium or better stocking in hardwoods.

Loudon County (Table 17, Appendix A) has 51 percent of the forested area stocked with hardwoods classified medium or better. These hardwood stands cover about 12,161 ha (30,050 a). Oak-hickory stands with medium or better stockings cover 44.9 percent (10,702 ha, 26,444 a) of the forest area.

Monroe County (Table 18, Appendix A) has 55,808 ha (137,900 a) of hardwoods classified as medium stocked or better, covering 43.9 percent of the total forest area. No distinctions were made as to what tree species make up the hardwood classification.

The tri-county area has many advantages for forest industry: raw materials, transportation, access to markets, adequate labor supply,

and community consciousness. There are also recreational attractions such as hunting, fishing, and camping facilities (Blount County, Tennessee State Planning Commission 1970).

Pulpwood will continue to be an important and growing industry. Some wood is now trucked to the Bowaters Plant, Calhoun, Tennessee, but most of the wood will continue to be shipped by rail. Soils suitable to pine growth and the competitive market point toward continued expansion of pulpwood production (Blount County, Tennessee State Planning Commission 1970).

Forest Cover Along Streams

Of the 378 km (235 mi) of streams that drain the study area, 191 km (119 mi) pass through wooded areas 0.41 ha (1 a) or larger. There are 152 km (94.3 mi) flowing through mixed forest stands, 35.1 km (21.8 mi) through hardwood forest stands, and 4 km (2.5 mi) through coniferous stands. The vegetation that borders the streams in open land was not included in this estimate. Almost all the permanent streams have some woody vegetation bordering its banks even in the most open situations.

The tree species most common along the stream courses in almost all cases are white oak and sycamore. Sweetgum, boxelder (Acer negundo), and black willow (Salix nigra) are also very common along stream borders. American hornbeam (Carpinus caroliniana) is a very prevalent species along streams on Chilhowee Mountain and in the Red Knobs. Nowhere on the study area are there large stands of bottomland hardwoods.

It must be noted that TVA has clear cut most of the standing timber bordering the Little Tennessee River and its tributaries. Some of these

clear cuts follow a tributary course for almost 8.05 km (5 mi) up stream from its mouth. It was observed in the field that raccoons utilize these forested areas along the Little Tennessee River and its drainages. How much an effect this clear cutting had on the raccoon population is not known, but at the conclusion of the field work, many tracks were still seen on the banks of the Little Tennessee River.

Human Population

The tri-county area comprises just under 3,815 km^2 (1,472 mi^2). The average number of persons living in each in 1960 was 71 per 2.59 km^2 (1 mi^2), about 15 fewer than the State average. The total population in the three Tennessee counties has climbed steadily and more than doubled since 1900, going from 89,000 at the turn of the century to 102,386 in 1950 and to nearly 105,000 in 1960. This growth, however, has not kept pace with the population growth of the Knoxville area nor the East Tennessee region. Between 1950 and 1960, as shown in Table 5, the tri-county area experienced slightly better than 2.2 percent increase as compared with 9.2 percent in the Knoxville area and 5.4 percent in the East Tennessee region for the decade. Blount and Loudon counties had population increases of 5.2 percent and 2.5 percent, respectively, while Monroe County reported a decrease of 4.9 percent (Tennessee Statistical Abstract 1974).

By 1970, the total population of the tri-county area climbed to 111,485 (Table 5). Blount, Loudon, and Monroe counties had population increases of 10.8 , 2.1, and 0.7 percent, respectively (U.S. Census 1970).

Table 5. Tri-county area population of 1950, 1960, and 1970.

County	1950	1960	1970	Percentage Change 1950 to 1960	Percentage Change 1960 to 1970
Blount	54,691	57,525	63,744	5.2	10.8
Loudon	23,132	23,757	24,266	2.5	2.1
Monroe	24,513	23,316	23,476	-4.9	0.7
Total	102,336	104,598	111,485	2.2	6.6

Source: Tennessee Statistical Abstract 1974, U.S. Census 1970.

The population of the study area in 1970 was 17,426 (East Tennessee Development District, personal communication).

Another conspicuous change that has been taking place inside the tri-county area is the shift from farm to nonfarm living. Loudon and Monroe counties had greater percentages of their respective populations on farms in 1960 than the state as a whole, 19 and 31 percent, respectively, compared with the state's 16.4 percent. By 1970, the number of people living on farms in Blount, Loudon, and Monroe counties dropped to 5 percent, 10 percent, and 16 percent respectively. These figures reflect the greater industrialization that has occurred in Blount County. Because Monroe County is lightly industrialized, there are fewer opportunities for nonfarm employment. Therefore, a greater portion of the population of Monroe County has remained on the farms (Table 20, Appendix A) (Blount County, Tennessee State Planning Commission 1970, U.S. Census 1970).

The three county area composed of Blount, Loudon, and Monroe counties is primarily a rural area (Table 6). Of the 105,000 inhabitants of the area in 1960, 60,000 (67 percent) were classified as rural. Of the total population of 102,000 in 1950, there were 70 percent classified as rural and 36 percent classified as rural-farm. The rural population of the tri-county area declined 3 percent from 1950 to 1960, while the total population increased by 2 percent (Blount County, Tennessee State Planning Commission 1970). By 1970, the rural population dropped 9.5 percent while the total population increased to 111,485 or 6.6 percent (Table 15, Appendix A) (U.S. Census 1970).

Table 6. Land area, density and population living in urban and rural areas. Blount, Loudon, and Monroe counties Tennessee and the study area, 1970 Decennial census.

County	Land Area/ Kilometer	Population/ Kilometer	Total Population	Urban	Rural	Percent of Total Population Urban	Rural
Blount	1,490.5	42.8	63,744	26,892	26,852	42.2	57.8
Loudon	613.6	39.5	24,266	9,052	15,214	37.3	62.7
Monroe	1,708.4	13.7	23,475	6,954	16,521	29.6	70.4
Total	3,812.5	29.2	111,485	42,898	68,587	38.5	61.5
Study Area*	520.8	33.5	17,426	6,383	11,043	36.6	63.4

Source*: East Tennessee Development District 1970, Knoxville, Tennessee.

Source: Tennessee Statistical Abstract 1974.

Approximately 63.4 percent of the total population of the study area is rural (Table 6, p. 38). Most of the urban inhabitants reside in the city of Maryville. Two other communities, Friendsville (pop. 575) and Greenback (pop. 285), are located within the study area. Although most of the population is rural, most of the people depend on industry instead of farming for income (East Tennessee Development District, personal communication).

Agricultural Land Use

The agriculture of the tri-county area is characterized by numerous small farms, many of which are classed as part-time operations. The proximity of Knoxville and Maryville, with many job opportunities offered to farmers in the area, has had a decided effect on the type of farming and size of farm operations carried out in this area. The fact that less than 50 percent of all farmers devote full time to farming indicates the importance of part-time farming and off-farm work to agriculture (Blount County, Tennessee State Planning Commission 1970).

Agricultural usage claims 162,284 ha (400,702 a) or 42.5 percent of the land in the tri-county area (Table 21, Appendix A). Of this 25 percent (95,450 ha, 235,680 a) is used for cropland, and 17.5 percent (66,834 ha, 165,022 a) is pastureland. Of Blount County's total land area (149,299 ha, 368,460 a), 32.9 percent (49,058 ha, 121,131 a) of the land area is devoted to agricultural purposes. In Loudon County, 74.2 percent (45,599 ha, 112,591 a) is devoted to agriculture. Monroe County has agricultural land totaling 39.5 percent (67,627 ha, 166,980 a) of its

total land area (Blount County, Tennessee State Planning Commission 1970). Within the study area, 52.2 percent (27,174 ha, 67,091 a) of the total area is devoted to agriculture. Most of this land is used as pasture for cattle.

Most of the farmers of the area produce feed for livestock and food crops for home use (Elder 1959, 1961). The commercial farmer generally has several farming enterprises, and practically all farms have some livestock. The chief crops are corn (Zea mays), wheat (Triticum aestivum), soybeans (Glycine max), and tobacco (Nicotiana tobacum) (Table 7).

Corn, the most important feed crop, is grown mainly along river bottoms (Elder, 1959, 1961). Most of the corn fields in the study area are located in the Little Tennessee River bottoms and in a few areas adjacent to the Red Knobs and Baker Creek. Soybean fields are also located along river bottoms. Hay crops, mainly lespedeza (Lespedeza sp.), red clover (Trifolium pratense) or alfalfa (Medicago sativa), provide livestock feed. Areas of wheat and oats (Avena sativa) are also farmed. Burley tobacco is the most important cash crop. Fruits, berries, and a wide variety of vegetables, particularly Irish potatoes (Solanum tuberosum) and sweet potatoes (Ipomoea batatas), are grown on practically all farms for home use, but few farms grow vegetables as a cash crop.

The majority of the large farming enterprises are for livestock, particularly those for beef and milk production (Table 8). Much of the land used for these enterprises is pasture. Consequently, a vast open land area is needed for this purpose. Permanent pasture is largely on

Table 7. Area harvested and production of principal cash crops, Blount, Loudon, and Monroe counties, Tennessee, 1969 (1974).

County	Tobacco		Corn		Soybeans		Wheat	
	ha.	kg.	ha.	kg.	ha.	kg.	ha.	kg.
Blount	201	401,852	1,328	100,107	744	25,648	388	17,046
Loudon	258	497,418	548	34,858	297	8,369	213	10,017
Monroe	379	756,682	1,402	83,282	642	18,447	341	13,983
Total	838	1,655,952	3,278	218,247	1,683	52,565	942	41,046

Source: Tennessee Statistical Abstract 1974.

Table 8. Number of livestock and poultry on farms, Blount, Loudon, and Monroe counties, Tennessee, 1969 (1974).

County	Cattle and Calves	Milk Cows	Hogs and Pigs	Sheep and Lambs	Horses and Ponies	Chickens[1]	Broilers[2]
Blount	38,350	3,995	5,396	187	1,318	86,746	180
Loudon	26,546	4,370	1,986	111	871	57,380	(a)
Monroe	31,076	6,529	2,862	384	885	61,196	246,748
Total	93,972	14,894	10,244	682	2,074	205,322	246,928

[1]Chickens three months old or older.

[2]Includes broilers and other meat-type chickens less than three months old.

[a]Negligible amount.

Source: Tennessee Statistical Abstract 1974.

soils that are too steep or too stoney to be easily cultivated or on soils that are very shallow to bedrock. Some of the soils of the bottom lands, that are too poorly drained to be cultivated, are also used for pasture. Rotation pastures furnish a considerable part of the pasturage in the tri-county area. The most important pasture plants are orchard-grass (Dactylis glomerata), timothy (Phleum pratense), fescue (Festuca sp.), bluegrass (Poa sp.), white clover (Trifolium repens), and lespedeza (Elder 1959, 1961).

Commercial Land Use

Commercial land use is concentrated mostly in the larger towns, with strip development occurring along many major highways in the three counties. Major Central Business Districts in the tri-county area are located in Maryville-Alcoa, Loudon, Lenoir City, Madisonville, Sweetwater, and Tellico Plains. There are three major shopping centers: Midland Center (Maryville-Alcoa), one in Lenoir City, and one in Sweetwater.

Several major highway-oriented commercial areas are located in the tri-county area. Some have developed as major points of concentrated tourist or highway oriented commercial areas. Others are merely strips of miscellaneous unrelated uses. All of the highway oriented commercial areas have problems of congestion and access (Blount County, Tennessee State Planning Commission 1970).

Small commercial areas which serve a combination of traveler and local needs are found at Lakemont, Hubbard, Vonore, Philadelphia, and within the study area, Greenback and Friendsville. Major strip commercial developments consisting of a variety of uses such as automobile dealers,

service stations, restaurants, motels, etc., are found on Highways 11, 411, 129 and 73 (Blount County, Tennessee State Planning Commission 1970).

Industrial Land Use

In Blount County, the largest manufacturing sites are located in Alcoa and Maryville. The largest Blount County industry in the Aluminum Company of America (ALCOA) which covers some 1,133 ha (2,800 a), primarily in the city of Alcoa. Other large industries are Veach-May-Wilson in Alcoa, Levi-Strauss in Maryville, and the Rockford Manufacturing Company at Rockford. The only industrial complex outside of Alcoa and Maryville is located at Singleton. Industries at Singleton include Institutional Jobbers, Singleton Materials Engineering Laboratory, TVA Singleton Terminal, and Fuller Refrigeration Terminal. A 96.9 ha (239 a) site located on Big Springs Road about 4.8 km (3 mi) west of Maryville is set aside for future industrial development. Other smaller industrial uses are located in scattered areas including Townsend and Little River and a few others along U.S. 411 and U.S. 129 (Deardorff 1976).

In Loudon County, the largest industrial uses are located in the cities of Loudon and Lenoir City. The largest industry is the Bacon Company, which has plants in Loudon and Lenoir City. Other large industries include Smith Chair Company and Maremont in Loudon, Yale and Towne and Elm Hill Meats in Lenoir City. The largest sites outside these towns are Union Carbide located just outside Loudon, Greenback Industries, and Philadelphia Hosiery Mill. Bacon Company is now building a new facility at the 40.5 ha (100 a) Fort Loudoun Industrial Development Company site at Loudon (Gaylon 1975).

Monroe County industrial sites are largely centered in Sweetwater, Madisonville, and Tellico Plains. The largest industrial plant in the county is the Carolyn Chenille Company which is located in Sweetwater. Other large sites include Vestal Manufacturing which is located in the 118 ha (290 a) Sweetwater Industrial Park, Sweetwater Rug Division in Sweetwater, Tellico-Manufacturing Company, Inc., Stokley Van-Camp, and More Industries in Tellico Plains, and Cherokee Sportswear and Moby Dick Sportswear in Madisonville. Madisonville Industrial Park (97.5 ha, 241 a) is located 1.6 km (1 mi) south of the Madisonville city limits (Blount County, Tennessee State Planning Commission 1970).

Industrial uses in the tri-county area have not created severe problems. Some stream pollution problems have resulted at Lenoir City, but no major air pollution problems are known. A major Sweetwater Industry is located directly in the flood plain, but urban renewal has opened the area for easier passage of flood waters (Blount County, Tennessee State Planning Commission 1970).

Four industries are located within the study area. Three are located near Greenback. Greenback Industries, Inc. is the largest, employing 70 people; it manufactures metallic powders. The other industries are Belcraft Cabinets, employing 6 individuals and Old Hickory Brick Company, Inc., employing 21 workers. A marble Quarry Company located in Friendsville employs 71 people and operates several rock quarries within the area. Sand and gravel are presently being dredged from the Little Tennessee River by three companies. The largest industrial plant that influences the study area is the ALCOA plant located in Alcoa. The plant employs several thousand people.

Public and Semi-Public Land Use

Public and semi-public land use includes churches, schools, cemeteries, recreational facilities, and all other types of federal, state, and local lands. There are 329 churches in Blount, Loudon and Monroe counties; 141, 79, and 109 respectively. Hundreds of cemeteries take up an unknown amount of land. School and recreational land occupy some 28 percent of the total land in the tri-county area: 46,103 ha (113,921 a) in Blount County, 240 ha (594 a) in Loudon County, and 58,949 ha (145,664 a) in Monroe County. Most of the recreation area in Blount County is taken up by the GSMNP. The GSMNP covers 39,167 ha (96,783 a) of which 1,053 ha (2,603 a) are in the Foothills Parkway. In Monroe County, the Cherokee National Forest occupies 57,415 ha (141,875 a) of which 32,375 ha (80,000 a) are part of the Tellico Wildlife Management Area (Blount County, Tennessee State Planning Commission 1970).

The TVA Tellico Project

The Tennessee Valley Authority (TVA) has had a tremendous impact on the study area bordering the Little Tennessee River. The TVA Tellico Dam Act called for the impounding of the last 85.5 km (33 mi) of the Little Tennessee River and its backwaters in order to form the new Tellico Reservoir. When the gates of the dam are closed and the reservoir filled, 1,986 ha (4,908 a) of the study area bordering the river will be under water.

TVA work crews have clear-cut and burned all the woody vegetation bordering the river up to the 248 m (813 ft) mark in elevation, the maximum flood level. At present, a U.S. Circuit Court order on the

preservation of the snail darter (Percina tanasi) has stopped construction on the dam and the flooding of the reservoir. Consequently, TVA has leased the land for farming, so much of this bottomland is still cultivated with the same crops as before. The impact of the clear-cutting and dam construction on the native raccoon population could not be evaluated, since the study was initiated after the cutting had begun.

Transportation

Lying partly within the metropolitan area of Knoxville and astride transportation arteries connecting Knoxville with Chattanooga and Atlanta, the tri-county area offers good transportation facilities for business and industry. The northern portion has access to modern, commercial navigation on the Tennessee River. All of the population centers are on important rail and highway routes. McGhee-Tyson Airport, a commercial airline terminal, is located near Maryville-Alcoa.

The tri-county area is served directly by the Tennessee River, which flows along the northern boundary of Blount County, through Loudon County, and near Monroe County. The Tennessee River is part of the inland waterway system of the United States. The port of Knoxville, with a public-use water terminal and barge service, is readily accessible to the area. Such commodities as grain and petroleum products move by barge to Knoxville and are distributed to the tri-county area and other southeastern markets (Blount County, Tennessee State Planning Commission 1970).

Rail service for the area is provided by the Southern Railroad System, and the Louisville and Nashville Railroad Company (L&N). The

Southern Railway's main line between Knoxville and Chattanooga serves Sweetwater, Loudon, and Lenoir City. The main line of the L&N between Knoxville and Atlanta bisects the tri-county area, passing through Vonore and Madisonville. Twenty km (12.5 mi) of main line track cross the study area from Vonore to Alinwick. Branch lines serve Tellico Plains, Greenback, Friendsville, Alcoa, and Maryville. Within the study area, a branch line originates at Jena, passes through Greenback and continues through Friendsville covering 15.3 km (9.5 mi) of track.

The tri-county area contains five principal through highways. U.S. 129 goes from Knoxville to Maryville and across the Appalachian Mountains to Murphy, North Carolina, Athens and Macon Georgia. U.S. 411 extends from Greenville through Maryville, Vonore, Madisonville, and on to Georgia. U.S. 11 connects Knoxville and Chattanooga via Lenoir City, Loudon, and Sweetwater. Interstate 40 closely parallels U.S. 70, and Interstate 75 closely follows the Route of U.S. 11.

State highways 72, 68, 95, and 73 provide connections between the U.S. highways. Highway 72 connects Kingston, Loudon, and Vonore. Highway 68 connects Spring City, Madisonville, Tellico Plains, and Ducktown. Highway 95 connects Oak Ridge, Lenoir City, and Maryville. Highway 73 connects Maryville, Townsend, and Gatlinburg.

Over the years, traffic volumes on most of the tri-county area have increased. Average daily traffic volumes as recorded by the Tennessee Highway Department for 1968 are shown in Figure 6 (Blount County, Tennessee State Planning Commission 1970).

The study area has ample highways passing through its boundaries. Four major thoroughfares conduct automotive traffic into, within, and

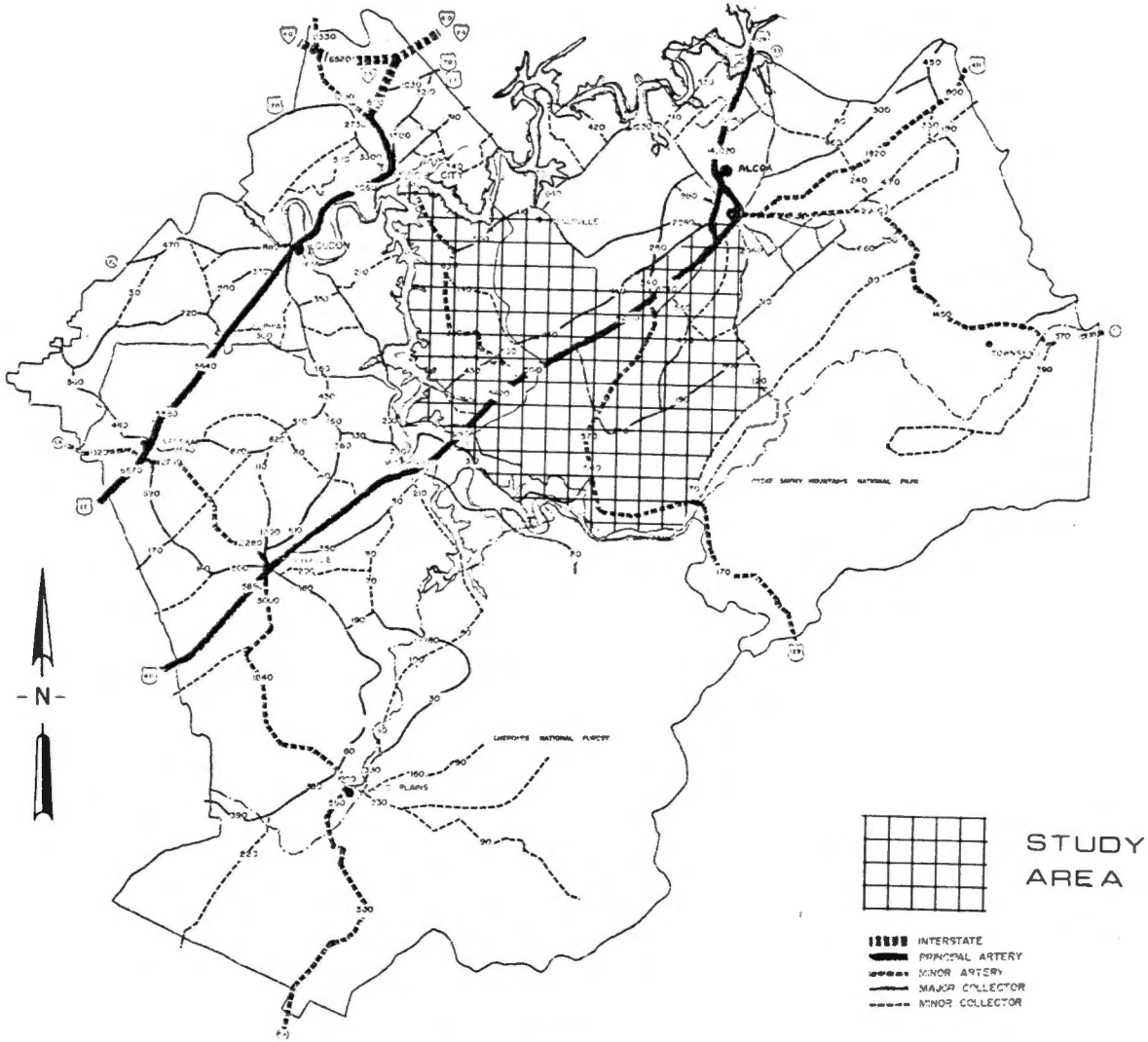

Figure 6. Status of roads (1969) and 1968 traffic counts in the tri-county and study area.

Source: Blount County, Tennessee State Planning Commission 1970.

through the study area. The routes are U.S. 411, U.S. 129, and State highways 95 and 72. There are numerous smaller highways and county roads that are also located within the area. There are approximately 682 km (424 mi) of road in the area (Table 22, Appendix A).

TVA Habitat Maps

The TVA habitat maps give a very general representation of the raccoon habitat available in the study area (Figure 7). Compared with Figure 5, p. 30, the good and average habitat types correlate with the forested areas along the Little Tennessee River, in the Red Knobs, and in the Chilhowee Mountain area. The areas classified as poor and nonhabitat are generally open pasture land or woodlands scattered in densely settled areas. Although this map is very general, it gives a fairly accurate representation of raccoon habitat in the study area. The areas of high raccoon density and numbers should correspond with the distribution of the higher rated habitat. Table 23 (Appendix A) rates the habitat factors according to quality and importance (percent) and Table 24 (Appendix A) illustrates the general habitat quality for each county.

III. POPULATION EVALUATION

Grids Trapped and Trap Activity

A total of 24 grids were trapped during the course of the study (Figure 8). Traps were set on 223 different nights between the dates 21 September 1975 and 22 November 1976 for a total of 3,928 trap nights. Table 25 (Appendix B) summarizes the number of trap nights for each

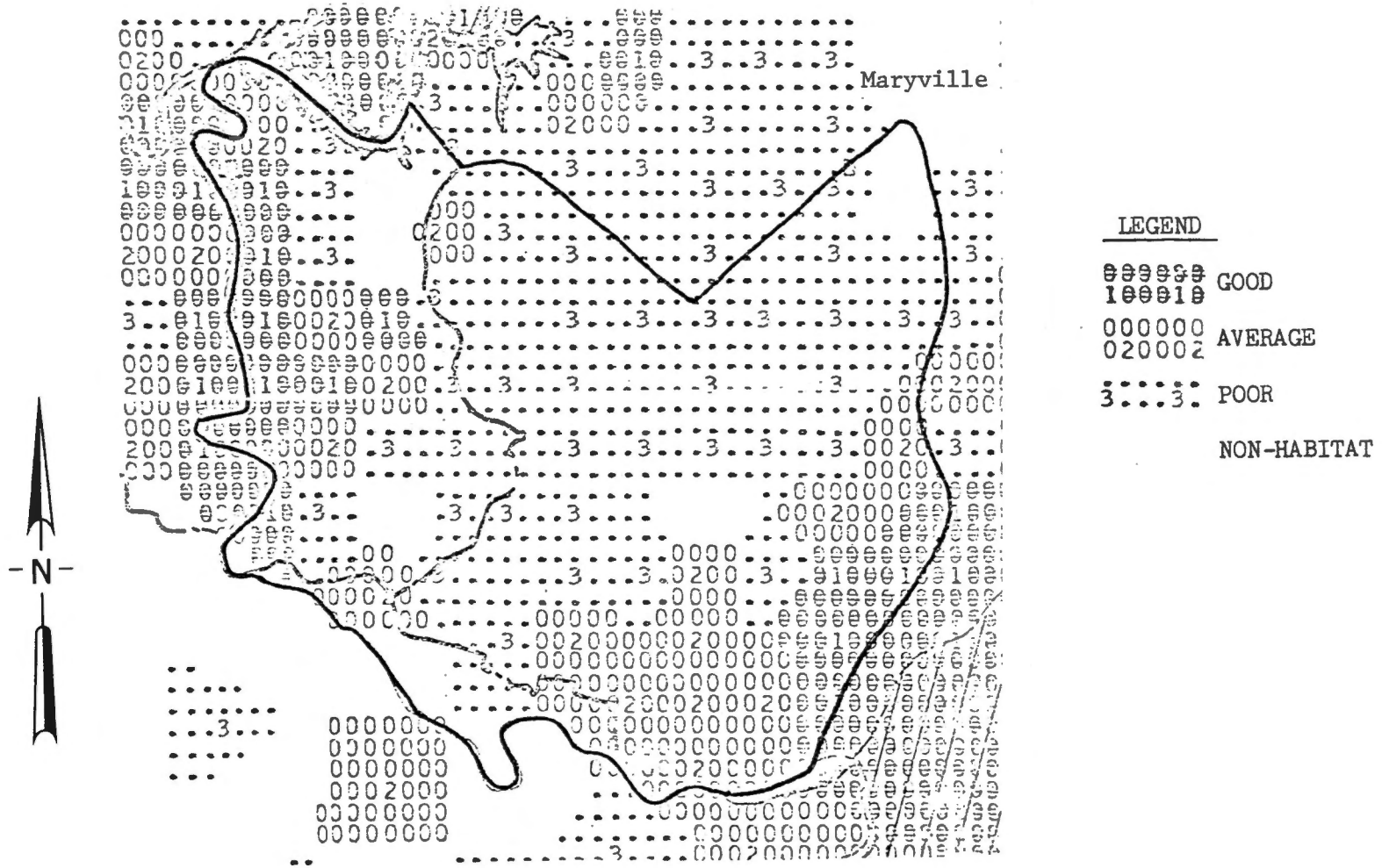

Figure 7. Computer generated habitat map showing the raccoon habitat in the study area.

Source: Dr. Larry E. Beeman, personal communication, Division of Forestry, Fisheries, and Wildlife Development, Tennessee Valley Authority, Norris, Tennessee 37828.

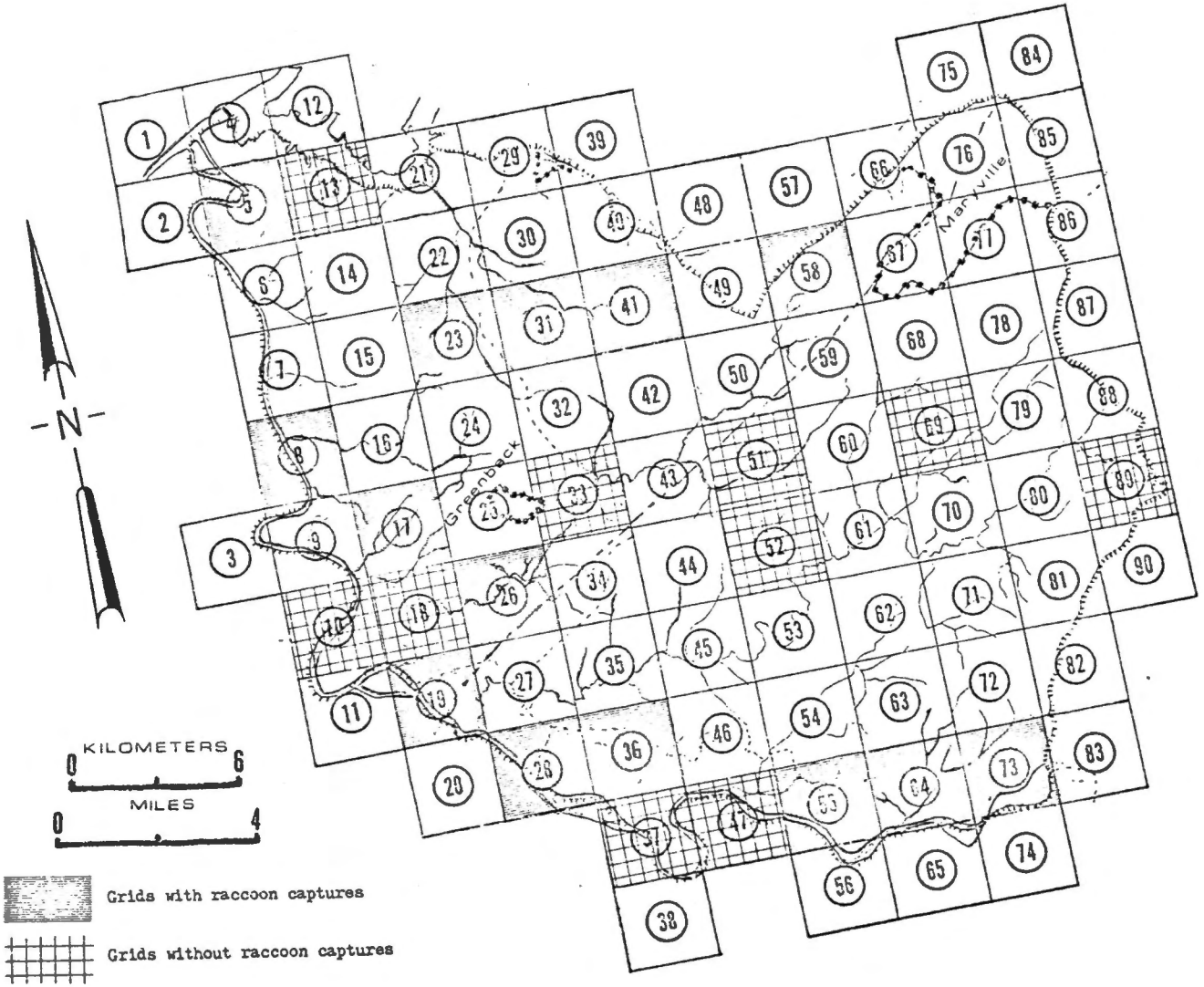

Figure 8. The 24 grids trapped in the study area from September 1975—November 1976.

grid per month. Grids that had raccoon captures or showed potential were trapped more than once.

Raccoon Captures

A total of 32 different raccoons were live-trapped in the study area. Six of these were subsequently recaptured a total of 15 times. The total trapping success was one per 83.6 trap-nights (1.2 percent) (Table 9). In addition, two raccoons were captured on the simulated hunts, making a total of 49 records for 34 animals. Fifteen females and 19 males were identified, giving a female to male ratio of 0.79. Eight juveniles (4 males, 4 females) and 26 nonjuveniles (15 males, 11 females) were captured, a ratio of 0.31 (Table 26, Appendix B). Three animals live-trapped were from the group that was stocked in the summer of 1975 (Table 4, p. 21). Tables 27 and 28 (Appendix B) summarize the data recorded on each raccoon.

Raccoons Found Dead

Approximately 23,813 km (14,800 mi) of road were driven in the study area from 21 September 1975 through 22 November 1976. No road killed raccoons were observed by U.T. personnel. From August 1975 through November 1976, the carcasses of 13 raccoons were found inside the study area. The remains of 2 other raccoons were found just outside the study area. Six of the carcasses, including 3 road kills, were reported by Wildlife Officers of the TWRA (Table 29, Appendix B).

Table 9. Number of trap-nights per month, total captures, percentage capture success, sex, and recaptures for raccoons captured in the study area from September 1975—November 1976.

Month	Trap-nights	Total Captures	Percentage Success	Male	Female	Recaptures
Sept. 1975	80	1	1.25		1	1
Oct.	207					
Nov.	343	4	1.17	3	1	1
Dec.	171	7	4.09	3	4	
Jan. 1976	186					
Feb.	55					
Mar.	322	3	0.93	2	1	
Apr.	658	9	1.37	9		6
May	387	2	0.52	2		2
June	184	2	1.09	1	1	
July	322	3	0.93	2	1	1
Aug.	43	1	2.33		1	
Sept.	372	8	2.15	2	6	4
Oct.	249	3	1.21	2	1	
Nov.	349	4	1.15	2	2	1
Total	3,928	47	1.20	28	19	15

Miscellaneous Species

Other wild and domestic animals that interact with the raccoon were present in the study area. Table 10 summarizes the information recorded on the miscellaneous species captured.

On numerous occasions free-roaming dogs were observed inside the study area. An average of 5 dogs a day were observed along the roads. Most of these animals appeared to be domesticated.

On approximately 67 occasions the researcher had direct contact with free roaming dogs by either capturing them in the live traps (30 times), seeing them following the trap line (35 times), or observing them harassing opossums in the traps (2 times). Signs of dogs harassing animals in the traps were noted on ten occasions; of these, three opossums, two cottontails, and two spotted skunks were killed.

Trap Disturbances

A total of 457 traps were sprung and had no captures or were unsprung with the bait stolen. More than 75 percent of the disturbed traps showed evidence of a dog crawling inside the trap and eating the bait. Because of its size, the animal was able to back out and let the trap door slam with no capture. The disturbance rate was one trap disturbed out of 8.6 trap nights (11.6 percent). Using the total miscellaneous species captured, a total of 890 traps were disturbed or captured some other species. The overall disturbance rate was one trap disturbed out of 4.4 trap nights (22.7 percent) (Table 11).

Table 10. Total number of miscellaneous species live-trapped, percentage trapping success, sex, and recaptures on the study area from September 1975—November 1976.

Species	Total Captures	Percentage Success	Male	Female	Recaptures
Opossum (*Didelphis virginiana*)	309	7.86	151	158	105
Cat (*Felis catus*)	39	0.99	14	14	7
Dog (*Canis familiaris*)	30	0.76	15	13	9
Cottontail (*Sylvilagus floridanus*)	7	0.17			
Spotted Skunk (*Spilogale putoris*)	7	0.17			
Striped Skunk (*Mephitis mephitis*)	6	0.15			
Woodchuck (*Marmota monax*)	2	0.05		2	
Muskrat (*Odatra zibethicus*)	1	0.03			
Box Turtle (*Terrapene carolina*)	24	0.61	19	4	
Snapping Turtle (*Chelydra serpentia*)	7	0.17			
Woodcock (*Philohela minor*)	1	0.03			
Total	433	11.02			

Table 11. Traps disturbed on the study area from September 1975—November 1976 and the overall disturbance rate.*

Month	Trap-nights	Total Disturbed	Disturbance Rate	Traps Sprung	Traps with Bait Absent
Sept. 1975	80	6	7.50	4	3
Oct.	207	9	4.35	7	2
Nov.	343	42	12.25	30	23
Dec.	171	41	23.98	32	18
Jan. 1976	186	13	6.99	6	3
Feb.	55	5	9.09	3	3
Mar.	322	80	24.84	58	53
Apr.	658	100	15.20	54	65
May	387	18	4.65	8	10
June	184	31	16.85	30	3
July	322	57	17.70	51	25
Aug.	43	4	9.30	4	
Sept.	372	13	3.49	7	8
Oct.	249	13	5.22	12	5
Nov.	349	25	7.16	22	10
Total	3,928	457	11.63	328	231

*Overall disturbance rate (total miscellaneous species + total traps disturbed) = 890 or 22.7 percent.

Simulated Hunts

During the period 31 December 1975 through 11 November 1976, 19 simulated hunts were conducted on 18 different nights (Table 12). The first 5 hunts were conduceed in grids that had been trapped and produced raccoons. The remaining hunts were held in areas where the raccoon hunters had had hunting success in the past (Figure 9).

A total of 8 raccoons was sighted, of which two were captured. No tagged animals were observed. The hunter successes per hunt and per hour were 42 and 11 percent respectively. A total of 18 opossums was "treed" on 17 occasions. Three striped skunks (Mephitis mephitis) were bayed on 3 "strikes," of these two were killed by the hounds.

The types of refuges found on the hunts are listed on Table 30 (Appendix B). No species of tree was preferred by either the raccoon or opossum. All the raccoons were observed in hardwood trees ranging in size from 9.14 m (30 ft) high and 30.3 cm (8 in) dbh to 27.4 m (90 ft) high and 45.72 cm (18 in) dbh. The houds barked "treed" on hardwoods 25 times (61 percent), conifers 6 times (15 percent), holes in the ground 2 times (5 percent), and a dead tree once (3 percent). Animals were bayed on the ground 5 times (13 percent).

Distribution of Raccoon Captures and Sightings

All the raccoons live trapped were within 50 m (164 ft) of a permanent water source. The two young males captured during the simulated hunts were also found in close proximity to a permanent water supply. All captures were made in wooded areas consisting mainly of mature hardwood trees. No raccoons were captured along stream courses

Table 12. Results from nineteen simulated raccoon hunts conducted on the study area from December 1975—November 1976.

Date	Grid Number	Duration of hunt (Hours)	Strikes	Treed	Species		
					Raccoon	Opossum	Skunk
30 Dec. 75	8	4.17	4			1	1
30 Dec. 75	28	3.17	5	4			
15 Jan. 76	28	3.08	5	4			1
4 Feb. 76	37	3.40	5	3		4	
23 Feb. 76	5	3.58	2				
1 Apr. 76	73	3.25	8	3	2		
21 Apr. 76	64	3.17	1				
12 May 76	31	3.33	7	1			
9 June 76	6	2.25	3	3		1	
23 June 76	43	4.67	2	2			1
8 July 76	23	4.00	3	2			
15 July 76	23	5.50	8	6	2	1	
5 Aug. 76	31	5.42	1	1	1		
2 Sep. 76	31	2.17	2	1	3		
16 Sep. 76	55	4.33	4	1			
5 Oct. 76	9	5.00	8	4		4	
12 Oct. 76	9-26	4.67	7	4		3	
19 Oct. 76	23	5.25	3	1			
9 Nov. 76	61	3.00	4	2		2	
Total		72.67	82	39	8	18	3

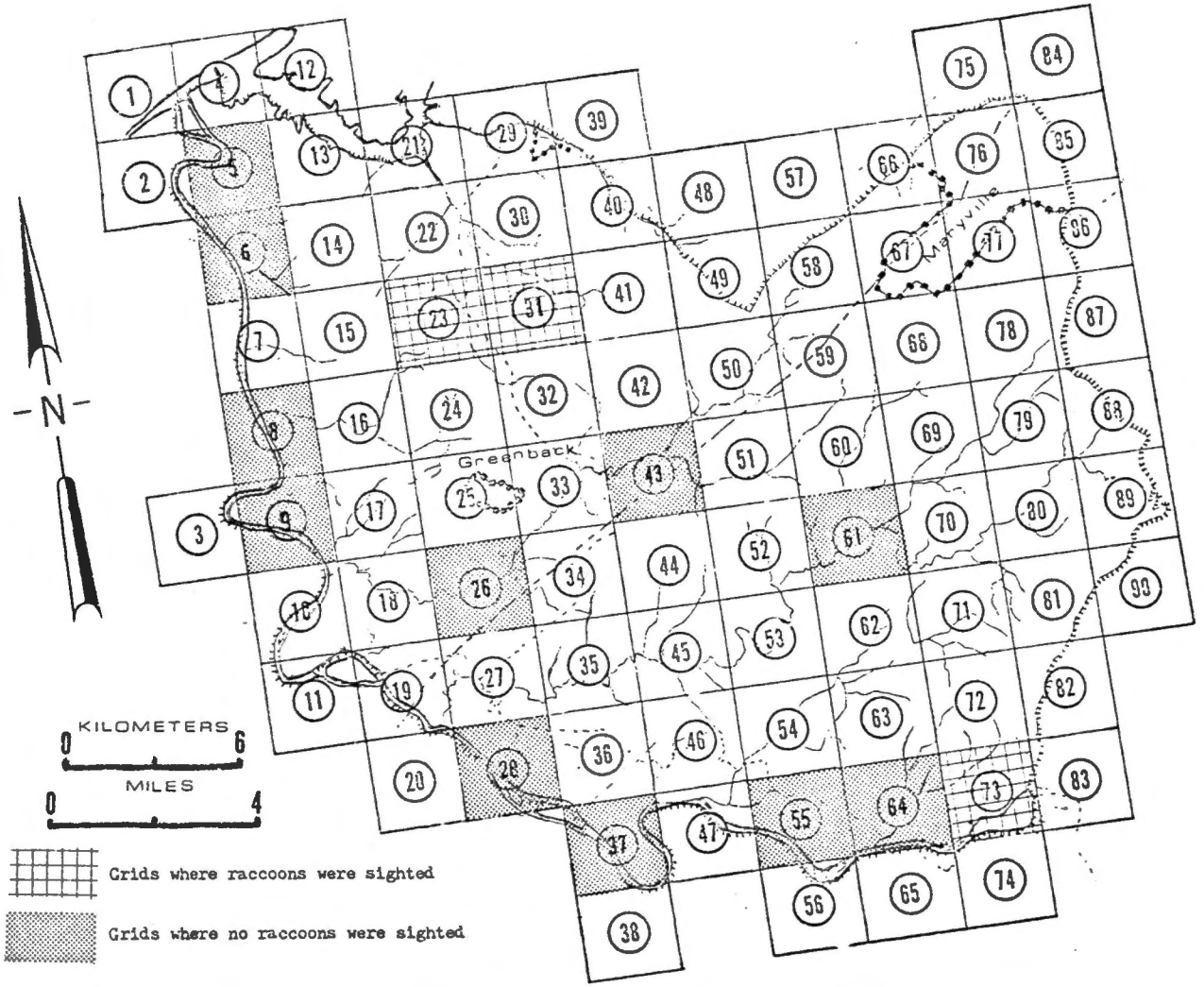

Figure 9. The 14 grids where simulated hunts were conducted from December 1975—November 1976.

in open land. Consequently, the distribution of raccoons in the study area seems to coincide with the distribution of the large expanses of woodland found on Chilhowee Mountain, the Red Knobs, and along the Little Tennessee River (Figure 5, p. 30). Figure 10 illustrates the distribution of raccoon captures and sightings during the course of the study.

Raccoon Population Density in the Study Area

A mathematical estimate of raccoon density in the study area was impossible due to the low number of captures. However, the poor trapping success suggests that the population density is extremely low.

Illegal Hunting

From 16 August 1975 through 15 October 1976, 11 known violations of hunting regulations occurred within the study area. During the year 1975-76, only 522 raccoon hunters were checked for compliance with hunting regulations in East Tennessee (Region 4 of the TWRA). The violation rate was 17 percent. No distinctions were made between areas and dates the hunters were checked.

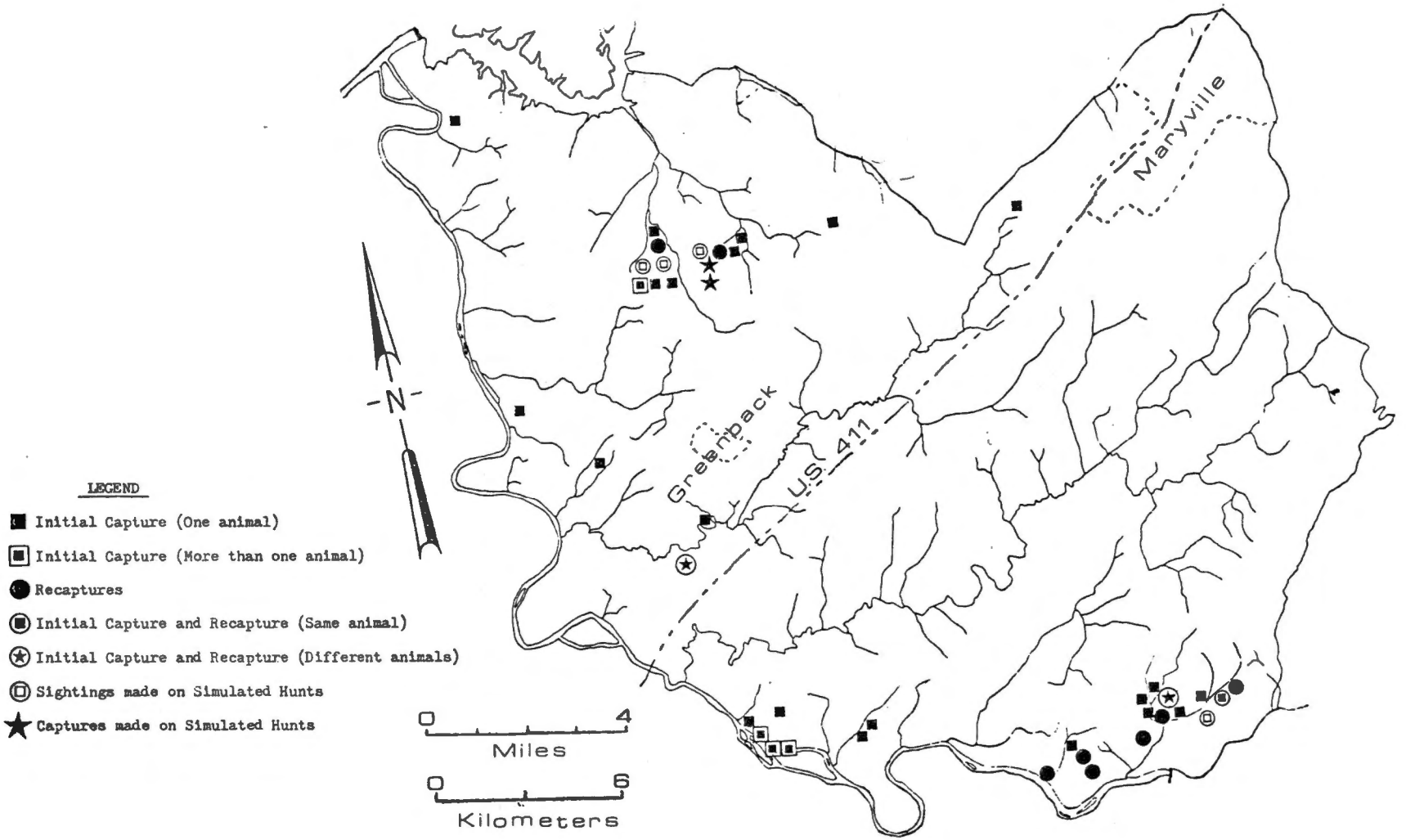

Figure 10. Distribution of raccoons captured or sighted in the study area, September 1975—November 1976.

CHAPTER V

DISCUSSION

I. HABITAT EVALUATION

Forest Cover

Forested land constitutes 45.5 percent of the study area. Approximately 90 percent of the study area and all of Loudon County fall within the ridge and valley physiographic province. The western portion of Loudon County constitutes 34.2 percent of the total study area. It was assumed that the forest cover inventory statistics for Loudon County (TVA 1973) would better describe the forest stand characteristics in the study area; as compared to the data collected from high altitude aerial photographs (RB57).

Sixty-five percent of the total forested area of Loudon County is hardwoods. Fifty-one percent of the total forested area is stocked medium or better with hardwoods, and 22.5 percent of the total forested area is composed of large sawtimber hardwoods dominated by oak-hickory stands (18.4 percent), an upland hardwood group. Hardwoods are a very important source of food and dens for raccoons. A hardwood forest component with an abundance of mature oaks is essential (Johnson 1970).

Food habit studies from forested areas have shown that naturally occurring fruits and other plant foods consistently made up 50-80 percent of the volume of the April to November diet. Although acorns are not high in preference among natural foods, they have been shown to be very

important as a source of winter food in areas with only a limited aquatic environment or when planted foods are not available (Stickel and Mitchell 1944, Kellner 1953, Johnson 1970).

Atkenson and Hulse (1953) stated that mature bottomland hardwood stands are the optimum raccoon habitat on the Wheeler National Wildlife Refuge, Alabama. In southern Illinois raccoons were only utilizing wood duck (Aix sponsa) nest boxes located in floodplain habitats (Brown and Bellrose 1943). Floodplain habitats along the Illinois River consisted of black willow, maple (Acer sp.), river birch (Betula nigra), elm (Ulmus sp.), cypress (Taxodium distichum), and black gum (Nyssa sylvatica). Yeager and Rennels (1943) mentioned that bottomlands are undoubtedly the preferred habitat of raccoons in Illinois. Cottonwood (Populus sp.), willow (Salix sp.), American elm (U. americana), silver maple (A. saccharinum), sugarberry (C. laevigata), and sycamore are the principal trees along the river banks. Acorn and nut-bearing species are scarce except on the highest ridges, where pin oak (Q. palustris) is abundant in association with burr oak (Q. macrocarpa), white oak, and shagbark hickory. Water locust (Gleditsia aquatica) and white ash (F. americana) are scattered widely. The raccoon habitat on the Horicon Marsh, Wisconsin consisted of about 36 islands (0.41-64.8 ha, 1-160 a) covered with quaking aspen (P. tremuloides), and willow (Dorney 1954). Some of the best raccoon habitat on the Swan Lake Wildlife Refuge, Missouri consisted mainly of varying age stands of pin oak, maple and elm (Twichell and Dill 1949).

Relative abundance in different types of habitat has been studied in several areas in the South. McKeever (1959) reported trapping success

using steel traps on a standardized trap line for 32,000 trap nights in various habitat types in southwestern Georgia and northwestern Florida. Capture of raccoons per trap night was greatest in bottomland hardwood; intermediate in cultivated lands, weeds and broomsedge, and upland hardwoods; slightly lower in mixed pine-hardwoods; lowest in pine forests. Caldwell (1963) used number of trails struck, while hunting with dogs under standardized conditions, as an index to relative abundance of raccoons in north-central Florida. The index rating from best habitat to poorest was as follows: (1) swamps, (2) farmlands, (3) hammocks, (4) sandhills, and (5) flatwoods. Since the upland hardwood habitat type is intermediate in preference for raccoons (McKeever 1959, Caldwell 1963), it seems unlikely that the forest cover in this region is a major limiting factor.

Lack of den trees has been offered as a limiting factor in Michigan (Stuewer 1943b); however, Preble (1941) found this factor to be unlikely in Ohio. In Minnesota, Mech et al. (1966) concluded that most daytime resting sites were ground beds in cattail marshes (Typha latifolia), alder swamps (Alnus sp.), and cedar swamps (Tuja occidentalis). Only a few were in trees, although many den trees were available. Besides den trees, there is also an abundance of rocky ledges and woodchuck (Mamota monax) burrows throughout the study area. Raccoons have been reported using as dens muskrat (Ondatra zibethicus) houses, bank burrows, caves, ground burrows, cracks in rocks, abandoned buildings, and thickets (Dorney 1954, Geis 1966). Giles (1942) discovered dens in Iowa to be one of the most important factors influencing annual production.

Forested Areas along Streams

There is a preponderance of streams in the study and surrounding areas. Over 378 km (235 mi) of permanent streams drain the study area (Figure 3, p. 9). Of this, approximately 300 km (187 mi) pass through wooded land. The proximity of den sites and feeding areas to a permanent water supply does not appear to be limiting to raccoons in the study area and surrounding areas. In Michigan, the location of a den in respect to food and water showed little relation to the amount of use (Berner and Gysel 1967).

Human Population and Land Use

With the growing human population in the tri-county and study areas, more land will become available for housing and suburban development (Blount County, Tennessee State Planning Commission 1970, Gaylon 1975, Deardorff 1976). This growth in population 6.6 percent from 1960-1970 is directly related to the expanding population of the Knoxville metropolitan area. Friendsville, Greenback, and Maryville constitute 1,214 ha (3,000 a) of suburban development in the study area.

The land use practices in East Tennessee are not conducive to high raccoon populations (Schultz 1956). However, since the raccoon is an opportunist, it can adapt to conditions brought about by man's presence. Studies by Schinner (1969) and Cauley (1970) have illustrated the adaptability of raccoons to the urban environment of Cincinnati, Ohio. In the Overton Park area of Memphis, Tennessee, there is a large population of raccoons. Man's direct encroachment on naturally occurring raccoon habitat does not necessarily affect the resident raccoon

population in a negative manner. However, the nature of the altered habitat may make the population of raccoons unavailable to sportsmen.

The remaining 27,174 ha (67,091 a) of the study area is devoted primarily to agricultural purposes. The majority of the farms are small part-time operations. Many of the small and all the large full-time operations are devoted to beef and dairy production. These types of agricultural practices are not conducive to high raccoon populations (Shultz 1956).

The hilly topography and rocky soil of this region make cattle farming more feasible than row crop farming. The only major cash crop grown in the tri-county and study areas that could be utilized by raccoon populations is corn (Yeager and Rennels 1943, Stickel and Michell 1944, Cabalka et al. 1953, Kellner 1953), but this only occupies a small proportion of the open land in the tri-county area: 3,278 ha (8,094 a). Consequently, the number of hectares of corn is minute compared to the large expanses of pastureland. For this area to support a higher raccoon population, much more corn should be cultivated. Crop wastes would be especially beneficial to raccoons. Corn is important as a food source in some areas, and is heavily utilized in winter where it is available (Johnson 1970). During late summer and autumn raccoons in Kansas gravitate toward fields of corn and sorghum and the grain makes up an important part of its diet (Stains 1956).

The commercial and industrial developments around Maryville do not appear to be on a grand enough scale to affect the local raccoon population significantly other than occupying land that could have been woodland. Water pollution from pesticides and industrial wastes might

pose a problem. Greenback Industries discharges heated water into Baker Creek, but this does not pose a problem (Tennessee Department of Public Health 1975). Alcoa Aluminum and local communities are the other major dischargers of wastes in the tri-county area (Tennessee Department of Public Health 1975). Water pollution in some areas might deplete the aquatic food fauna for raccoons, but with the numerous small creeks in the study area and surrounding areas, this factor seems unlikely (Tennessee Department of Public Health 1975).

The TVA Tellico Project has probably had some impact on the raccoon population in the study area. Over 1,986 ha (4,908 a) of land was cleared for eventual flooding. This included some mature hardwood forests and prime agricultural lands. As a result, portions of the native raccoon population may have either emigrated from the area or increased home ranges.

Transportation

Almost every section of the study area is accessible by vehicle. With the high number of local raccoon hunters, the easy accessibility to raccoon habitat makes it harder for a population to withstand overharvest. Except for the very mountainous portions, most of East Tennessee's wild areas have easy access from the road, less than 2 km (1.3 mi).

Road kills can give a general representation of population changes and density (Johnson 1970, Oxley et al. 1976). With the high traffic counts, the low number of raccoon road kills reported during this study indicates a very low density of raccoons in the study and surrounding areas.

TVA Habitat Maps

The habitat maps provided by TVA (Dr. Larry E. Beeman, personal communication) give a very general representation of the raccoon habitat available (Figure 7, p. 51). The good and average habitat types correlate with the forested areas along the Little Tennessee River, in the Red Knobs and in the Chilhowee Mountain area (Figure 5, p. 30). The habitat classified as poor and nonhabitat are generally pastureland, small woodlots, and suburban areas.

In some areas where the map illustrates good habitat, very little raccoon sign was found. One such location in the study area was the eastern boundary bordering Chilhowee Mountain. In areas bordering the Little Tennessee River, the habitat was rated as average, but raccoon sign was quite common. Raccoons can be found in habitat types rated good and average, but the distinction between such types does not appear to be clear.

Density and distribution of raccoons in various habitat types tends to vary over the year (Johnson 1970). These maps do give an accurate representation of where raccoons should be located under optimum conditions; however, other extrinsic factors, such as heavy harassment from free-roaming dogs and hunting, may tend to lower the number of raccoons found in a given habitat type at a given time.

II. POPULATION EVALUATION

Raccoon Captures

Although the study area covers 52,084 ha (128,602 a), the trapping effort was concentrated in the forested portion. If there was a

population of any reasonable size, the capture rate should have been much higher.

Howard Hall (personal communication), while conducting a study on the ecology of rabies in three counties in Northeast Tennessee, had a live trapping success of only 0.31 percent for raccoons. Out of 1,282 trap-nights covering a period of three years (May 1973—September 1975), he captured only 4 raccoons. Even though he was not actively trapping for raccoons, he used traps, bait and trap sites similar to those in this study. He was also trapping an extremely large area of habitat similar to that of the present study.

During the period 27 January 1973 through 16 April 1974, Keeler (1978) had a capture success of 7.56 percent in Cades Cove, GSMNP (977 ha, 2,413 a). Out of 2,870 trap-nights, 217 raccoons were captured (1/13.23 trap-nights). His high success rate was attributed to a scarcity of food due to a mast failure during the first year, coupled with a high population density. The forested areas in Cades Cove are composed of upland and cove hardwoods similar to those found on Chilhowee Mountain in the study area.

Woods (1978) also had a high capture success on the Chuck Swan Wildlife Management Area (WMA) in East Tennessee. This management area covers approximately 10,100 ha (25,000 a). From July through October 1976 he captured 145 raccoons (112 individuals) out of 1628 trap-nights. His overall success was one raccoon per 11.2 trap-nights (8.91 percent). Forest cover types in Chuck Swan WMA are very similar to those found on the Red and Black Sulphur Knobs in the study area.

Sonenshine and Winslow (1972) has capture successes similar to this study on two different localities in Virginia; the Montpelier area had an overall success rate of 0.67 percent over 6 years and the Newport News area had 1.58 percent success over 4 years. These areas studied were only 136.5 and 68.5 ha (337 and 169 a) respectively.

Miscellaneous Species

The high number of opossum captures (309) indicate that there may be competition for food or habitat with the raccoon. However, it is felt this is unlikely. On Chuck Swan WMA, Woods (1978) had 194 opossum captures in addition to the 145 raccoon captures. The opossum is a versatile, adaptable species with a high reproductive potential. It appears to do well where raccoons do not, but it also thrives in areas where raccoons are plentiful.

Wood and Odum (1964) found that over a 9-year period on the Atomic Energy Commission Savannah River Plant Area, the populations of gray fox (Urocyon cinereoargenteus), red fox (Vulpes vulpes), raccoon, and bobcat (Lynx rufus) fluctuated concurrently. Trapping was done the same way, in the same place and at the same time each year. Despite a more than three-fold variation in the number of animals caught, the percentage of each species remained almost constant. The same ecological factors affected them all and no increased competition occurred. The area was unhunted and undisturbed.

Preble (1941) indicated that free-roaming dog predation may account for as much as 20 percent of the annual kill in Ohio. Pregnant females and young on the ground are especially vulnerable. Wing (1940) stated

that dogs in Northeastern Tennessee "roam freely throughout the year and undoubtedly have a serious effect upon the game, especially during the breeding season." In this area, hunting-dog blood predominates and increases the effectiveness and foraging ability of the dogs in gaining food (Wing 1940).

The high rate of disturbed traps (11.6 percent) in the study area indicates that there is a large number of free-roaming dogs. These dogs are either pets of local residents or strays. During the course of of the study, many dogs (average 5/day) were observed in the study area. No matter what relationship the dog has to man, it still presents the same problem for the raccoon. Any young raccoon moving about may be subject to harrassment by these dogs. A land owner (personal communication) stated that he always permitted his dogs free range. One night his dogs treed a female raccoon with some young near his house. As he was pulling his dogs away from the tree, one of the young raccoons jumped out and ran. A dog caught it and ate it on the spot; how often this episode occurs is unknown. The apparently low raccoon density in East Tennessee may reflect in part the influence of free-roaming dogs. Free-roaming dogs can be detrimental to the raccoon population during the spring and summer months.

Intensive studies have not been undertaken to determine the impact of free-roaming dogs on wildlife populations, but it may be assumed that free-roaming dogs impose an additional burden to the struggle for survival by providing an abnormally high ratio of predators to the prey species, particularly the young. These predators can maintain high populations due to their dependence on man.

Simulated Hunts

The percentage raccoon hunter success in the study area (42 percent) falls midway between the range for East Tennessee (13.3—76.7 percent) (Whitehead 1975). However, the hunter success in the study area during the regular statewide hunting season was zero. Compared to the statewide range (40.9—70.0 percent), hunter success in the study area is low.

Hunter success is (1) inversely proportional to the number of hunters and (2) directly proportional to the number of animals. However, a higher number of hunters should increase the total harvest. The decreasing raccoon hunter success in East Tennessee (Whitehead 1975) can probably be attributed to the increasing number of raccoon hunters and an over harvest.

All the raccoons sighted were treed in hardwoods. The more refuges available to the animal, the greater the chance it has to escape. The type of refuge is very critical to the animal being hunted. Animals taking shelter in ground burrows or high up in a hollow tree have a greater chance for survival. In Iowa, raccoons subject to heavy hunting pressure were found using rock dens in preference to tree dens (Giles 1942). Without secure den sites, raccoons might be eliminated in a given area under intensive pressure. Regularly used dens should be preserved from destruction. Some den trees are of greater public value in terms of recreation provided by raccoons than as timber (Butterfield 1950).

Raccoon Population Density and Distribution in the Study Area

No reliable information is available on long term trends of raccoon populations in East Tennessee. In a limited game survey in northeastern Tennessee, Wing (1940) stated that the raccoon is present but not common. No trapping or collecting of raccoons was undertaken in this survey. From a statewide farmer survey, Shultz (1956) concluded that the highest raccoon populations in Tennessee are in West and Central Tennessee. Smith et al. (1974) found that raccoons occur in small numbers throughout northeastern Tennessee. Keeler (1978) estimated the population density in Cades Cove, GSMNP to be one per 7.1 ha (17.5 a). After a distimper outbreak in the winter of 1973-74, the population dropped to one per 21 ha (51.8 a). The population density on Chuck Swan WMA during the fall of 1976 was estimated to be one per 23.1 ha (57 a) (Woods 1978). Raccoons are much more abundant in West Tennessee (Shultz 1956, Whitehead 1975).

An estimate of the raccoon density in the study area was impossible due to the low number of captures. Compared to such areas as Cades Cove, GSMNP and Chuck Swan WMA, the poor trapping success indicates a low population density.

The accurate determination of wild animal density per unit area is relatively difficult with most species, and the raccoon is no exception. Steuwer (1943a), Yeager and Rennels (1943), Dorney (1954), and Cunningham (1962) have variously estimated raccoon densities ranging from one per 4.05 ha (10 a) to one per 6.48 ha (16 a). Butterfield (1944) described raccoon populations in Ohio varying from one raccoon per 4.74 ha (11.7 a)

to one raccon per 42.93 ha (106 a), as revealed by live trapping, and indicated that the variation seemed to depend upon habitat and hunting pressure. Dry hill land had fewer raccoon signs than did watershed streams and bottomland, and ridges seemed to constitute physical barriers to raccoon movements. Probably the greatest density of raccoons which has been reported came from Twichell and Dill (1949) who captured 100 raccoons from a 41.31 ha (102 a) area of the Swan Lake Wildlife Refuge, Missouri. Johnson (1970) indicated densities of about one raccoon per 8.1 ha (20 a) and 2 ha (5 a) in Alabama.

The habitat preferred by the raccoon in the study area is limited to the mountainous regions and to forested areas along streams. With the growing suburban and industrial developments in the tri-county area, preservation of this type of habitat is critical in order to maintain a huntable population. Johnson (1970) stated that optimum raccoon habitat in Alabama is composed of a mature hardwood forest interspersed with grassy openings containing plum (Prunus sp.), blackberries (Rubus sp.), black cherry (P. serotina), persimmon (Diospyrous virginia), greenbriers (Smilax sp.), privet (Ligustrum sp.) and other fruit producing species.

Since the agricultural practices are not conducive to high raccoon densities, it seems probable that the raccoon in this area must depend upon acorns, persimmons, blackberries, corn, insects, and aquatic animals. Areas with mature mast producing trees and other palatable vegetation associated with a water supply rich in aquatic fauna would better support a higher raccoon population. The availability of these foods is not constant through the year, and a shortage during a particular season may be very critical. Insects have been stressed as being a buffer against

starvation in early spring before plant matter becomes available (Whitney and Underwood 1952).

An inadequate winter nutritional level may limit raccoon populations. Kellner (1953) indicated that the short growing season, scarcity of aquatic life, the uncertainty of the mast crop in mountainous areas, and harsh weather, all contribute to the variability of raccoon populations in Southwestern Virginia. Whitney and Underwood (1952) reported finding emaciated and starving raccoons late in the winter in New England. The most important mortality factor found in raccoon populations in east central Minnesota by Mech et al. (1968) was starvation and extreme parasitism which was especially prevalent in juveniles. Juveniles were not as capable of storing fat as were adults. Weight losses of 50 percent in winter are common in Minnesota and Michigan (Stuewer 1943b, Mech et al. 1968). Weight loss in winter is an important factor in that malnutrition increases the debilitating effects of parasites and increases susceptibility to disease.

At high densities, disease may be a controlling influence on raccoon populations. Canine distemper (Mech et al. 1968, Keeler 1978) and pneumonia are most often cited as principal causes of death from disease. However, Shaffer (1948) and Kellner (1953) judged that parasites and disease were not limiting to raccoon populations in Southwestern Virginia.

In general, the quality and quantity of wild animal populations are directly related to the fertility and productivity of the soil. This very striking relationship was shown by Crawford (1950) and Nagel (1953) working with raccoons in Missouri. They concluded that regardless of sex and age differences, the average weight of raccoon populations was

directly proportional to the fertility of their habitat. Soil fertility was rated on the basis of calcium, phosphorus, nitrogen, and potassium content in conjunction with crop yields by county. When the relationship between soil fertility and average raccoon harvest per 4.1 ha (10 mi) was plotted, it was evident that highly fertile areas produced the largest raccoons, but not the greatest harvest. This resulted from the very intensive use of highly fertile areas for maximum crop production, thus severely limiting available raccoon habitat. Moderately fertile soils produced a greater harvest and heavier raccoons than poor soils. The low fertility areas were predominantly forested and contained a relatively stable habitat, but still produced the fewest and smallest raccoons. Raccoon habitat in the tri-county area and in the study area is affected by a similar situation. The lower more fertile soils are clear for pasture and cultivation while the less fertile soils are located on hill sides which are predominantly forested.

Exploitation by Man

Sport hunting, trapping for fun, and deliberate efforts at reducing populations by trapping or poisoning are important factors in the population ecology of raccoons (Johnson 1970). Hunting is probably the major factor controlling raccoon populations in East Tennessee, but the dog training season is probably as detrimental to the raccoon as the open hunting season. The low number of violations in the study area indicates the problem the Wildlife Officers had in checking raccoon hunters in the Loudon County portion (17,798 ha, 43,961 a). This portion of the

study area could not be closed to dog training, so illegal hunting could easily be disguised as dog training.

The raccoons in Cades Cove, GSMNP and Chuck Swan WMA did not have continuous hunting pressure as was the problem in the study area. It is illegal to hunt in a National Park and the TWRA allows only 9 night hunts per year on Chuck Swan WMA. This low hunting pressure is probably the most important factor influencing raccoon populations on these areas (Brown and Bellrose 1943). Apparently, only in protected areas in East Tennessee, such as wildlife management areas, state parks, and national parks, can raccoon numbers increase to a high density. Other factors control population levels in these areas, but only hunting can lower these numbers well below the carrying capacity of the habitat.

Steuwer (1943b) noted that a 17 percent increase in the raccoon population occurred from 1939 to 1940 after closure of his study area to hunting. Sport hunters in Alabama accounted for 93 percent of the raccoon harvest (Johnson 1970). The use of highly trained hounds is the deciding factor when comparing take by trapping versus hunting. In Georgia, Cunningham (1962) found that collecting raccoons with hounds was five times more successful on his study area which was closed to hunting than on public hunting areas. Atkeson and Hulse (1953) compared the effectiveness of hunting versus trapping to reduce a very dense population on the Wheeler National Wildlife Refuge, Alabama. Three hunting seasons totaling 72 hunting days removed 1,677 raccoons in a period totaling 248 trapping days. The number of raccoons removed by hunting was 4.5 times greater than by trapping; hunting required less than one-third of the time. Trapping grounds were normally allotted according to regulations,

with 15 trappers involved. The hunts were carried out without guns; over 1,000 persons a year participated in the night hunts. The authors concluded that night hunting was more efficient in removing the raccoons in a shorter period of time and resulted in less interference with waterfowl and less damage to beneficial forms of wildlife which were accidentally trapped. There were also less crippling and better utilization of the meat; selectivity could be exercised by leaving young animals. A considerable amount of recreation was also provided for a large number of people.

Hunters in southwestern Virginia placed intensive hunting pressure as the most important factor limiting raccoon numbers (26.5 percent) (Clements 1972). Wardens, biologists, and game managers also placed intensive hunting pressure first (37 percent). Illegal hunting (19.9 percent), high harvest per hunter (12.5 percent), killing all raccoons treed (5.9 percent), and high daily bag limit (1.5 percent) were additional limiting factors listed by hunters in Virginia.

In eastern Kentucky the Kentucky Department of Fish and Wildlife Resources ran a survey on raccoon hunters during the training season (Wright 1977). During this period, a total of 1,925 raccoon hunters were checked. There were 696 (36 percent) violations of fish and wildlife laws; of which, 544 (28 percent) involved the use of firearms out of season.

It is not unreasonable to assume that illegal hunting, which occurs in Eastern Kentucky, also presents a problem in East Tennessee. Since illegal hunting may partially account for a shortage of raccoons in this region, the management of the hunter is important. Although the state-

wide hunting season lasts only from the second week in October through February, many counties, such as Loudon County, have private acts that enable the raccoon hunter to "train" his dog the remainder of the year. These training seasons need to be evaluated as to what impact they have on resident raccoon populations. Since East Tennessee has such a low raccoon population density, permitting hunters to harass the animals in the spring and summer months, when the young of the year are beginning to move about, will retard any natural population growth (Wright 1977).

III. CONCLUSIONS AND RECOMMENDATIONS

There are two general causes for the low raccoon population in the study area and surrounding areas of East Tennessee: (1) agricultural practices and (2) harassment from hunting and free-roaming dogs. Of these, harassment is the only factor that can possibly be changed. Limited food, dens, water, and other habitat variables may limit the population size overall, but harassment may prohibit any buildup even to the carrying capacity of the habitat.

Since the spring and summer months are the critical periods for young raccoons (Wright 1977), it is recommended that the dog training season in East Tennessee be sharply curtailed. It is impractical to require all dogs to be restrained, but enforced dog licensing procedures may cut down on the number of strays and also aid in the identification of illegal hunters. Since the habitat for the raccoon in East Tennessee is located in the wooded areas, protection of this land area from further human development would also help conserve a huntable population.

CHAPTER VI

SUMMARY

A study on the status of the raccoon in East Tennessee was conducted from July 1975 to November 1976. Objectives were to evaluate the habitat characteristics of an area in East Tennessee selected for raccoon transplant purposes in respect to natural features, land use practices, and cultural attributes and to determine the population density and distribution of resident raccoons on the study area.

A study area was selected by officials of the Tennessee Wildlife Resources Agency (TWRA) on the recommendations of local raccoon hunter clubs. The study area lies within the tri-county area of Blount, Loudon, and Monroe counties, Tennessee, and covers an area of 52,084 ha (128,602 a). Approximately 90 percent of the study area is located in the ridge and valley physiographic province and 10 percent is located in the Unaka Mountain physiographic province, along Chilhowee Mountain.

The study area is located in the Little Tennessee River Valley, and the Little Tennessee River constitutes 53.1 km (33 mi) of the area's border. The Tennessee River on Fort Loudoun Lake has 9.17 km (5.7 mi) of shoreline bordering the study area. Over 378 km (235 mi) of permanent streams are located within the area.

The forested areas vary in compositional proportions between conifers and hardwoods. Within the study area, the area covered by woodland is approximately 23,697 ha (58,511 a). In the tri-county area, forests account for some 201,993 ha (498,748 a). Hardwood stands cover some

3,571 ha (8,817 a) of the study area. Approximately 2,257 ha (5,572 a) of the study area is covered with coniferous stands. Over 75 percent of the forested area within the study area is of the mixed forest types and covers 17,869 ha (44,122 a). Because of the hilly topography on some portions of the study area, there was a great deal of difficulty in separating from the aerial photographs (RB57) the predominant pine stands on the dry south-facing slopes, so these were averaged together into the mixed forest classification.

Within Blount County, hardwood types covered 22,023 ha (54,375 a) coniferous types covered 19,742 ha (48,750 a), and mixed 9,112 ha (22,500 a). In Loudon County, hardwoods covered 13,145 ha (32,454 a), coniferous 8,278 ha (20,434 a), and mixed types 2,432 ha (6,010 a). Hardwood types covered 63,181 ha (156,000 a), coniferous types 43,945 ha (108,500 a), and mixed types 20,132 ha (49,700 a) within Monroe County.

Blount County has 15,935 ha (39,375 a) of the total forest area being stocked medium or higher in oak-hickory (31.3 percent). Loudon County has 51 percent of the forested area stocked with hardwoods classified medium or better, 44.9 percent (10,702 ha, 26,444 a) in oak-hickory stands. Monroe County has 55,808 ha (137,900 a) of hardwoods classified as medium or better.

Of the 378 km (235 mi) of streams that drain the study area, 191 km (119 mi) pass through a wooded area 0.41 ha (1 a) or larger. There are 152 km (94.3 mi) flowing through mixed forest stands, 35.1 km (21.8 mi) through hardwood forest stands, and 4 km (2.5 mi) through coniferous stands.

In 1970, the total human population of the tri-county area climbed to 111,485. From 1960 to 1970, Blount, Loudon, and Monroe counties had population increases of 10.8, 2.1, and 0.7 percent, respectively. The population of the study area in 1970 was approximately 17,426.

The three county area is primarily a rural area. By 1970, the rural population dropped 9.5 percent while the total population increased to 111,485 or 6.6 percent. Approximately 63.4 percent of the total population of the study area is rural. Most of the urban inhabitants reside in the city of Maryville.

The agriculture of the tri-county area is characterized by numerous small part-time farms. The majority of the farming enterprises are for livestock, particularly those for beef and milk production. Much of the land used for these enterprises is pasture. Within the study area, 52.2 percent (27,174 ha, 67,091 a) of the total area is devoted to agriculture. Most of this land is used as pasture for cattle.

Commercial land use is concentrated mostly in the larger towns, with strip developments occurring along many major highways in the three counties. The largest manufacturing sites are located in Alcoa and Maryville. The largest industry is the Aluminum Company of America (ALCOA), which covers some 1,133 ha (2,800 a). Four industries are located within the study area, but none dominate the land use.

The TVA Tellico Project was responsible for clearing 1,986 ha (4,908 a) of the study area bordering the Little Tennessee River. At present a U.S. Circuit Court order on the preservation of the snail darter has stopped construction on the dam and the flooding of the

reservoir. The impact this project has on native raccoon populations is not known, since the study was initiated after the cutting had just begun.

The tri-county area contains five principal through highways: U.S. 129, U.S. 411, U.S. 11, Interstate 40, and Interstate 75. The study area has ample highways passing through its boundaries. Four major thorough fares conduct automotive traffic through the study area: U.S. 411, U.S. 129, and State highways 95 and 72. There are numerous smaller highways and county roads that are also located within the area. There are approximately 682 km (424 mi) of road in the area. Over the years, traffic volumes in most of the tri-county area have increased.

The TVA habitat maps give a very general representation of the raccoon habitat available in the study area. The areas classified as poor and nonhabitat are generally open pasture land or woodlands scattered in densely settled areas. The areas rated as good and average correlate to the forested areas.

From 21 September 1975 through 22 November 1976, a total of 24 grids (809 ha, 2,000 a) were trapped on 223 different nights for a total of 3,928 trap-nights. A total of 32 (17 males, 15 females) different raccoons were trapped. The capture success, including 15 recaptures, was one per 83.6 trap-nights (1.2 percent).

Out of 15 raccoons found dead in the study and surrounding areas, the cause of death on 7 was undetermined. Of the 23,813 km (14,800 mi) driven in the study area, the researcher observed no road kills.

There were 433 miscellaneous species captured or one out of 9.07 trap-nights (11 percent). On numerous occasions free roaming dogs were observed inside the study area, an average of 5 dogs a day were

sighted. This high number observed indicate a high population of potential raccoon predators. On 67 occasions the researcher had direct contact with free-roaming dogs: in live traps (30 times), following trap line (35 times), or harassing opossums in traps (2 times). Signs of dogs harassing animals in the traps were noted on 10 occasions.

A total of 457 traps were sprung and had no captures or were unsprung with the bait stolen. Over 75 percent of the traps disturbed showed signs of a dog reaching inside the trap and eating the bait. The disturbance rate was one trap out of 8.6 trap-nights (11.6 percent). The overall disturbance rate, including miscellaneous species, was one trap out of 4.4 trap-nights (22.7 percent).

From 31 December 1975 through 11 November 1976, a total of 19 simulated hunts were conducted on 18 different nights. Out of 82 trail strikes, the dogs treed 39 times. Raccoons were observed on 6 occasions. A total of 8 raccoons were sighted; of these 2 males were captured and tagged. A total of 18 opossums and 3 striped skunks were sighted. The percentage hunter success per hunt was 42 percent; the percentage hunter success per hour was 11 percent. No species of tree was preferred by either the raccoon or opossum.

All captures were made in wooded areas consisting mainly of mature hardwoods. No raccoons were captured along stream courses passing through open land.

Due to the low number of captures, an estimate of raccoon density in the study area was impossible. The poor trapping success suggests

that the population density is extremely low and probably below the carrying capacity of the environment.

From 16 August 1975 through 15 October 1976, 11 violations of hunting regulations within the study area were made. During the year 1974-75, 17 percent of the raccoon hunters checked in East Tennessee (Region 4 of the TWRA) were in violation. Location and dates of the checks and violations were not distinguished.

It was assumed that the forest cover inventory statistics for Loudon County (TVA 1973) would better describe the forest stand characteristics in the study area as compared the data collected from the high altitude aerial photographs (RB57). Twenty-two percent of the total forested area of Loudon County is made up with large sawtimber hardwoods dominated by oak-hickory stands (18.4 percent), an upland hardwood group. It seems unlikely that the forest cover in this region is a major limiting factor.

With the preponderance of permanent streams in the study and surrounding areas, a shortage of woodland in close proximity to water does not appear to be limiting to raccoons.

With the growing development in the area, human population growth in the suburbs does not always affect a raccon population in a negative manner. There are also high populations in Cincinnati, Ohio, and Memphis, Tennessee. However, the nature of this habitat makes the raccoon unavailable to hunters.

Agricultural practices appear to be the major limiting land use practice affecting the raccoon in East Tennessee. Cattle production practices are not conducive to high raccoon population. If more land

were planted in corn, the carrying capacity of the environment would be much higher.

The TVA Tellico Project probably had some negative effect on the raccoon population in the study area by either emigration from the area or increasing home ranges. The high traffic volumes would tend to have little effect as a population depressant, but the high number of roads makes access to remote areas easy for raccoon hunters.

The TVA habitat maps give a very general representation of the raccoon habitat available. The good and average habitat types correlate with the forested areas. The poor and nonhabitat correlate with pasture and suburban land. This map should not be mistakenly used in describing the density and distribution of local raccoon populations, because other extrinsic factors, such as heavy harassment from free roaming dogs and hunting, may tend to lower the number of raccoons found in a given habitat type at a given time.

Trapping success in the study area indicates a low population density as compared with other studies done on the open county and protected areas. The simulated hunts illustrated that hunter success in the study area falls midway between the range for East Tennessee, but is low when compared statewide. The hunter success during the regular statewide season was zero.

Free-roaming dogs appear to be a problem. Due to their dependence on man, these animals maintain an abnormally high ratio of predator to prey species. Exploitation by man in the way of hunting and dog training appears to be the major limiting factor of raccoon populations in the study area and surrounding areas.

There are two general causes for the low raccoon population density in the study and surrounding areas of East Tennessee: (1) agricultural practices and (2) harassment from hunting and free-roaming dogs. It is recommended that the dog training season in East Tennessee be sharply curtailed, and a special dog licensing law passed to aid in identification between stray and domestic dogs. Protection of wooded areas from further human development would also help conserve a huntable population.

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APPENDICES

APPENDIX A

Table 13. Commercial forest area in hectares by type and stand size, Blount County, Tennessee, 1971.

Forest Type	Large Sawtimber	Small Sawtimber	Poles	Seedlings & Saplings	Total	Percentage
Shortleaf Pine	759	1,519	759	0	3,037	6.0
Virginia Pine	759	4,556	5,316	2,278	12,909	25.4
Yellow Pine Mixture	0	1,519	759	0	2,278	4.5
White Pine	0	759	0	0	759	1.5
Cedar	0	0	0	759	759	1.5
Elm—Ash—Soft Maple	0	0	1,521	0	1,521	3.0
Oak—Hickory	2,278	8,353	4,556	1,519	16,706	32.8
Black Locust	0	0	2,278	0	2,278	4.5
Sassafras—Persimmon	0	0	0	759	759	1.5
Yellow Poplar	0	0	759	0	759	1.5
Yellow Pine—Hardwoods	0	3,038	1,519	2,278	6,835	13.4
Yellow Pine, White Pine—Hardwoods	0	759	759	0	1,518	3.0
Cedar—Hardwoods	759	0	0	0	759	1.5
Total	4,555	20,503	18,224	7,593	50,877	
Percent	9.0	40.3	35.8	14.9		100.0

Source: TVA 1971.

Table 14. Commercial forest area in hectares by types and stand size, Loudon County, Tennessee, 1973.

Forest Type	Large Sawtimber	Small Sawtimber	Poles	Seedlings & Saplings	Total	Percentage
Shortleaf Pine	0	2,434	0	487	2,921	12.2
Loblolly Pine	0	0	974	487	1,461	6.1
Virginia Pine	0	974	487	0	1,461	6.1
Yellow Pine Mixture	0	0	974	487	1,461	6.1
Cedar	0	0	0	974	974	4.1
Oak—Hickory	4,381	3,408	2,921	974	11,684	49.0
Yellow Poplar	487	487	0	0	974	4.1
Northern Red Oak—Basswood—Ash	487	0	0	0	487	2.1
Yellow Pine—Hardwoods	487	974	487	0	1,948	8.2
Cedar—Hardwoods	0	487	0	0	487	2.0
Total	5,842	8,764	5,843	3,409	23,858	
Percent	24.5	36.7	24.5	14.3		100.0

Source: TVA 1973.

Table 15. Commercial forest area by type and stand size in hectares, Monroe County, Tennessee, 1965.

Forest Type	Large Sawtimber	Small Sawtimber	Poles	Seedlings & Saplings	Total	Percentage
Shortleaf Pine	932	8,222	2,754	0	11,908	9.0
Virginia Pine	932	5,508	7,290	6,399	20,129	16.0
Yellow Pines	891	2,754	2,754	2,754	9,153	7.0
White Pine	891	932	0	0	1,823	1.0
Cedar	0	0	932	0	932	1.0
Upland Hardwoods	5,508	14,661	21.951	6,399	48,519	38.0
Northern Hardwoods	3,645	0	932	0	4,577	4.0
Cove Hardwoods	2,754	3,645	3,686	0	10,085	8.0
Yellow Pine—Hardwoods	0	5,468	4,577	2,754	12,799	10.0
Yellow Pine, White Pine—Hardwoods	932	1,823	891	0	3,646	3.0
Cedar—Pine—Hardwoods	0	932	932	1,823	3,687	3.0
Total	16,485	43,945	46,699	20,129	127,258	
Percentage	13.0	34.0	37.0	16.0		100.0

Source: TVA. 1965.

Table 16. Commercial forest area by type and tree stocking in hectares, Blount County, Tennessee, 1971.

Forest Type	Tree Stocking					
	Over	Well	Medium	Poor	Total	Percentage
Shortleaf Pine	1,519	759	759	0	3,037	6.0
Virginia Pine	5,316	3,797	3,797	0	12,910	25.4
Yellow Pine Mixture	0	759	1,519	0	2,278	4.5
White Pine	0	759	0	0	759	1.5
Cedar	0	0	759	0	759	1.5
Elm—Ash—Soft Maple	0	0	1,519	0	1,519	3.0
Oak—Hickory	1,519	8,353	6,075	759	16,706	32.8
Black Locust	0	759	1,519	0	2,278	4.5
Sassafras—Persimmon	0	0	0	759	759	1.5
Yellow Poplar	0	759	0	0	759	1.5
Yellow Pine—Hardwoods	1,519	2,278	2,278	759	6,834	13.4
Yellow Pine, White Pine—Hardoods	0	759	759	0	759	3.0
Cedar—Hardwoods	0	759	0	0	759	1.5
Total	9,873	19,741	18,984	2,277	50,875	
Percentage	19.4	38.8	37.3	4.5		100.0

Source: TVA 1971.

Table 17. Commercial forest area in hectares by type and tree stocking, Loudon County, Tennessee, 1973.

Forest Type	Tree Stocking					
	Over	Well	Medium	Poor	Total	Percentage
Shortleaf Pine	487	1,947	487	0	2,921	12.2
Loblolly Pine	974	0	487	0	1,461	6.1
Virginia Pine	0	1,460	0	0	1,460	6.1
Yellow Pine Mixture	487	974	0	0	1,461	6.1
Cedar	0	0	487	487	974	4.1
Oak—Hickory	974	7,302	2,434	974	11,684	49.0
Yellow Poplar	0	974	0	0	974	4.1
Northern Red Oak—Basswood—Ash	487	0	0	0	487	2.0
Yellow Pine—Hardwoods	0	974	974	0	1,948	8.2
Cedar—Hardwoods	0	0	487	0	487	2.0
Total	3,409	13,631	5,356	1,461	23,857	
Percentage	14.3	57.1	22.4	6.1		100.0

Source: TVA 1973.

Table 18. Commercial forest area in hectares by type and tree stocking, Monroe County, Tennessee, 1965.

Forest Type	Tree Stocking					
	Over	Well	Medium	Poor	Total	Percentage
Shortleaf Pine	1,823	9,153	932	0	11,908	9.0
Virginia Pine	7,331	4,577	7,331	891	20,130	16.0
Yellow Pines	1,823	2,754	3,645	932	9,154	7.0
White Pine	0	1,823	0	0	1,823	1.0
Cedar	0	0	0	932	932	1.0
Upland Hardwoods	6,399	17,345	19,238	5,508	48,490	38.0
Northern Hardwoods	0	932	2,754	891	4,577	4.0
Core Hardwoods	0	7,331	1,823	932	10,086	8.0
Yellow Pine—Hardwoods						
Yellow Pine—White—	2,754	5,468	3,645	932	12,799	10.0
Pine—Hardwoods	0	932	1,823	891	3,646	3.0
Cedar—Pine—Hardwoods	1,823	932	932	0	3,687	3.0
Total	21,953	51,247	42,123	11,909	127,232	
Percentage	17.0	40.0	33.0	10.0		100.0

Source: TVA 1965.

Table 19. A partial list of tree species found in the study area.

Common Name	Scientific Name
Loblolly pine	*Pinus taeda*
Pitch pine	*Pinus rigida*
Shortleaf pine	*Pinus echinata*
Table mountain pine	*Pinus pungens*
Virginia pine	*Pinus virginiana*
White pine	*Pinus strobus*
Eastern red cedar	*Juniperus virginiana*
Eastern hemlock	*Tsuga canadensis*
Black oak	*Quercus velutina*
Northern red oak	*Quercus rubra*
Southern red oak	*Quercus falcata*
Blackjack oak	*Quercus marilandica*
Scarlet oak	*Quercus coccinea*
Willow oak	*Quercus phellos*
Chestnut oak	*Quercus prinus*
Chinquapin oak	*Quercus muehlenbergii*
Swamp white oak	*Quercus bicolor*
White oak	*Quercus alba*
American basswood	*Tilia americana*
Yellow buckeye	*Aesculus octandra* sp.
Cucumber tree	*Magnolia acuminata*
Black gum	*Nyssa sylvatica*
Sweet gum	*Liquidambar styraciflua*
Magnolia	*Magnolia* sp.
Red maple	*Acer rubrum*
Yellow poplar	*Liriodendron tulipifera*
Ash	*Fraxinus* sp.
American beech	*Fagus grandifolia*
Yellow birch	*Betula alleghaniensis*
Black cherry	*Prunus serotina*
Flowering dogwood	*Cornus florida*
Elm	*Ulmus* sp.
Hickory	*Carya* sp.
Sugar maple	*Acer saccharum*
Common persimmon	*Diospyros virginiana*
Black walnut	*Juglans nigra*
River birch	*Betula nigra*
Sweet birch	*Betula lenta*
Hackberry	*Celtis occidentalis*
Carolina silverbell	*Halesia carolina*
Sourwood	*Oxydendrum arboreum*
Sycamore	*Platanus occidentalis*
Northern catalpa	*Catalpa speciosa*

Table 19 (continued)

Common Name	Scientific Name
Black locust	Robinia pseudoacacia
Honey locust	Gleditsia triacanthos
Red mulberry	Morus rubra
Sassafras	Sassafras albidum
Black willow	Salix nigra
Boxelder	Acer negundo
Tree-of-Heaven	Ailanthus altissima
American hornbeam	Carpinus caroliniana
Ironwood	Ostrya virginiana
Royal paulownia	Paulownia tomentosa
Eastern redbud	Cercis canadensis
Striped maple	Acer pensylvanicum
Mimosa	Albizia julibrissin
Pawpaw	Asimina triloba
Stiff cornel dogwood	Cornus stricta
Coastal plains willow	Salix caroliniana

Source: TVA, Division of Forestry, Fisheries, and Wildlife Development.

Table 20. Nonfarm and farm population of tri-county area, 1940-1970.

County	Year	Total Number	Nonfarm		Farm	
			Number	Percent	Number	Percent
Blount	1940	41,116	23,126	56.0	17,990	44.0
	1950	54,691	39,567	72.0	15,124	28.0
	1960	57,525	51,507	90.0	6,018	10.0
	1970	63,744	60,554	95.0	3,190	5.0
Loudon	1940	19,838	10,634	54.0	9,204	46.0
	1950	23,182	15,944	69.0	7,238	31.0
	1960	23,757	19,302	81.0	4,455	19.0
	1970	24,266	21,877	90.0	2,389	10.0
Monroe	1940	24,275	6,660	27.0	17,615	73.0
	1950	24,513	10,440	43.0	14,073	57.0
	1960	23,316	15,989	69.0	7,327	31.0
	1970	23,475	19,607	84.0	3,868	16.0

Source: Blount County, Tennessee State Planning Commission 1970, U.S. Census 1970.

Table 21. Agricultural trends in the tri-county area, 1954, 1964, and 1970.

County	Number of Farms	Area of Farms (ha)	Average Size (ha)
Blount			
1954	2,847	76,668	24.8
1964	1,501	49,058	32.7
1970	1,573	57,105	36.4
Loudon			
1954	1,400	54,091	38.6
1964	1,105	45,499	41.3
1970	1,064	44,955	42.1
Monroe			
1954	2,540	85,807	33.8
1964	1,633	67,627	41.4
1970	1,553	68,445	44.1
Total			
1954	6,787	210,566	31.0
1964	4,239	162,284	38.3
1970	4,190	170,505	40.9

Source: Blount County, Tennessee State Planning Commission 1970.

Table 22. Distances of roads located within the study area.

Road	Kilometers	Miles
U.S. 411	27.35	17
U.S. 129	30.57	19
State 95	27.74	16
State 72	12.87	8
Foothills Parkway	9.65	6
Primary Roads	69.19	43
Secondary Roads	149.64	93
Gravel Roads	357.20	222
Total	684.21	424

Table 23. Limiting factors of the raccoon in hectares and percentage of total land area in Blount and Loudon counties, Tennessee.*

Limiting Factor	Blount	Percentage	London	Percentage	Total	Percentage
Required Vegetation	67,271	63.0	32,916	54.0	100,187	60.0
Interspersion	0	0.0	1,856	3.0	1,856	1.0
Quality	0	0.0	0	0.0	0	0.0
Travel Lanes	0	0.0	0	0.0	0	0.0
Food	3,797	4.0	0	0.0	3,797	2.0
Water	2,392	2.0	0	0.0	2,392	1.0
Den Trees	759	1.0	974	2.0	1,733	1.0
Unidentified	32,179	30.0	25,753	42.0	57,932	35.0
Total	106,398	100.0	61,499	100.0	167,897	100.0

*Monroe County is not included due to lack of data.

Source: Robert T. Brooks, Jr., personal communication, Division of Forestry, Fisheries, and Wildlife, Tennessee Valley Authority, Norris, Tennessee 37828.

Table 24. Habitat evaluation for the raccoon in Blount and Loudon counties, Tennessee. Habitat rating is given as percentage of total land area.*

	Percentage Habitat Rating				
	Suitable		Unsuitable		
County	Good	Average	Poor	Nonhabitat	Total
Blount	7.850	28.049	55.766	8.333	99.998
Loudon	27.752	32.698	37.174	2.374	99.998
Total	17.801	30.374	46.470	5.354	99.999

*Monroe County is not included due to lack of data.

Source: Robert T. Brooks, Jr., personal communication, Division of Forestry, Fisheries, and Wildlife, Tennessee Valley Authority, Norris, Tennessee 37828.

APPENDIX B

Tab

Mon$	58	64	69	73	89	Total
Sep						80
Oct	65					207
Nov						343
Dec			35			171
Jan						186
Feb						55
Mar		193				322
Apr		375		144		658
May		214		133		387
Jun					88	184
Jul						322
Aug	20					43
Sep[7]		30		24		372
Oct[7]					88	249
Nov[4]						349
Tot[8]	85	812	35	201	176	3,928

Table 26. Ages of raccoons captured in the study area from September 1975—November 1976.

Age Class	Male	Female	Total
Juveniles Preweaned* (25.4—111.7 days)	4	4	8
I (0—14 mo.)	7	5	12
II (15—38 mo.)	6	3	9
III (39—57 mo.)	2	1	3
IV (58—86 mo.)			
V (> 86 mo.)		2	2

*Preweaned are not included with age class I.

Table 27. Tag numbers, location of initial capture, number of recaptures, and general parameters of raccoons captured in the study area from September 1975—November 1976.

Rototag #	Monel Tag #	Date of 1st Capture	Grid	Times Recaptured	Sex	Wt(Kg)	Age*	Measurements TL-T-HF-E
1	T3901	9-23-75	19		F	1.54	81 d	583-233-94-50
2	T3903	11-01-75	26	1	M	3.10	I	755-240-100-58
3	T3904	11-07-75	26		M	3.40	I	685-215-95-55
4	T3905	11-18-75	5		F	5.04	III	790-250-107-60
5	T3906	12-03-75	28		F	4.60	I	731-235-105-55
6	T3907	12-05-75	28		F	4.60	I	763-233-110-60
7	T3908	12-05-75	28		M	5.10	II	800-270-113-63
8	T3909	12-08-75	28		M	5.21	II	762-221-100-61
9	T3910	12-14-75	28		F	6.00	V	750-200-111-60
10	T3912	12-16-75	28		M	5.78	I	748-223-100-65
11	T3913	12-18-75	8	S	F	2.85	I	693-210-92-58
12	T3914	3-20-76	41		M	2.85	I	700-230-95-56
13	T3915	3-24-76	64		F	3.05	II	695-225-91-64
14	T3917	3-29-76	64	3	M	4.90	III	755-220-97-60
15	T3916	4-11-76	73	6	M	2.60	I	703-250-108-57
16	T3918	4-21-76	64		M	3.55	II	760-230-115-50
17	T3920	4-29-76	73		M	5.70	II	830-250-115-50
18	T3921	6-26-76	23	1	F	5.90	II	840-290-130-60
19	T3113	6-28-76	31	1 S	M	4.20	III	670-160-107-55
20	T3166	7-16-76	31	S	F	3.55	II	765-235-99-60
21	T3922	7-27-76	23		M	3.40	I	760-250-98-60
22	T3923	8-05-76	23	H	M	1.00	85.5 d	512-167-85-44
23	T3930	8-06-76	58		F	1.40	111.7 d	623-213-92-55

Table 27 (continued)

Rototag #	Monel Tag #	Date of 1st Capture	Grid	Times Recaptured	Sex	Wt(Kg)	Age*	Measurements TL-T-HF-E
24	T3924	9-03-76	31	H	M	1.60	111.7 d	560-150-95-47
25	T3925	9-05-76	55	3	F	3.50	I	738-243-109-62
26	T3927	9-21-76	73		F	1.50	85.5 d	640-205-108-50
27	T3928	9-23-76	64		M	1.60	96.6 d	555-250-92-40
28	T3929	9-24-76	23		F	1.00	96.6 d	49--128-86-45
29	T3931	10-07-76	17		F	3.75	V	740-230-111-54
30	T3933	10-10-76	23		M	1.50	111.7 d	540-170-90-40
31	T3932	10-15-76	23		M	4.30	II	790-270-85-60
32	T3935	11-12-76	28		M	7.47	II	170-280-114-65
33	T3936	11-12-76	36		F	2.60	I	707-217-97-55
34	T3937	11-15-76	36		M	3.35	I	690-210-95-60

*Age for juvenile raccoons is given in days.

^{S}Raccoon was stocked in summer of 1975.

^{H}Raccoon was captured during simulated hunts.

Table 28. Dates and locations of all captures, approximate distances moved from initial capture, and reproductive and physical condition of raccoons captured in the study area from September 1975—November 1976.

Rototag #	Date	Grid	Trap Site	Distance from First Capture	Sex	Reproductive Condition*	Physical Condition	Remarks
1	9-23-75	19	3		F	I	Good	
2	11-01-75	26	12		M	A	Good	
	11-04-75	26	17	3 km			Good	
3	11-07-75	26	17		M	A	Good	
4	11-18-75	5	15		F	A(Y)	Excellent	
5	12-02-75	28	2		F	A(N)	Excellent	
6	12-05-75	28	2		F	A(N)	Excellent	
7	12-05-75	28	5		M	A	Excellent	
8	12-08-75	28	4		M	A	Excellent	
9	12-14-75	28	7		F	A(Y)	Poor	Blind in left eye
10	12-16-75	28	7		M	A	Excellent	
11	12-18-75	8	5		F	A(N)	Good	Stocked in grid 9 4 km from trap site on 7-25-75, Tag # T2945
12	3-20-76	41	5		M	A	Good	
13	3-24-76	64	12		F	A(Y)	Excellent	
14	3-29-76	64	13		M	A	Poor	Compound fracture of
	4-05-76	64	16	0.3 km			Poor	right ear leg, simple
	4-07-76	64	14	0.2 km			Poor	fracture of left front
	4-08-76	64	5	1.5 km			Poor	leg. Sign of dogs.
15	4-11-76	73	7		M	A	Excellent	Transmitter
	4-20-76	73	7				Excellent	

Table 28 (continued)

Rototag #	Date	Grid	Trap Site	Distance from First Capture	Sex	Reproductive Condition*	Physical Condition	Remarks
15	4-26-76	73	7		M	A	Excellent	
	4-30-76	73	7				Excellent	
	5-04-76	73	7				Excellent	
	5-09-76	73	8	0.3 km			Excellent	
	9-24-76	73	8	0.3 km			Poor	Transmitter collar caused festering wound around neck. Released in grid 73 on 10-05-76.
16	4-21-76	64	18		M	A	Excellent	Transmitter
17	4-29-76	64	16		M	A	Excellent	Transmitter
18	6-26-76	23	10		F	A(L)	Excellent	Nursing young
	9-19-76	23	9	0.1 km		(Y)	Excellent	Lost monel tag replaced tag #3926 Transmitter on recapture.
19	6-28-76	31	7		M	A	Good	Stocked in grid 31
	7-15-76	31	5	0.1 km			Good	0.2 km from trap site on 7-16-75. Tag #T3113.
20	7-16-76	31	9		F	A(L)	Excellent	Stocked in grid 49 on 8-13-75 9 km from trap site. Tag #T3166. Nursing young.
21	7-27-76	23	12		M	A	Good	
22	8-05-76	23			M	I	Excellent	Captured in white oak tree on simulated hunt.
23	8-06-76	58	5		F	I	Poor	Fractured right humerous. Released 10-05-76 in grid 31.

Table 28 (continued)

Rototag #	Date	Grid	Trap Site	Distance from First Capture	Sex	Reproductive Condition*	Physical Condition	Remarks
24	9-03-76	31			M	I	Excellent	Captured in sycamore tree on simulated hunt
25	9-05-76	55	3		F	A(N)	Excellent	Transmitter
	9-15-76	55	21	1.5 km			Excellent	
	9-21-76	55	16	0.7 km			Excellent	
	11-01-76	55	24	2 km			Excellent	Replaced transmitter on last recapture
26	9-21-76	75	5		F	I	Excellent	
27	9-23-76	64	17		M	I	Excellent	
28	9-24-76	23	21		F	I	Excellent	
29	10-07-76	17	5		F	A(Y)	Poor	Old, blind in left eye.
30	10-10-76	23	5		M	I	Good	
31	10-15-76	23	13		M	A	Excellent	Transmitter
32	11-12-76	28	2		M	A	Excellent	Transmitter
33	11-12-76	36	8		F	I(N)	Good	Transmitter
34	11-15-76	36	3		M	I	Good	Transmitter

*Reproductive Condition: I—immature, A—adult, (Y)—had young previously, (N)—has not reproduced, (L)—lactating.

Table 29. Raccoons found dead in or near the study area from August 1975—November 1976.

Date	Sex	Tag #	Cause of Death	Location
8-14-75	F			Study Area—Clover Hill Cr.
8-21-75	F	T3106		Study Area—Grid 24
9-30-75	F		Vehicle	Blount Co.—Topside Rd., Lakemont
11-22-75	F		Vehicle	Study Area—Brick Mill Rd., Baker Cr.
12-02-75	F		Shot	Study Area—Grid 69 in dump
12-02-75	M		Shot	Study Area—Grid 69 in dump
12-02-75	M		Shot	Study Area—Grid 69 in dump
12-02-75	M		Shot	Study Area—Grid 69 in dump
12-02-75				Study Area—Grid 69 in dump
12-02-75				Study Area—Grid 69 in dump
1-11-76	M	T3169	Shot	Loudon Co., West bank of Little Tennessee River, 1 mile below Tellico Dam
8- -76	M			Study Area—Clover Hill Community
10-08-76	F		Vehicle	Study Area—Morganton Rd.
10-19-76				Study Area—Grid 23, by Cloyd Cr. bridge
11- -76				Study Area—Grid 36, along Smoky Branch

Table 30. Refuge sites observed during simulated hunts from September 1975—November 1976.

Refuge	Frequency	Raccoon	Opossum	Skunk
Oak sp.	6	3	2	
Virginia Pine	3		1	
Ground	3			3
Dogwood	2		2	
Hickory sp	2		2	
Hole	2			
Red Cedar	2		1	
Sourwood	2		3	
Sycamore	2	1		
Trap	2		2	
Yellow Poplar	2	2		
Ash sp.	1	1		
Black Cherry	1			
Black Locust	1	1		
Bladdernut	1		1	
Dead Tree	1			
Elm sp.	1		1	
False tree	1			
Hackberry	1		1	
Persimmon	1		1	
Sassafras	1		1	
Sugar Maple	1		1	
White Pine	1			

Table 31. Number of trap-nights per month, total captures, percentage capture success, sex, and recaptures for opossums captured in the study area from September 1975—November 1976.

Month	Trap-nights	Total Captures	Percentage Success	Male	Female	Recaptures
Sept. 1975	80	13	16.25	8	5	1
Oct.	207	40	19.32	16	24	2
Nov.	343	34	9.91	20	14	7
Dec.	171	21	12.28	14	7	9
Jan. 1976	186	22	11.83	12	10	8
Feb.	55	16	29.09	8	8	16
Mar.	322	50	15.53	20	30	24
Apr.	658	20	3.04	10	10	7
May	387	14	3.62	10	4	4
Jun.	184	17	9.24	5	12	4
Jul.	322	14	4.35	4	10	8
Aug.	43					
Sept.	372	27	7.26	10	17	9
Oct.	249	13	5.22	5	8	5
Nov.	349	8	2.29	2	6	2
Total	3,928	309	7.87	144	165	106

VITA

Edward Leslie Warr was born in Memphis, Tennessee, on November 2, 1952. He graduated from Central High School, Memphis, Tennessee, in 1970. He entered college in September 1970 and received the degree of Bachelor of Arts with a major in Zoology in June 1974 from The University of Tennessee at Knoxville. He began graduate work in Wildlife and Fisheries Science at The University of Tennessee in September 1974. He is a member of Gamma Sigma Delta, the honor society of agriculture, The Wildlife Society, and the American Society of Mammalogists.

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