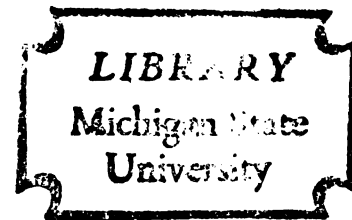




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A LATE PLEISTOCENE HERPETOFAUNA
FROM BAKER BLUFF CAVE,
SULLIVAN COUNTY, TENNESSEE

Thesis for the Degree of M. S.
MICHIGAN STATE UNIVERSITY
George Henry Van Dam
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ABSTRACT

A LATE PLEISTOCENE HERPETOFAUNA
FROM BAKER BLUFF CAVE,
SULLIVAN COUNTY, TENNESSEE

by

George Henry Van Dam

Baker Bluff Cave is located in extreme northeastern Tennessee (Sullivan County), physiographically lying in the southern portion of the Ridge and Valley Province of the Appalachians, west of the Great Smokies (Unaka Range). It is located in the Carolinian Biotic Province (Dice, 1943).

Due to the discovery of a caribou (Rangifer tarandus) lower premolar, the Carnegie Museum decided to sample the site at a depth below that of the amateur excavation. Four C^{14} tests run by the Carnegie Museum, at different stratigraphic levels, give datings ranging from 555 ± 185 C^{14} years B.P. to $19,100 \pm 850$ C^{14} years B.P.

The Baker Bluff Cave Herpetofauna consists of at least five species of urodeles, five species of anurans, one species of turtle, one species of lizard and 11 species of snakes.

Perhaps the most striking thing about the herpetofauna

is that there is nothing that strongly indicates that the climate or topography was any different than it is in the area today.

The Baker Bluff Cave Herpetofauna exhibits many similarities to the Ladds site (Late Pleistocene), of northwestern Georgia (Holman, 1967).

Four major habitats are indicated at the Baker Bluff Cave by the herpetological remains, but it is impossible to conclude the exact nature of the environment immediate to the cave because the bones were apparently derived from wide-ranging predators.

A LATE PLEISTOCENE HERPETOFAUNA
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SULLIVAN COUNTY, TENNESSEE

By

George Henry Van Dam

A THESIS

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in partial fulfillment of the requirements
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MASTER OF SCIENCE

Department of Geology

To Ann

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INTRODUCTION

Baker Bluff Cave is located in extreme northeastern Tennessee (Sullivan County) on the South Fork of Holston River, a tributary of the Tennessee River at latitude $36^{\circ}27'30''$ North, longitude $82^{\circ}28'$ West approximately seven miles south of the Tennessee-Virginia border and 40 miles west of the Tennessee-North Carolina border. The cave is on the west bank of the river three miles northwest (downstream) of the junction of the South Fork Holston River and the Watanga River at an elevation of approximately 1,550 feet above sea level.

Physiographically, the cave site lies in the southern portion of the Ridge and Valley Province of the Appalachians, west of the Great Smokies (Unaka Range). Biologically, Baker Bluff Cave is located in the Carolinian Biotic Province (Dice, 1943).

The cave is small, approximately 12 feet by 30 feet, and prior to excavation was filled to within four feet of the ceiling by sediments. The top three feet of sediment were excavated by amateurs searching for Indian artifacts, who informed the Carnegie Museum, Section of Vertebrate

Fossils, of the site. Due to their discovery of a caribou (Rangifer tarandus) lower premolar, it was decided to sample the site at a depth below that of the amateur excavation. In 1970, the Carnegie Museum excavated a shaft four feet by three feet and seven feet deep, beginning at the original three foot level and extending down to the ten foot level. Although time breaks apparently exist in this sequence (see below), periods of sedimentation were probably continuous as no stratification is evident.

No evidence of human occupation was seen during the museum excavation.

It appears that all of the bones, seeds, shells, etc., were either predator-derived, brought in by rodents, or were remains of animals that lived and died in the cave. Large bones were scarce and extensively rodent-gnawed.

Four C¹⁴ tests run by the Carnegie Museum at Baker Bluff Cave on uncharred bone fragments give datings ranging from 555±185 C¹⁴ years B.P. to 19,000±850 C¹⁴ years B.P. The relationship of these C¹⁴ dates to the levels are as follows:

4-5 Ft. Level	555±185 C ¹⁴ years B.P.
6-7 Ft. Level	10,560±220 C ¹⁴ years B.P.
	11,640±250 C ¹⁴ years B.P.
9-10 Ft. Level	19,100±850 C ¹⁴ years B.P.

Dates below the six foot level indicate a late Wisconsinan age.

Fossils of the Baker Bluff Cave Fauna include gastropoda, fishes, amphibians, reptiles, birds, and mammals. The present report deals with the herpetofauna of Baker Bluff Cave.

Several people are involved in identifying the vertebrates and invertebrates from Baker Bluff Cave, Frederick C. Hill, University of Louisville, is studying the fish remains; Paul W. Parmalee, University of Tennessee, is studying the birds; Elaine Anderson, Maryland Academy of Science, and John E. Guilday, Carnegie Museum, are studying the mammals. In addition, gastropoda are being identified by Leslie Hubricht of Meridian, Mississippi.

SYSTEMATIC PALEONTOLOGY

This section consists of an annotated list of all species identified from the Baker Bluff Cave Fauna. Criteria for osteological identification of the species are discussed; habitats are also noted.

Except for the presence of Lampropeltis getulus and possibly Ambystoma tigrinum, all species are found in the area today.

A checklist of the species discussed is given below.

Class Amphibia

Order Urodela

Family Ambystomatidae

Ambystoma opacum (Gravenhorst)

Ambystoma maculatum (Shaw)

Ambystoma sp. indet.

Family Proteidae

Necturus maculosus (Rafinesque)

Family Cryptobranchidae

Cryptobranchus alleganiensis (Daudin)

Family Plethodontidae

Desmognathus sp. indet.

Order Anura

Family Bufonidae

Bufo americanus Holbrook

Bufo woodhousi fowleri Girard

Bufo sp. indet.

Family Hylidae

Hyla sp. indet.

Family Ranidae

Rana sylvatica LeConte

Rana catesbeiana Shaw

Rana sp. indet.

Class Reptilia
Order Testudines
Family Emydidae
 Graptemys geographica (LeSueur)
Order Squamata
Suborder Sauria
Family Scincidae
 Eumeces fasciatus (Linnaeus)
Suborder Serpentes
Family Viperidae
 Crotalus horridus Linnaeus
Family Colubridae
Subfamily Xenodontinae
 Heterodon platyrhinos Latreille
Subfamily Colubrinae
 Diadophis punctatus (Linnaeus)
 Carphophis amoenus (Say)
 Coluber or Masticophis sp. indet.
 Lampropeltis triangulum (Lacepede)
 Lampropeltis getulus (Linnaeus)
 Elaphe sp. indet.
Subfamily Natricine
 Natrix sipedon (Linnaeus)
 Natrix sp. indet.
 Thamnophis sirtalis (Linnaeus)
 Thamnophis sauritus (Linnaeus)
 Thamnophis sp. indet.

Fossils are from the collection of the Carnegie Museum of Natural History (CM).

Class Amphibia

Order Urodela

Family Ambystomatidae Hallowell

Assignment to the family Ambystomatidae is based on characters discussed by Holman (1962): centrum amphicoelous, weakly constricted ventrally, without spine produced from its posteroventral surface; neural spine obsolete and single throughout.

Ambystoma opacum (Gravenhorst)

Material: CM29754-CM29757. Two pre-caudal vertebrae (4-5'); one pre-caudal vertebra (5-6'); five pre-caudal vertebrae (6-7'); one pre-caudal vertebra (8-9').

Remarks: Tihen (1958) pointed out that the Ambystomatidae can be divided up into major groups using vertebral ratios. He stated that the most useful ratios were (1) the length of the centrum divided by its width at the anterior end, and (2) the combined zygapophyseal width divided by the zygapophyseal length. In addition, Tihen (1958) also noted that in the A. maculatum group and in the

subgenus Linguaelapsus (at least in the posterior part of the trunk) the postzygapophyses extends as far, usually farther posteriorly, than does the neural arch.

In my examination of the material, I used the length of the centrum divided by its width at the anterior end for species determination.

Ambystoma maculatum (Shaw)

Material: CM29758-CM29760. Six pre-caudal vertebrae (4-5'); three pre-caudal vertebrae (5-6'); four pre-caudal vertebrae (6-7').

Remarks: Material was assigned to A. maculatum based on criteria discussed under A. opacum.

Ambystoma sp. indet.

Material: CM29761-CM29767. Three pre-caudal vertebrae (3-4'); 15 pre-caudal vertebrae (4-5'); seven pre-caudal vertebrae (5-6'); seven pre-caudal vertebrae (6-7'); three pre-caudal vertebrae (7-8'); seven pre-caudal vertebrae (8-9'); one pre-caudal vertebra (9-10').

Remarks: Material which was too fragmentary for measurement or those whose ratios fell within the ranges of both A. maculatum and A. opacum were assigned to genus only.

Some specimens referred to Ambystoma species exhibited the back-swept neural arch characteristic of A. tigrinum as pointed out by Holman (1969); but, these could not be assigned to species because anterior thoracic vertebrae of A. maculatum and A. opacum have this characteristic. Conant (1975) states that Ambystoma opacum occurs in a variety of habitats, ranging from moist, sandy areas to dry hillsides. A. maculatum is occasionally found (from spring to autumn) beneath stones or boards.

Family Proteidae Tschudi

Specimens were assigned to the Proteidae by comparison with recent specimens and using criteria of Holman (1968) who noted that their vertebrae are amphicoelous and the transverse processes are undivided.

Necturus maculosus (Rafinesque)

Material: CM29768-CM29773. Fifteen pre-caudal vertebrae (3-4'); 22 pre-caudal and two caudal vertebrae (4-5'); five pre-caudal vertebrae (5-6'); three pre-caudal vertebrae (6-7'); five pre-caudal vertebrae (7-8'); three pre-caudal vertebrae (8-9').

Remarks: The fossils were indistinguishable from Recent material of N. maculosus. Necturus maculosus habitats



include lakes, ponds, rivers, streams and other permanent bodies of water (Conant, 1975).

Family Cryptobranchidae Cope

Cryptobranchus alleganiensis (Daudin)

Material: CM29774-CM29779. Thirty pre-caudal, three caudal vertebrae and one right dentary (3-4'); 73 pre-caudal vertebrae and two vomers (4-5'); 33 pre-caudal vertebrae (5-6'); nine pre-caudal vertebrae (6-7'); one pre-caudal vertebra (7-8'); four pre-caudal vertebrae (9-10').

Remarks: Meszoely (1967) gave characteristics for the identification of Cryptobranchus: (1) deeply amphicoelous cotyles, circular in outline; (2) centrum relatively short in respect to the diameter of the cotyle; (3) ventral surface of the centrum rounded without keel or processes; (4) large lateral fossa anterior to the base of the transverse process; and (5) very large size. In addition, Holman (1968) notes that the transverse processes are undivided.

Due to the fragmentary nature of much of the material I found it sometimes difficult to separate vertebrae of Cryptobranchus alleganiensis and Necturus maculosus. I have found the following criteria useful in differentiating these two: (1) in C. alleganiensis the sides of the centrum are

more sculptured than in N. maculosus, (2) in C. alleganiensis the upper transverse process is heavy and cylindrical in shape (N. maculosus has a very wing-like upper transverse process) and, (3) C. alleganiensis has the articular facets of the transverse processes exhibiting a single opening whereas in N. maculosus there are usually two distinct openings. C. alleganiensis is always found in rivers and larger streams where water is running and ample shelter is available in the form of large rocks, snags or debris (Conant, 1975).

Family Plethodontidae Gray

Desmognathus sp. indet.

Material: CM29780-CM29785. Twenty-two vertebrae (3-4'); 158 vertebrae (4-5'); 95 vertebrae (5-6'); 81 vertebrae (6-7'); 19 vertebrae (7-8'); 21 vertebrae (8-9').

Remarks: These specimens have been assigned to Desmognathus based on Soler (1950) who states that their vertebrae are opisthocoelous and have pointed processes arising from the dorsal surfaces of the postzygapophyses. I am unable to carry the identification any further due to lack of Recent comparative material.

Desmognathus fuscus, D. quadramaculatus, D. monticola and D. wrighti are all present in northeastern Tennessee

today and it is not unlikely that all four are present in the collection. Desmognathus fuscus occurs in brooks, near springs, and in seepage areas, most commonly along edges of small woodland streams, where stones, chunks of wood and miscellaneous debris provide ample shelter both for the salamanders and for their food. D. quadramaculatus is abundant in boulder-strewn brooks and also found near waterfalls or other places where cold water drips or flows. D. monticola prefers boggy spots in cool, well-shaded ravines and banks of mountain brooks. D. wrighti is today a resident chiefly of high spruce-fir forests and lives under moss and bark on rotting logs or beneath rotting wood or litter on the forest floor near seepage areas (Conant, 1975).

Order Anura

Family Bufonidae Fitzinger

Fossil Bufo as pointed out by Holman (1962) may be identified by the following characteristics: ilium with dorsal blade absent; dorsal prominence produced dorsally, well developed, grooved or irregular in shape; sacral vertebrae procoelus, with one anterior and two posterior condyles; sacrum free from urostyle, its diapophyses moderately expanded.

Bufo americanus Holbrook

Material: CM29786-CM29792. Twelve right and seven left ilia (3-4'); 17 right and 24 left ilia (4-5'); ten right and ten left ilia (5-6'); three right and seven left ilia (6-7'); two right ilia (7-8'); two right ilia (8-9'); three left ilia (9-10').

Remarks: Holman (1967) pointed out that the ilium of Bufo woodhousi fowleri has the base of the dorsal protuberance narrower than in equal-sized B. americanus. Habitats seem to be shallow bodies of water in which to breed (temporary pools or ditches or shallow portions of streams, for example), shelter in the form of hiding places where there is some moisture, and an abundant food supply of insects and other invertebrates (Conant, 1975).

Bufo woodhousi fowleri Girard

Material: CM29793-CM29795. Three right ilia (3-4'); two right and three left ilia (4-5'); one left ilia (5-6').

Remarks: Assignment of material to Bufo w. fowleri was based on criteria given in the discussion of B. americanus. Bufo w. fowleri occurs chiefly in sandy areas, around shores of lakes or in river valleys (Conant, 1975).

Bufo sp. indet.

Material: CM29796-CM29801. Two left ilia, four sacral vertebrae (3-4'); three right and two left ilia, 15 sacral vertebrae and ten fronto-parietals (4-5'); four sacral vertebrae and six fronto-parietals (5-6'); two fronto-parietals (6-7'); one sacral vertebra and one fronto-parietal (7-8'); two sacral vertebrae and two fronto-parietals (8-9').

Remarks: Ilia were assigned to Bufo sp. when: (1) the anterior or posterior portions of the prominence were missing, thus making it impossible to examine the prominence-protuberance relationship, or (2) when the boundaries of the dorsal protuberance were not clearly defined within the prominence. Tihen (1962) pointed out that the fronto-parietal is the most reliable single element for identification of the greatest number of New World Bufo. I could not find any distinct differences between the fronto-parietals of B. americanus and B. w. fowleri.

Family Hylidae Hallowell

Hyla sp. indet.

Material: CM29802. One left ilium (3-4').

Remarks: Specimen is assigned to the genus Hyla based on characters given by Holman (1962): ilium with dorsal blade absent; dorsal prominence produced dorsolaterally, well

developed, usually round and smooth.

The bone is too fragmentary for specific identification, but in comparison with Recent material, it most closely resembles Hyla chrysoscelis and H. versicolor in the shape of the dorsal prominence.

Family Ranidae Bonaparte

All specimens are assigned to the family Ranidae based on the following characteristics given by Holman (1962): ilium with dorsal blade well developed and arising anterior to dorsal prominence, without lateral deflection, and with deep notch between it and dorsal acetabular expansion.

Rana sylvatica LeConte

Material: CM29803-CM29807. Five right and four left ilia (3-4'); six right and six left ilia (4-5'); eight right and three left ilia (5-6'); one right and three left ilia (6-7'); two left ilia (9-10').

Remarks: Assignment to Rana sylvatica is based on Holman (1967) who noted that Rana palustris LeConte, R. pipiens and R. sylvatica LeConte may be distinguished from R. catesbeiana Shaw and R. clamitans Latreille in that the posterodorsal border of the ilial shaft slopes more gently into the dorsal acetabular expansion in the former

group than in the latter. Furthermore, R. pipiens and R. palustris may be separated from R. sylvatica in that the prominence for the origin of the vastus externus head of the triceps femoris muscles is larger, less produced, and less roughened than in R. sylvatica. Based on this criteria, the specimens are assigned to R. sylvatica.

In examination of nine Recent specimens of R. sylvatica and two of R. palustris, the above characteristics hold in separating the two species. Rana sylvatica is usually encountered in or near moist wooded areas, but it often wanders considerable distances from water (Conant, 1975).

Rana catesbeiana Shaw

Material: CM29808. One left ilium (4-5').

Remarks: This specimen is assigned to Rana catesbeiana on the basis of characters discussed above and also on observations of Tihen (1954) who says that R. catesbeiana ilia appear to be highly sculptured. R. catesbeiana is an aquatic frog that prefers larger bodies of water than most other frogs. It is a resident of lakes, ponds, bogs and sluggish portions of streams (Conant, 1975).

Rana sp. indet.

Material: CM29809-CM29813. Three sacral vertebrae (3-4'); two sacral vertebrae (4-5'); two sacral vertebrae (5-6'); one sacral vertebra (6-7'); one sacral vertebra (8-9').

Remarks: I am unable to differentiate these vertebrae to species but they do have the diplasiocoelous condition with cylindrical rather than expanded diapophyses (Holman, 1962). The sacral vertebrae more closely resemble those of R. sylvatica in the shape of the neural canal and in their small size.

Class Reptilia

Order Testudines Batsch

Family Emydidae

Graptemys geographica (LeSueur)

Material: CM29814. One pro-neural bone (4-5').

Remarks: Material is assigned to G. geographica based on the shape, location of shield impressions and surface sculpturing to that of Recent material. Graptemys geographica occurs in large bodies of water. It prefers rivers rather than creeks, and lakes rather than ponds (Conant, 1975).

Order Squamata

Suborder Sauria

Family Scincidae

Eumeces fasciatus (Linnaeus)

Material: CM29815-CM29817. One pre-caudal vertebra (3-4'); three pre-caudal vertebrae (4-5'); one pre-caudal vertebra (6-7').

Remarks: E. fasciatus has a more backswept neural spine than E. laticeps. Eumeces fasciatus lives in rock piles and decaying debris in or near woods. The habitat is usually damp (Conant, 1975).

Suborder Serpentes Linnaeus

Family Viperidae

Crotalus horridus Linnaeus

Material: CM29818-CM29824. Twenty-seven vertebrae (3-4'); 50 vertebrae (4-5'); 27 vertebrae (5-6'); nine vertebrae (6-7'); four vertebrae (7-8'); two vertebrae (8-9'); two vertebrae (9-10').

Remarks: Holman (1963) gives characters to differentiate Crotalus from Agkistrodon. In Agkistrodon a distinct pit usually occurs on either side of the cotyle of the centrum. Each of these pits contains one moderately large fossa. In Crotalus the distinct pits are usually absent and the one or

more fossae that occur on either side of the cotyle of the centrum are minute. In addition, Crotalus horridus has a lower neural spine than either C. adamanteus or Agkistrodon piscivorus (Holman, 1967). The material most closely resembles Crotalus horridus in these characters and is therefore assigned to it. Crotalus horridus lives in timbered terrain; usually it is common in second-growth where rodents abound (Conant, 1975).

Family Colubridae

Subfamily Xenodontinae

Holman (1973b) states that members of this subfamily lack hypapophyses on their lumbar vertebrae and have depressed vertebral neural arches and wide vertebral hemal keels. Based on this criteria the material is assigned to this subfamily.

Heterodon platyrhinos Latreille

Material: CM29825-CM29827. One pre-caudal vertebra (5-6'); one pre-caudal vertebra (6-7'); one pre-caudal vertebra (8-9').

Remarks: Holman (1962) states that the genus Heterodon Latreille may be diagnosed by the following strong characters: hypapophyses absent; vertebrae wider than long

through zygapophyses; neural arch flat; neural spine longer than high, usually thickened dorsally, and with its anterior and posterior borders concave; prezygapophyseal processes large, pointed or truncated; epizygapophyseal spines absent; hemal keel very broad and indistinct on many thoracic vertebrae.

In addition, Holman (1963) was able to differentiate between H. platyrhinos and H. nasicus in that in the former, the anterior zygapophyseal faces are more elongate, and in dorsal view, their anterior margins are much flatter than in the latter species. This material best compares to the characteristics of H. platyrhinos. Heterodon platyrhinos lives in sandy areas (Conant, 1975).

Subfamily Colubrinae

Colubrinae never bear lumbar hypapophyses as in the subfamily Natricine, and they lack the combination of the depressed neural arch and the very wide hemal keel of the Xenodontinae (Holman, 1973b).

Diadophis punctatus (Linnaeus)

Material: CM29828-CM29830. Twenty-six pre-caudal vertebrae (3-4'); 19 pre-caudal vertebrae (4-5'); six pre-caudal vertebrae (5-6').

Remarks: Holman (1967) gives characters to distinguish between the vertebrae of Diadophis punctatus and Carphophis amoenus. He states that the most consistent way to tell the two forms apart is that the neural spine is higher, thicker, and usually with more of a posterior overhang in the former than in the latter species. The above fossils more closely resemble those of D. punctatus in these characters.

Diadophis punctatus is a woodland snake, usually most common in cutover areas that include an abundance of hiding places in the form of stones, logs, bark slabs, or other rotting wood. Rocky, wooded hillsides are also favored (Conant, 1975).

Carphophis amoenus (Say)

Material: CM29831-CM29832. Sixteen pre-caudal vertebrae (3-4'); seven pre-caudal vertebrae (4-5').

Remarks: Fossils are assigned to C. amoenus based on criteria discussed under Diadophis punctatus. Carphophis amoenus is partial to moist earth and disappears deep underground in dry weather (Conant, 1975).

Coluber or Masticophis Linnaeus

Material: CM29833-CM29837. One pre-caudal vertebra (4-5'); three pre-caudal vertebrae (5-6'); seven pre-caudal

vertebrae (6-7'); one pre-caudal vertebra (7-8'); three pre-caudal vertebrae (8-9').

Remarks: Holman (1962) gives characteristics of the lumbar vertebrae for the genus Coluber: hypapophyses absent; vertebrae longer than wide through zygapophyses; neural arch vaulted; neural spine about as high as long, thin and delicate, not beveled anteriorly; epizygapophyseal spines usually well developed; hemal keel narrow throughout.

The vertebrae of Coluber, Masticophis and Opheodrys are similar in that they are elongate and the neural spine is thin and delicate. But the former two genera differ in that they are larger, the neural spine is higher, and a well developed epizygapophyseal spine is almost always present. The fossils resemble the characters of the former two genera in this respect. Based on the present geographic ranges of Masticophis and Coluber it would appear that the fossils represent Coluber, but I am unable to separate the two genera on vertebral remains.

Lampropeltis Fitzinger

Remarks: The vertebrae of Pituophis, Elaphe and Lampropeltis are very similar but have been separated on the basis of characters of Holman (1965). Pituophis is distinct from the other two genera in having a higher neural spine

with an indented anterior edge. The genera Elaphe and Lampropeltis can be separated by the more depressed neural arch of the latter. The fossils resemble Lampropeltis in this respect.

Lampropeltis triangulum (Lacepede)

Material: CM29838-CM29843. Eight pre-caudal vertebrae (3-4'); 33 pre-caudal vertebrae (4-5'); 11 pre-caudal vertebrae (5-6'); five pre-caudal vertebrae (6-7'); one pre-caudal vertebra (7-8'); three pre-caudal vertebrae (8-9').

Remarks: Fossils are assigned to L. triangulum because the vertebrae possess lower neural spines than those of L. getulus. Also L. getulus vertebrae are quite robust with thick neural spines and neural arches, and the hemal keels and sub-central ridges are usually quite strong, with the valleys between them quite deep (Holman, 1965).

Lampropeltis getulus (Linnaeus)

Material: CM29844-CM29848. One pre-caudal vertebra (3-4'); two pre-caudal vertebrae (4-5'); six pre-caudal vertebrae (5-6'); two pre-caudal vertebrae (8-9'); two pre-caudal vertebrae (9-10').

Remarks: The fossils have been assigned to L. getulus

based on criteria discussed under L. triangulum. L. getulus occurs regionally, but has not been recorded in the immediate area. It is possible that Recent L. getulus may be collected in the area in the future.

Elaphe sp. indet.

Material: CM29849. Three pre-caudal vertebrae (6-7').

Remarks: Material is assigned to the genus Elaphe sp. indet. because they have a more vaulted neural arch than Lampropeltis, but less vaulted than Pituophis (Holman, 1973a). In addition, Pituophis exhibits strongly developed epizygapophyseal spines which are lacking in the fossils (Auffenberg, 1963).

The material is too fragmentary to assign it to the specific level.

Subfamily Natricine

Material is assigned to the subfamily Natricine on characters given by Holman (1973b): hypapophyses on their lumbar vertebrae, and Auffenberg (1965): epizygapophyseal spines are usually present.

Natrix sipedon (Linnaeus)

Material: CM29850-CM29852. Two pre-caudal vertebrae (3-4'); one pre-caudal vertebra (4-5'); three pre-caudal vertebrae (5-6').

Remarks: Brattstrom (1967) discusses criteria used in distinguishing Natrix vertebrae from Thamnophis. In general, Thamnophis vertebrae are elongate when viewed from above, while Natrix vertebrae are almost square. In addition, Natrix vertebrae tend to have higher neural spines (Holman, 1962). The fossil material most closely resembles Natrix in these characters.

Natrix septemvittata and N. sipedon occur in the area today. N. septemvittata possesses a long, low neural spine and N. sipedon possesses a much higher one (Auffenberg, 1963). The fossils resemble the latter in this respect.

Natrix sp. indet.

Material: CM29853. One pre-caudal vertebra (5-6').

Remarks: The fossil is too fragmentary for specific identification but genera was determined using criteria discussed under Natrix sipedon.

Thamnophis sauritus (Linnaeus)

Material: CM29854-CM29856. One pre-caudal vertebra

(3-4'); five pre-caudal vertebrae (4-5'); one pre-caudal vertebra (8-9').

Remarks: Criteria for assignment to Thamnophis was discussed under Natrix sipedon. Material is assigned to T. sauritus in that the accessory processes are oblique to the longitudinal axis of the centrum; in T. sirtalis the accessory processes are at right angles to the longitudinal axis of the centrum (Holman, 1962).

Thamnophis sirtalis (Linnaeus)

Material: CM29857-CM29860. Eleven pre-caudal vertebrae (3-4'); six pre-caudal vertebrae (4-5'); two pre-caudal vertebrae (5-6'); one pre-caudal vertebra (6-7').

Remarks: The fossils were assigned to T. sirtalis based on criteria discussed under T. sauritus.

Thamnophis sp. indet.

Material: CM29861-CM29866. Fifteen pre-caudal vertebrae (3-4'); 20 pre-caudal vertebrae (4-5'); three pre-caudal vertebrae (5-6'); two pre-caudal vertebrae (6-7'); one pre-caudal vertebra (8-9'); one pre-caudal vertebra (9-10').

Remarks: The material was too fragmentary for specific identification but could be assigned to genus based on

characters discussed under Natrix sipedon.

DISCUSSION

The Baker Bluff Cave fauna consists of at least five species of urodeles, five species of anurans, one species of turtle, one species of lizard and 11 species of snakes.

All of these forms, as far as can be determined, are living in the area today. Only Lampropeltis getulus, which occurs regionally, is not found in the immediate area today.

Perhaps the most striking thing about the herpetofauna is that there is nothing that strongly indicates that the climate or topography was any different than it is today in northeastern Tennessee. In addition, inspection of Tables I and II giving minimum numbers of individuals from each level show no discernible trends in the herpetofauna that indicate that climatic or ecological conditions changed markedly from approximately 20,000 years B.P. to approximately 600 years B.P.

The Baker Bluff Cave Herpetofauna exhibits many similarities to the Late Pleistocene Herpetofauna from Ladds, Georgia, located in the northwestern part of the state (Holman, 1967). At least ten species, mostly snakes, from the Ladds, Georgia, site are also present at Baker Bluff Cave.

The Baker Bluff Cave fauna is indicative of four major ecological preferences (Table III). (1) A permanent aquatic habitat based on the evidence of Rana catesbeiana and Graptemys geographica; (2) a marsh-stream border situation indicated by the water snakes Natrix and Thamnophis and the toad Bufo w. fowleri; (3) an open, sandy area indicated by Heterodon platyrhinos; and (4) a moist woodland habitat where the majority of the identified Colubrinae, Crotalus horridus, Ambystoma opacum and A. maculatum lived.

The diversity of habitats exhibited by the herpetofauna strongly indicates that the fossil remains were probably deposited by raptors, most likely owls. As a result of this type of accumulation, it is impossible to conclude what the exact nature of the environment was in immediate proximity to the cave site, but the herpetological remains show that the four major habitats discussed were present in the area.

TABLE I
MINIMUM NUMBER OF INDIVIDUALS
AMPHIBIANS

Species	3-4'	4-5'	5-6'	6-7'	7-8'	8-9'	9-10'	Total
<u>Ambystoma opacum</u>	0	1	1	1	0	1	0	4
<u>Ambystoma maculatum</u>	0	1	1	1	0	0	0	3
<u>Ambystoma sp.</u>	1	1	1	1	1	1	1	7
<u>Necturus maculosus</u>	1	1	1	1	1	1	0	6
<u>C. alleganiensis</u>	1	1	1	1	1	0	1	6
<u>Desmognathus sp.</u>	1	1	1	1	1	1	0	6
<u>Bufo americanus</u>	12	24	10	7	2	2	3	60
<u>Bufo w. fowleri</u>	3	3	1	0	0	0	0	7
<u>Bufo sp.</u>	4	15	4	1	1	2	0	27
<u>Hyla sp.</u>	1	0	0	0	0	0	0	1
<u>Rana sylvatica</u>	5	6	8	3	0	0	2	24
<u>Rana catesbeiana</u>	0	1	0	0	0	0	0	1
<u>Rana sp.</u>	3	2	2	1	0	1	0	9

TABLE II
MINIMUM NUMBER OF INDIVIDUALS
REPTILES

Species	3-4'	4-5'	5-6'	6-7'	7-8'	8-9'	9-10'	Total
<u>Graptemys geographica</u>	0	1	0	0	0	0	0	1
<u>Eumeces fasciatus</u>	1	1	0	1	0	0	0	3
<u>Crotalus horridus</u>	1	1	1	1	1	1	1	7
<u>Heterodon platyrhinos</u>	0	0	1	1	0	1	0	3
<u>Diadophis punctatus</u>	1	1	1	0	0	0	0	3
<u>Carphophis amoenus</u>	1	1	0	0	0	0	0	2
<u>Coluber or Masticophis</u>	0	1	1	1	1	1	0	5
<u>L. triangulum</u>	1	1	1	1	1	1	0	6
<u>L. getulus</u>	1	1	1	0	0	1	1	5
<u>Elaphe sp.</u>	0	0	0	1	0	0	0	1
<u>N. sipedon</u>	1	1	1	0	0	0	0	3
<u>Natrix sp.</u>	0	0	1	0	0	0	0	1
<u>Thamnophis sauritus</u>	1	1	0	0	0	1	0	3
<u>Thamnophis sirtalis</u>	1	1	1	1	0	0	0	4
<u>Thamnophis sp.</u>	1	1	1	1	0	1	1	6

TABLE III
ECOLOGICAL PREFERENCE CHART

Species	Permanent Aquatic	Marsh- Stream Border	Moist Woodland	Open Wooded
<u>Ambystoma opacum</u>			X	
<u>Ambystoma maculatum</u>			X	
<u>Ambystoma sp.</u>				
<u>Necturus maculosus</u>	X			
<u>Cryptobranchus alleganiensis</u>	X			
<u>Desmognathus</u>	X			
<u>Bufo americanus</u>			X	
<u>Bufo w. fowleri</u>		X		
<u>Bufo sp.</u>				
<u>Hyla sp.</u>		X		
<u>Rana sylvatica</u>			X	
<u>Rana catesbeiana</u>	X			
<u>Rana sp.</u>				
<u>Graptemys geographica</u>	X			
<u>Eumeces fasciatus</u>			X	
<u>Crotalus horridus</u>			X	
<u>Heterodon platyrhinos</u>				X
<u>Diadophis punctatus</u>			X	
<u>Carphophis amoenus</u>			X	
<u>Coluber or Masticophis</u>				X
<u>Lampropeltis triangulum</u>			X	
<u>Lampropeltis getulus</u>			X	
<u>Elaphe sp.</u>				
<u>Natrix sipedon</u>		X		
<u>Natrix sp.</u>				
<u>Thamnophis sauritus</u>		X		
<u>Thamnophis sirtalis</u>		X	X	
<u>Thamnophis sp.</u>				

Ecological preferences from Holman (1972) and Conant (1975).

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