SEASONAL ACTIVITY OF REPTILES AT A WOODLAND AND A FIELD POND IN LAND BETWEEN THE LAKES: RESULTS AFTER SEVEN YEARS OF DATA COLLECTION

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SEASONAL ACTIVITY OF REPTILES AT A WOODLAND AND A FIELD POND IN LAND BETWEEN THE LAKES: RESULTS AFTER SEVEN YEARS OF DATA COLLECTION

A Thesis

Presented for the

Master of Science

Degree

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Charles Austin Rozelle

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DEDICATION

Firstly, I would like to dedicate this thesis to my beloved wife, Kitty, for her undying love, patience, understanding, and self-sacrifice throughout my collegiate career. Her devotion has enabled me to accomplish all of my goals. My gratitude to her is inexpressible.

Secondly, I must offer my deepest gratitude to Dr. A. Floyd Scott; my mentor, my most revered critic, but above all, my friend. His guidance, companionship, and patience have been invaluable. He has affected me at the deepest of levels, and a simple thank you is inadequate at best.

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Much appreciation is extended Drs. William H. Ellis, Dean Emeritus and Steven W. Hamilton, Professors of Biology at Austin Peay State University, for their assistance and guidance in the preparation of this manuscript. Their willingness to share their knowledge and time has been of great value to me.

Gratitude is also expressed to the numerous undergraduate and graduate research assistants who, along with myself, collected the data analyzed in this thesis.

ABSTRACT

I analyzed data on reptile captures and selected abiotic conditions recorded from 1 July 1987 through 30 June 1994 at two closely situated ponds in the Tennessee portion of Land Between The Lakes. Objectives were to: 1) compare yearly changes in the composition, richness, relative abundance, activity levels, and directional movements of reptile species at each pond; 2) attempt to correlate fluctuations in activity levels with selected abiotic factors; 3) evaluate the potential impact of habitat alteration (clearing, discing, and seeding grass) at the field pond on community dynamics; and 4) look for evidence of any population or community trends developing over the study period. Ponds were visited every other day (except during colder periods of winter) to collect data. Reptiles were captured in pit traps set in pairs on either side of metal drift fences placed around the periphery of each pond. Abiotic variables monitored included air temperature, soil temperature, soil moisture, relative humidity, and rainfall. Overall, 336 captures (207 at the woodland pond and 129 at the field pond) representing 16 species were recorded. Although captures at the woodland pond exceeded those at the field pond, the average captures per pit for the study was 6.5 at each pond. Species richness for the study period was

14 at the woodland pond and 13 at the field pond. Four species of lizards and three species of turtles were documented at each pond; snakes numbered seven species at the woodland pond and six species at the field pond. Lizard captures dramatically exceeded those of turtles and snakes, comprising 78% at both ponds. Seasonal changes in activity levels were similar at the two ponds peaking in summer at both, but the second-most active period was fall at the field pond and spring at the woodland pond. Movements toward and away from the ponds were statistically equal (Yates corrected chi square) at 112 versus 95 (woodland pond) and 62 versus 67 (field pond). Results of correlation analyses (Spearman rank-order coefficient) comparing changes in cumulative monthly captures and monthly means (totals in case of rainfall) of abiotic factors were also similar at the two ponds. At each, captures were positively correlated with soil temperature and air temperature but not correlated with rainfall, humidity, or soil moisture. Habitat modification at the field pond (beginning in Fall, 1991 and occurring periodically through Fall, 1993) coincided with a 50% decrease (6 to 3) in species richness that lasted for two years (1992 and 1993). Average captures per pit decreased steadily at both ponds from 1991 through the end of the study. Results indicated the following about the reptile communities at the two ponds: 1) species composition

and levels of activity are similar: 2) fluctuating levels of activity over the annual cycle correlate with temperatures, but not other factors monitored; 3) directional movement in relation to each pond is random; 4) yearly activity appears to be decreasing; 5) the influence of habitat alteration (if any) at the field pond was not readily discernible; and 6) the study should be continued for several more years before accepting fully the results obtained in this study.

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CHAPTER I

INTRODUCTION

Several studies dealing with seasonal and/or monthly changes in the activity and community dynamics of amphibians and/or reptiles at or near ponds in the southeastern United States have been completed (Murphy, 1963; Gibbons et al., 1979; Dodd and Charest, 1988; Phelps and Lancia, 1995; Dodd, 1992). In a five year study completed in 1990, Dodd (1992) found 26 species using a continuous drift fence around a pond in an old-growth, long-leaf pine woods in central Florida. In two summers of sampling in 1992 and 1993, Phelps and Lancia (1995) recorded 14 species using a drift fence beside a blackwater swamp in South Carolina.

All of these investigations were conducted in either the Piedmont or the Coastal Plain portions of the Southeastern United States leaving the Interior Low Plateaus component unstudied. This study was an attempt to remedy this situation by monitoring changes in the composition and activity of the reptilian communities at two ponds on the Interior Low Plateaus of north-central Tennessee in the area known as Land Between The Lakes (LBL).

Objectives

The major goal of this study was to analyze data on reptilian activity and selected abiotic factors collected over a 7-year period at two closely situated ponds, one surrounded by woodland, the other by field. This involved the following objectives:

1) Compare yearly changes in the composition, richness, relative abundance, activity levels, and directional movements of the reptilian species at each pond.

2) Attempt to correlate changes in species richness and levels of reptilian activity with variations in selected abiotic factors being monitored at each pond.

3) Look for evidence of community changes following habitat alterations (clearing, plowing, disking, planting and mowing at the field pond beginning in 1991.

4) Identify any long-term population trends developing in the reptile communities at either or both ponds.

Limitations of Study

This was a descriptive study, without replicates, of reptilian activity that occurred around two ponds of differing character in northwestern Middle Tennessee. As such, the conclusions drawn apply only to the immediate study site and not to similar ponds in the general area or region. The technique used to capture animals worked well for lizards, turtles, and small snakes, but wasn't effective in capturing adults of the larger species of snakes in the area. Also, a larger number of captures would have resulted had the drift fences around each pond been continuous rather than with gaps.

CHAPTER II

STUDY AREA

General Setting

The setting for this study was Tennessee Valley Authority's (TVA) Land Between The Lakes (LBL), a 68,000-ha parcel of public property on the extreme western edge of the Highland Rim Section of the Interior Low Plateaus physiographic province. Established in 1963 as a multiple-use, national recreation and demonstration area, LBL averages about 13 km wide and extends 61 km between the lower reaches of the Tennessee and Cumberland rivers (each impounded to form Kentucky and Barkley lakes, respectively) from its southern boundary near Dover, Tennessee to its northern limit near Grand Rivers, Kentucky (Thach et al., 1987). Heavily forested (89%) but dotted with many small and some larger breaks in the canopy (Thach et al., 1987), LBL is heavily dissected by small, closely situated tributaries (many intermittent) draining mainly eastward and westward into Barkley and Kentucky lakes, respectively (Harris, 1980). This has produced a topography characterized by narrow ridges, steep slopes, and ravines (Chester and Ellis, 1995). More than 500 small ponds, some natural but most man-made, are scattered across LBL (Scott and Twombly, 1994).

Vegetationally, LBL is located in the transition zone of the Eastern and Western Mesophytic forest regions, an area referred to as the Oak-Hickory Association (Braun, 1950). Like most of the surrounding region, its dissected uplands support a variety of plant communities on its dry ridges, slopes, ravines, and bluffs (Chester and Ellis, 1989). Fralish and Crooks (1988) studied forest communities in the Kentucky portion of LBL and found them to be dominated by oaks (*Quercus alba* and *Q. stellata*) and hickories (*Cary tomentosa* and *C. ovata*). Concerning its vascular flora, LBL is described as a botannical crossroads with over 1300 taxa including elements from the prairies to the north and west, Coastal Plain to the south, and mesic forests to the east (Chester and Ellis, 1995).

Geologically, LBL has substrata consisting mainly of Quaternary-age alluvial deposits underlain by Mississippian-age St. Louis and Warsaw limestones (Hardeman, 1966). Outcrops are common along ridges and bluffs occur frequently along the shorelines of Kentucky and Barkley lakes.

Soils of LBL's upland areas are composed of three complexes: 1)Brandon-Lax - generally well-drained and confined to the upland ridge running the length of LBL,

2) Baxter-Hammack - well-drained and found as upland soils on sloping to steeply sloped topography, and 3) Brandon-Saffel - also well-drained occurring in sloping to very steeply sloped areas (USDA, 1953). Loess typically covers these soils to varying depths of up to 1.3 m (Fralish and Crooks, 1989). In the bottomland areas, soils are generally alluvial in nature, having been derived from the erosion of upland soils. They exhibit some variation, but are mostly silty at the surface and become rockier as depth increases (Harris, 1988).

The climate of the LBL region is of the humid, mesothermal type with relatively mild winters and little or no water deficiency in any season (Thornthwaite, 1948). The following data on selected climatic variables are based on data taken over a 34-year period (1921 to 1955) at Dover, Tennessee, the nearest official weather station (NOAA, 1974). The mean annual temperature is 15.1°C with January being the coldest month (4.4°C) and July the warmest (25.9°C). The mean annual precipitation is 121.3 cm with January being the wettest month (14.7 cm) and October the driest (7.2 cm). Average dates of the first fall and last spring frosts are 19 October and 15 April, respectively.

Location

The study area was in the Tennessee (Stewart County, Tharpe, TN topographic quadrangle) portion of LBL along the north side of LBL Road 220, approximately one km east of LBL 100 (The Trace) (Fig. 1). At latitude/longitude 36°35'14"N, 87°55'45"W and an elevation 168 m above sea level (U. S. Dept. of Interior, 1957), it consisted of two artificial ponds approximately 30 m apart, one surrounded by woodland, the other by old-field shrubs and herbs (until fall 1991 when clearing was carried out). Both ponds were constructed in the 1950s, prior to establishment of LBL, for use by farm animals (pers. comm. Mr. Guy Nolin, former resident of area).

Woodland Pond

The westernmost pond was situated in a mature, second-growth forest (Fig. 2) consisting of upland-hardwood species dominated by White Oak (*Quercus alba*), but also including American Ash (*Fraxinus americana*), Wild Black Cherry (*Prunus serotina*), Winged Elm (*Ulmus alata*), Mockernut Hickory (*Carya tomentosa*), and Black Gum (*Nyssa sylvatica*). Oval in shape, this pond was approximately 10 m wide by 20 m long and had a bottom composed of mud covered by decaying leaf litter and other organic debris.

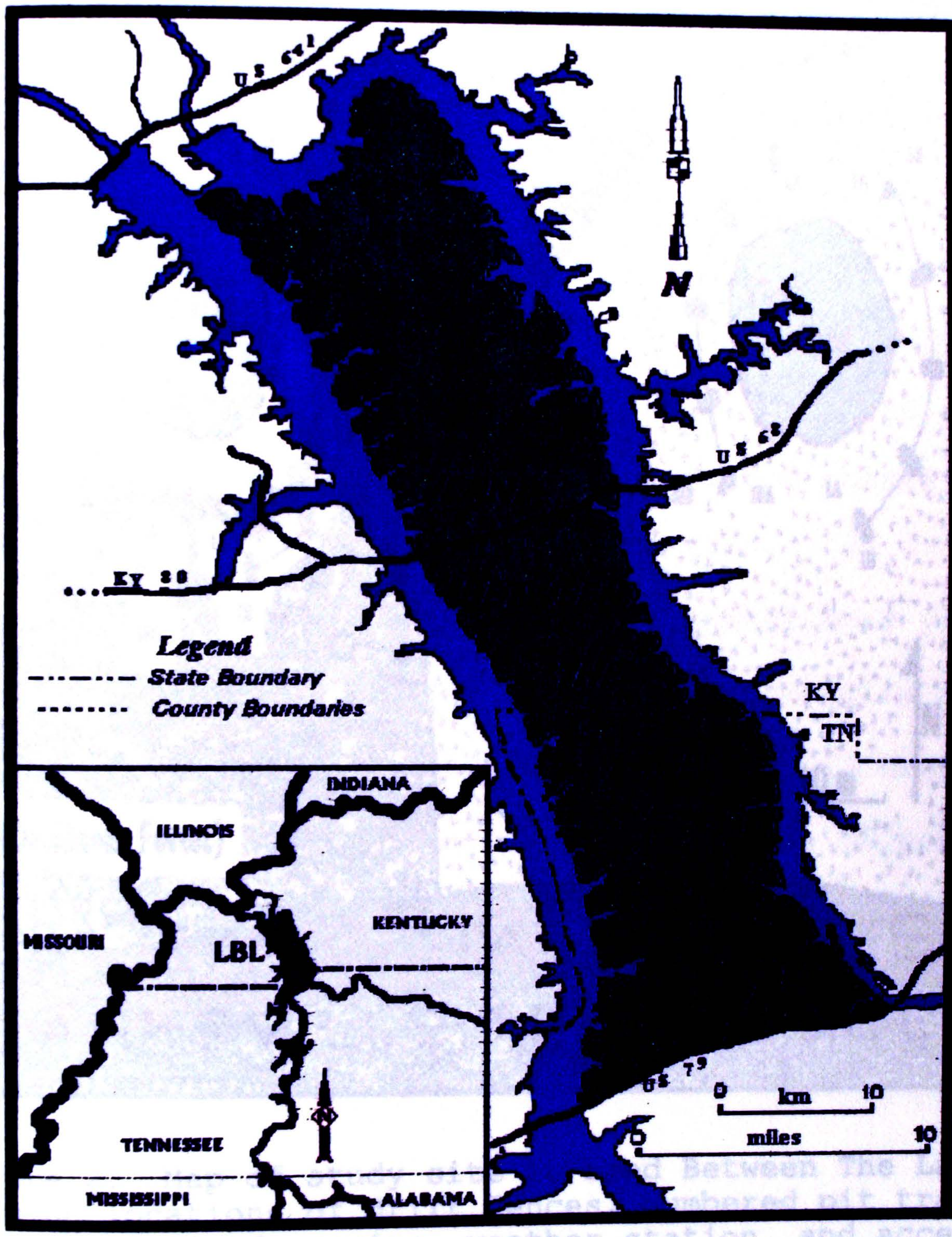


Figure 1. Location of the study area (star) in Land Between The Lakes (LBL) and LBL's position with respect to the lower Ohio River Basin (inset).

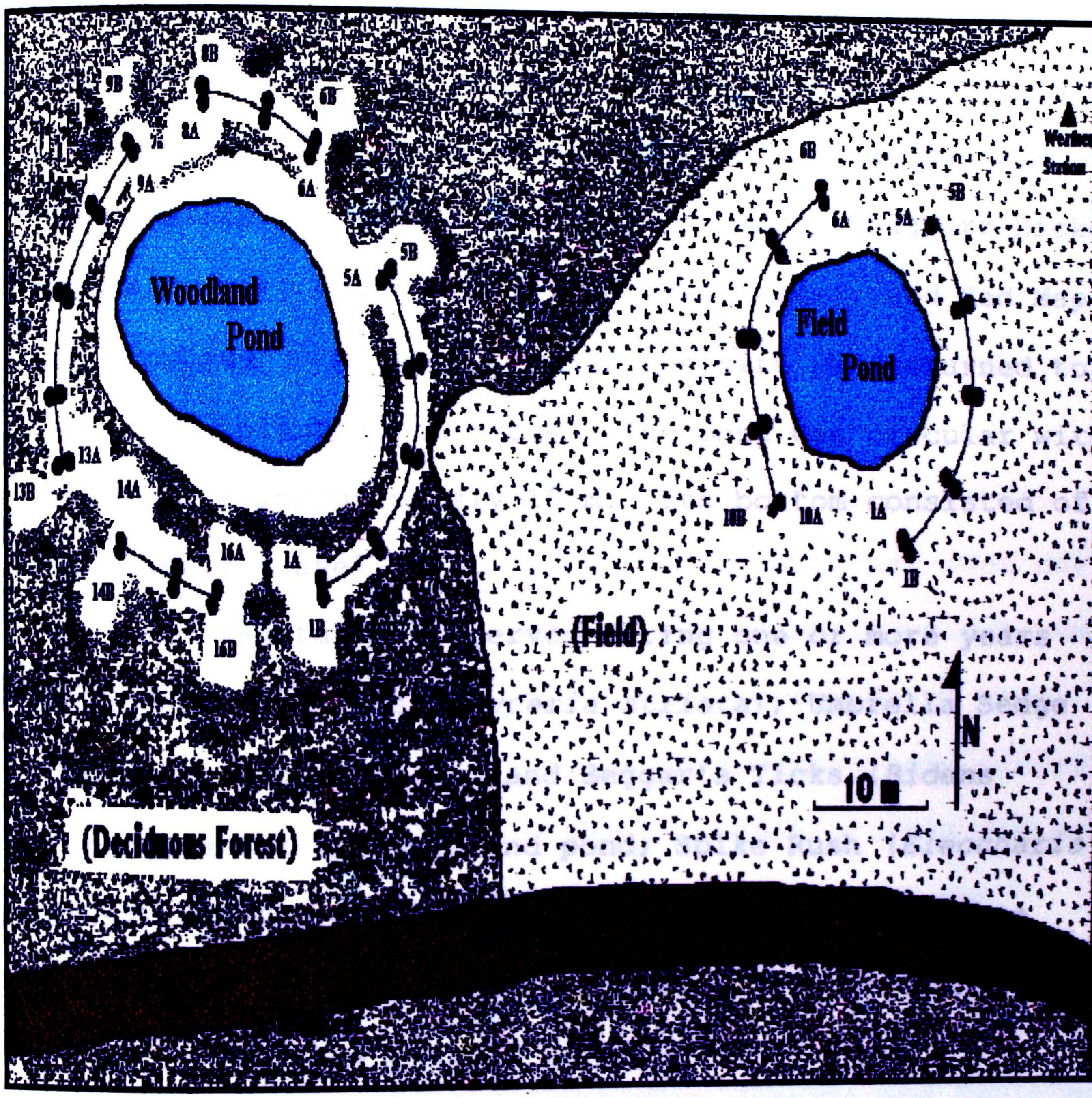


Figure 2. Map of study site in Land Between The Lakes showing locations of drift fences, numbered pit traps, forest and field margins, weather station, and access road.

Field Pond

The easternmost pond was at the edge of a field (Fig. 2) that was in the shrub stage of succession from the start of data collection (1987) until Fall, 1991, when it was cleared. Prior to this, the pond was surrounded by old-field shrubby vegetation composed mainly of Winged Elm (*Ulmus alata*), Smooth Sumac (*Rhus glabra*), Shagbark Hickory (*Carya ovata*), Sugar Maple (*Acer saccharum*), and Red Maple (*Acer rubrum*). After clearing, the site was returned to open field planted in fescue. The pond was circular with a diameter of approximately 10 m. Its bottom consisted of mud over cherty gravel.

Pond vegetation observed during one or more years included Manna Grass (*Glyceria striata*), Umbrella Sedge (*Cyperus erythrorhizos*), and Beggar's Ticks (*Bidens tripartita*) at the woodland pond; Spike Rush (*Eleocharis obtusa*) and Panic Grass (*Panicum dicotomiflorum*) were observed at the field pond. Pondweed (*Potomogeton diversifolius*) was present in both.

CHAPTER III

METHODS AND MATERIALS

Data Collection

Data (appended) collection began at the site in July 1987 and continued through the end of July 1994. Field observations and measurements were recorded on specially designed data sheets and later computerized using dbase III Plus software.

Visits to the site were made once every other day with one exception. Since little to no activity was seen during the coldest portions of each winter (generally mid-December through January), only weekly visits were made at these times to collect weather related data, empty rain guages, and change weather charts. Though normally taken during the morning hours, visits were occasionally made in the afternoon when there were schedule conflicts.

Reptiles were captured in pitfall traps along drift fences similar to those described by Gibbons and Semlitsch (1981). Sections of drift fencing circumscribed each pond (Fig. 2) and served to intercept animals moving in the vicinity. At the woodland pond, pits totaled 32 in 16 pairs set 5 m apart along four sections of fence. The field pond was equipped with 2 sections of fence each with 5 pairs of pits (also spaced 5 m apart) for a total of 20. Pits consisted of 19-liter plastic buckets buried in the soil to a level even with the top rim of the bucket. All pits on the inside of the fence were designated "A", and whereas those on the outside of the fence were designated "B." Fences were constructed of aluminum flashing (45.7 cm wide) buried to a depth of approximately 5 cm to preclude animals from burrowing under. Distance (which fluctuated with water level) from fences to waterline at each pond was approximately 5 m. Areas on either side of the fences were kept free of tall grass, weeds, and brush to prevent animals from climbing over the fence and to ensure adequate soil visibility when checking pits.

Information recorded for each individual encountered included species, sex (if evident), snout-vent length (SVL), trap number where captured, and miscellaneous remarks. Captured animals were released to the opposite side of the fence from their point of capture after being examined. A limited number of specimens of each species were kept as voucher specimens. There were often individuals that were found dead in the pits. Preparation of voucher specimens followed the recommendations of Pisani (1973).

A weather station consisting of a Belfort®

hygrothermograph (spring driven) and a Sierra/Misco® rain gauge was installed at the field pond at the start of the study (July 1987). Air temperature, relative humidity, and rainfall were monitored continuously throughout the period of data collection at this station. A second weather station was installed at the woodland pond on 4 April 1991, for use in making comparisons of weather conditions at the two ponds. Occasionally, instrument malfunctions at one or both stations resulted in no weather data for a few days at the site. In these cases, data collected at the closest official weather station (Dover, TN) were used.

Other relevant abiotic data recorded around each pond (beyond that monitored at weather stations) included soil temperature and soil moisture. Soil temperature (^{0}C) was read with a Reotemp® temperature probe. Soil moisture was measured with a LIC® soil moisture meter measured on a scale from 0 (dry) to 10 (saturated).

Data Analysis

Data were stored and manipulated with dbase III Plus database management software. Statistical analyses were performed with Ecological Analysis-PC (Eckblad, 1986-89) and Statistica™ (StatSoft, 1997) software.

CHAPTER IV

RESULTS

Field Pond

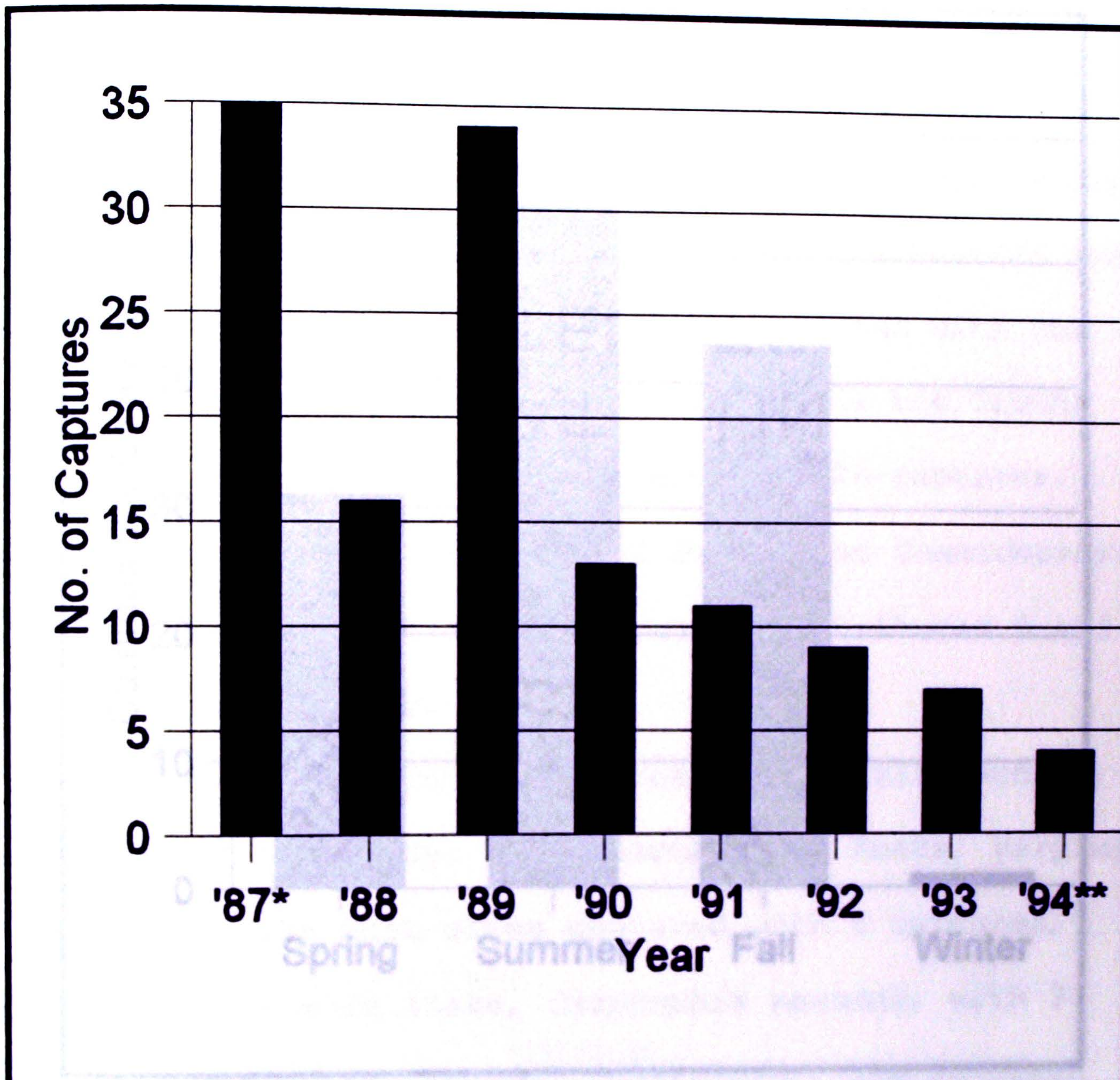
Annual Captures

A total of 129 reptile captures were recorded at the field pond during the study period. This amounted to 6.5 captures per pit overall and 0.92 captures per pit annually. Total captures per year are shown in Fig. 3.

Seasonal Activity

For this study, seasons were defined as follows: 1) Winter was 1 Dec.-28 Feb., 2) Spring was 1 Mar.-31 May, 3) Summer was 1 Jun.-31 Aug. and 4) Fall was 1 Sept.-30 Nov.

Seasonal differences in reptile activity at the field pond (as reflected by cumulative captures per season) are shown in Fig. 4. Activity was greatest in summer at 54 captures (42% of total), followed by fall with 43 (33%), and spring, at 31 (24%). Only 1 reptile capture was recorded during the winter period.



*1 July - 31 December
**1 January - 30 June

Figure 3. Total reptile captures recorded each year in pit traps at a field pond in Land Between The Lakes, Stewart County, Tennessee. Total number of captures = 129, Number of pits = 20.

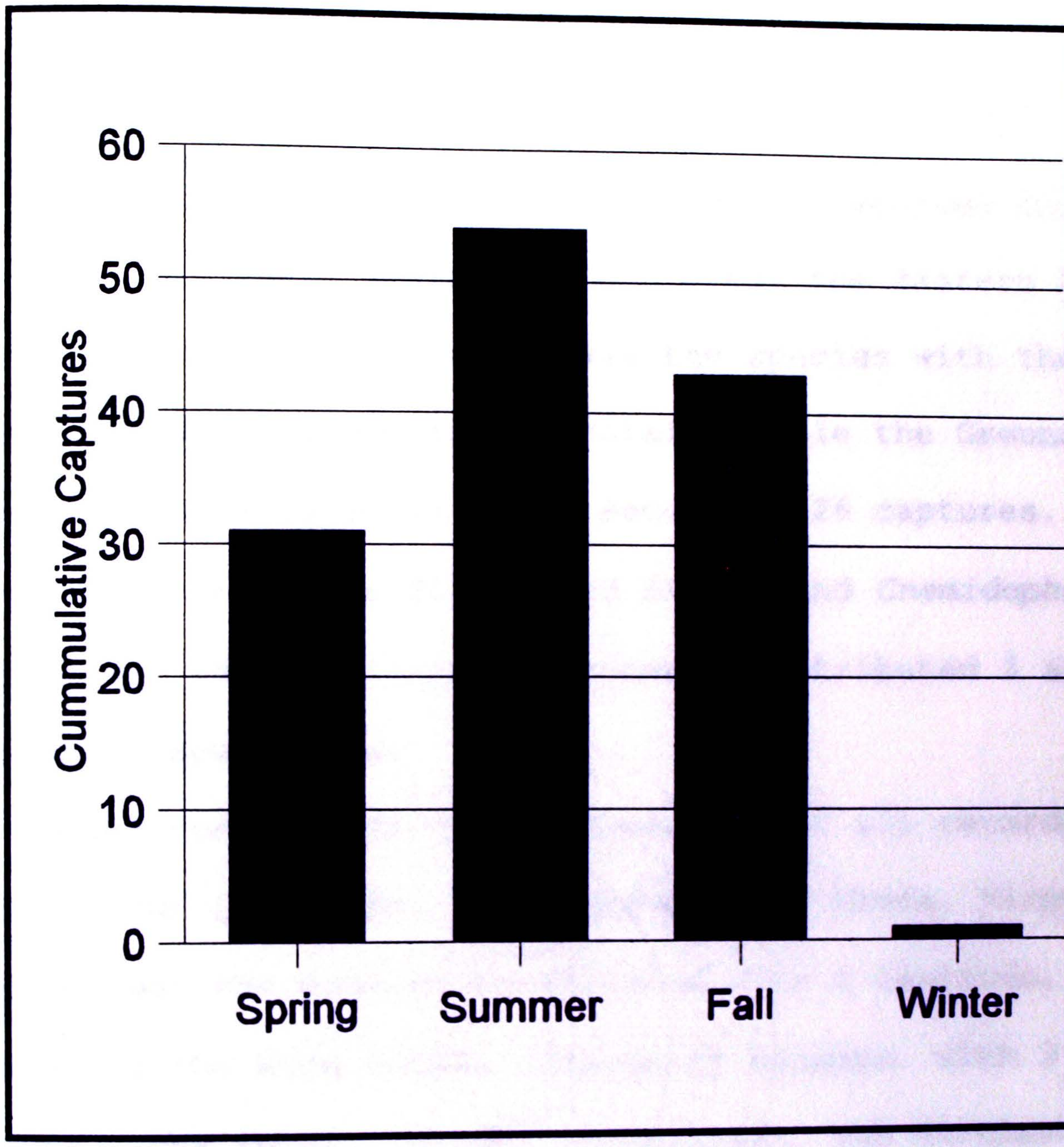


Figure 4. Cumulative numbers of reptile captures per season (Spring = 1 Mar.-31 May, Summer = 1 Jun.-31 Aug., Fall = 1 Sept.-30 Nov., Winter = 1 Dec.-28 Feb.) recorded in pit traps (N = 20) at the field pond.

Relative Abundance and Species Richness

A total of 13 reptile species representing 7 families were recorded at the field pond during the study period (Table 1).

Lizards were by far the most plentiful group of reptiles, with 104 captures (81% of total) recorded during the study. Of the 4 species encountered, the Eastern Fence Lizard, *Scleroporus undulatus,* was the species with the highest number of captures (69 total), while the Ground Skink, *Scincella lateralis*, was second at 26 captures. *Eumeces fasciatus*, the Five-lined Skink, and *Cnemidophorous sexlineatus*, the Six-lined Racerunner, contributed 5 and 4 captures, respectively.

Snakes contributed 14 captures (11% of all records) to the total for the study. The Smooth Earth Snake, *Virginia valeriae*, was the most often captured with 4 captures, followed by the Worm Snake, *Carphophis amoenas*, with 3 captures. The Racer, *Coluber constrictor*, the Northern Brown Snake, *Storeria dekayi*, and the Northern Water Snake, *Nerodia sipedon*, each were captured twice during the study. One venomous species, *Agkistrodon contortrix* (Copperhead), was documented at the field pond, but with only 1 capture.

Turtles, though not encountered as often as the previous classes, accounted for 11 records or 9% of all

Table 1. Reptile species (listed by major groups and families) captured at the field pond during the study period (1 July 1987-30 June 1994) and their percent of total (rounded to nearest whole percent).

FAMILY AND SPECIES	TOTAL CAPTURES	PERCENT OF TOTAL CAPTURES
LIZARDS		
Scincidae		
Eumeces fasciatus	5	4
Scincella lateralis	26	20
Scleroporus undulatus	69	54
Teiidae		
Cnemidophorus sexlineatus	4	3
SNAKES		
Colubridae		
Carphophis amoenus	3	2
Coluber constrictor	2	1
Nerodia sipedon	2	1
Storeria dekayi	2	1
Virginia valeriae	4	3
Viperidae		
Agkistrodon contortrix	1	<1
TURTLES		
Kinosternidae		
Kinosternon subrubrum	2	1
Chelydridae		
Chelydra serpentina	5	4
Emydidae		
Terrapene carolina	4	3

captures. *Chelydra serpentina*, the Common Snapping Turtle, was the dominant turtle species numbering 5 captures. The Eastern Box Turtle, *Terrapene carolina*, was second with 4 captures, and the Eastern Mud Turtle, *Kinosternon subrubrum*, accounted for 2 captures.

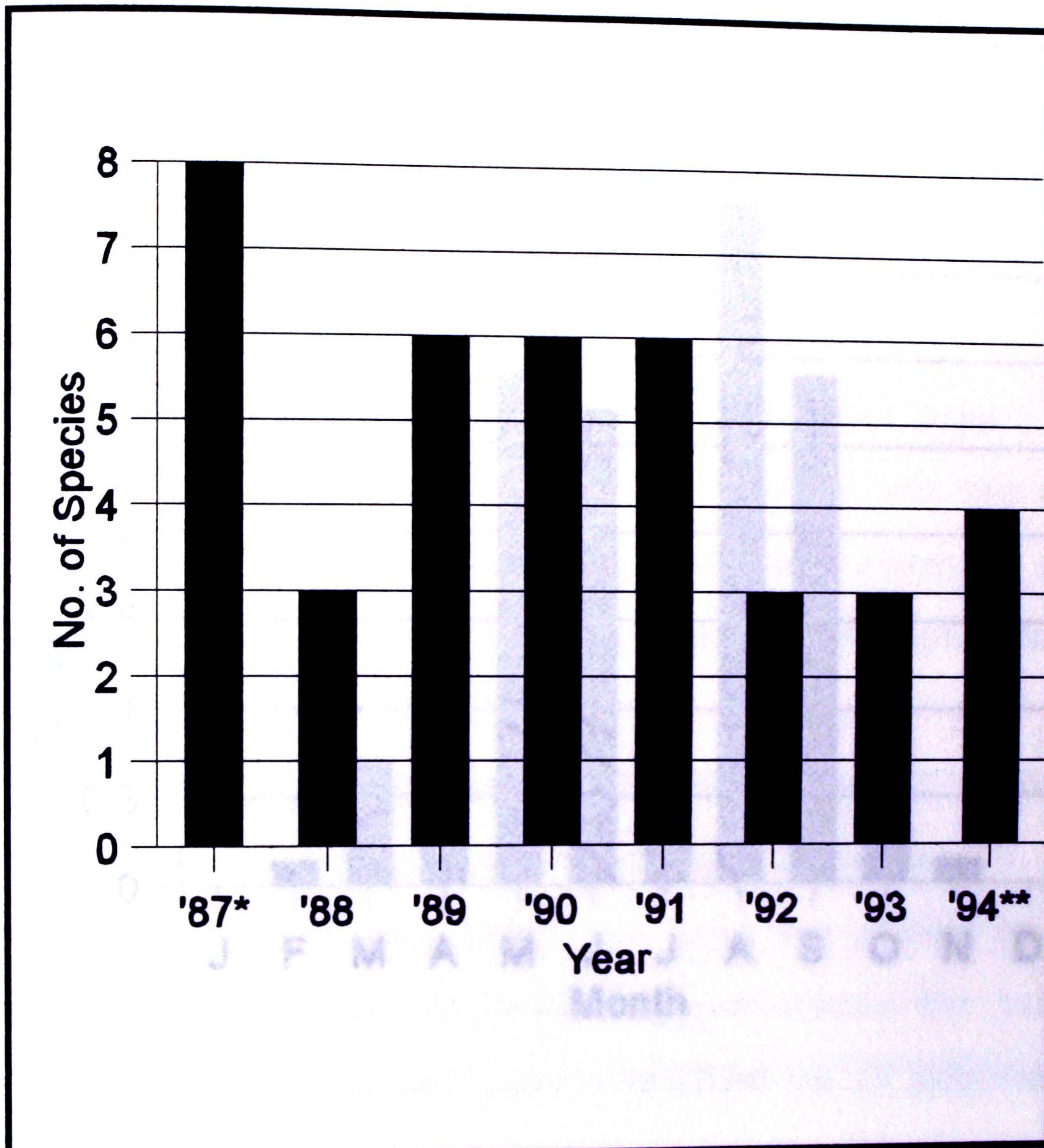
Species richness per year over the study period averaged 5.6 at the field pond (Fig. 5). Levels ranged from lows of 3 species each in 1988, 1992, and 1993, to a high of 8 species in 1987. Average monthly species richness is shown in Fig. 6. As would be expected, the warmer months produced the greatest diversity of species.

Directional Movement

Captures on the pond side of the fence (indicating outward movement) at the field pond outnumbered slightly those on the outside of the fence. Sixty-seven were from the pond side versus 62 from the opposite side. However, this difference was not significantly different ($P > 0.10$, d.f. = 1, $X^2 = .193$, critical value = 3.84) indicating movement in relation to the pond was statistically equal.

Influence of Abiotic Factors

Correlation analyses (Spearman rank-order coefficient, r_s) between cumulative monthly capture levels at the field



*1 July - 31 December
** 1 January - 30 June

Figure 5. Annual species richness recorded at the field pond over the study period.

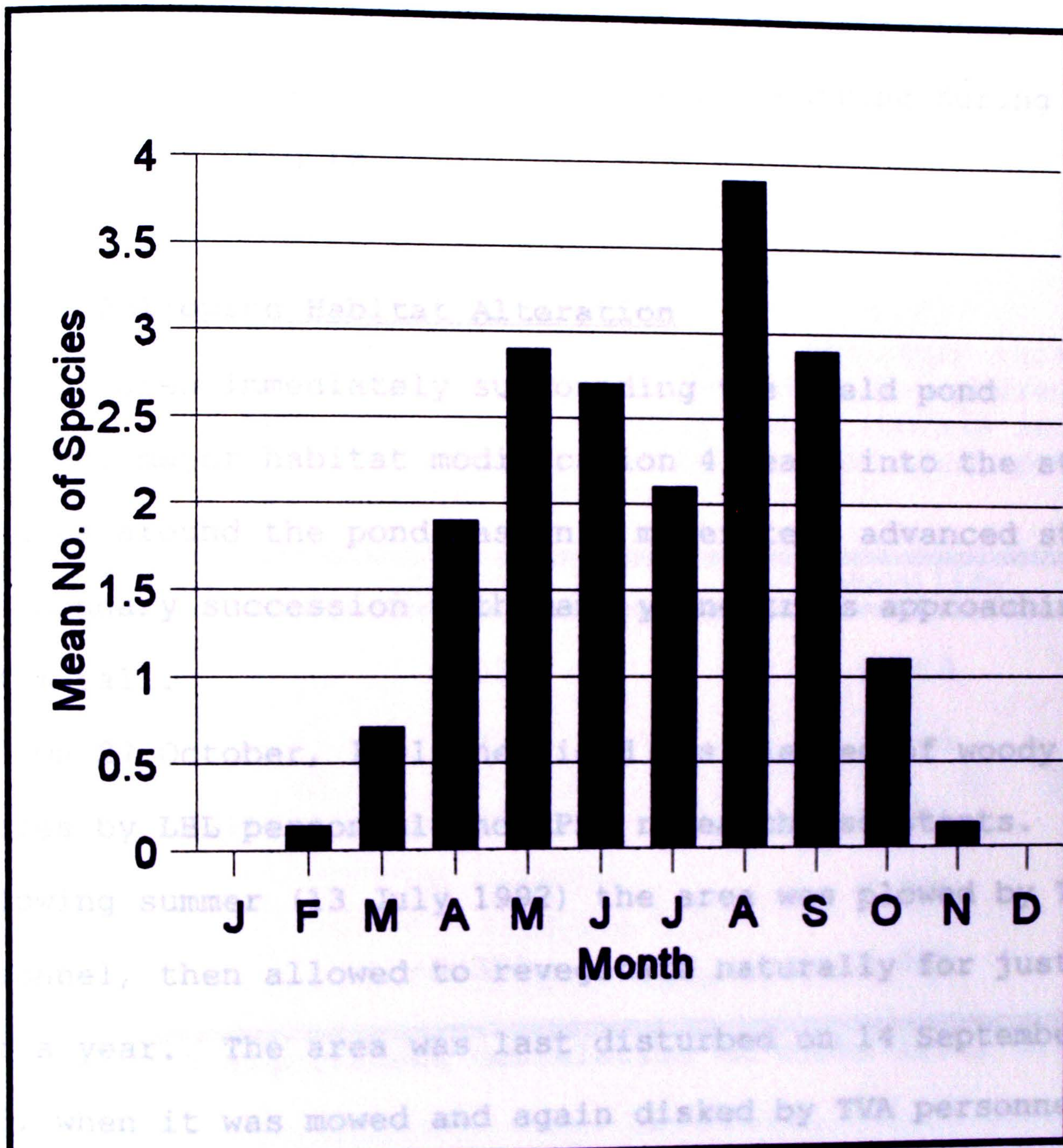


Figure 6. Mean monthly species richness at the field pond for the study period.

pond and monthly means (or totals in case of rainfall) of the abiotic factors monitored yielded mixed results. Captures were positively correlated (Table 2) with soil temperature and air temperature. This indicates that reptilian activity around the pond was occurring during the warmer months (Figure 7).

Changes Following Habitat Alteration

The area immediately surrounding the field pond underwent major habitat modification 4 years into the study. The area around the pond was in a moderately advanced stage of secondary succession with many young trees approaching 3 to 4 m tall.

On 27 October, 1991 the field was cleared of woody species by LBL personnel and APSU research assistants. The following summer (13 July 1992) the area was plowed by TVA personnel, then allowed to revegetate naturally for just over a year. The area was last disturbed on 14 September 1993, when it was mowed and again disked by TVA personnel.

The disturbance around the field pond coincided with a 50% decrease in annual species richness that lasted for 2 years before starting to rise again (Fig. 5). For the 5 years prior to habitat alteration, species richness averaged 6 species per year. In the two years (1992 and 1993)

Table 2. Results of correlation analyses (Spearman rank-order coefficient) comparing cumulative monthly captures at the field pond with cumulative monthly means (totals in case of rainfall) of abiotic factors monitored over study period, ($P < 0.05$, $N = 12$, Critical Value = 0.587).

Abiotic Factor	**Spearman R_s**	**Probability**
Soil Moisture	-.036	0.913
Soil Temp.	0.776*	0.003
Relative Humidity	-0.082	0.801
Air Temp.	0.753*	0.005
Rainfall	-0.380	0.223

* Indicated a significant correlation at alpha level 0.05.

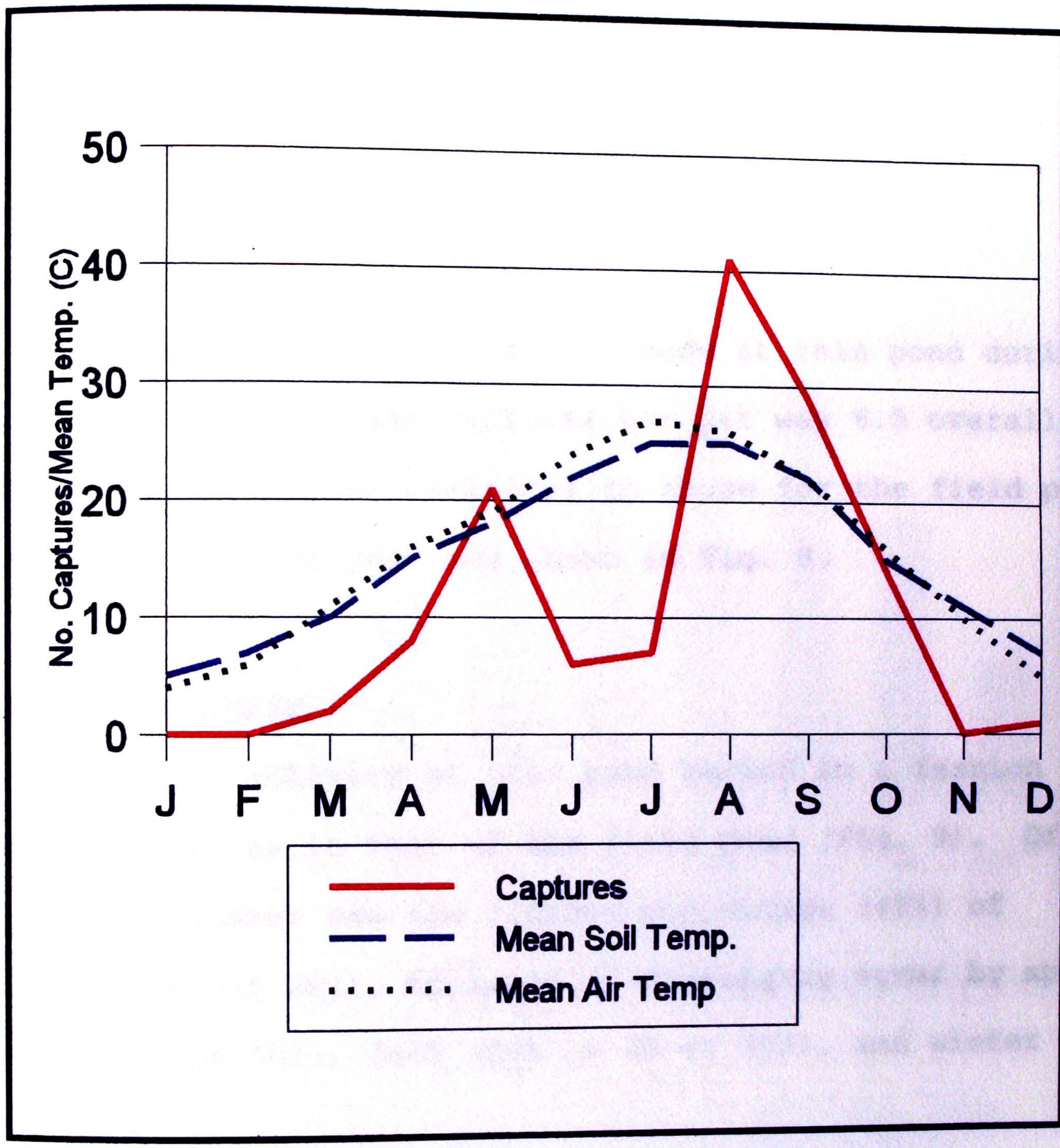


Figure 7. Relationships between cumulative monthly reptile captures at the field pond and cumulative monthly means of temperature (soil and air) occurring over the study period.

immediately following disturbance only 3 species per year were documented. In 1994, the number of species was back to 4.

Woodland Pond

Annual Captures

A total of 207 captures were made at this pond during the study. The average captures per pit was 6.5 overall and 0.92 annually, values identical to those for the field pond. Total captures per year are shown in Fig. 8.

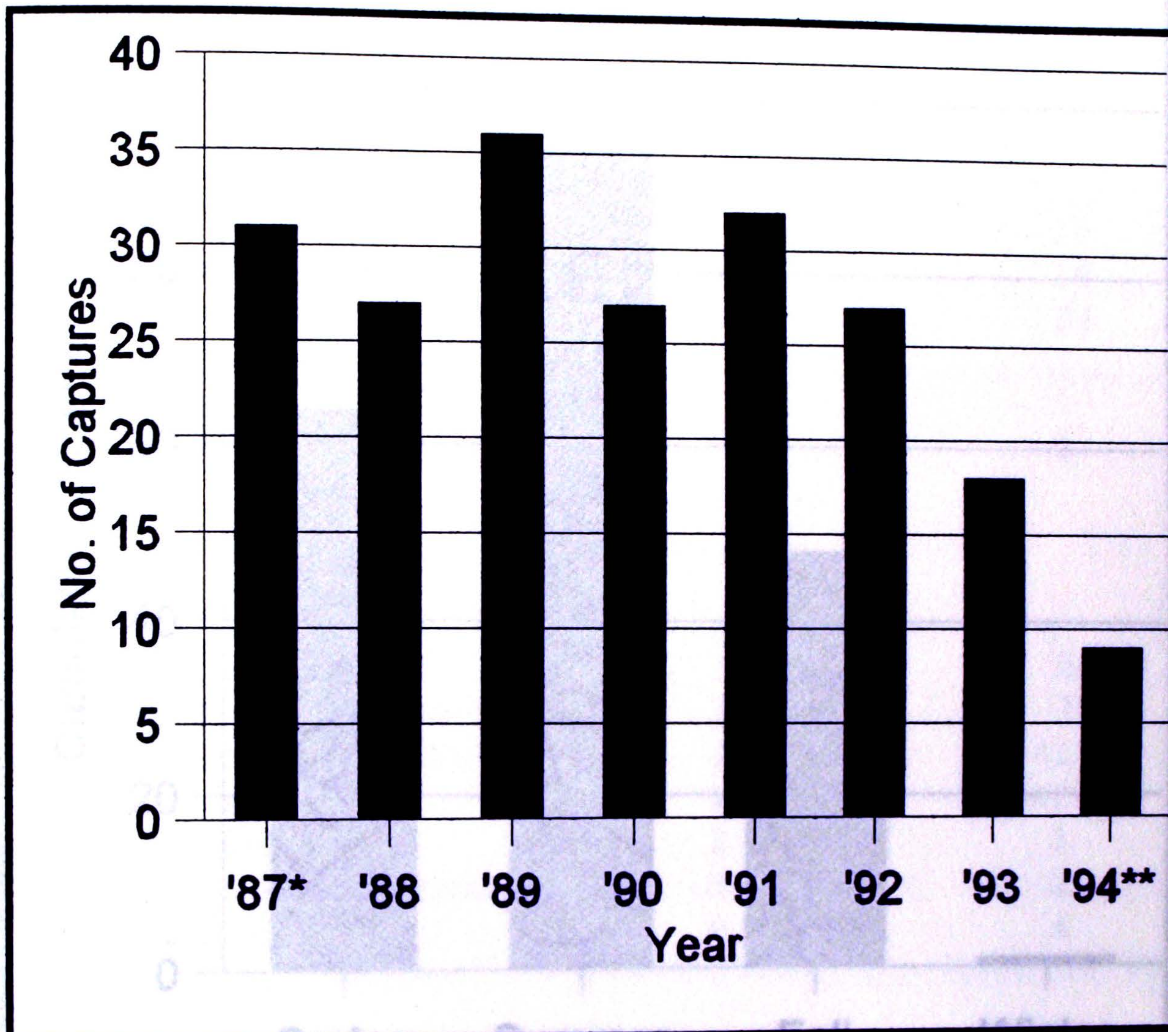
Seasonal Activity

Seasonal activity at this pond varied in a fashion somewhat similar to that of the field pond (Fig. 9). Of the 4 seasons, summer saw the highest percentage (45%) of captures (94 of 207), followed in descending order by spring (31% or 64 of 207), fall (23% or 48 of 207), and winter (<1% or 1 of 207).

Relative Abundance and Species Richness

A total of 14 reptile species were recorded at the woodland pond during the study period (Table 3).

Like the field pond, *Scl. undulatus* was the most



*1 July - 31 December
**1 January - 30 June

Figure 8. Total reptile captures recorded each year in pit traps at a woodland pond in Land Between The Lakes, Stewart County, Tennessee. Total number of captures = 207. Number of pits = 32.

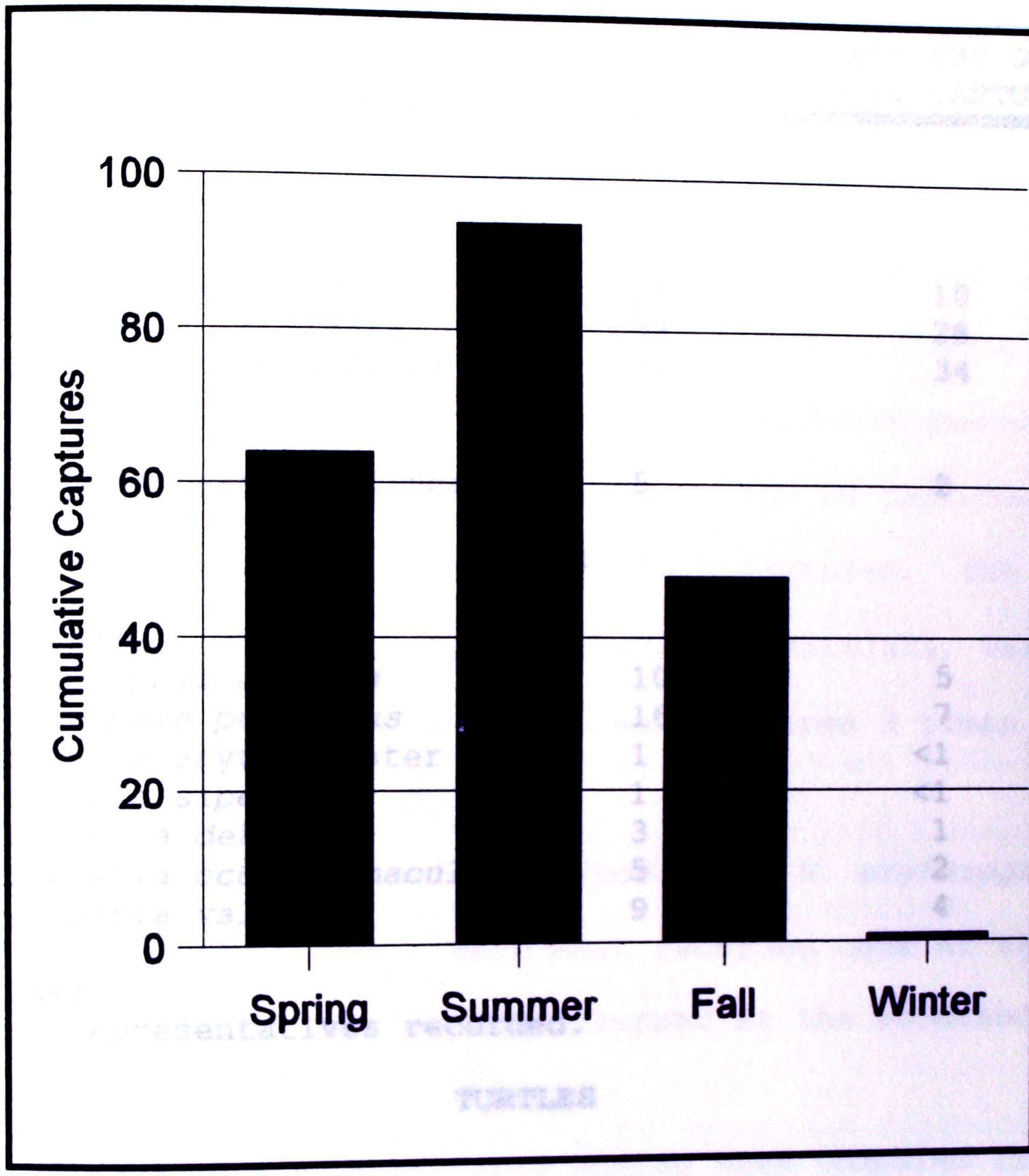


Figure 9. Cumulative numbers of captures per season recorded in pit traps (N = 32) at the woodland pond.

Table 3. Reptile species (listed by major groups and families) captured at the woodland pond during the study period (1 July 1987 - 30 June 1994)and their percent of total (rounded to the nearest whole percent).

FAMILY AND SPECIES	TOTAL CAPTURES	PERCENT OF TOTAL CAPTURES
LIZARDS		
Scincidae		
Eumeces fasciatus	21	10
Scincella lateralis	58	28
Scleroporus undulatus	71	34
Teiidae		
Cnemidophorus sexlineatus	5	2
SNAKES		
Colubridae		
Carphophis amoenus	10	5
Diadophis punctatus	16	7
Nerodia erythrogaster	1	<1
Nerodia sipedon	1	<1
Storeria dekayi	3	1
Storeria occipitomaculata	5	2
Virginia valeriae	9	4
Viperidae		
No representatives recorded.		
TURTLES		
Kinosternidae		
Kinosternon subrubrum	1	<1
Chelydridae		
Chelydra serpentina	3	1
Emydidae		
Terrapene carolina	3	1

abundant, with 71 captures, and *Sci. lateralis*, was second with 58 captures. *Eumeces fasciatus* was more abundantly represented at this pond with 21 captures, but *Cn. sexlineatus* was still poorly represented with only five captures.

Snakes contributed 45 records (22% of all records) to the total for the woodland pond. The Ringneck Snake, *Diadophis punctatus*, was the most commonly encountered species with 16 captures documented. *Carphophis amoenas* was the next most frequently trapped snake with 10 captures, closely followed by *V. valeriae*, with 9 captures. The Northern Redbelly Snake, *Storeria occipitomaculata*, was recorded 5 times. *Storeria dekayi* was captured 3 times at this pond during the study.

Two water snakes, *Nerodia sipedon* and *N. erythrogaster*, (Plainbelly Water Snake), were each recorded once at this pond. No venomous species were trapped at the woodland pond.

Turtles, though relatively scarce when compared to other reptile groups, accounted for 7 records or 3% of all reptile captures at the woodland pond. *Chelydra serpentina*, was equally as common as *T. carolina*, with 3 captures recorded for each species. *Kinosternon subrubrum*, contributed one capture to the total.

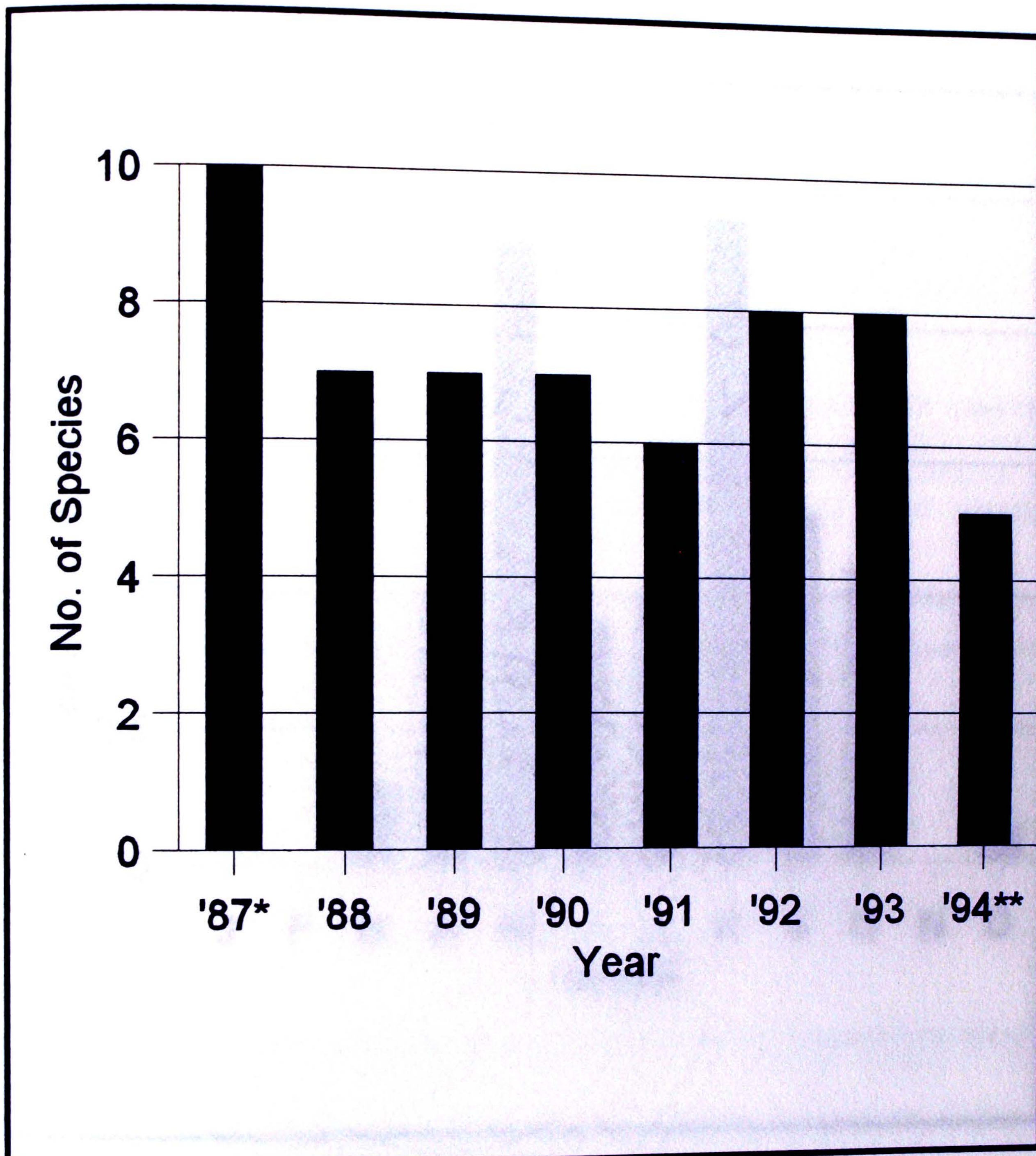
Species richness at the woodland pond averaged 8 per year during the study (Fig. 10) and ranged from a low of 5 species in 1994 to 10 species in 1987 (highest for either pond). Average monthly species richness is shown in Figure 11. Though a bimodal spike in richness is reflected, the late summer-early fall portion of the year experienced the greatest number overall.

Directional Movement

Directional movement at this pond was again slightly skewed, but in a direction opposite that of the field pond. More captures (112) were logged for inward (towards the pond) movements, than outward movements (95). But as was true at the field pond, there was no significant difference ($P>0.05$, d.f.=1, $X^2=2.09$, critical value = 3.84) between the totals suggesting equal movement in both directions.

Influence of Abiotic Factors

Results of correlation analyses (Spearman rank-order coefficient, r_s) between cumulative monthly capture levels and the abiotic factors monitored were similar to those for the field pond. Captures at the woodland pond again exhibited a significant positive correlation ($P < 0.05$) with mean monthly soil and air temperatures (Table 4, Figure 12).



*1 July - 31 December
** 1 January - 30 June

Figure 10. Annual species richness recorded at a woodland pond over the study period.

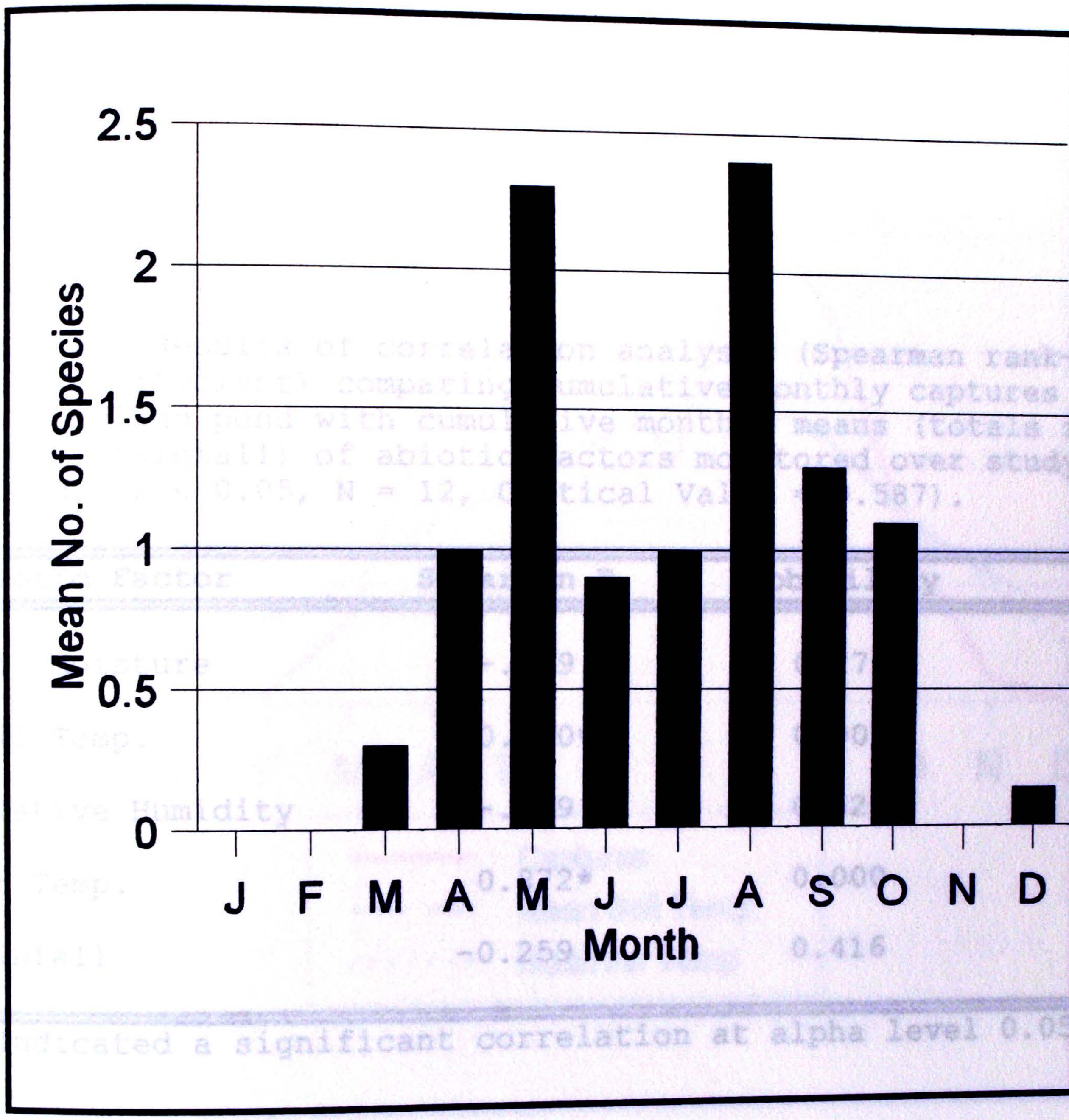


Figure 11. Mean monthly species richness recorded at the woodland pond for the study period.

Table 4. Results of correlation analyses (Spearman rank-order coefficient) comparing cumulative monthly captures at the woodland pond with cumulative monthly means (totals in case of rainfall) of abiotic factors monitored over study period, ($P < 0.05$, $N = 12$, Critical Value = 0.587).

Abiotic Factor	Spearman R_s	Probability
Soil Moisture	-.339	0.279
Soil Temp.	0.900*	0.000
Relative Humidity	-.159	0.620
Air Temp.	0.872*	0.000
Rainfall	-0.259	0.416

* Indicated a significant correlation at alpha level 0.05.

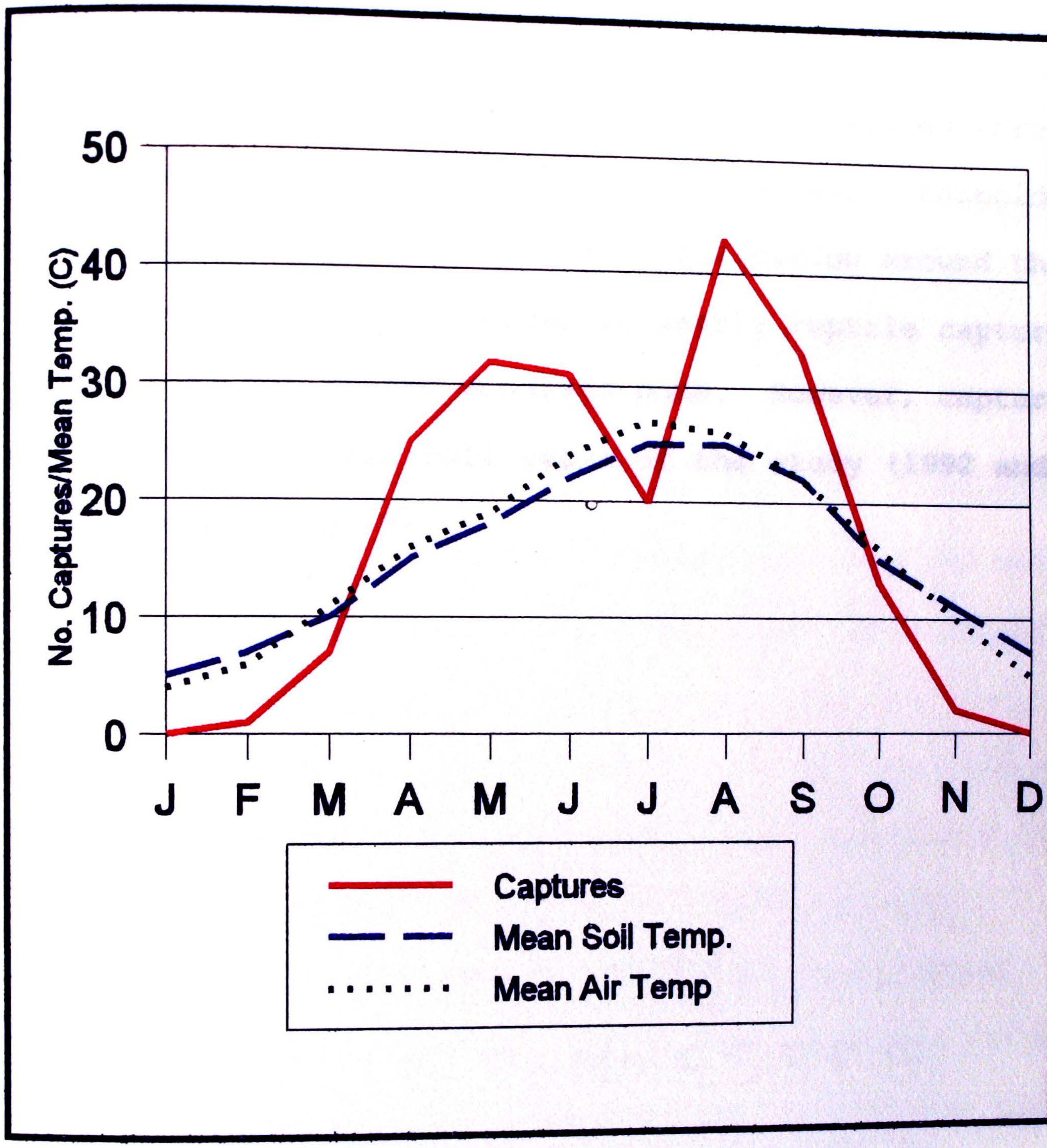


Figure 12. Relationship between cumulative monthly reptile captures at the woodland pond and cumulative monthly means of temperature (soil and air) occurring over the study period.

Changes Following Habitat Alteration

Species richness dropped slightly (by 1 species) at the woodland pond during 1991, the year habitat modification began at the field pond. It then rebounded in 1992 to its second highest level of 8 species, where it remained through 1993, the last full year of the study (Fig. 10). Coinciding with the same incidence of habitat modification around the field pond was a slight increase in yearly reptile captures (up from 27 to 32) at the woodland pond. However, capture totals for the last two full years of the study (1992 and 1993) were down (Fig. 8).

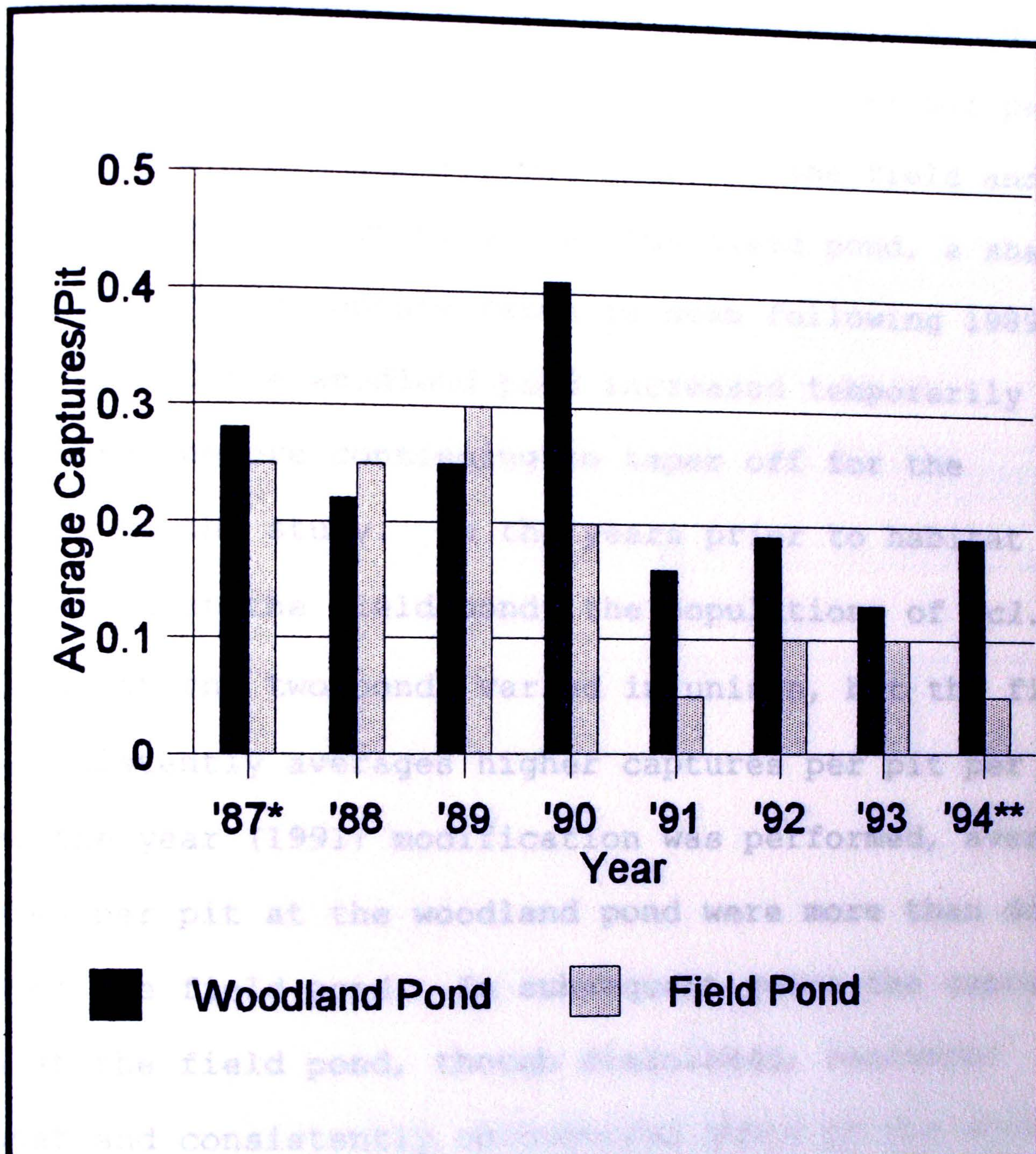
CHAPTER V

DISCUSSION

Comparative Capture Rates

Of the 16 species encountered, only *Scincella lateralis* and *Scleroporus undulatus* were captured in sufficiently large numbers to permit a meaningful comparison of yearly capture rates between the two ponds.

Average captures per pit per year for *Sci. lateralis* at each pond are shown in Fig. 13. Average captures per pit for *Sci. lateralis* (1.8) at the woodland pond were slightly higher (1.3) than that of the field pond. For the study period however, yearly captures per pit at the woodland pond averaged 0.26, while at the field pond they averaged 0.19. For the first 3.5 years of the study, yearly average captures per pit at the woodland pond fluctuated before peaking in 1990, then remained low for the remainder of the study. Though average yearly captures per pit at the field pond peaked a year earlier (1989), a decline similar to that at the woodland pond was evident. Based on average captures per pit per year, the *Sci. lateralis* population in the vicinity of the woodland pond appears to have remained the most stable, with the exception of the spike in 1990



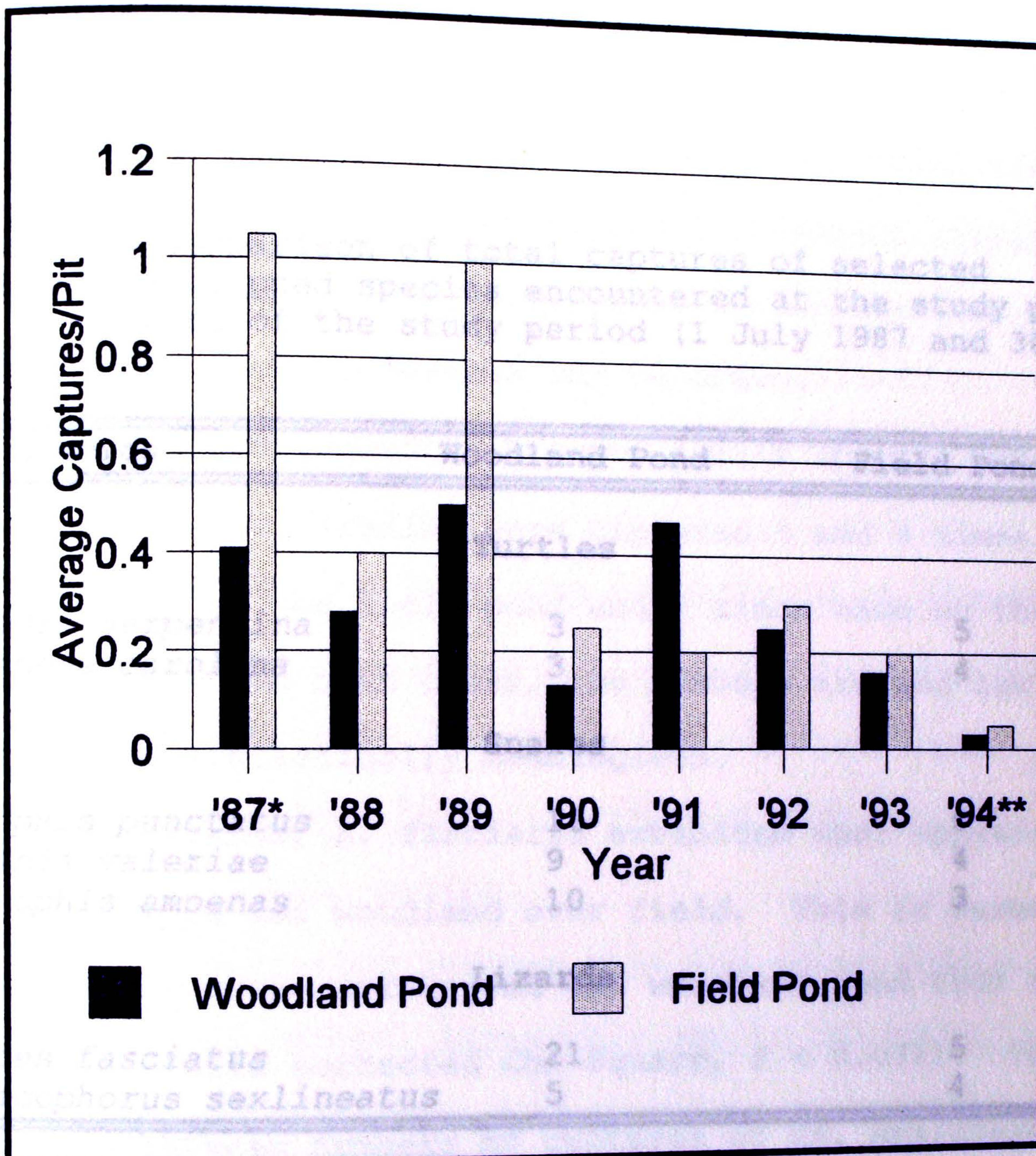
* 1 July - 31 December
** 1 January - 30 June

Figure 13. Comparison of yearly average captures per pit for *Scincella lateralis* at a woodland and field pond in Land Between The Lakes, Stewart County, Tennessee.

prior to habitat modification.

The average captures per pit (Fig. 14) for *Scl. undulatus* over the study period was 3.5 at the field pond and 2.2 at the woodland pond, while captures per pit per year for the period was 0.49 and 0.32 for the field and woodland ponds, respectively. At the field pond, a sharp decline in average capture rates is seen following 1989, while those of the woodland pond increased temporarily through 1991 before continuing to taper off for the remainder of the study. In the years prior to habitat modification at the field pond, the populations of *Scl. undulatus* at the two ponds varied in unison, but the field pond consistently averages higher captures per pit per year. During the year (1991) modification was performed, average captures per pit at the woodland pond were more than double those of the field pond. In subsequent years the capture rates at the field pond, though diminished, recovered somewhat and consistently outnumbered those at the woodland pond as they had in years prior to habitat modification.

Capture totals representing the less-frequently encountered species appear in Table 6. *Diadophis punctatus* was documented 16 times at the woodland pond, but never at the field pond, suggesting it preferred the woodland habitat. This inference is supported by a Yates corrected



* 1 July - 31 December
** 1 January - 30 June

Figure 14. Comparison of yearly average captures per pit for *Sceloporus undulatus* at a woodland and field pond in Land Between The Lakes, Stewart County, Tennessee.

Table 5. A comparison of total captures of selected infrequently trapped species encountered at the study ponds over the course of the study period (1 July 1987 and 30 June 1994).

Species	Woodland Pond	Field Pond
	Turtles	
Chelydra serpentina	3	5
Terrepene carolina	3	4
	Snakes	
Diadophis punctatus	16	0
Virginia valeriae	9	4
Carphophis amoenas	10	3
	Lizards	
Eumeces fasciatus	21	5
Cnemidophorus sexlineatus	5	4

Chi-square test which shows the difference in numbers of captures (16 vs. 0) to be significant ($P < 0.001$). *Virginia valeriae* and *Carphophis amoenus* also had more captures at the woodland pond that the field pond (9 and 10 versus 4 and 3, respectively). However, the differences between these low sample sizes are not significantly different (Yates corrected Chi Square, $P > 0.05$), thus no conclusions concerning habitat preference can be drawn.

Among the infrequently trapped turtle species, *Ch. serpentina* and *T. carolina* were captured 5 and 4 times, respectively, at the field pond and 3 times each at the woodland pond. In both cases, the numbers are too low for analysis and statistically meaningless.

Among lizards, *E. fasciatus* exhibited what appeared to be a preference for woodland over field. This is based on significantly more captures at the woodland pond than at the field pond (Yates corrected Chi Square, $P < 0.001$). The difference between numbers of captures of *Cn. sexlineatus* at the two ponds (5 versus 4) was negligible, but also meaningless due to the low sample size.

Comparisons with Similar Studies

In his 5-year survey of herpetofaunal activity at a temporary pond in the north Florida sandhills, Dodd (1992) found that reptile captures declined as the study progressed. He also found, using similarly designed pit traps, that captures of larger snakes were very infrequent due to their ability to escape with relative ease. Like this study, he also found that at most a few species were dominant within the community. He asserted that among abiotic factors, temperatures, rather than moisture related factors, contributed more to determining reptile activity levels.

Phelps and Lancia (1995) documented 19 species of reptiles in their work involving the effects of clearcut on swamp herpetofaunas. They found that they also had great difficulty in capturing larger snakes and that their conclusions could have been strengthened with replications of their experimental design.

Direct comparisons between this and other studies of its type are, in effect, impossible due to the many uncontrollable variables such as sampling methodology, climate, geology and soils, physiography, habitat, and stage of succession. Most comparable studies have occurred in the Coastal Plain area of the southeastern U.S. where environmental conditions are dramatically different from those in this study.

CHAPTER VI

CONCLUSIONS

The results of this study indicate the following about the reptile communities at the two study ponds:

1) Their species composition and levels of activity are similar.
2) Fluctuations in levels of activity over the annual cycle correlate closely with temperatures, but not with rainfall, relative humidity, or soil moisture.
3) Directional movement in relation to each pond is random.
4) Total yearly reptile captures are decreasing at both ponds.
5) The influence, if any, of habitat alteration at the field pond on the reptile communities at the two ponds was unclear.
6) The study should be continued for several more years before accepting fully the results obtained in this study.

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APPENDIX A

Monthly Means (Totals in Case of Rainfall) of Abiotic Data Monitored at the Study Site over the Study Period (1 July 1987 through 30 June 1994)

Appendix A

	Woodland Pond		Field Pond		Weather Station		
Yr/month	Soil moisture*	Soil temp (°C)	Soil moisture*	Soil temp (°C)	Air temp (°C)	Rel humidity (%)	Rainfall (cm)
1987							
Jul	2.00	23.30	6.48	23.02	24.66	74.66	14.07
Aug	1.60	23.70	7.20	22.15	23.19	70.85	7.70
Sep	1.50	20.86	6.51	19.73	23.07	63.65	7.01
Oct	1.50	13.90	4.92	12.12	13.47	63.95	5.00
Nov	2.40	11.01	6.07	10.50	11.42	68.73	24.41
Dec	2.20	4.72	6.60	7.50	6.32	74.74	21.82
1988							
Jan	3.50	4.75	7.50	4.75	1.50	71.38	0.89
Feb	3.94	5.17	6.61	5.11	3.78	70.89	13.21
Mar	4.02	9.38	6.52	8.76	10.77	66.45	6.99
Apr	4.00	11.25	6.63	12.84	15.94	67.72	6.96
May	4.06	13.51	7.39	16.19	20.23	68.62	7.09
Jun	2.04	19.15	6.06	19.02	26.17	54.79	0.66
Jul	2.13	21.98	4.09	24.03	28.65	59.32	8.59
Aug	2.14	26.30	5.84	26.96	28.87	72.19	9.98
Sep	2.07	20.38	5.67	23.27	23.07	79.10	11.94
Oct	1.75	13.20	4.80	13.88	13.73	75.11	15.11
Nov	1.77	8.46	3.79	8.72	11.30	75.65	20.80
Dec	1.50	2.85	4.04	2.70	5.52	72.34	8.26
1989							
Jan	2.44	4.19	4.22	3.74	7.90	77.26	6.17
Feb	2.23	5.16	3.75	4.77	3.54	81.91	30.02
Mar	2.40	9.37	3.77	9.44	12.01	74.05	16.36
Apr	2.54	13.71	4.88	14.55	16.55	67.23	11.86
May	1.89	15.44	4.98	16.23	20.06	74.84	8.31

Appendix A, continued.

Yr/month	Woodland Pond Soil moisture*	Woodland Pond Soil temp (°C)	Field Pond Soil moisture*	Field Pond Soil temp (°C)	Weather Station Air temp (°C)	Weather Station Rel humidity (%)	Weather Station Rainfall (cm)
Jun	2.53	19.19	5.42	19.71	24.62	82.27	32.38
Jul	2.52	21.69	5.57	22.63	26.79	82.44	18.52
Aug	1.34	21.79	5.27	22.49	26.74	78.52	8.05
Sep	1.56	19.08	5.31	19.45	22.00	82.08	12.27
Oct	2.33	14.58	4.92	14.46	18.00	73.77	7.47
Nov	3.38	10.41	5.95	10.11	10.98	72.53	8.79
Dec	2.15	3.17	5.00	2.73	0.13	76.93	2.11
1990							
Jan	2.28	5.83	5.22	5.61	7.86	75.15	12.70
Feb	3.50	7.72	5.02	7.80	10.52	73.46	29.82
Mar	4.03	10.19	5.38	10.00	11.95	74.66	10.72
Apr	2.21	13.41	4.90	13.73	15.47	68.40	7.14
May	1.84	16.94	4.38	17.22	19.23	79.77	19.43
Jun	1.43	20.64	4.05	21.86	25.48	77.00	10.54
Jul	0.53	26.58	4.65	27.38	26.79	77.03	11.07
Aug	0.39	25.51	4.48	26.46	26.03	75.42	6.30
Sep	0.73	26.28	3.39	27.18	23.84	75.86	14.07
Oct	1.53	13.76	3.86	13.87	14.79	73.32	17.35
Nov	2.37	12.94	6.03	12.54	13.32	70.77	9.63
Dec	2.10	9.97	5.40	9.23	8.21	82.93	42.77
1991							
Jan	1.94	6.35	5.25	5.81	3.11	87.22	5.94
Feb	1.74	7.80	4.93	6.67	7.61	73.72	20.78
Mar	1.79	9.75	6.02	9.62	11.74	69.34	12.14
Apr	2.42	15.15	5.14	15.20	19.68	70.73	11.43
May	1.93	19.02	4.81	19.76	24.20	81.94	20.42

Appendix A, continued.

Yr/month	Woodland Pond Soil moisture*	Woodland Pond Soil temp (°C)	Field Pond Soil moisture*	Field Pond Soil temp (°C)	Weather Station Air temp (°C)	Weather Station Rel humidity (%)	Weather Station Rainfall (cm)
Jun	2.21	21.42	5.71	22.21	26.76	77.70	14.15
Jul	2.09	23.43	7.79	24.25	28.59	75.93	9.42
Aug	1.08	22.54	3.53	22.76	28.47	70.64	3.79
Sep	0.32	21.42	5.52	21.74	24.62	72.40	5.56
Oct	0.34	15.18	4.31	15.26	18.71	71.03	7.90
Nov	2.20	11.44	5.65	11.01	9.28	69.31	9.98
1992							
Jan	2.50	6.63	6.13	5.88	2.71	74.47	4.60
Feb	1.09	10.09	5.20	9.48	7.57	71.93	9.73
Mar	1.72	10.66	5.03	10.88	10.29	68.77	14.73
Apr	2.03	14.61	6.48	15.79	16.27	66.67	5.41
May	2.47	16.64	6.46	18.78	19.22	73.90	14.55
Jun	3.16	19.59	6.89	21.51	22.40	71.20	11.25
Jul	2.11	23.14	7.75	26.12	26.53	79.71	16.64
Aug	2.20	23.53	7.96	26.53	23.47	84.09	14.45
Sep	1.63	20.02	4.40	21.47	20.78	88.82	9.30
Oct	1.73	15.15	4.55	16.19	13.94	84.27	4.50
Nov	2.58	12.22	6.09	12.01	6.45	86.73	6.30
Dec	2.69	8.38	6.63	7.88	2.02	86.22	7.21
1993							
Jan	1.63	6.81	6.63	7.10	4.55	80.68	9.60
Feb	3.18	6.61	5.75	7.13	4.57	73.46	12.14
Mar	4.44	8.38	7.38	10.03	11.55	81.10	11.07
Apr	4.07	13.69	7.56	14.63	13.66	86.37	13.69
May	4.02	18.25	7.45	20.33	15.85	87.94	17.70

Appendix A, continued.

Yr/month	Woodland Pond Soil moisture*	Woodland Pond Soil temp (°C)	Field Pond Soil moisture*	Field Pond Soil temp (°C)	Weather Station Air temp (°C)	Weather Station Rel humidity (%)	Weather Station Rainfall (cm)
Jun	1.97	20.87	7.27	23.54	23.58	75.10	6.73
Jul	1.53	24.49	7.18	27.12	28.90	71.81	13.13
Aug	0.84	24.70	4.98	26.65	24.79	73.63	9.53
Sep	1.28	20.19	4.41	21.84	21.80	76.07	13.06
Oct	0.98	14.77	3.96	15.81	17.32	72.19	12.34
Nov	1.06	10.66	2.96	10.31	9.37	82.60	14.66
Dec	1.56	8.45	4.00	7.02	5.05	79.39	10.74
1994							
Jan	3.02	5.09	6.15	4.00	-0.13	82.32	13.23
Feb	2.90	8.22	6.67	6.10	4.52	75.50	16.50
Mar	2.67	9.18	6.72	9.57	10.58	73.58	18.95
Apr	2.60	14.39	6.95	15.94	14.88	66.37	14.76
May	2.17	16.33	6.17	19.29	17.65	71.13	8.76
Jun	1.47	22.25	4.93	26.08	21.78	79.90	17.40

* 0 - 10 with 0 = dry and 10 = saturated.

APPENDIX B

Cumulative Capture Data Recorded During Each Month of the Year over the Study Period

APPENDIX B

Pond/month	In/Out	Total	Major group (In / Out)		
			Snake	Lizard	Turtle
Woodland					
Jan		0			
Feb	1/0	1		1/0	
Mar	3/4	7	1/0	1/4	1/0
Apr	11/14	25	0/2	11/11	0/1
May	16/16	32	4/2	12/13	0/1
Jun	18/13	31	5/0	12/13	1/0
Jul	11/9	20	4/3	7/6	
Aug	22/21	43	5/4	16/15	1/2
Sep	21/12	33	8/4	13/8	
Oct	7/6	13	3/0	4/6	
Nov	2/0	2		2/0	
Dec		0			
Total	**112/95**	**207**	**30/15**	**79/76**	**3/4**
Field					
Jan		0			
Feb		0			
Mar	0/2	2		0/1	0/1
Apr	3/5	8	0/3	3/2	
May	6/15	21	0/1	4/12	2/2
Jun	2/4	6	0/1	1/2	1/1
Jul	3/4	7	0/2	3/0	0/2
Aug	24/17	41	3/1	19/16	2/0
Sep	16/13	29	1/0	15/13	
Oct	7/7	14	0/2	7/5	
Nov		0			
Dec	1/0	1		1/0	
Total	**62/67**	**129**	**4/10**	**53/51**	**5/6**

VITA

Charles Austin Rozelle was born in Paragould, Greene County, Arkansas on March 6, 1964 the son of Dr. James F. and Jenette K. Rozelle. He spent his formative years in Hopkinsville, Christian County, Kentucky. He graduated from Christian County High School in 1982. He then enlisted in the U.S. Army and completed tours of duty with the 93rd Evacuation Hospital (attached to the 82nd Airborne Division) and the 1st Infantry Division (FWD) "Big Red One" based in Southern Germany. Upon completion of his military service, he returned to Hopkinsville briefly before moving to Clarksville, Tennessee where he enrolled at Austin Peay State University. He graduated from APSU in 1993 with a Bachelor of Science Degree in Biology. He subsequently enrolled as a graduate student in the Department of Biology. He received his Master of Science (Biology) Degree in May of 1999. While a student at APSU he worked as an undergraduate and graduate research assistant in the Center For Field Biology under Dr. A. Floyd Scott. He also worked as a graduate teaching assistant for two years. He plans to pursue a career in biological research and instruction.