A SURVEY OF THE AMPHIBIANS AND REPTILES OF WATAUGA COUNTY, NORTH CAROLINA

A Thesis

by

JOSEPH KELLY WILLIAMS TT

Submitted to the Graduate School Appalachian State University in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE

May 1983

Major Department: Biology

Appalachian Collection Appalachian State University Library Boone, North Carolina

A SURVEY OF THE AMPHIBIANS AND REPTILES OF WATAUGA COUNTY, NORTH CAROLINA

> A Thesis by Joseph Kelly Williams

APPROVED BY: airman. Member, Thesis Committee ment of Biology aure

Dean of the Graduate School

Archives Closed LPS 175 . Aqok Th 434

May 1983

ABSTRACT

A SURVEY OF THE AMPHIBIANS AND REPTILES OF WATAUGA COUNTY, NORTH CAROLINA Joseph Kelly Williams, B. A., M. S., Appalachian State University Thesis Chairman: R. Wayne Van Devender

A survey of the reptiles and amphibians of Watauga County was conducted with the following objectives: to determine which species are present, to determine distribution patterns, to suggest reasons for these patterns, to collate literature records, and to provide a basis for further studies of local species. Collecting and observation was conducted from 1977 until 1982. Additional records included data for some 6,000 specimens from various museums and contributors. A total of 29 amphibians (out of 31 probable and 42 possible) and 18 reptiles (out of 26 probable and 37 possible) were found in Watauga County, including 4 amphibians and 9 reptiles not previously recorded. Only the bog turtle (Clemmys muhlenbergi) was previously recorded but not found in the present study. The mud salamander (Pseudotriton montanus) represented the only significant range extension found in the present study. Records from Watauga County included the hellbender (Cryptobranchus alleganiensis), and Weller's salamander (Plethodon welleri), which have special concern

Copyright by Joseph Kelly Williams 1983 All Rights Reserved

iv

status in North Carolina, and the bog turtle (Clemmys muhlenbergi), which is threatened in North Carolina.

V

The interplay of total distributions of each species was suggested as a reason for the number of species found in Watauga County. Northern, southern, widespread, montane and relic populations were evident.

Three incidental species were noted, and pursuit of species not yet recorded in the county was encouraged by commentary on expected records and collecting biases. Additional collecting, field notes, and contributions of local residents were proposed as sources of supplemental data. Population dynamics, management opportunities, and taxonomy were suggested as topics for future studies.

ACKNOWLEDGEMENTS

Many people have supported the present study throughout its long duration. My heartfelt thanks go to each and every one. Department of Biology, Appalachian State University, provided assistance in the form of teaching assistantships for four semesters. Dr. J. Frank Randall inspired the present study, arranged facilities for a live collection, served on the final thesis committee, and provided data from field work of his students. John L. Mackay stimulated my interest by organizing my "snake shows" in local schools. Dr. Edgar D. Greene provided pertinent literature and served as a thesis committee chairman. Dr. William C. Dewel and Dr. Jeffrey A. Butts also provided guidance and served on the final committee. Dr. Richard N. Henson served on a committee and enlightened me in many ways on a continental United States biology field trip.

Numerous people provided specimens, observations, and access to private land. Local residents offered many interesting captures and tales. W. H. "Marty" Martin donated specimens from the Blue Ridge Parkway. Steve "Swamp" Morrow, Bud Hollowell, Parker Whitt and others accompanied me in the field at various times. Dr. John Wiley karyotyped local gray treefrogs. Dr. Alvin L. Braswell and Dr. William M. Palmer of N. C. State Museum of Natural History provided substantial assistance and access to records and crossfiles.

vi

Hugh Morton generously permitted collecting trips on Grandfather Mountain. The management of Powder Horn Mountain permitted frequent trips to their ponds. Dr. J. Frank Randall, Dr. Kent Robinson, and Dr. F. Ray Derrick made their county retreats available for the study. Local law enforcement authorities graciously endured the alarming practice of hunting along roads on rainy nights.

Dr. R. Wayne Van Devender gave opportune momentum to the present study in many ways. On our first collecting trip he found Plethodon richmondi under a small piece of wood and thus began his inspiring record of finding local animals in overlooked places. In a short time he amassed a fortuitous resource in the form of voluminous field notes, preserved specimens and pertinent journal reprints. His manuscript reviews were equally thorough, informative and challenging. Without Dr. Van Devender's advice and fellowship my efforts would not have matured from sporadic ventures to productive commitment. My thanks also go to his wife Amy and family for tolerance in the wake of driven ecologists, amateur and professional.

I wish to express profound appreciation to my parents, Dr. and Mrs. John Fox Williams, who were twice remarkably successful in rearing five intelligent children and in settling in the Blue Ridge mountains. Without my parents' constant moral support and counsel, literary help, financial support, and patience with my inclination for live animal collections, the present study would not have been possible.

My thanks also go to Thomas and Elizabeth Haggerty. They saw through my diversions, and shared with me their remarkable cairn terrier, Trixie Dixie.

DEDICATION

This work is dedicated to Trixie Dixie, who knew more than she liked to admit. She preferred the freedom of an ignorant facade to the responsibility of intelligence, and to this end she applied her charms as only the best of dogs could do. To her masters' credit, she often blew her cover and performed admirably.

We had a lot in common.

TABLE OF CONTENTS

LIST OF TABLES	• • X
LIST OF FIGURES	.xi
INTRODUCTION	1
REVIEW OF LITERATURE	3
MATERIALS AND METHODS	9
RESULTS	.15
DISCUSSION	.71
LITERATURE CITED	.76
APPENDICES	.82
VITA	.96

Table

- 1 Composition of herpetological co regions near Watauga County, NC.
- 2 Endangered or threatened species occur in Watauga County, NC (Bru committee, 1977).....
- 3 Herpetofaunal diversity found in NC (from Appendix A and Conant,

х

ommunities in
8
s that possibly
uce and
n Watauga County,
1975)72

LIST OF FIGURES

Figure

1	Map of Watauga County, NC and collecting sites
	visited11
2	Map of Watauga County, NC and surrounding
	areas17
3	Topography of Watauga County, NC. Part A shows
	1000-foot (305-m) contours and highest peaks.
	Part B shows limits of watersheds19
1	Weather data for Boone, NC, in 1981

INTRODUCTION

Watauga County lies in the Blue Ridge Mountains of extreme northwestern North Carolina. It is potentially interesting to herpetology for several reasons. Politically, its proximity to Tennessee and Virginia involves environmental concerns of North Carolina with those of neighboring states. Geographically, its location produces an interplay of northern and southern physiography. Varied combinations of elevation, drainage, vegetation, climate and land use produce a multitude of habitats in Watauga County. Grandfather Mountain and the New River watershed are "cluster areas" for endangered species (Tuelings and Cooper, 1977) which means Watauga County is an area where endangered and threatened species appear to be abundant and in need of study. This need is especially evident for herpetofauna. Bruce (1977a) noted that "since amphibians and reptiles are generally secretive animals, basic information on the distribution and ecology of many is lacking." Additionally, most endangered and threatened North Carolina herpetofauna "are relatively poorly known. Thus, a continuing effort in basic research is called for ... " (Bruce, 1977a). A survey of the amphibians and reptiles of Watauga County was proposed since no such work was available. The objectives were: to collate literature records, to determine which species occur in Watauga County, to determine distribution patterns of these species

to suggest reasons for these patterns, and to provide a basis for further studies of local species.

REVIEW OF LITERATURE

No list of amphibians and reptiles has been published for Watauga County, but many related papers have been scattered through the general literature. In favor of brevity, review of the literature was limited to most pertinent works. Primary purposes in this review were: to compile a working list of species, to compile county records from the literature, to compile references for adjacent areas, to find previous local studies, to identify possible taxonomic and ecological problems, and to review what was known in general about Watauga County and vicinity.

Pertinent literature was organized hierarchically based on geography since local studies logically provided data for surveys of larger areas. Lists for the vicinity of Watauga County were most important, followed in order by lists for the Southern Appalachians, North Carolina, eastern United States and North America. Few herpetofaunal lists were available for the area around Watauga County. Breder and Breder (1923) reported seventeen species of amphibians and twelve reptiles in a small area in Ashe County, North Carolina that was only eight miles (13 km) from Watauga County. Salamander species collected from nearby Grandfather Mountain in Avery County, North Carolina included nine by

Dunn (1917), four by Hairston (1949), and eight by Gordon, et al.

(1962). Hairston (1949) also reported two salamander species from Mortimer in Caldwell County.

Few lists were available for other Southern Appalachian areas. The Great Smoky Mountains National Park of southwestern North Carolina and adjacent Tennessee was surveyed and analyzed zoogeographically by King (1939), who listed seventy-one species of amphibians and reptiles. Huheey and Stupka (1967) listed seventy-two species for the same area. Dunn (1917) found thirty-three species in Transylvania County, North Carolina.

Numerous authors discussed Southern Appalachian salamanders. Hairston (1949) studied twelve plethodontid species of the Black Mountains and related areas. Organ (1961) reported ecological studies of five species of <u>Desmognathus</u> at Whitetop Mountain and Mount Rogers in Virginia. Highton (1962) used specimens of salamanders from this area when he revised the genus Plethodon.

North Carolina's first state herpetology was Brimley's <u>The</u> <u>Amphibians and Reptiles of North Carolina</u> (1944). DePoe, et al. (1961) summarized and updated the state's herpetology. Martof, et al. (1980) gave the most recent herpetofaunal accounts for the state. These three works provided progressively better views of the distribution of herpetofauna in the state and in Watauga County.

Larger scale references included works on North American turtles (Ernst and Barbout, 1972), eastern North America (Conant, 1975) and North America (Behler and King, 1979; Society for the Study of Amphibians and Reptiles [SSAR], 1971 et seq.). The <u>Catalogue of American Amphibians and Reptiles</u> (SSAR, 1971 et seq.) provided thorough accounts summarizing what was known about many species found in Watauga County.

Although a summary of all references to local species was beyond the scope of this review, some significant work was available on the herpetofauna of the area, and some literature records warranted mention. Brimley (1944) noted some species for Watauga County, but gave only one locality: <u>Eurycea longicauda</u> "at Foscoe in Watauga County at 3,100 feet elevation...." Numerous records concerning Grandfather Mountain in adjacent Avery County added information on several species for Watauga County. These included studies of four salamander species (Hairston, 1949), <u>Gyrinophilus</u> and <u>Pseudotriton</u> (Martof and Rose, 1962), <u>Plethodon jordani</u> and <u>Desmognathus</u> species (Hensel and Brodie, 1976), <u>Plethodon welleri</u> and <u>P. yonahlossee</u> (Wortham, et al., 1977), a specimen of <u>Clemmys</u> <u>muhlenbergi</u> (Dunn, 1917), and the type descriptions of <u>Leurognathus</u> <u>marmoratus</u> (Moore, 1899), <u>P. welleri</u> (Walker, 1931), and <u>P. yonahlossee</u> (Dunn, 1917).

Some biological aspects of Watauga County were subjects of graduate theses in the Department of Biology at Appalachian State University (ASU). These included pollution of the New River (Carrol, 1964), hepatic flora (Hicks, 1964), common mosses (Bagnell, 1969), Boone Fork sphagnum bog phytoecology (Moore, 1972), monogenetic trematodes of trout (Alart, 1974), first year vascular flora in the Tater Hill lake basin (Flisser, 1979), and benthic algal communities of Boone Fork Creek (Bullman, 1981). Two recent theses involved salamanders of Watauga County: mimetic salamander

4

palatability (Berry, 1980), and <u>Plethodon</u> <u>yonahlossee</u> populations (Harris, 1981).

Numerous sources provided background data for Watauga County. Arthur (1915) discussed the history of the county line. Clay et al. (1975) compiled much information in a North Carolina atlas. Fenneman (1938) described the Blue Ridge physiographic province. National Oceanic and Atmospheric Administration (NOAA, 1982) provided climatological data and the New River Valley Resource Conservation and Development Project Council (1974) described economic resources of Watauga County. North Carolina Department of Transportation (NCDOT) provided maps of state-maintained roads, and the United States Geological Survey published topographic quadrangle maps of the area. United States Department of Agriculture (USDA, 1958) surveyed soils and related information for the county.

Herpetological references disagreed on numerous subjects. Two types of problems became apparent while compiling a working list of herpetofauna of Watauga County: unstable taxonomy and variation in range descriptions. Herpetologists have long sought taxonomic stability and standardization, but the results have sometimes changed with further research. Martof, et al. (1980), for example, listed three-lined and longtail salamanders as distinct species whereas Collins, et al. (1982) listed them as subspecies; and <u>Plethodon</u> <u>longicrus</u> was accepted by Behler and King (1979), but omitted by Collins, et al. (1982). Collins, et al. (1982), which generally followed the most recently published research, was used as the taxonomic standard for the present study (excluding <u>Eurycea gutto</u>lineata and E. longicauda). Range description format differences made compilation difficult. Martof, et al. (1980) provided maps while DePoe, et al. (1961) gave brief word descriptions. Boundary lines on range maps were occasionally drawn by conjecture and included an error factor. Conant (1975) mentioned the impossibility of verifying all available locality data, even though his work was considered remarkably accurate.

Despite the problems encountered, the literature analysis provided tentative lists of species to be expected in the county (Appendix A). A summary of these lists provided a composition profile for comparison with other areas (Table 1).

Watauga near regions in communities of herpetological Composition -TABLE

County, NC.

Source	Martof, et al. (1980)*	Brimley (1944)*	DePoe, et al. (1961)	Martof, et al. (1980)	Conant (1975)		Huheey and Stupka (1967)	Breder and Breder (1923)		(Appendix A)		(Appendix A)		(total of Watauga County probable and marginal)	
seiseq2 IstoT	158	141	72	57	58		11	26		57		22		64	
AIJITAAA	75	70	33	26	26		36	12		26				37	
Serpents	39	17	51	17	10		22	6		17		2		22	
Sauria	12	10	00	4	3		00	-		4		2		9	
zənibuta9T	24	19	4	5	5		9	2		5		4		6	
ZNAIGIHAMA	83	17	39	31	32		35	14		31				42	
BIURA	31	29	14	6	10		12	2		6		5		14	
candata	52	42	25	22	22		23	12		22		9		28	
Area	North Carolina	North Carolina	N. C. Mountains	Watauga County	Watauga County	Great Smoky Mts.	Nat. Park	Ashe County	Watauga County	probable	Watauga County	marginal	Watauga County	possible	

(*Alligator record excluded.)

MATERIALS AND METHODS

A list of species that might occur in Watauga County (Appendix A) was compiled from general references (Martof, et al., 1980; Conant, 1975). The list helped in planning field work and searching for unrecorded species. Final listing for Watauga County was based on species recorded within Watauga County during and prior to the present study.

Various schemes of selecting sites were investigated, but most schemes were impractical. The methods used involved noting promising areas, following up tips from local residents, and seeking out extremes of elevation and unusual habitats such as bogs, rock outcrips, and balds. Collecting sites were distributed throughout most of the county (Fig. 1). Several collecting techniques (Conant, 1975; Stebbins, 1966) were tried; but dip netting, collecting from roads, tracking down calling frogs, collecting at night with headlamps and turning ground cover provided the most information. Collecting live and dead animals from roads was the easiest method of sampling large areas in a short time and most county roads were searched at various times. Logs, bark, boards, loose stones and trash were turned in search of unrecorded species. Whenever possible, cover items were replaced to reduce habitat disturbance. An attempt was made to collect voucher specimens at each site, especially if

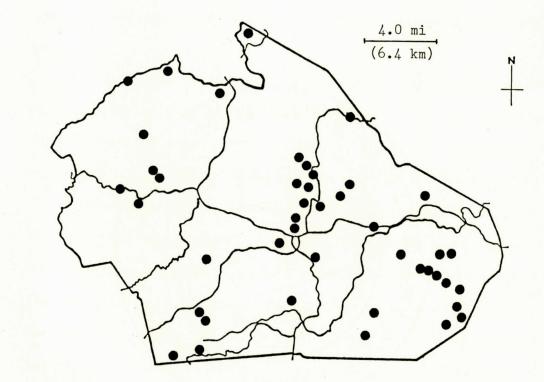


Figure 1.

Figure 1. Map of Watauga County, NC and collecting sites visited.

specimens appeared atypical or were out of the expected habitat. Collecting on the Blue Ridge Parkway National Park was restricted to capture-release techniques.

Notation and preservation techniques of Duellman (1962) and Pisani (1973) were followed for voucher specimens. Some specimens were kept live for identification, photography or observation. Specimens and copies of all notes were deposited in the ASU collection.

The Catalogue of American Amphibians and Reptiles (SSAR, 1971 et seq.), Behler and King (1979) and Conant (1975) were used for initial identification of specimens. Difficult specimens were checked using the ASU collection and the aid of R. W. Van Devender.

Collecting was done intermittently from March 1977 through October 1982. No estimate was made of time spent in the field due to the variable intensity of collecting. There were no criteria for estimating time actually spent collecting when productive periods could range from night-long collecting on roads to happening upon a specimen in one's backyard. Most unsuccessful excursions were not recorded. Collecting was done during all months but no effort was made to collect throughout one continuous year.

In August 1977 North Carolina State Museum of Natural History (NCSM) crossfiles were searched for Watauga County records. NCSM crossfiles contained North Carolina records from 49 collections, including most major museums. A return visit in August 1982 revealed no additional records, except those from ASU. In January 1983 NCSM crossfiles were checked for North Carolina records closest to Watauga County of species expected but not found in the

present study (pers. comm. Alvin L. Braswell, January 1983). Since NCSM had compiled a reasonably exhaustive list of existing records no search of other museum collections was made. Records for some 6,000 preserved specimens from Watauga County were used in the present study. These included 152 specimens of the author (JW), over 5,000 in the Appalachian State University collection (ASU), 270 in the R. W. Van Devender personal collection (RWV), 159 in the North Carolina State Museum of Natural History (NCSM), and 215 in other collections at the American Museum of Natural History (AMNH), Academy of Natural Sciences of Philadelphia (ANSP), Austin Peay State University (APSU), Charleston Museum (ChM), Carnegie Museum (CM), Cornell University (CU), Duke University (DU), University of Michigan Museum of Zoology (UMMZ), and private collections of E. E. Brown (EB) and P. J. Crutchfield (PC). Records were listed and distributions plotted on Watauga County base maps. Sight records (those which lacked numbered specimens) of R. W. Van Devender and the author were plotted.

For each species found in Watauga County an account was prepared to include scientific name, species author, official common name, observed altitude range (to the nearest 100 feet), relative abundance, and comments on identification, distribution patterns, habitat preferences and activity patterns. Notable localities were given as airline distances from the county seat at Boone (intersection of US highway 321 and Secondary Road 1102) to the nearest 0.5 mile (followed by conversion to km). Numbers for relevant museum specimens were given in parentheses.

Relative abundance of each species was based on specimen records and specimens seen in the field. Categories used were abundant, common, fairly common, uncommon, rare, very rare, and missing. Abundant species were present in large numbers throughout the county. Common species were present in moderate numbers throughout the county. Fairly common species were present in moderate numbers at scattered sites in the county. Uncommon species were known from four to ten sites. Rare meant species were found at two to three sites. Very rare species were known from only one site. A missing species was known from an old record but was not recollected in the present study. Asterisks (*) were used to indicate species not recorded before the present study.

Zoogeographic and ecological correlates of the observed distributions were sought in an effort to learn how the herpetological community was formed. Species expected but not found in Watauga County were examined in light of records near the county, habitat preferences and availability, and collecting biases. Three incidental species (nonviable species introduced in Watauga County) were noted.

Although collecting sites (Fig. 1) were scattered, most records were concentrated around Boone and on paved roads. Some large areas were poorly sampled. Records of various museums and contributors filled in some of these gaps. The sparsity of Chrysemys picta, Chelydra serpentina, Cryptobranchus alleganiensis, and snake and lizard records suggested that lakes, large streams, off-road areas and low elevations were under-searched.

RESULTS

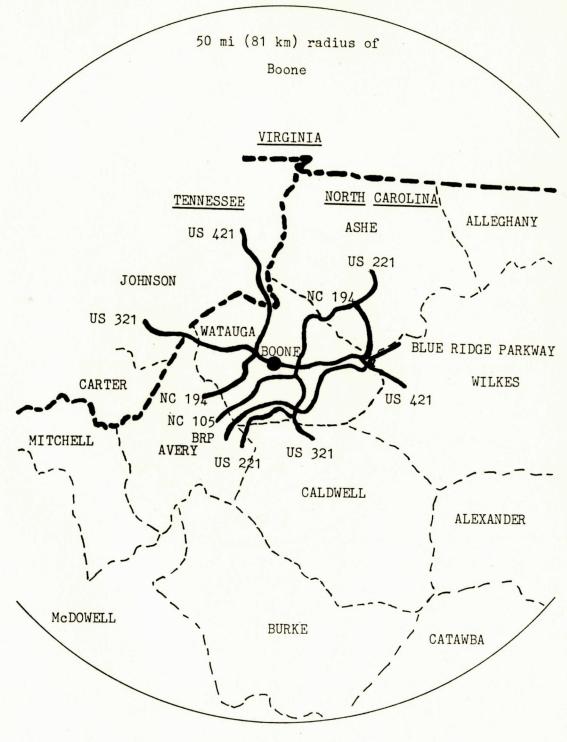
A survey of the animals of an area should logically present two kinds of data. The first kind would include important physical, biological and political aspects of the area studied. The second type of data would consist of the lists of species encountered and associated observations about them. The following three sections present a description of the study area, species accounts, and maps of recorded localities for each species.

Description of Area

Physiography and Relief. - While Watauga County, North Carolina was established in 1849, its boundaries have been stable only since 1911 (Arthur, 1915). It is bordered by Ashe, Wilkes, Caldwell, and Avery counties in North Carolina and by Johnson County in Tennessee (Fig. 2). Watauga County includes nearly 203,000 acres (82,000 ha) (United States Bureau of the Census, 1982a) between north latitudes 36°5' and 36°25' and west longitudes 81°55' and 81°25'. The county lies within the Blue Ridge physiographic province (Fenneman, 1938).

The shape of the county is a very irregular pentagon. The county line runs along numerous peaks, ridges and streams. Land features of the county are generally those of a high, dissected and rolling plateau (Fig. 3A). The county is cut by a network of 15

Figure 2. Map of Watauga County, NC and surrounding areas.



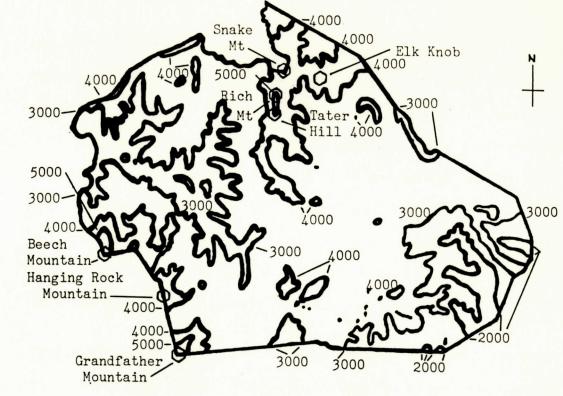


Figure 3. Topography of Watauga County, NC. Part A shows 1000-foot (305-m) contours and highest peaks. Part B shows limits of watersheds.

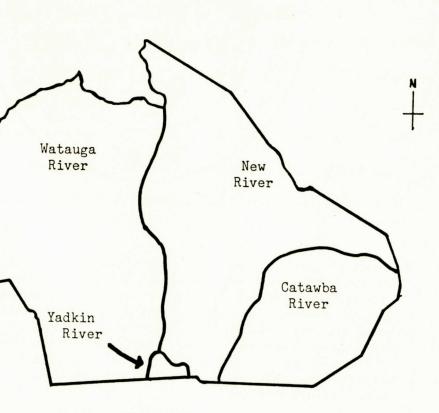


Figure 3B.

Figure 3A.

streams that have produced undulating to very steep relief. Twelve percent of the county has a 60% or greater slope, 54% has a 30 to 60% slope. 20% has a 15 to 30% slope, and only 13% has a 0 to 5% slope (USDA, 1958). Lowest elevations occur where streams leave the county, and the lowest is 1320 feet (402 m) on Elk Creek. Seven peaks exceed 5000 feet (1542 m) in elevation. Calloway Peak of Grandfather Mountain attains the highest elevation. 5.924 feet (1800 m), and is only 720 feet (220 m) shorter than the highest peak in eastern North America.

Biotic Factors. - Southern Appalachian flora and fauna are very rich. especially among certain groups such as salamanders (Cooper, 1977). Streams found here are considered the center of origin and an area of high diversity of the lungless salamanders of the Family Plethodontidae (Wake, 1966). The varied topography, water and climate of Watauga County provide numerous niches for salamanders and other species.

While forests originally covered Watauga County except for rock outcrops and balds. little or no virgin forest survives. USDA (1958; which cites Cruikshank, 1941) describes forests of Watauga County:

The upland hardwoods type occupies probably 75 percent of the forested area. It includes the forests growing on the drier north and east slopes.... Chestnut was by far the dominant species, but as a result of chestnut blight practically all the trees have died in the last two decades. though many remain standing. Other important species are chestnut, black, red, white, and Northern red oaks and hickories, in decreasing order of abundance. Associated species are scarlet oak, yellow-poplar, red maple, black locust, dogwood, and sourwood.

The cove hardwoods type occupies about 15 percent of the forested area. It includes the forests on bottoms. terraces, colluvial accumulations, and narrow coves, and the northern hardwoods on the moist slopes.... Dominant species are chestnut (dead but standing) and yellow-poplar. Basswood, white and Northern red oaks, black birch, red and sugar maples, white ash, hemlock, and black locust are important species. Associated species are cucumbertree, buckeye, chestnut, black and red oaks, dogwood, and sycamore.

The white pine-hardwoods type occurs mainly southeast of the Blue Ridge and on the Blue Ridge plateau in the extreme eastern part of the county. It resembles the upland hardwoods type in all respects except it includes considerable white pine. Some areas have an almost pure stand of white pine. These areas usually represent land that has either been clean-cut or cleared and cultivated, and then reforested naturally or by man. Virginia pines grow to some extent on the drier sites at lower altitudes.

The fir-spruce type of forest occurs on only a few acres at or near the top of Grandfather and Bald Mountains. It consists of Fraser fir and red spruce.

Forests are more common on steeper, stonier land. About 23,700 acres (9600 ha) or 12% of the county with 60% or steeper slope and 58,000 acres (23,800 ha) or 29% of the county with 30 to 60% slope is forested (USDA. 1958).

Endangered species are a concern in Watauga County. Tuelings and Cooper (1977) defined "cluster areas" for North Carolina to focus attention on areas where endangered and threatened species appeared concentrated. Two of thirty-nine cluster areas occur partly in Watauga County: Grandfather Mountain and the New River watershed. Bruce and committee (1977) used the following categories for North Carolina herpetofauna. Endangered species are close to extinction within North Carolina, although possibly abundant elsewhere, or are nationally endangered. Threatened species are likely to change to endangered or are experiencing rapid, unnatural decrease in numbers. Species of special concern

are rare or vulnerable. Species with undetermined status lack sufficient data for assessment. Eleven of 29 species listed by Bruce and committee (1977) may occur in Watauga County (Table 2).

Natural and Federal Areas. - Four relatively natural or "wilderness" areas of under 1,000 acres (400 ha) occur on Elk Knob and Rich, Flat Top and Grandfather mountains. The Dugger Mountain natural area includes 10,000 to 12,000 acres (4,000 to 5,000 ha) in the southeastern section of the county (USDA, 1974).

Federally managed lands in the county include parts of Pisgah National Forest and the Blue Ridge Parkway National Park. Pisgah National Forest extends into the western fifth of Watauga County but only 393 acres (159 ha) in this area are now federally owned (pers. comm. John P. Kennedy, District Ranger, Grandfather District, USDA Forest Service, 30 March 1979). Approximately 26 miles (42 km) of the Blue Ridge Parkway road and 9600 acres (3900 ha) of National Park lie in the county (pers. comm. Ole Olson, Park Ranger, Blue Ridge Parkway National Park, 18 November 1982). Federal lands consist mostly of high-altitude, scenic and forested land, including potential habitat of Desmognathus wrighti, Hemidactylium scutatum, Plethodon welleri, and Clemmys muhlenbergi.

Geology, Hydrology, Climate and Soils. - The Southern Appalachian Mountains date from Pre-Cambrian and early Paleozoic eras and are some of the world's oldest formations (USDA, 1958). Rocks of the area are basically metamorphosed sedimentary rocks, including various kinds of gneiss and schist with small amounts of igneous rock. Rock outcrops constitute 0.1% of the county, with the rest

TABLE 2. Endangered or threatened species that possibly occur in Watauga County, NC (Bruce and committee, 1977).

Species

Amphibia

Caudata

Ambystoma talpoideum, mole salama Cryptobranchus alleganiensis, he. Eurycea longicauda, longtail sala Hemidactylium scutatum, four-toed Necturus maculosus, mudpuppy Plethodon wehrlei, Wehrle's salar Plethodon welleri, Weller's salar Anura

Pseudacris brachyphona, mountain chorus frog undetermined Reptilia Testudines Clemmys muhlenbergi, bog turtle Trionyx spiniferus, spiny softshell turtle Squamata, Lacertilia

Eumeces anthracinus, coal skink

Status

ander	special concern
llbender	special concern
amander	special concern
d salamander	undetermined
	undetermined
mander	undetermined
mander	special concern

threatened undetermined

special concern

of the county covered with various types of soil (USDA, 1958). The effects of mining for building material are relatively insignificant (New River Valley Resource Conservation and Development Project Council, 1974). The lack of calcareous rock limits caves to the fissure type. There is no evidence of herpetological fossils in the county.

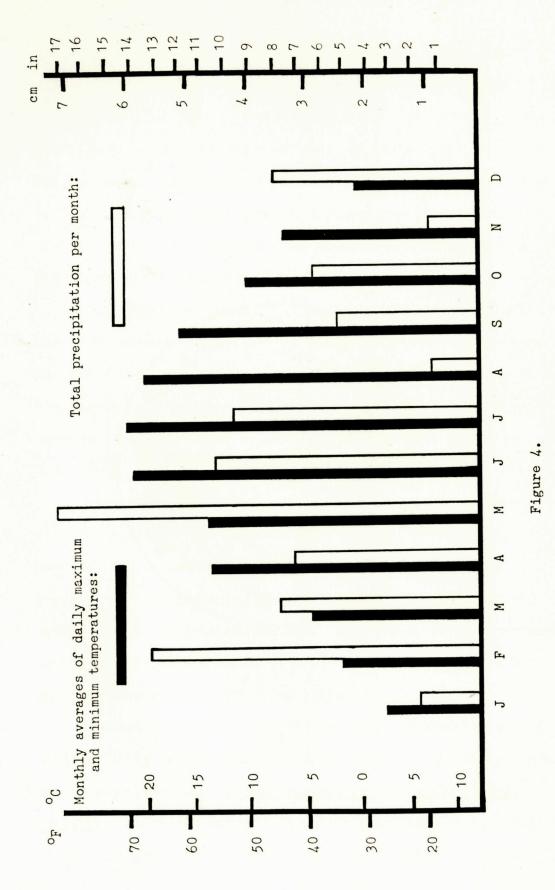
Watauga County has 11 man-made lakes 5 to 40 acres (2 to 16 ha) in size plus numerous farm ponds and temporary pools. Impoundments are subject to fluctuation during droughts and dam failures. The Blue Ridge Parkway roughly follows the crest of the Blue Ridge and marks the Eastern Continental Divide in Watauga County. South and east of the Parkway land generally slopes sharply downward to the foothills in nearby counties (USDA, 1958). Headwaters of the New, Watauga, Yadkin and Catawba rivers are found in Watauga County (Figure 3b). Streams south and east of the divide join the Catawba and Yadkin rivers and flow to the Atlantic. The Watauga River flows west into the Tennessee River and thence to the Mississippi River and Gulf of Mexico. The New River flows north to the Ohio River and thence to the Mississippi River and Gulf of Mexico.

Watauga County has a montane climate that is generally temperate and humid (Fig. 4). Winters are broken by warm spells. The average annual minimum and maximum temperatures are O^OF (-18^OC) and 90°F (32°C), respectively. Mean frost free period is May 6 to October 6 (154 days), but killing frost can occur in mid-June and September (USDA, 1958). The average daily maximum temperature for 1981 at Boone was 50°F (10°C) (NOAA, 1982).

Figure 4. Weather data for Boone, NC, in 1981.

24

Annalachian State University Library sailors3 stroll snac



Rainfall is slightly greater in spring and summer and minimal in fall, when very dry conditions can occur. Total precipitation for 1981 at Boone was 39.38 inches (101 cm) (NOAA, 1982), well below the average of about 57 inches (145 cm) (USDA, 1958). Relative humidity for Watauga County averages 55 to 65 percent. Variation in topography produces great variation in microclimates. Fog is frequent on mountaintops and along the Blue Ridge crest (USDA, 1958).

Cool climate and extensive forests in Watauga County produce cool streams and low loss of water to the air. Evapotranspiration loss in North Carolina is lowest (50-60%) in most of the mountains, including Watauga County. Stream temperatures average below $36^{\circ}F(2^{\circ}C)$ in January and about $69^{\circ}F(21^{\circ}C)$ in July (Clay, et al., 1975).

Soils of Watauga County are described in detail by USDA (1958). Most soils of the county have a loam or stony loam surface zone and a friable, permeable subsoil. Soils vary greatly due to differences in parent material (rocks), relief, water, climate, vegetation and age. In general, soils of Watauga County are strongly acid. They are less leached, more friable and more permeable than Piedmont soils. The most significant soil relationship for herpetofauna of Watauga County is Wehadkee loam, peaty phase, or bog soil, which may be associated with <u>Clemmys muhlenbergi</u> and <u>Hemidactylium</u> <u>scutatum</u>. This soil occurs in greatest quantities at the heads of Beech, Howard and Long Hope creeks (USDA, 1958).

26

Human Influences. - Land use in Watauga County is primarily agricultural. However, farmland is limited to about 28% of Watauga County by steep, stony, erodable land (USDA, 1958). For various reasons farmland has also declined from 137,085 acres (55,000 ha) in 1967 (Moore, et al., 1969) to 59,980 acres (24,283 ha) in 1978 (U. S. Bureau of the Census, 1982a).

Economic trends are toward development of second homes and recreation and away from agriculture. The rapid growth of Boone is due primarily to the growth of Appalachian State University. Major land use trends in Watauga County are reported by Moore, et al. (1969).

Watauga County is the fourth-fastest growing in population in North Carolina (Clay, et al., 1975). Between 1970 and 1980 Boone grew 16.4% to 10,191 and Watauga County grew 35.3% to 31,666 (U. S. Bureau of the Census, 1982b). Most of the population is distributed along highways in the county (Moore, et al., 1969).

The county is covered by a sinuous network of state maintained roads ranging in quality from ungraded, often impassable roads to five-laned highways. As of 18 November 1982 there were approximately 450 miles (726 km) of state maintained roads in Watauga County including about 90 miles (145 km) of highway, 170 miles (274 km) of paved secondary roads and 290 miles (468 km) unpaved secondary roads (pers. comm. R. D. Hodges, Watauga County supervisor, NCDOT, 18 November 1982). Large areas of the county remain virtually roadless.

Species Accounts

Class Amphibia, Order Caudata

Ambystoma maculatum (Shaw), spotted salamander, 3100-3600' (945-1098 m), fairly common.

Spotted salamanders found in the present study were the typical stout, black salamanders with yellow spots on the body and yellow or orange spots on the head. Adults were commonly found crossing wet roads at night in March and April to breed in ponds. Salamanders were rarely found from May to February. except as overwintering larvae in ponds at 4 mi (6.5 km) NNE and 4.5 mi (7.2 km) NE Boone. Local residents occasionally brought in impressively large specimens.

Cryptobranchus alleganiensis (Daudin), hellbender, 2600-3100' (793-854 m), uncommon, 2.5 mi (4.0 km) E, 6 mi (9.7 km) WNW and 4.5 mi (7.2 km) SW Boone.

The hellbender, a giant, brown, flat-headed aquatic salamander with gill slits, was usually found under large rocks in Watauga and New River drainages. Larvae and adults were found at 4.5 mi (7.2 km) SW Boone. A dead egg was found there in September 1982. ASU 1200 was found 2 May 1976 out of water on the Hound Ears golf course, perhaps in response to flooding. Local reports indicated that hellbenders probably occurred in most deep, swift and rocky streams in the county.

Desmognathus fuscus (Green), dusky salamander, 1400-3600' (427-1098 m), common.

Dusky salamanders were typically variable. Their tails were slightly to moderately keeled and the bellies were strongly mottled. Dorsal patterns varied from uniformly black, olive or brown to rows of paired yellow, red or brown spots on a darker ground color. Adults were found in small streams of wooded ravines and crossing wet roads at night. The most southwesterly record, Price Lake at 6 mi (9.7 km) SSW Boone, may have been outside the given range for this species.

Desmognathus monticola Dunn, seal salamander, 1800-3900' (549-1189 m), abundant.

Seal salamanders had very pale unspotted bellies and strongly keeled tails. Juveniles had distinct alternating brown spots with black edges and a zig-zag pattern on the tail. In adults the spots dissipated leaving scattered dark spots on the brown to gray dorsum. Adults were found in most small streams and crossing wet roads at night. They probably occurred near streams throughout the county.

Desmognathus ochrophaeus Cope, mountain dusky salamander, 1800-5900' (549-1789 m), abundant.

Mountain dusky salamanders were extremely variable in coloration. All had rounded tails and mottled bellies, but almost any dorsal pattern was possible. They seemed to be the most abundant salamander in the county and were found in wet places under rocks, wood and leaves in most areas of the county. Adults were easily collected at night on wet rock faces. Desmognathus quadramaculatus (Holbrook), blackbelly salamander, 2000-3900' (610-1189 m), abundant.

Blackbelly salamanders had a short, strongly keeled tail and robust bodies. The belly was pale in juveniles and uniformly black in adults. Adults were seen crossing roads during warm night rains and under cover in or near deeper streams. They probably occurred throughout the county and were prized as bait by local fishermen.

Desmognathus wrighti King, pigmy salamander*, 5900' (1789 m), very rare, 10 mi (16 km) SW Boone.

Pigmy salamanders had very short, round tails and chevronlike dorsal patterns. They were recorded near Calloway Peak of Grandfather Mountain by R. W. Van Devender and students on 26 April 1981 (ASU 6447-50). Pigmy salamanders were common at high elevation seeps on Grandfather Mountain, but specimens from within Watauga County were scant due to the relative inaccessibility of this area. Searches on other high peaks in the county failed to uncover additional populations.

Eurycea bislineata (Greene), two-lined salamander, 1800-3900' (541-1189 m), abundant.

Two-lined salamanders were rather variable. Some had the typical two dark lines and spots, while others lacked one or both of these dorsal markings. Ground color was pale yellow to orange. Males were cirrate or had swollen heads. Adults were found under cover in aquatic habitats from seeps to rivers and occasionally under moist cover away from water on wooded slopes. Adults were frequently seen on roads at night during warm rains, and larvae were found in leafy stream beds. This species probably occurred throughout the county.

Eurycea guttolineata (Holbrook), three-lined salamander, 1400-3200' (427-976 m), rare, 11 mi (18 km) ESE, 1 mi (1.6 km) S and 2 mi (3.2 km) NNE Boone.

The three-lined salamander, a fairly large black and yellow or brown striped species, was found in the Catawba River drainage along Elk Creek (ASU 1446, 1817-8, 2152-71, 2356, 2653, 5050-61), and in the New River drainage along Winkler's (ASU 8029) and Howard's creeks (UMMZ 1112, 1117, 1122, 1123). The Elk Creek population (represented by larval and adult specimens) was possibly endangered by the operation of a gravel quarry. Searches in both drainages failed to produce more populations; but they possibly occurred along other creek bottoms in larger valleys.

Three-lined and longtail salamanders were treated as distinct species since populations occurred within 2.5 mi (4.0 km) of one another without evidence of interbreeding.

Eurycea longicauda (Green), longtail salamander, 2700-2800' (823-854 m), uncommon, 8 mi (13 km) WNW, 6 mi (9.7 km) W, 4 mi (6.4 km) WSW and 2.5 mi (4 km) WSW Boone.

Longtail salamanders were yellow to orange with black spots and long barred tails. They were found in the Watauga River drainage from NC 105 to US 321 W Boone. Adults and juveniles were found at night on wet roads and in deep granitic crevices. Some salamanders were found in grass near crevices or along a stream. <u>Gyrinophilus porphyriticus</u> (Green), spring salamander, 1400-3900' (427-1189 m), fairly common.

The spring salamander, a large, pink to orange species with black flecks and bicolor lines from eye to snout, was found under stones in springs and creeks at scattered localities. Adults were also frequently seen crossing wet roads at night. Larvae were collected from most streams searched. It probably occurred in smaller, cold streams throughout the county. It was a favorite bait of local fishermen.

Leurognathus marmoratus (Moore), shovelnose salamander, 2700-3900' (823-1189 m), fairly common.

Shovelnose salamanders were usually black or yellowish brown with squared, lighter blotches. Tails were keeled and venters were often very dark. Some were easily confused with <u>Desmognathus</u> <u>quadramaculatus</u>. Specimens were generally found under cover in deeper water of clear streams at widely scattered localities. Several adults were collected at night from splash zones of cascades. Larvae were also collected at several sites. It was not collected from lower elevations.

Notophthalmus viridescens (Rafinesque), eastern newt, 1400-3800' (427-1159 m), common.

Aquatic stages of the eastern newt were green and yellow with scattered black spots and red and black dorsal spots. Terrestrial efts were orange with red and black dorsal spots. Eastern newts were seen at numerous localities. Efts were collected from wet roads

at night and from forest floors, and adults were seen breeding in spring in many ponds including Tater Hill Lake before dam failure.

Plethodon cinereus (Green), redback salamander, 3000-3400' (915-1037 m). uncommon, 6.5 mi (10 km) SW, 1 mi (1.6 km) NNW, 1.5 mi (2.4 km) WNW, and 1.5 mi (2.4 km) NE Boone.

Redbacks. small black salamanders with red or yellow dorsal stripes and mottled bellies, were found under cover in forests, often in association with Plethodon richmondi. The scarcity of records probably reflected their limited number or locally spotty distribution.

Plethodon glutinosus (Green), slimy salamander, 1800-3800' (549-1159 m), common.

Slimy salamanders, typically black with evenly scattered white flecks, were found at lower elevations throughout the county. They were frequently found under cover around or in wooded areas with Plethodon richmondi and Plethodon jordani. Adults were seen at night on wet roads or forest floors.

Plethodon jordani Blatchley, Jordan's salamander, 1400-3900' (427-1189 m), common.

Jordan's salamanders, locally black to light gray with lighter venters, apparently did not hybridize with Plethodon glutinosus as happens in some areas, although the two species were found in association. Juveniles and adults were collected from wet roads and forest floors at night and under cover during the day.

Plethodon richmondi Netting and Mittleman, ravine salamander. 1600-4000' (489-1200 m), fairly common.

Ravine salamanders were the typical small, black animals with small legs and brassy flecks. None had red stripes. They were found in larger numbers in the spring and fall on wooded slopes under cover, especially large, thin rocks. It was often found under the same cover item with other Plethodon species. As many as eight ravine salamanders were found under a single rock. Plethodon welleri Walker, Weller's salamander*, 3800-5900' (1159-1798 m), rare, 12.5 mi (20 km) N and 10 mi (16 km) SW

Boone.

Two distinct populations of Weller's salamanders were found. Those from Stone Mountain at the state line were black with gold blotches and mottled venters, while those from Grandfather Mountain at Calloway Peak were similar but with dark venters. A few individuals had no gold blotches and were uniformly dark. Both adults and juveniles were collected from beneath cover on talus slopes and bald areas. As with Desmognathus wrighti, Weller's salamanders were more accessible on other parts of Grandfather Mountain.

Plethodon yonahlossee Dunn, Yonahlossee salamander, 2600-3900' (793-1189 m), fairly common.

Yonahlossee salamanders were impressive animals with large black bodies, a red or chestnut dorsum and white-blotched sides. They were recorded at scattered localities. Some variation in color pattern was evident with reduced red pigment or white flecking

in some specimens. Adults and juveniles were found on wooded slopes under cover, or crossing forest floors and wet roads at night.

Pseudotriton montanus Baird, mud salamander*, 2800-3700' (754-1128 m) uncommon, 11 mi (18 km) N, 3 mi (4.8 km) N, 4.5 mi 7.2 km) ESE, 4.5 mi (7.2 km) S, 6 mi (9.7 km) SSW, and 4.5 mi (7.2 km) SW Boone.

Local salamanders resembled Pseudotriton ruber but had larger, rounder spots and brownish eyes. Specimens from 1 mi (1.6 km) NE Boone were larvae and one metamorphosed individual. Watauga County specimens represent a bridge between the given range to the east and west. Only 6 adults were collected. These showed variation in spotting, ground color and body shape. Adults were found on wet roads at night or in stream environs.

Pseudotriton ruber (Latrielle), red salamander, 3200-3900' (967-1189 m), common.

This species was typically red with scattered black flecking. The spotting was denser in some adults making them darker. Flecking was not concentrated on the chin and lacked white pigment. Adults were collected commonly from wet roads at night and rarely from stream beds under cover. Larvae were common at several sites in leaf litter of streams.

Class Amphibia, Order Anura

Bufo americanus Holbrook, American toad, 1800-3600' (549-1098 m). common.

The large American toad, variably brown, gray or red with one or two warts per spot, short spurs between cranial crest and parotid gland and large tibial warts, was found in large numbers of calling males and responding females throughout the county. One of the first frogs to breed in the spring, their spiral egg clusters appeared in most ponds and puddles, even where water frequently did not last long enough for larvae to transform. Some specimens were rather large. Adults and juveniles were commonly found on wet roads in rainy weather from spring through fall.

Bufo woodhousii Girard, Woodhouse's toad*, 1400-1700' (427-518 m), uncommon, 9 mi (14 km) WNW, 3.5 mi (5.7 km) NE, 8.5 mi (13.9 km) E, and 11 mi (18 km) ESE Boone.

The smaller Woodhouse's toad, brownish with three or more warts per spot, spotted bellies, cranial crests touching parotid glands and smaller tibial warts, was seen at three sites in the county. One or two calling males were heard at 11 mi (18 km) ESE Boone. This was the rarest frog in the county, represented by few individuals.

Hyla chrysoscelis Cope, Cope's gray treefrog*, 1400-3600' (427-1098 m), uncommon, 12.5 mi (20 km) NW, 11 mi (18 km) ESE, 11.5 mi (18 km) ESE, 6 mi (9.7 km) ESE, 7.5 mi (12 km) SE, and 9 mi (14 km) SE Boone.

Cope's gray treefrog, a large, mottled treefrog with a bright yellow pattern on concealed surfaces of its hind legs, was found calling and breeding at several widely scattered sites. Adults observed breeding at 11 mi (18 km) ESE Boone called in fairly

large chorus until midnight, then quietly amplexed in puddles and pools. Some of these specimens were karyotyped as H. chrysoscelis, but initial voice recordings at various local sites show differences in pulse rate and may indicate the presence of outwardly identical H. versicolor.

Hyla crucifer Wied, spring peeper, 1400-3400' (427-1006 m). abundant.

Spring peepers were the typical small light brown frogs with dorsal x-shaped patterns. They were the most common local frog and were heard calling from almost any body of water in spring through fall. Large numbers were found live or dead on roads in rainy weather.

Rana catesbeiana Shaw, bullfrog, 1400-3900' (427-1189 m), common.

Large green or brown bullfrogs, typically lacking dorsolateral folds, were found in most large ponds and streams. Large larvae were found year round at breeding sites, and many transformed into swarms of small bullfrogs. Local residents occasionally hunted larger specimens for the reportedly tasty legs.

Rana clamitans Latrielle, green frog, 1400-3900' (427-1189 m), common.

Green frogs were brown or green frogs and had long dorsolateral folds. They were found at several widely scattered localities. Calling males were heard in spring. Possibly the species was under-collected due to its superficial resemblance to R. catesbeiana.

Rana palustris Le Conte, pickerel frog, 1400-4000' (427-1220 m). common.

The distinctive pickerel frog, with brown blotches, yellow concealed surfaces of hind legs, and prominent dorsolateral folds, was recorded at scattered sites in the county. It probably occurred at most ponds over a wide range of elevation.

Rana sylvatica Le Conte, wood frog, 1400-3900' (427-1189 m). common.

The brown or red wood frog, identified by its brown eye patch. was the first frog to call each year and could be heard as early as mid-February. Adults were found at most ponds over a wide range of elevation, and were commonly seen live or dead on roads during rainy weather.

Class Reptilia, Order Testudines

Chelydra serpentina (Linnaeus), snapping turtle*, 2600-3400' (793-1037 m), uncommon, 11 mi (18 km) WNW, 9 mi (14 km) WNW, 4.5 mi (7.2 km) NE, 9 mi (14 km) SSW, and 1 mi (1.6 km) NNE Boone. Aquatic snapping turtles, massive brown animals with large

heads and tails and small plastrons, were seen in several ponds and streams. Two large specimens were hooked with liver bait from Watauga River, and one was spotted in a pool at Boone Fork Bog. This species was probably more common in deep water than records indicated.

Chrysemys picta (Schneider), painted turtle*, 2600' (793 m), very rare, 7 mi (11 km) WNW Boone.

A basking turtle was first sighted by "Swamp" Morrow near his residence. on a pond above Watauga River at 8 mi (13 km) W Boone in 1979. Another specimen was spotted on Watauga River at 7 mi (11 km) NWN Boone on 21 June 1981 and identified C. picta by Thomas M. Haggerty. A maximum of nine turtles of various sizes were seen basking on the river bank and logs at the latter site in 1982. R. W. Van Devender identified these turtles at a distance as probably C. picta, and possibly other species. They appeared to show the black carapace, yellow eye marks and red edges of the shell of typical painted turtles. Repeated attempts to collect specimens for identification, marking and release have failed. The river bottom was soft at this site and vegetation consisted mostly of Typha latifolia (cat-tail).

Clemmys muhlenbergi (Schoepff), bog turtle, 3400' (1037 m), missing, 6.5 mi (10 km) SSW Boone.

A specimen (NCSM 13734) of the bog turtle, a small black species with orange facial blotches, was collected near the Blue Ridge Parkway by Ken Nemuras on 23 May 1972. Attempts to recollect this species failed. C. muhlenbergi was the only previously reported species that was not found during the present study. It is a secretive species and prefers wet grassy fields and bogs. The species may have been locally extirpated.

Terrapene carolina (Linnaeus), eastern box turtle, 2500-4400' The box turtle, a variable yellow, orange, black and brown

(762-1342 m), uncommon, 6.5 mi (10 km) E, 8.5 mi (14 km) NNW, 6.5 mi (10 km) ESE, and about 4 mi (6.5 km) SE and at Boone. species with a double-hinged plastron, was seen at widely scattered localities in a variety of environs. Since it was a secretive, camouflaged species, it was probably more abundant than records indicated. They are more conspicuous in spring.

Class Reptilia, Order Squamata, Suborder Sauria

Eumeces fasciatus (Linnaeus), five-lined skink*, 1800-2800' (561-854 m), rare, 9.5 mi (15 km) E, 8 mi (13 km) E and 11 mi (18 km) ESE Boone.

The five-lined skink, a brown lizard with five stripes, a wide median subcaudal scale row, four labial scales before the subocular, and some red heads or blue tails, was represented by few local specimens. This skink apparently only occurred at lower elevations south and east of the Parkway.

Sceloporus undulatus (Latreille), eastern fence lizard*, 2800' (854 m), rare, 9.5 mi (15 km) E, and 8.5 mi (14 km) E Boone. Eastern fence lizards were the typical gray-brown with jagged dorsal patterns and spiny keeled scales. This species was only recorded at lower elevations south and east of the Parkway where it was fairly common near dry basking sites.

Order Squamata, Suborder Serpentes

Agkistrodon contortrix (Linnaeus), copperhead*, 2800-3600' (854-1098 m), rare 5.5 mi (8.9 km) SSE, 8 mi (13 km) SE, and about 6 mi (9.7 km) SE Boone.

Copperheads were brown pit vipers with hourglass-shaped blotches. They had vertical pupils, keeled scales, and a pair of small dark spots on the brown to orange head. They were collected at few sites but may have been present at others. This snake was undoubtedly eradicated in many parts of the county. Specimens were collected from the Parkway, and near residences and dens south of the Parkway. One captive female bore two yellow-tailed young on 19 August 1977.

Carphophis amoenus (Say), worm snake*, 1800-3300' (549-1006 m), rare, 1 mi (1.6 km) NE and 8 mi (13 km) E Boone.

Worm snakes from Watauga County had the typical coloration of brown above and pink below. The small, fossorial snakes were found by R. W. Van Devender under a log in a field and crossing a road at night in a rainstorm. Their secretive habits could have led to an underestimate of their numbers and distribution.

Coluber constrictor Linnaeus, racer, 2800-3000' (854-916 m). uncommon, 8.5 mi (14 km) WNW, 7 mi (11 km), 7.5 mi (12 km) W, 4.5 mi (7.2 km) WSW, and near Boone.

Typical black racers with white chins and smooth scales were found in the western half of the county. This snake often escapes

the most agile herpetologists, and may have been seen but unrecognized more than once. Blotched juveniles and dead adults were collected.

Crotalus horridus Linnaeus, timber rattlesnake*. 1800-2800! (549-854 m), rare, 8 mi (13 km) SE, 8.5 mi (14 km) E, and about 5.5 mi (8.9 km) SE Boone.

Timber rattlers were variably black or yellow with jagged black crossbands. They were found at Triplett, Aho, and Sampson Mountain with Agkistrodon contortrix. Timber rattlers were probably eradicated in many areas, but local residents report they were never as common as the copperhead. One captive specimen passed an acorn in its feces.

Diadophis punctatus (Linnaeus), ringneck snake, 1800-4000' (549-1220 m), fairly common.

Local ringneck snakes were variable and had broken or complete neck rings, spotted to unspotted venters, and brown, gray or black ground color. Adults and eggs were collected under cover in fields or on roads. The largest specimen was 394 mm in total length (NCSM 4111).

Elaphe obsoleta (Say), rat snake, 1800-3800' (549-1159 m), fairly common.

Adult rat snakes were uniformly black above with mottled gray and black venters. They were seen at scattered localities. mostly as dead specimens on the road.

Heterodon platyrhinos Latreille, eastern hognose snake*, 3000' (915 m), very rare, 7.5 mi (12 km) W Boone.

Two eastern hognose snakes were seen near Sugar Grove by Richard N. Henson. This was an unusually high-elevation site for this snake, one of the rarest in the county.

Lampropeltis triangulum (Lacepede), milk snake, 2800-4000' (854-1220 m), uncommon, 11.5 mi (18 km) WNW, 9.5 mi (15 km) NW, 9 mi (14 km) NNW, 9 mi (14 km) W, 4 mi (6.4 km) WSW, 2.5 mi (4.0 km) WNW, and 5.5 mi (8.9 km) SSE Boone.

Milk snakes, typical red-blotched juveniles and brownblotched adults with checkered venters, were found in the western half of the county. Most were dead on the roads. They may have been more abundant than records indicated.

Nerodia sipedon (Linnaeus), northern water snake, 1500-4100' (457-1250 m). common.

Water snake adults were a mostly dark brown species with red to white venters having black or red crescent patterns, and keeled scales. Juveniles were white with gray blotches. Specimens were found along most bodies of water. A captive female bore eleven young on 30 August 1977. Residents often confused this species with Agkistrodon contortrix and A. piscivorous, which does not survive in the North Carolina mountains.

Regina septemvittata (Say), queen snake, 2800-3600' (854-1098 m). fairly common.

Brown and buff-striped queen snakes were found at scattered localities near water. A captive female bore nine young on 25 August 1977. This species apparently reached unusually high elevations in the county.

Thamnophis sauritus (Linnaeus), eastern ribbon snake, 3100-4400' (945-1342 m), uncommon, 11.5 mi (18 km) NW, 7.5 mi (12 km) N, 3 mi (4.8 km) NE, and 3 mi (4.8 km) SE Boone.

Long thin ribbon snakes, with distinctive brown and yellow stripes and keeled scales, were represented by only three adults. They were associated with bodies of water and apparently reached unusually high elevations in the county. Thamnophis sirtalis (Linnaeus), common garter snake, 1500-4400'

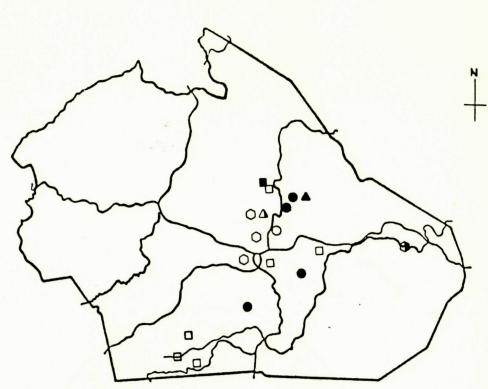
(457-1342 m), common.

Common garter snakes were variably spotted green or brown with bright or dull stripes. This species was usually found near water or seen as dead specimens on the road. It was the most commonly encountered snake in the county. Newborn specimens were found 9 September 1979 by R. W. Van Devender.

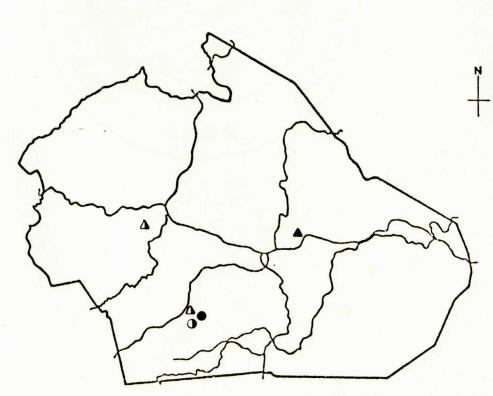
Distribution Maps

Symbols: **I** = JW specimen, precise locality; **I** = JW specimen, rough locality; □ = any sight locality; ● = ASU specimen, precise locality: \mathbf{O} = ASU specimen, rough locality; \mathbf{O} = ASU specimen, conjectural locality; • = NCSM specimen, precise locality; \mathbf{O} = NCSM specimen, rough locality; \mathbf{O} = NCSM specimen, conjectural

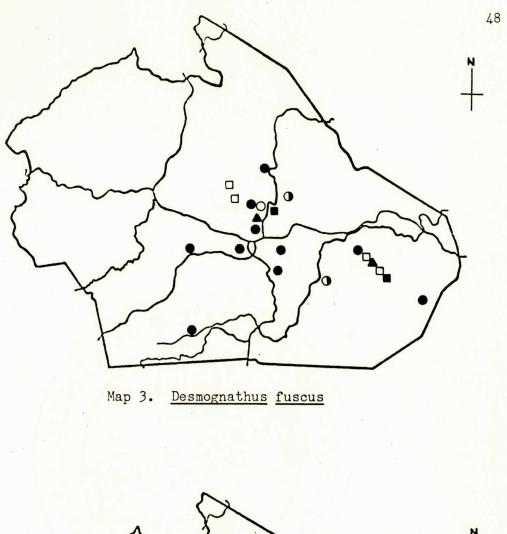
locality; \triangle = other specimen, precise locality; \triangle = other specimen, rough locality; Δ = other specimen, conjectural locality. Locality data were deemed as precise (given as road mileage to 0.1 mi or similarly related to landmark), rough (given as a road or landmark reference) and conjectural (given as a town, long road, mountain or section of county). Generally, records without specimen numbers are considered sight records, overlapping symbols are not plotted, and specimen records are plotted in deference to sight records for each site.

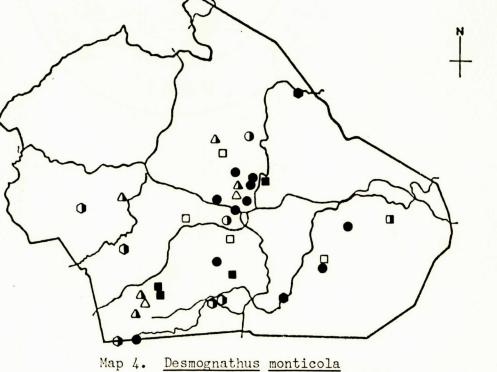


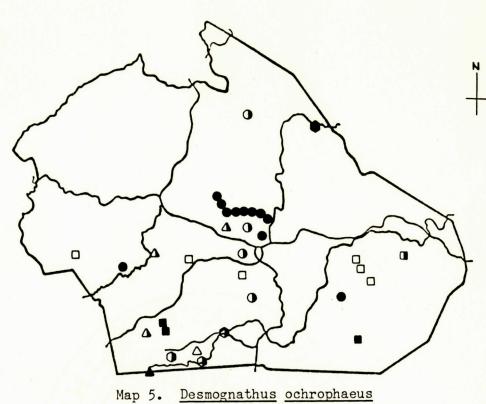
Map 1. Ambystoma maculatum

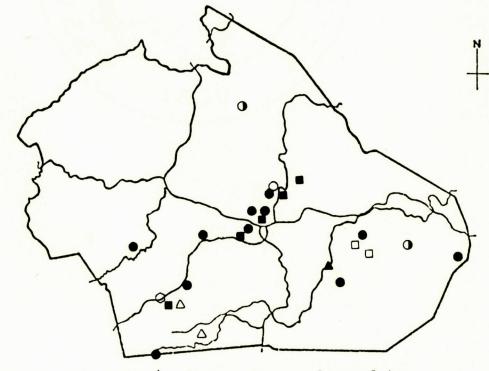


Map 2. Cryptobranchus alleganiensis

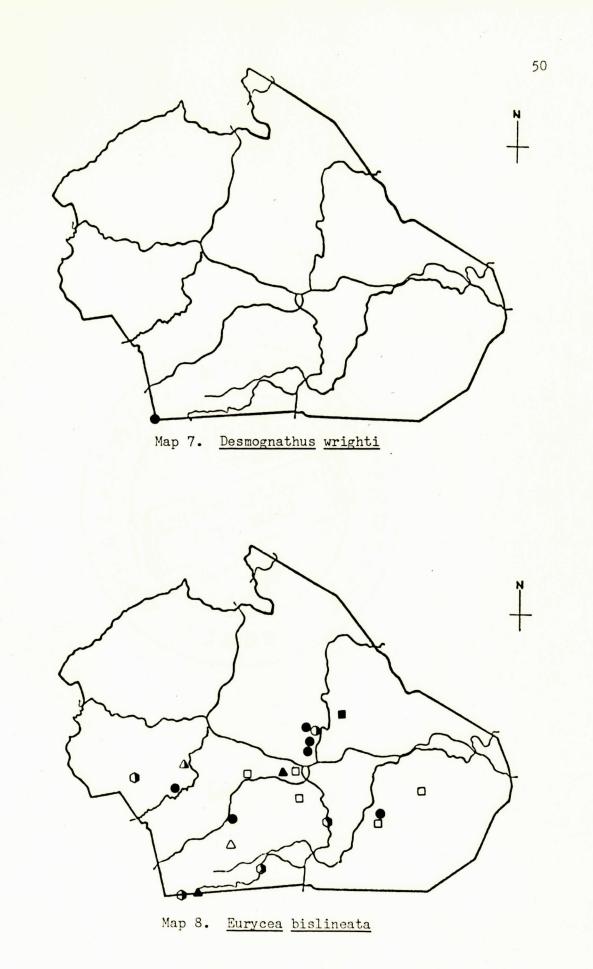


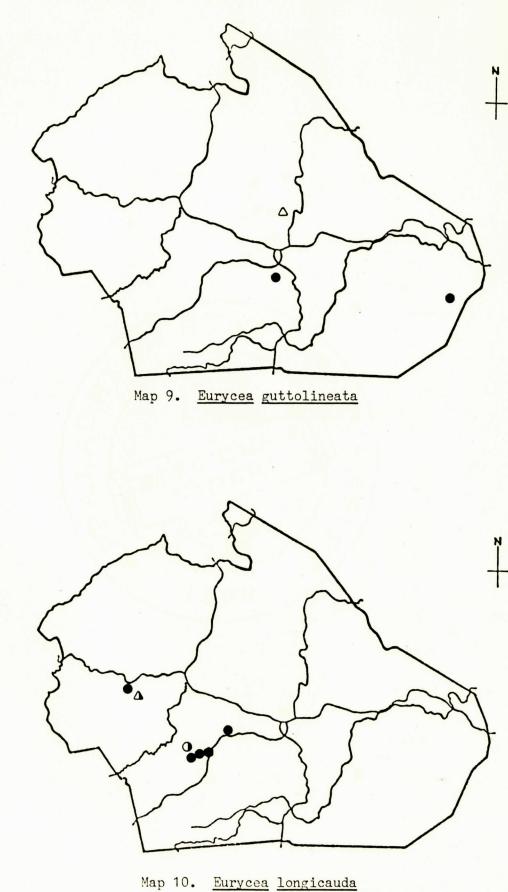


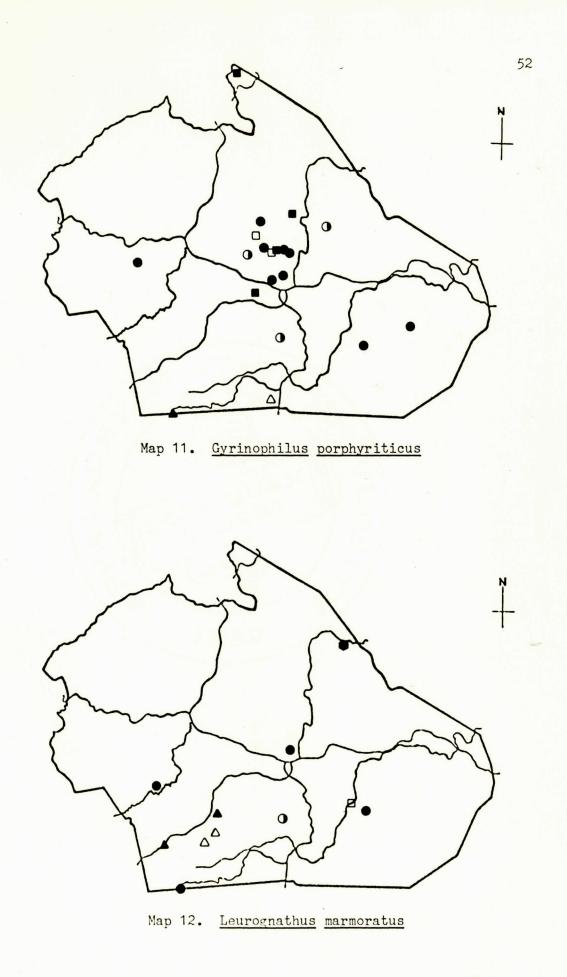


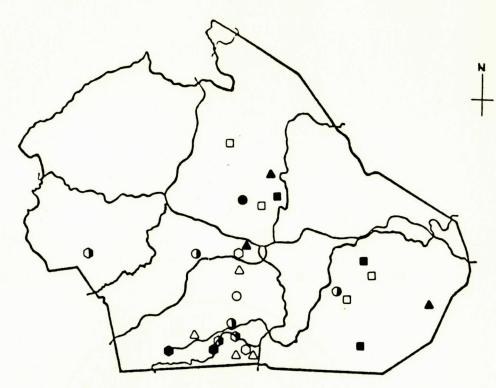


Map 6. Desmognathus quadramaculatus

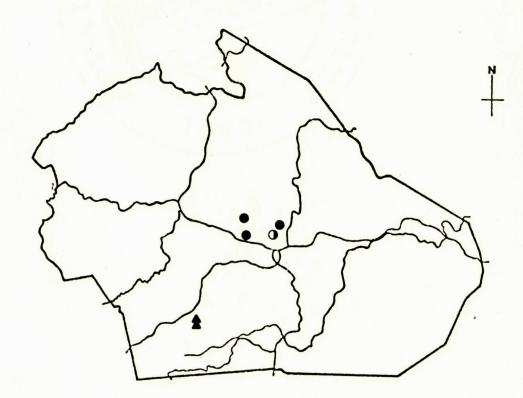




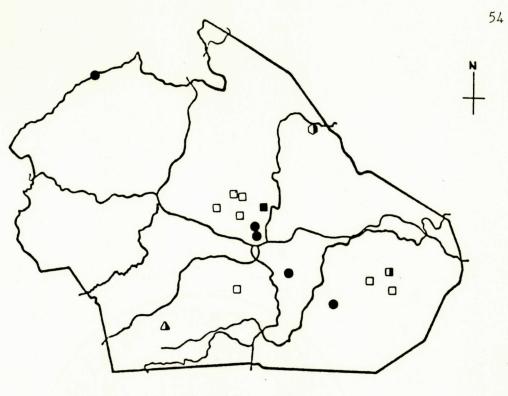




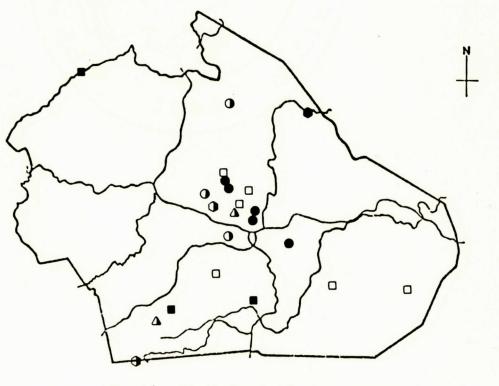
Map 13. Notophthalmus viridescens



Map 14. <u>Plethodon cinereus</u>



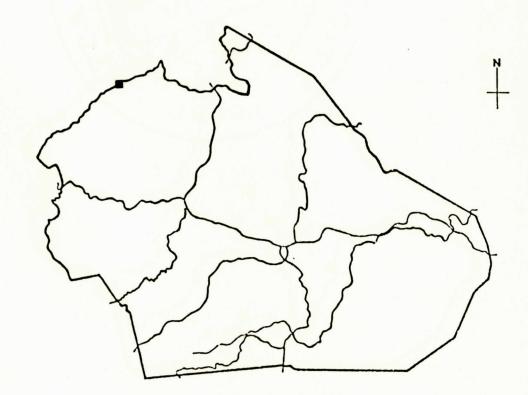
Map 15. Plethodon glutinosus



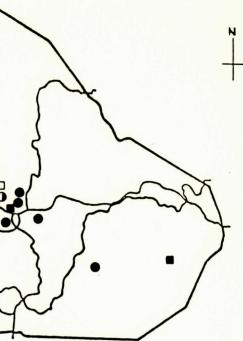
Map 16. Plethodon jordani

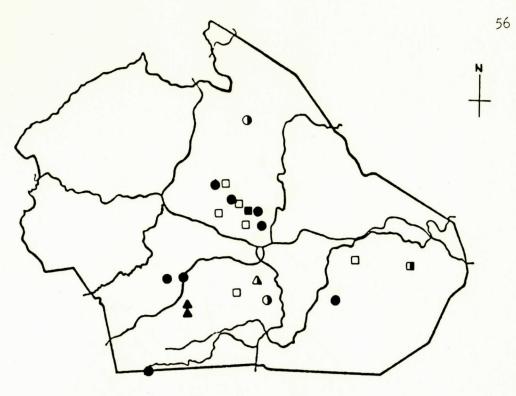
000

Map 17. Plethodon richmondi

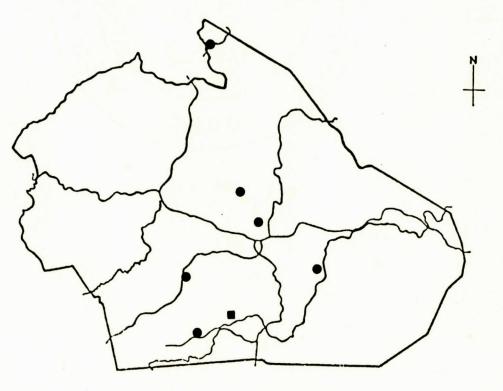


Map 18. <u>Plethodon</u> welleri

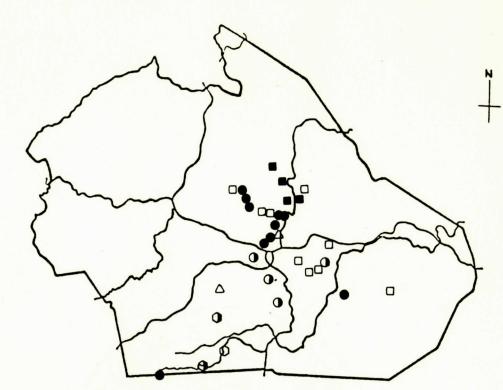




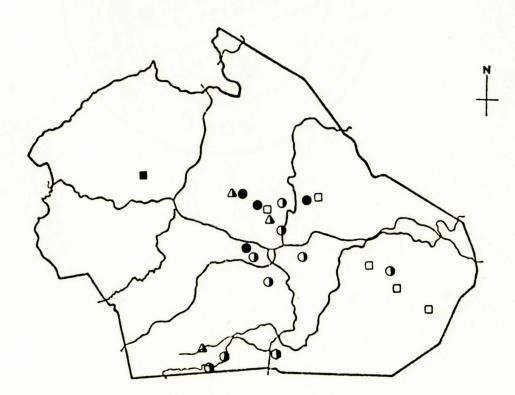
Map 19. <u>Plethodon</u> yonahlossee



Map 20. <u>Pseudotriton montanus</u>

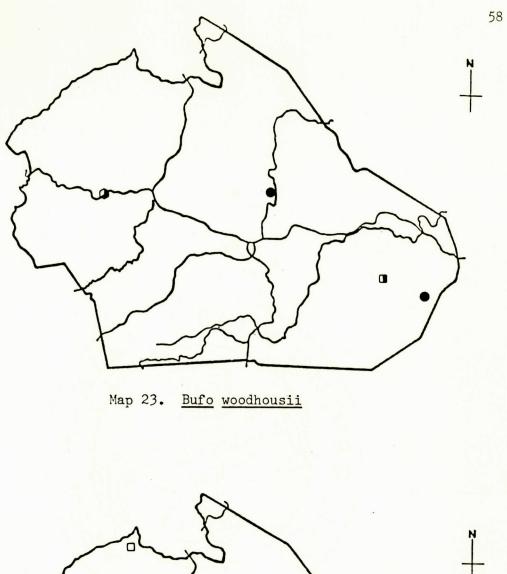


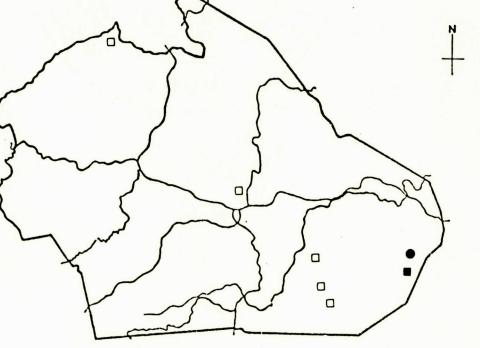
Map 21. <u>Pseudotriton</u> ruber



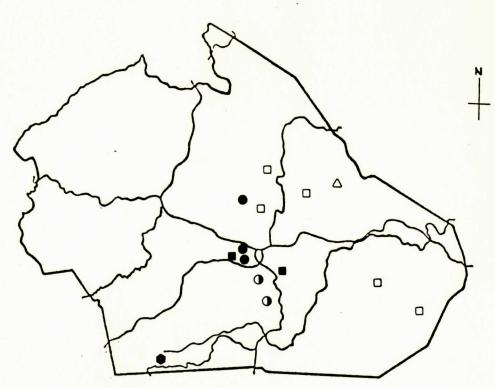
Map 22. Bufo americanus



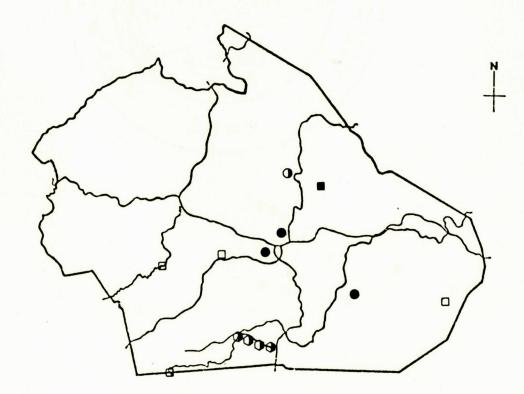




Map 24. Hyla chrysoscelis

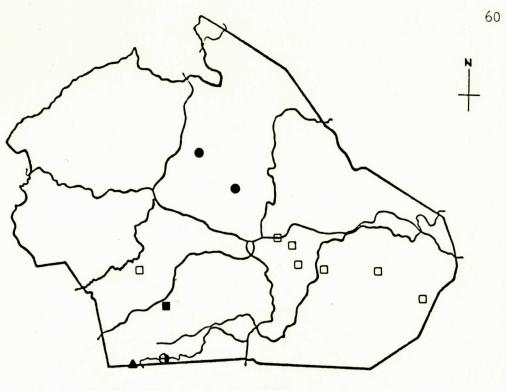


Map 25. Hyla crucifer

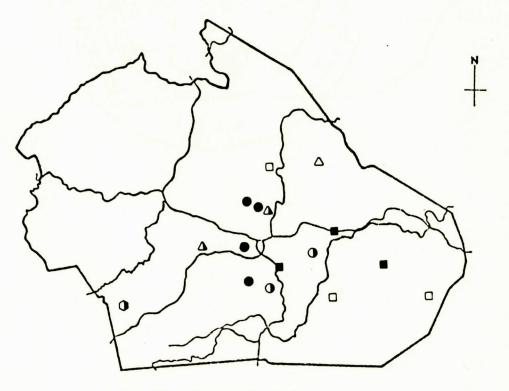


Map 26. Rana catesbeiana

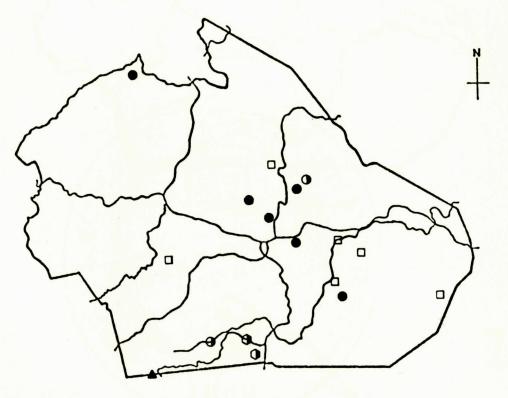




Map 27. Rana clamitans

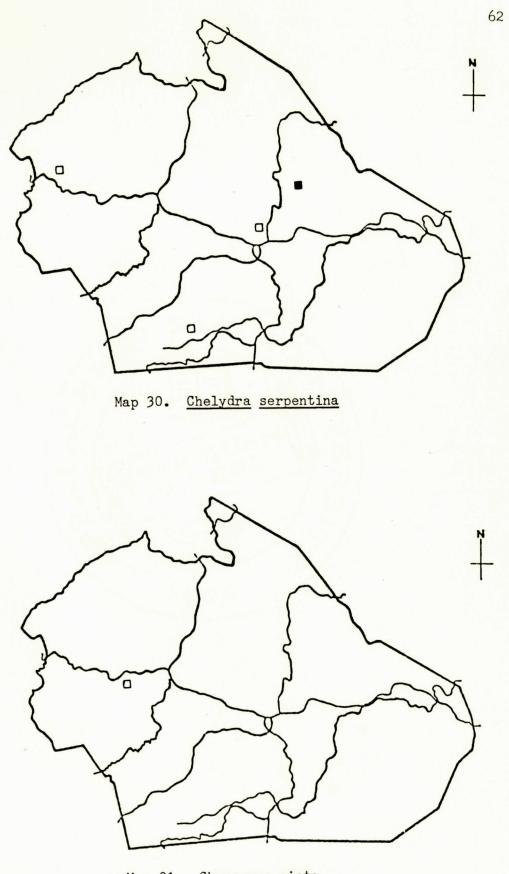


Map 28. Rana palustris

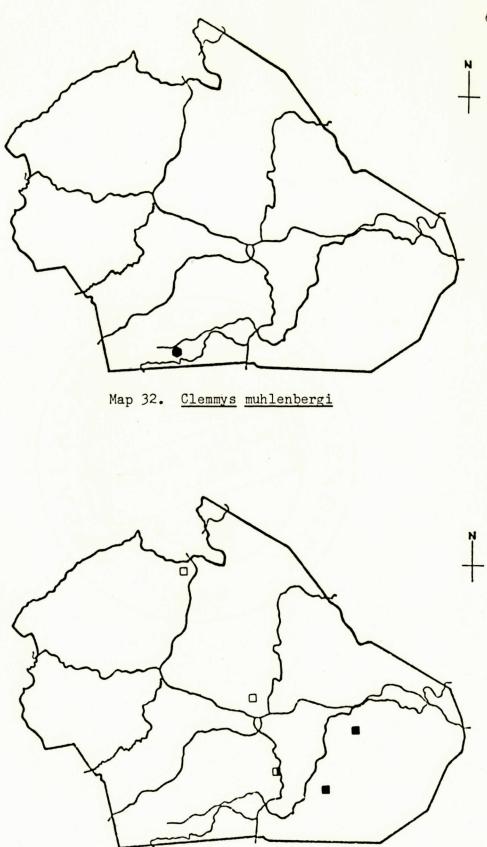


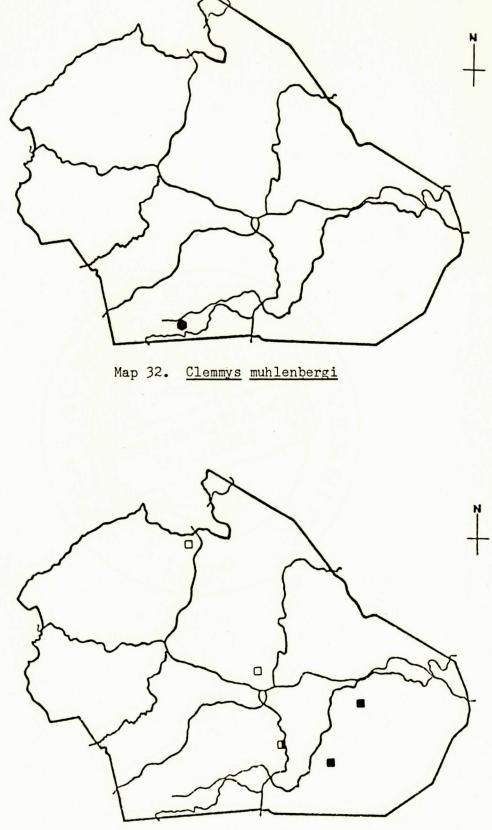
Map 29. Rana sylvatica



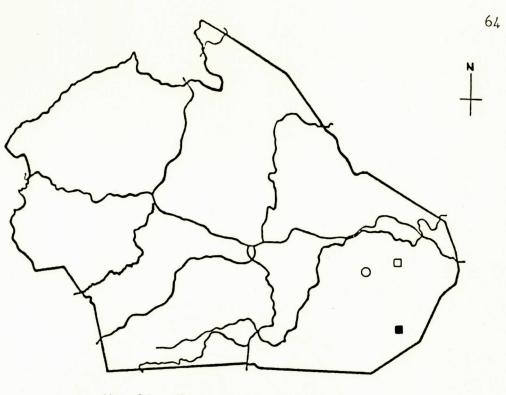


Map 31. Chrysemys picta

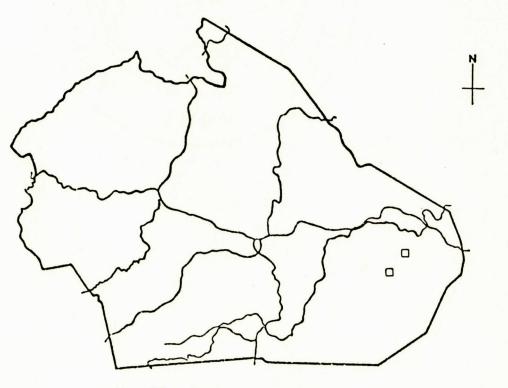




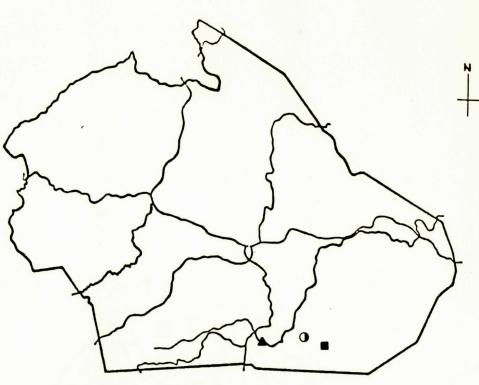
Map 33. Terrapene carolina



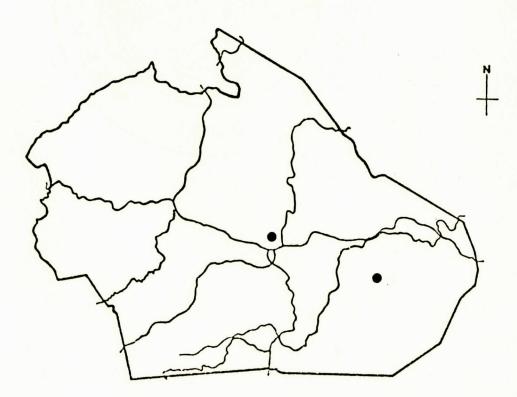
Map 34. Eumeces fasciatus



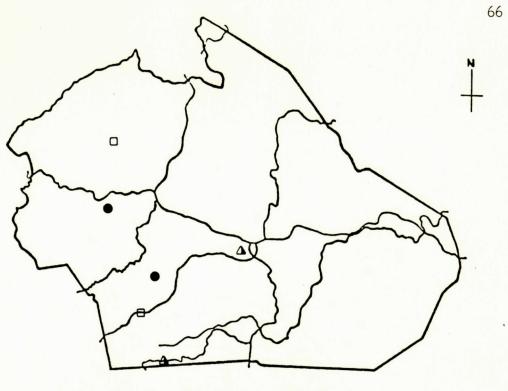
Map 35. <u>Sceloporus</u> undulatus



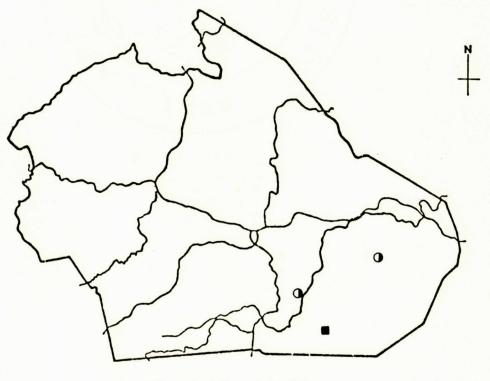
Map 36. Agkistrodon contortrix



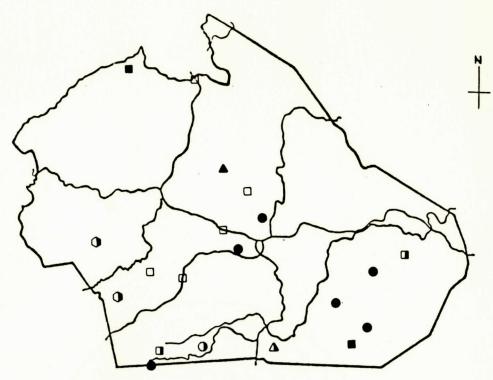
Map 37. Carphophis amoenus



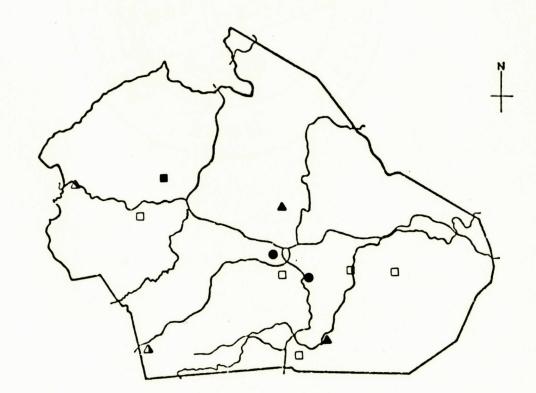
Map 38. Coluber constrictor



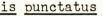
Map 39. Crotalus horridus

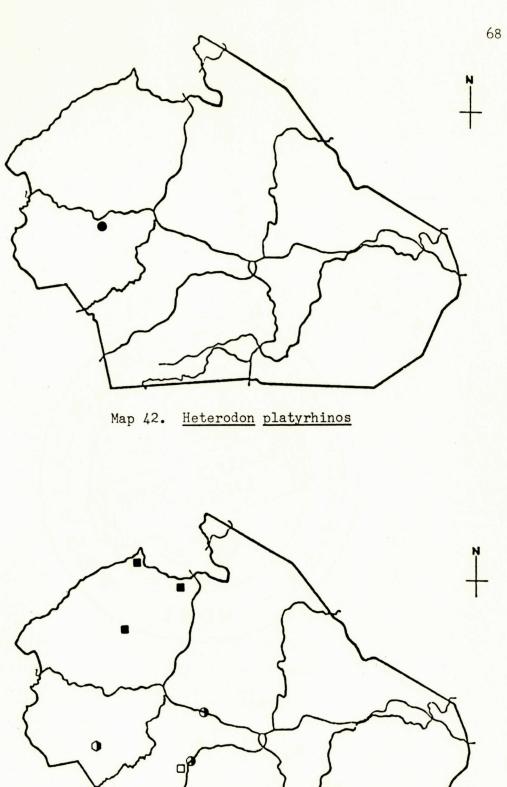


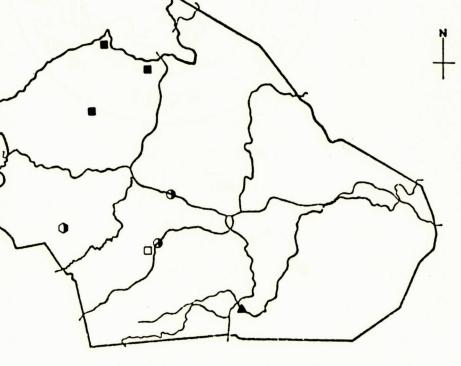
Map 40. <u>Diadophis</u> <u>punctatus</u>



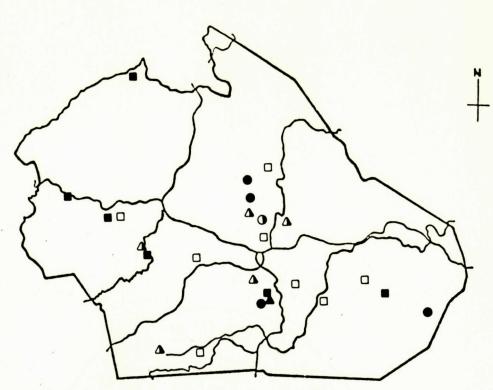
Map 41. Elaphe obsoleta



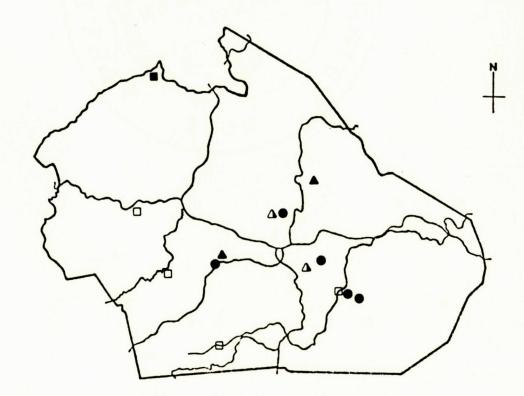




Map 43. Lampropeltis triangulum



Map 44. Nerodia sipedon

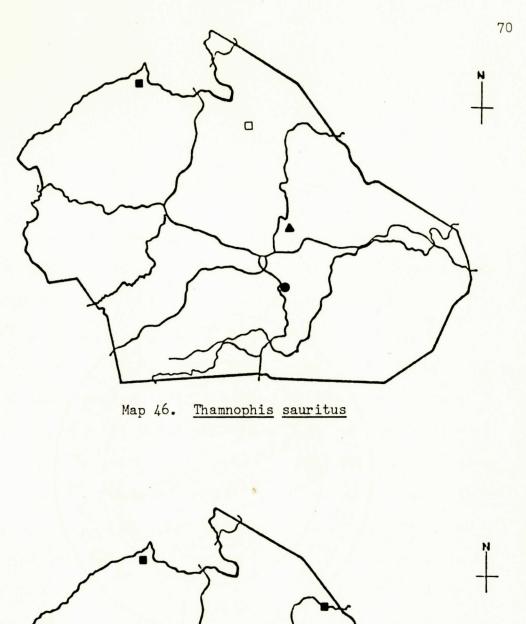


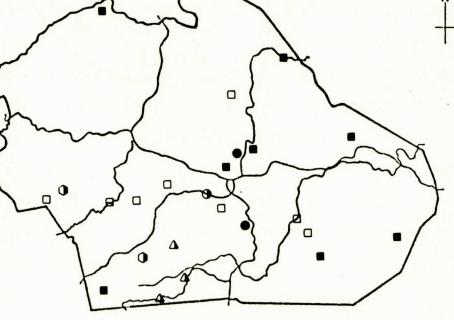
Map 45. <u>Regina septemvittata</u>

Analysis of Results

Biological surveys have been analyzed in various ways. Cain (1930) discussed diversity of trees and shrubs of the Great Smoky Mountains area on the basis of "intraneous" (not near limits of distribution) and "extraneous" (near limits of distribution) species. King (1939) followed Cain's method in discussing herpetofauna of Great Smoky Mountains National Park, and also presented graphs of elevational ranges. Rossman (1960) surveyed herpetofauna of southern Illinois, gave percentages of intraneous and extraneous forms, and categorized extraneous species as southern, northern and western. Bruce (1965) surveyed herpetofauna of the southeastern escarpment of the Blue Ridge Mountains in relation to eastern, montane, northern and southern distributions. Rubin (1965) surveyed herpetofauna of Vigo County, Indiana, and discussed distribution patterns within the county in relation to southwestern, southern, eastern, and northern species.

The herpetofaunal composition in Watauga County is apparently due to the interplay of total distribution of each species. Of the 21 salamander, 8 frog, 4 turtle, 2 lizard and 12 snake species found in Watauga County (Table 3), northern, southern, widespread, montane, and relic influences are evident (Conant, 1975). Of





Map 47. Thamnophis sirtalis

DISCUSSION

all species found, 15% are northern (ranges extended only as far south as central Georgia), 6% are southern (extended only as far north as New York), 60% are widespread in eastern United States (extended to New York and central Georgia), 15% are montane (mostly limited to the southern Appalachians), and 4% are relic (ranges were discontinuous). Most of the reptiles and all of the snakes have widespread distribution. Plethodon welleri and Clemmys muhlenbergi are relic populations.

Three concerns are suggested by results of the present study. More locality data would greatly improve the knowledge of local species, especially for less than common species. As local specimens and field notes accumulate, taxonomic and ecological problems could be answered. Rapidly changing human influences should necessitate planning and management to protect local diversity.

Future surveys may be more productive with the additional use of seines and turtle traps in lakes and rivers, and drift fences in off-road areas. Surveying south of the Blue Ridge Parkway may also produce more specimens of Piedmont species. Chrysemys picta, included in the county list on the basis of sight records alone, merits capture-release studies to determine population trends. This study would also determine whether Pseudemys scripta (sliders) and Graptemys geographica (map turtles) are also present. This turtle site may constitute a refugium for more than one species. Seidel and Green (1982) found Pseudemys

NC Herpetofaunal diversity found in Watauga County, (from Appendix A and Conant, 1975). s. TABLE

IstoT lo %	15	9	60	15	4	100
ГвтоТ	2	ŝ	28	2	8	47
AIJITTAAA	0	۲	16	0	-	18
sətnəqrə2	0	0	12	0	0	12
Birusd	0	-	-	0	0	2
sənibutsəT	0	0	б	0	-	4
AIAIHAMA	2	2	12	4	۲	29
BIUNA	2	0	9	0	0	ω
втвривО	5	R	9	7	۲	21
Species	northern	southern	widespread	montane	relic	total

Future Studies

well outside the known range at Bluestone Reservoir on the New River in Summers County, West Virginia; and <u>Graptemys</u> ranges through eastern Tennessee (Conant, 1975). Relic populations may also be demonstrated if <u>Ambystoma talpoideum</u>, <u>Hemidactylium</u>, or <u>Clemmys muhlenbergi</u> are found.

Local residents provided many interesting contributions, including the sighting of an uncollected albino <u>Elaphe obsoleta</u>, reports of <u>Cryptobranchus</u> in Winkler's and Kraut creeks and the New River, and reliable reports of <u>Agkistrodon</u> and <u>Crotalus</u> in western sections. More of these contributions would certainly help, especially if new localities are reported and verified. Alerts concerning clearing for roads and buildings, plowing and excavation, flood damage, sudden stream pollution, lake drawdowns and other ephemeral and extreme alterations of the environment would also help in collecting exposed or annihilated populations.

Many biological problems need local study. Variation in local specimens demonstrates a need for studies of subspecific status, especially among salamanders. Local breeding dates and population trends could be taken from additional field notes. Environmental hazards such as acid rain, exploitation, urbanization and drought should be assessed. West (1980) noted that when acid rain causes a pH of 7.0 or less in water at breeding sites, eggs of some salamanders fail to hatch. Bruce (1977b) noted that <u>Clemmys muhlenbergi</u> is threatened by commercial collecting and habitat destruction. Minton (1968) noted a drastic change in herpetofaunal diversity when streams were altered for housing sites. Jaeger (1980) noted extinction of a population of <u>Plethodon shenandoah</u> in Virginia due to drought and competition.

In general, local land use planning and private landowners could easily accomodate maintenance of amphibian and reptile diversity. Few species seem to be immediately susceptible to extirpation. Populations of <u>Plethodon welleri</u>, <u>Eurycea guttolineata</u>, <u>E. longicauda</u>, <u>Cryptobranchus</u>, <u>Chrysemys</u>, and <u>Clemmys</u> <u>muhlenbergi</u> could probably best be protected by maintaining the status quo. Murray, et al. (1977) proposed a "special interest area" for the protection and study of salamanders in Mount Rogers National Recreation Area. Similar proposals might be of benefit in Watauga County, in cooperation with private landowners. Interpretation of the values of local herpetofaunal diversity encourages public support. As Murray, et al. suggested,

the best method of education is to provide a modest interpretive facility.... Central to the exhibit would be a series of vivaria and aquaria housing the species in as natural a setting as could be maintained.... The possibilities for the imaginative development of what should be essentially a living museum are unlimited.

LITERATURE CITED

- Alart, E. J. 1974. A survey of monogenetic trematodes from the gills of Salmo gairdneri, Salverinus fontinalis and Salmo trutta in Watauga County, North Carolina. Unpubl. MS thesis, Appalachian St. Univ., Boone, North Carolina.
- Arthur, J. P. 1915. A history of Watauga County, North Carolina, with sketches of prominent families. Everett Waddey, Richmond, Virginia.
- Bagnell, C. B. 1969. Twenty-five common mosses of Watauga County, North Carolina. Unpubl. MA thesis, Appalachian St. Univ., Boone, North Carolina.
- Behler, J. L., and F. W. King. 1979. The Audubon Society fieldguide to North American reptiles and amphibians. Chanticleer Press, Inc., New York.
- Berry, J. A. 1980. The relative palatability of mimetic salamanders (Notophthalmus viridesens, Pseudotriton ruber, Plethodon jordani, Desmognathus spp.) to garter snakes (Thamnophis sirtalis). Unpubl. MS Thesis, Appalachian St. Univ., Boone, North Carolina.
- Breder, C. M., and R. B. Breder. 1923. A list of fishes, amphibians and reptiles collected in Ashe County, North Carolina. Zoologica 4:3-23.
- Brimley, C. S. 1944. Amphibians and reptiles of North Carolina. Carolina Tips, 1939-1943. Carolina Biological Supply Company, Elon College, North Carolina.
- Bruce, R. C. 1965. The distribution of amphibians and reptiles on the southeastern escarpment of the Blue Ridge Mountains and adjacent piedmont. J. Elisha Mitchell Sci. Soc. 81:19-24.
- Bruce, R. C. 1977a. Amphibians and reptiles introduction. p. 299-301. In: Endangered and threatened plants and animals of North Carolina. J. E. Cooper, S. S. Robinson, and J. B. Funderburg, (eds.). N. C. St. Mus. Nat. Hist., Raleigh, North Carolina.
 - . 1977b. Clemmys muhlenbergi, p. 314-315. In: Endangered and threatened plants and animals of North Carolina. J. E. Cooper, S. S. Robinson, and J. B. Funderburg, (eds.). N. C. St. Mus. Nat. Hist., Raleigh, North Carolina.

- Bruce, R. C., and committee. 1977. Amphibians and reptiles and J. B. Funderburg, (eds.). N. C. St. Mus. Nat. Hist., Raleigh, North Carolina.
- Bullman, V. 1981. The seasonal and linear distribution of benthic algal communities in a North Carolina mountain stream. Unpubl. MA thesis, Appalachian St. Univ., Boone, North Carolina.
- Cain, S. A. 1930. Certain floristic affinities of the trees and shrubs of the Great Smoky Mountains and vicinity. Butler Univ. Bot. Ser. 1:129-156.
- Carrol, O. W. 1964. Industrial waste and human sewage pollution within the New River drainage basin of Watauga County. Unpubl. MA thesis, Appalachian St. Univ., Boone, North Carolina.
- Clay, J. W., D. M. Orr, and A. W. Stuart, eds. 1975. North Caro-
- Collins, J. T., R. Conant, J. E. Huheey, J. L. Knight, E. M. Rundquist, and H. M. Smith. 1982. Standard common and current scientific names for North American amphibians and reptiles. 2nd ed. SSAR circ. no 12.
- Conant, R. 1975. A field guide to reptiles and amphibians of Company, Boston.
- Cooper, J. E., S. S. Robinson, and J. B. Funderburg. eds. 1977. Endangered and threatened plants and animals of North Caro-St. Mus. Nat. Hist., Raleigh, North Carolina.
- Cruikshank, J. W. 1941. Forest resources of the mountain region Expt. Sta., Forest Survey Release No. 7.
- De Poe, C. E., J. B. Funderburg, and T. L. Quay. 1961. The amphibians and reptiles of North Carolina: a preliminary checklist and bibliography. J. Elisha Mitchell Sci. Soc. 77:125-136.
- Duellman, W. E. 1962. Directions for preserving amphibians and reptiles, p. 37-40. In: Collecting and preparing study specimens of vertebrates. E. R. Hall (ed.). Misc. Publ. Univ. Kansas Mus. Nat. Hist. no. 30.

accounts, p. 299-329. In: Endangered and threatened plants and animals of North Carolina. J. E. Cooper, S. S. Robinson,

lina atlas. Univ. N. C. Press, Chapel Hill, North Carolina.

eastern and central North America. 2nd ed. Houghton Miflin

lina. Proceedings of the Symposium on Endangered and Threatened Biota of North Carolina. 1. Biological Concerns. N. C.

of North Carolina. Forest Service, USDA, Appalachian Forest

- Dunn. E. R. 1917. Reptile and amphibian collections from the North Carolina mountains, with especial reference to salamanders. Bull. Amer. Mus. Nat. Hist. 37:593-634.
- Ernst. C. H., and R. W. Barbour. 1972. Turtles of the United States. Univ. Press of Kentucky, Lexington, Kentucky.
- Erwin, C. 1979. Geographic distribution: Ambystoma talpoideum. Herp. Rev. 10:23.
- Fenneman, N. W. 1938. Physiography of Eastern United States. McGraw-Hill Book Company, New York.
- Flisser, D. E. 1979. First year vascular flora in the Tater Hill Lake basin, Watauga County, North Carolina. Unpubl. MS thesis, Appalachian St. Univ., Boone, North Carolina.
- Gentry, G. 1955. An annotated check list of the amphibians and reptiles of Tennessee. J. Tenn. Acad. Sci. 30:168-176.
- Gordon, R. E., J. E. Macmahon, and D. B. Wake. 1962. Relative abundance, microhabitat, and behavior of some Southern Appalachian salamanders. Zoologica 47:9-14.
- Hairston, N. G. 1949. The local distribution and ecology of the plethodontid salamanders of the Southern Appalachians. Ecol. Monogr. 19:47-73.
- Harris, G. A. 1981. The reproductive ecology and population analysis of the salamander Plethodon yonahlossee. Unpubl. MA thesis, Appalachian St. Univ., Boone, North Carolina.
- Hensel, J. L., and E. D. Brodie. 1976. An experimental study of aposematic coloration in the salamander Plethodon jordani. Copeia 1976:59-65.
- Hicks, M. L. 1964. The hepatic flora of Watauga County, North Carolina. Unpubl. MA thesis, Appalachian St. Univ., Boone, North Carolina.
- Highton, R. 1962. Revision of North American salamanders of the genus Plethodon. Bull. Fla. St. Mus. 6:235-367.
- Huheey, J. E., and A. Stupka. 1967. Amphibians and reptiles of the Great Smoky Mountains National Park. Univ. of Tenn. Press, Knoxville, Tennessee.
- Jaeger, R. G. 1980. Density-dependent and density-independent causes of extinction of a salamander population. Evolution 34:617-621.

- King, W. 1939. A survey of the herpetology of Great Smoky Mountains National Park. Amer. Midl. Nat. 21:531-582.
- Martof, B. S., W. M. Palmer, J. R. Bailey, and J. R. Harrison, III. Univ. N. C. Press, Chapel Hill, North Carolina.
- Martof, B. S., and F. L. Rose. 1962. The comparative osteology of and Pseudotriton. Copeia 1962:727-732.
- Minton, S. A. 1968. The fate of amphibians and reptiles in a suburban area. J. Herpetol. 2:113-6.
- Moore, Gardner and Associates. 1969. Report on Watauga County sewerage requirements to 1990. Moore, Gardner and Assoc., Asheboro, North Carolina.
- Moore, J. P. 1899. Leurognathus marmorata, a new genus and species of salamander of the family Desmognathidae. Proc. Acad. Nat. Sci. 51:316-324.
- Moore, T. A. 1972. The phytoecology of Boone Fork Sphagnum Bog.
- Murray, J. J., H. G. M. Jopson, and J. A. Organ. 1977. Proposal for a special interest area for the protection and study of the amphibian fauna of the Mt. Rogers National Recreation Area. Univ. Va., Charlottesville. (Unpublished).
- National Oceanic and Atmospheric Administration, Environmental Data and Information Service. 1982. Climatological data, 1981 North Carolina.
- New River Valley Resource Conservation and Development Project Council. 1974. New River Valley resource conservation and Raleigh, North Carolina.
- Organ, J. A. 1961. Studies of the local distribution, life history, in Virginia. Ecol. Monog. 31:189-220.
- Pisani, G. R. 1973. A guide to preservation techniques for amphibians and reptiles. SSAR circ. no. 1.
- Rossman, D. A. 1960. Herpetofaunal survey of the Pine Hills area

1980. Amphibians and reptiles of the Carolinas and Virginia.

the anterior cranial elements of the salamanders Gyrinophilus

comprehensive study as to population, economy, and water and

Unpubl. MS thesis, Appalachian St. Univ., Boone, North Carolina.

annual summary, North Carolina. Nat. Clim. Cent. Asheville,

development: project plan. Soil Conservation Service, USDA,

and population dynamics of the salamander Genus Desmognathus

of southern Illinois. Flor. Acad. Sci. Quart. J. 22:207-225.

- Rubin, D. 1965. Amphibians and reptiles of Vigo County, Indiana. Unpubl. MS thesis, Ind. St. Univ., Terre Haute, Indiana.
- Seidel, M. E., and B. Green. 1982. On the occurrence of cooter turtles (subgenus <u>Pseudemys</u>) in the upper Ohio River Valley. Herp. Rev. 13:132-134.
- Society for the Study of Amphibians and Reptiles. 1971 et seq. The Catalogue of American amphibians and reptiles. S. G. Tilley, ed., Smith College, Northampton, Massachusetts.
- Stebbins, R. C. 1966. A field guide to western reptiles and amphibians. Houghton Mifflin Co., Boston, Massachusetts.
- Tuelings, R. P., and J. E. Cooper. 1977. Cluster areas, p. 409-433. <u>In</u>: Endangered and threatened plants and animals of North Carolina. J. E. Cooper, S. S. Robinson, and J. B. Funderburg, (eds.). N. C. St. Mus. Nat. Hist., Raleigh, North Carolina.
- U. S. Department of Agriculture. 1958. Soil Survey of Watauga County, N. C. Series 1944, No. 5. U. S. Gov. Printing Off., Washington, D. C.
- . 1974. An appraisal of potentials for outdoor recreational development, Watauga County, NC. U. S. Gov. Printing Off., Washington, D. C.
- U. S. Bureau of the Census. 1982a. North Carolina census of Agriculture, 1978. U. S. Gov. Printing Off., Washington, D. C.
- . 1982b. 1980 Census of Population Vol. 1, Chap. B, General Population Characteristics, Part 35, North Carolina. U. S. Gov. Printing Off., Washington, D. C.
- Van Devender, R. W., and P. F. Nicoletto. The reptiles of Lower Wilson Creek, Caldwell County, North Carolina: a thermal refugium for reptiles? Brimleyana, <u>In press</u>.
- Wake, D. B. 1966. Comparative osteology and evolution of the lungless salamanders, Family Plethodontidae. Memoirs Southern Cal. Acad. Sci. 4:1-111.
- Walker, C. E. 1931. Description of a new salamander from North Carolina. Proc. Junior Soc. Nat. Sci. (Cincinnati), 2:48-51.

Watauga Democrat. 1976. See you later alligator. 14 October:16.

West, S. 1980. Acid from heaven. Sci. News 117:76-8.

Wortham, J. W. E., R. A. Brandon, and A. Martan. 1977. Comparative morphology of some plethodontid salamander spermatozoa. Copeia 1977:666-680.

Working List of Amphibians and Reptiles of Watauga County

APPENDICES

APPENDIX A

The working list of amphibians and reptiles of Watauga County, North Carolina, was based on range maps of Martof, et al. (1980) and Conant (1975). Abundance values appear in the last column for species found in Watauga County. Asterisks (*) indicate species not recorded before the present study. Species listed as probable or marginal were assumed to possibly occur in the county.

Probable Species

Species whose range included Watauga County (Martof, et al., 1980) were:

Class Amphibia, Order Caudata

Ambystoma maculatum, spotted salamander Ambystoma opacum, marbled salamander Cryptobranchus alleganiensis, hellbender Desmognathus fuscus, dusky salamander Desmognathus monticola, seal salamander Desmognathus ochrophaeus, mountain dusky salamander Desmognathus quadramaculatus, blackbelly salamander Desmognathus wrighti, pigmy salamander* Eurycea bislineata, two-lined salamander Eurycea guttolineata, three-lined salamander Eurycea longicauda, longtail salamander Memidactylium scutatum, four-toed salamander Leurognathus marmoratus, shovelnose salamander

uncommon common abundant abundant abundant very rare abundant rare uncommon fairly common

fairly common

fairly common

Notophthalmus viridescens, eastern newt Plethodon cinereus, redback salamander Plethodon glutinosus, slimy salamander Plethodon jordani, Jordan's salamander Plethodon richmondi, ravine salamander Plethodon welleri, Weller's salamander* Plethodon yonahlossee, Yonahlossee salamander Pseudotriton ruber, red salamander Class Amphibia, Order Anura Bufo americanus, American toad Bufo woodhousii, Woodhouse's toad Hyla chrysoscelis, Cope's gray treefrog* Hyla crucifer, spring peeper Pseudacris triseriata, striped chorus frog Rana catesbeiana, bullfrog Rana clamitans, green frog Rana palustris, pickerel frog Rana sylvatica, wood frog

<u>Class Reptilia, Order Testudines</u> <u>Chelydra serpentina</u>, snapping turtle* <u>Chrysemys picta</u>, painted turtle* <u>Clemmys muhlenbergi</u>, bog turtle <u>Sternotherus odoratus</u>, stinkpot <u>Terrapene carolina</u>, eastern box turtle* common uncommon common common fairly common rare fairly common common

common uncommon uncommon abundant

common uncommon common common

46

uncommon very rare missing

uncommon

Class Reptilia, Order Squamata, Suborder Sauria

Eumeces anthracinus, coal skink	
Eumeces fasciatus, five-lined skink*	rare
Eumeces laticeps, broadhead skink	
Sceloporus undulatus, eastern fence lizard*	rare

Class Reptilia, Order Squamata, Suborder Serpentes Agkistrodon contortrix, copperhead* Carphophis amoenus, worm snake* Coluber constrictor, racer Crotalus horridus, timber rattlesnake* Diadophis punctatus, ringneck snake Elaphe guttata, corn snake Elaphe obsoleta, rat snake Heterodon platyrhinos, eastern hognose snake* Lampropeltis getulus, common kingsnake Lampropeltis triangulum, milk snake Nerodia sipedon, northern water snake Opheodrys aestivus, rough green snake Regina septemvittata, queen snake Storeria dekayi, brown snake Storeria occipitomaculata, redbelly snake Thamnophis sauritus, eastern ribbon snake Thamnophis sirtalis, common garter snake

rare rare uncommon rare fairly common fairly common very rare uncommon common fairly common

uncommon common

Species whose range approached to 50 mi (81 km) of Boone (Martof, et al., 1980; Conant, 1975 was used only for ranges in Tennessee) included:

Class Amphibia, Order Caudata Ambystoma talpoideum, mole salamander Aneides aeneus, green salamander Eurycea lucifuga, cave salamander Necturus maculosus, mudpuppy Plethodon wehrlei, Wehrle's salamander Pseudotriton montanus, mud salamander

Class Amphibia, Order Anura

Acris crepitans, northern cricket frog Gastrophryne carolinensis, eastern narrowmouth toad Pseudacris brachyphona, mountain chorus frog Rana utricularia, southern leopard frog Scaphiopus holbrookii, eastern spadefoot

Class Reptilia, Order Testudines Graptemys geographica, map turtle Pseudemys scripta, slider Sternotherus minor, loggerhead musk turtle Trionyx spiniferus, spiny softshell

uncommon

Class Reptilia, Order Squamata, Suborder Sauria Cnemidophorus sexlineatus, six-lined racerunner Scincella lateralis, ground skink

<u>Class Reptilia, Order Squamata, Suborder Serpentes</u> <u>Cemophora coccinea</u>, scarlet snake <u>Lampropeltis calligaster</u>, prairie kingsnake <u>Pituophis melanoleucus</u>, pine snake <u>Tantilla coronata</u>, southeastern crowned snake <u>Virginia valeriae</u>, smooth earth snake

APPENDIX B

Expected Species

Only 3 amphibian and 8 reptile species that probably occur in Watauga County have not been recorded (Appendix A). All marginal species, except Pseudotriton montanus, were not recorded. This indicates (but does not prove) that these species do not occur in the county. However, considering the paucity of records for some local species and collecting biases of the present study, species that existed in the county may have been missed. Therefore, the following notes are presented to encourage further pursuit of species as yet unrecorded.

Ambystoma opacum (Gravenhorst), marbled salamander, probable.

This stocky, black and white salamander is uncommon in the mountains (Martof, et al., 1980), and might be found in flood plains in southeastern Watauga County. The nearest North Carolina record is from Surry County, at 8.5 mi (14 km) S of Pilot Mountain (NCSM 16272).

Hemidactylium scutatum (Schlegel), four-toed salamander, probable.

This small brown salamander with a white belly and constricted tail base is scattered in North Carolina (Martof, et al., 1980). It may yet be found breeding in March or April in local bogs and shallow ponds. The nearest North Carolina records are Surry County, 8.5 mi (14 km) S town of Pilot Mountain (NCSM 16215-8), and Buncombe County, 2.25 mi (3.6 km) NNW of Avery Creek (NCSM 19038). Gentry (1955) found this species in Johnson County, Tennessee. Pseudacris brachyphona (Cope), mountain chorus frog, marginal.

Mountain chorus frogs are small brown to gray with blotched dorsums and white upper lips. They breed in shallow streamside

in the state (Martof, et al., 1980), and may show up at lower elevations in Watauga County. The nearest North Carolina records are Wilkes County, 2 mi (3.2 km) SE Wilbar (DU R-636) and Caldwell County, Lower Wilson Creek (Van Devender and Nicoletto, 1983). Elaphe guttata (Linnaeus), corn snake, probable.

This red, yellow, black and white snake has dorsal blotches and keeled scales. Though this species reaches 2500 ft (760 m) in the state (Martof, et al., 1980), they are uncommon in the mountains. It may appear at lower elevations in the county. The nearest North Carolina record is Burke County near Valdese (NCSM 1470a).

Lampropeltis getulus (Linnaeus), eastern kingsnake, probable. This large black snake has smooth scales and a white chainlike pattern. It reaches 2500 ft (760 m) but is uncommon in the mountains (Martof, et al., 1980). The nearest North Carolina record is Caldwell County, at Lenoir (USNM 14540).

Opheodrys aestivus (Linnaeus), rough green snake, probable.

This small, slender green snake has a yellow venter and keeled dorsal scales. It reaches 3000 ft (910 m) and may appear in foliage over small streams at lower elevations (Martof, et al.. 1980).

Storeria dekayi (Holbrook), brown snake, probable.

This brown, red or gray snake has keeled scales and a light dorsal stripe bordered by rows of spots. It reaches high elevations in the mountains and might be found under debris in wooded

ponds from February to April (Martof, et al., 1980). The nearest record is Johnson County, Tennessee (Gentry, 1955). Pseudacris triseriata (Wied), striped chorus frog, probable.

Though in the northern part of its range this species may reach high elevations, it only reaches low elevations in the mountains of North Carolina (Martof, et al., 1980). This small brown or gray frog with a white upper lip and dark eve stripe might be found breeding in the late winter in flood pools in southeastern Watauga County. The nearest record is from below Kerr Scott Dam in Wilkes County (ASU 7501).

Sternotherus odoratus (Latreille), stinkpot, probable.

This small turtle has two eye lines and only an anterior plastron hinge. It is rare in the mountains (Martof, et al., 1980), but it may turn up in soft-bottomed streams. The nearest North Carolina record is Alleghany County, 5 mi (8.1 km) NW Sparta (NCSM 6358-9, 6414-9).

Eumeces anthracinus (Baird), coal skink, probable.

This small blue and brown skink has only four light dorsal stripes and one postmental scale. Its range only enters Watauga County in the southeast corner, and its populations are scattered and disjunct. It is found near water on wooded, rock slopes (Martof, et al., 1980). The nearest North Carolina record is Caldwell County at Globe (NCSM 21268-9).

Eumeces laticeps (Schneider), broadhead skink, probable.

This large skink has five upper labial scales before the subocular scale, thirty or thirty-two rows of body scales, and breeding males have broad red heads. It is rare at higher elevations urban areas or forests (Martof, et al., 1980) in southeastern Watauga County.

Storeria occipitomaculata (Storer), redbelly snake, probable. This variable brown or gray snake has keeled scales and usually a small labial blotch, a light dorsal stripe bordered in black, three orange nape blotches and an orange venter. Its habitat preference is similar to that of S. dekayi (Martof,

et al., 1980).

Significant recent locality records extend North Carolina ranges given in Martof, et al (1980), so that additional species may be considered as possibly occurring in Watauga County. These include Anolis carolinensis, Eumeces inexpectatus, Scincella laterale and Tantilla coronata at Lower Wilson Creek. Caldwell County (Van Devender and Nicoletto, 1983, in press); and Ambystoma talpoideum on the Blue Ridge Parkway, Alleghany County (Erwin, 1979).

A few non-native species have been recorded in Watauga County and are mentioned as a note on the hazards of the exotic pet trade and in keeping live non-native specimens. These observations concern only outdoor records, and none of these species were expected to survive or reproduce in the county. Caiman sp., caiman

This animal was collected by Bryan Norris in October 1976 near the Watauga River about 6 mi (9.7 km) SW Boone (Watauga Democrat, 1976). It was deemed an alligator and given to wildlife enforcement officers and apparently sent to the North Carolina coast. R. W. Van Devender assigned this specimen to the genus Caiman by its picture.

Anolis carolinensis (Voigt), green anole This species was collected by Vickie Vaughan in November 1980 at Longvue Motel, Boone (ASU 5219). It was apparently a fugitive specimen. Anolis carolinensis has been recorded in Caldwell County.

Cemophora coccinea (Blumenbach), scarlet kingsnake

A specimen collected by John Mackay in May 1977 from southeastern Chatham County, South Carolina was released in September 1978 in the Appalachian State University wooded area near campus. Martof, et al. (1980) gave the range of this species as occurring in Caldwell County. The specimen has not been observed since its release.

APPENDIX C

Incidental Species

Joseph Kelly Williams was born in Charlotte, North Carolina, on 8 January 1954. He attended schools in Syosset, New York and Boone, North Carolina and graduated from Watauga High School in June 1972. The following September he entered Appalachian State University, and in May 1976 he received a Bachelor of Arts degree in Biology. In the fall of 1976 he accepted a teaching assistantship at Appalachian State University and began study toward a Master's degree. During the summers of 1978-1981 he was employed as naturalist counselor at Camp Mondamin in Tuxedo, North Carolina. A return to graduate research and coursework resulted in his being awarded the Master's degree in May 1983.

The author is a member of Beta Beta Beta, North Carolina Herpetological Society, Society for the Study of Amphibians and Reptiles, and Sierra Club.

Mr. Williams' address is 812 Faculty Street, Boone, North Carolina, 28607.

His parents are Dr. and Mrs. John F. Williams, also of Boone.

VITA