TULANE STUDIES IN ZOOLOGY

Volume 1, Number 4 August 15, 1953

A POPULATION OF HOLBROOK'S SALAMANDER, *EURYCEA LONGICAUDA GUTTOLINEATA* (HOLBROOK).

ROBERT E. GORDON

DEPARTMENT OF ZOOLOGY, TULANE UNIVERSITY OF LOUISIANA, NEW ORLEANS

TULANE UNIVERSITY
NEW ORLEANS

TULANE STUDIES IN ZOOLOGY is devoted primarily to the zoology of the area bordering the Gulf of Mexico. Each number is issued separately and deals with an individual study. As volumes are completed, title pages and tables of contents are distributed to institutions exchanging the entire series.

Manuscripts submitted for publication are evaluated by the editor and by an editorial committee selected for each paper. Contributors need not be members of the Tulane University faculty.

Manuscripts should be submitted on good paper, as original typewritten copy, double-spaced, and carefully corrected.

Separate numbers may be purchased by individuals, but subscriptions are not accepted. Authors may obtain copies for personal use at cost.

Address all communications concerning exchanges, manuscripts, editorial matters, and orders for individual numbers to the editor. Remittances should be made payable to Tulane University.

Price for this number $0.25.

George Henry Penn, *Editor,*
c/o Department of Zoology,
Tulane University of Louisiana,
New Orleans, U. S. A.

A POPULATION OF HOLBROOK'S SALAMANDER, *EURYCEA LONGICAUDA GUTTOLINEATA* (HOLBROOK).

ROBERT E. GORDON
Department of Zoology, Tulane University of Louisiana, New Orleans.

Knowledge of the life cycle and general ecology of many of the more abundant North American caudate amphibians is variously incomplete or lacking. Holbrook's salamander, *Eurycea longicauda guttolineata* is no exception. The literature records of this form are based on a few recently metamorphosed individuals or larvae. No samples have been available from which information relative to variation and population structure can be obtained. Two samples, collected from the same population in 1950 and 1952, are deposited in the collections of Tulane University (Tulane 13314 and 14905).

The author is indebted to Allan H. Chaney for information concerning the 1950 sample, collected by the 1950 Tulane Field Crew, and to Mr. Chaney and Robert G. Webb for aid in securing the 1952 sample. Both collections were taken during field trips made possible by grants for summer research to Dr. Fred R. Cagle, to whom the author owes much for opportunity to participate in the 1952 field expedition and for valued criticism of this manuscript.

Both samples were taken approximately two miles south of Marianna, Jackson Co., Florida on the Chipola River, the same locality mentioned by Chaney and Smith (1950) and Tinkle (1952), although the latter was misinformed as to the distance from Marianna. Sixty-three individuals (Tulane 14905), collected in three man hours, were taken on August 23, 1952 between 2:30 and 3:30 P.M. The salamanders were collected in an irregularly shaped depression, approximately three-quarters of an acre in size, located in the river's floodplain. Piles of debris and high water marks indicated previous inundation, although no surface water was present. The vegetation was predominately gum-cypress, with ironwood occupying the drier edges of the area. The understory was sparse. A thick grass-herb layer was encroaching toward the center from the drier sides of the depression. The habitat fits Carr's (1940) description of the "Low Hammock." Fallen timber and other surface litter was abundant.

The majority of the salamanders was collected from patches of ground devoid of vegetation, but dense in surface debris and cypress knees. Individuals were found under all sizes of debris; as many as three were found under the same cover. The sky was overcast and rain imminent. Several of the salamanders were active and could be seen moving on the surface.

Associated species found under surface debris with *Eurycea l. guttolineata* were *Desmognathus fuscus fuscus, Microhyla carolinensis, Eumeces fasciatus,* and *Diadophis punctatus punctatus.*

The second sample, collected July 12, 1950, consists of eighty-one specimens, approximately half of which (according to information supplied by A. H. Chaney) were found in the area of the 1952 sample by Chaney. The other individuals were taken in adjacent areas along the river.

Gonadal Development and Egg Deposition

The gonads of 144 individuals were examined macroscopically. The gonads and accessary ducts of 56 specimens in the size range (snout-vent) 21 to 39 mm (mean 34) are distinctly immature. The testes and ducts contain no pigment. The compact ovaries contain many small white ovocytes not enlarged with yolk material.

Eighty-eight specimens (varying in size from 43 to 61 mm, mean 52 mm) possess enlarged gonads and ducts when compared to the above group. The testes and vasa deferentia are pigmented in varying degrees. The ovocytes appear to contain yolk material.

Forty-seven females (40 in the 1950 sample and 7 in the 1952 sample) constitute a size group falling within the range 46 to 61 mm, average 53 mm. A correlation between condition of the oviduct, ovary and body length is apparent (fig. 1). Twenty-four individuals in the size range 46 to 54 mm (mean 50) possess compact ovaries containing ovocytes of approximately the same size. The oviducts are firm, flat and without convolution (fig. 1, open squares).

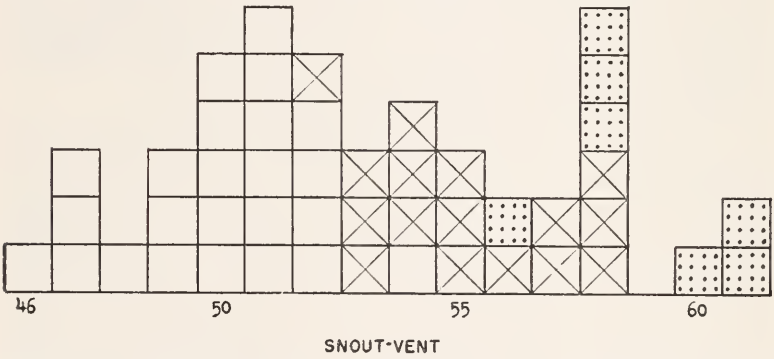

Figure 1. Ovarian condition correlated with body length. Each square represents one individual. Open squares indicate ovaries compact, oviducts straight. Squares with diagonals, ovaries contain luteal-like structures and oviducts convoluted. Dotted squares indicate compact ovaries and convoluted oviducts, and represent specimens taken in August. All other individuals were collected in July.

Twenty-three individuals in the size range 53 to 61 mm (average 56) possess one feature in common, the oviduct is always convoluted (at least one loop is present) and, in the majority of individuals, this convolution occurs in the proximal end. The ovaries of the July 1950 individuals (squares with diagonals, fig. 1) vary in the number of collapsed follicles present. These same structures have been referred to as "corpora lutea" by McCurdy (1931), and presumably are the remains of former ovarian follicles after ovulation has occurred (McCurdy, *op. cit.;* Fisher and Richards 1950). Three individuals with snout-vent lengths of 54, 58 and 56 mm possess no collapsed follicles. The ovocytes are of two distinct sizes and the oviducts are convoluted. All of the females collected in August 1952 (dotted squares, fig. 1) possess ovaries which have completely recovered, *i.e.* no collapsed follicles are present, ovocytes are of two distinct sizes,

but the oviducts are convoluted.

The possession of a convoluted oviduct, at least prior to the egg-laying season, seems to indicate that the individual has ovulated at least once. This feature, plus the varying degrees of recovery from ovulation, permits us to divide the sample into two groups, those individuals which have ovulated and presumably are sexually mature, and a group which is becoming sexually mature and will be ready for ovulation during the next reproductive season.

This interpretation is in sharp contrast with that made by Pope and Pope (1949) for *Plethodon glutinosus glutinosus.* They report a group of twelve "spent" individuals (collected in late June, late July and the first week in August) having ovaries which were not compact, the eggs being of various sizes, and whose oviducts were not swollen or convoluted. The body lengths of these individuals are shorter than (yet overlap those of) a series of eleven obviously gravid specimens (Pope and Pope, *op. cit.,* fig. 63). The reproductive season is extended, presumably from June, or late May, through September (Pope and Pope, *op. cit.*).

The testis and vas deferens do not lend themselves as nicely to macroscopic examination as do the female structures. Francis (1934) reports that the Mullerian and Wolffian ducts are never pigmented in female *Salamandra* while ". . . Muller's duct, and its associated urino-genital duct . . ." are always pigmented in the male. Goin (1950) states that the sex of *Ambystoma c. bishopi* may be determined ". . . by examination of the Mullerian duct, which is pigmented in the males and unpigmented in the females . . .". Pigmentation appears macroscopically to be confined to that portion of the vas deferens (urino-genital or Wolffian duct) from which Muller's duct is indistinguishable macroscopically (Francis, *op. cit.*) in mature male *Eurycea.* Twenty-five males in the size range 43 to 54 mm (average 50) possess vasa deferentia of which less than 50 percent of the surface area is pigmented (see fig. 2). Of these, eight individuals (average 50, extremes 48 to 54 mm) have no pigmentation, or melanophores are faintly noticeable bilaterally along a line near the dorsal surface of the duct. The duct in all of the twenty-five males is firm and straight, exhibiting no convolutions. Sixteen specimens, ranging from 51 to 58 mm, mean 54, have vasa deferentia which are convoluted but vary from complete to partial pigmentation, always exceeding 50 percent of the surface of the duct. In this latter group, pigmentation is absent from the proximal part of the duct, the distal part being pigmented and convoluted. From the study of all individuals, the spread of pigmentation seems to be from the distal to the proximal end of the duct.

A general increase of pigmentation with size is suggested; this may possibly be correlated with age and sexual maturity. If it is correlated with the latter, then, as in the females, we have two groups of animals, one (diagonal squares, fig. 2) sexually mature, having been sexually active in one reproductive season; the other group (open squares, fig. 2) just becoming sexually mature, will be ready for sexual activity during the next reproductive season.

Sexual maturity is apparently reached at the same size in both sexes.

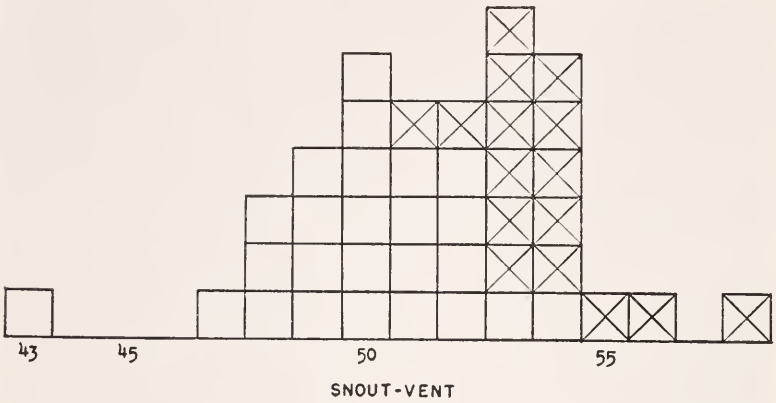

Figure 2. Condition of vasa deferentia correlated with body length. Open squares indicate vas deferens pigmented less than 50 percent, no convolutions. Squares with diagonals, vas deferens pigmented 50 percent or more and convoluted. Each square represents one individual.

All evidence in the literature points to egg deposition in December since females collected in November contain large ovarian eggs (Brimley 1896, 1939; Parker 1948). Females collected in August 1952 possess ovocytes of two distinct sizes and represent the largest individuals in the August sample. The largest females collected in the July 1950 sample show varying degrees of recovery from the "spent" ovarian condition. It would appear that egg deposition occurs in late autumn for this Florida population, possibly in December. It is interesting to note the length of the recovery phase from ovulation until maturing ovocytes again make up the bulk of the ovary.

Vomerine Teeth

Counts were made on 144 individuals. Since only 39 percent of the specimens have the same number of teeth on both sides, the sum of the right and left counts is used in all calculations (see Pope and Pope, 1949). Two individuals were discarded since the vomerine teeth were not clearly separable from those of the parasphenoid. There is no significant difference between the sexes in the number of vomerine teeth. An increase in number of teeth with size is indicated. Males less than 40 mm (snout-vent) have an average of 14.4 teeth, while females of a similar size group possess averagely 14.2 teeth. Of the individuals measuring more than 40 mm, males average 19.8 teeth and females 19.7 teeth.

Body Measurements

The means and extremes for the various body measurements are presented in Table 1. All measurements are in millimeters. Snout-vent length is measured from tip of the snout to the anterior edge of the vent. Head length is measured from the tip of the snout to the gular fold. Head width is a measurement taken across the head at the angle of the jaws. The axilla-groin measurement is the distance between the limb insertions.

Table 1. Body measurements.

No.	Snout-vent	Axilla-groin	Head length	Head width
		Sexually mature		
♂	51.4	28.1	11.5	8.5
41	43 - 58	23 - 32	7 - 13	7 - 9
♀	52.9	29.6	11.6	8.0
47	46 - 61	24 - 35	10 - 14	7 - 9
		Sexually immature		
♂	34.2	18.3	8.3	5.7
33	29 - 37	16 - 20	7 - 9	5 - 6
♀	34.6	18.6	8.5	5.8
22	31 - 39	16 - 21	8 - 9	5 - 7

The mature female reaches a total length only slightly larger than the male. The average length for thirty-nine females is 148 mm (extremes 122 to 167 mm). Thirty-four mature males average 147 mm in total length (extremes 125 to 165 mm).

Population Structure

Sex ratio.—The sex ratios do not deviate significantly from an expected 1 to 1 ratio of either the 1950 sample taken as a unit, the 1952 sample, or the two distinct size groups represented by both samples combined.

Table 2. Sex ratios.

Sex	1950	1952	Juvenile	Adult
♂	40	34	33	41
♀	40	29	22	47

Size groups.—The July 1950 sample (open squares, fig. 3) is composed (with a single exception) of individuals in the size group 43 to 58 mm (snout-vent). These specimens as indicated above are either sexually mature or would presumably have been mature by the December 1950 reproductive season.

Parker (1948) reports that larvae collected in April measure 31 to 34 mm total length. Bishop (1943) gives the measurements of larvae collected June 18 as varying from 22 to 39 mm. The measurements of two recently transformed individuals are reported by Sinclair (1951) as 22.5 and 24 mm body length, and 41.5 and 45 mm total length. The single juvenile in the July 1950 sample measures 21 and 45 mm for the two lengths, and probably represents a recently metamorphosed individual.

The body length frequency of the August 1952 sample presents a distinctly different picture (squares with diagonals, fig. 3). Only eight individuals are sexually mature. Fifty-five specimens (average 34, extremes 29 to 39 mm) are sexually immature and apparently represent individuals metamorphosing the previous June or July.

If we assume that sexual maturity is reached in the second reproductive season following metamorphosis, *i.e.* when the salamander is two years old, then the unusual distribution of size groups in the two samples may be explained in the following way.

It may be postulated that the collection of a large segment of adults in July 1950, by reducing egg deposition the following December, would reduce the number of sexually maturing individuals in 1952. This would explain the absence of the size group 42 to 55

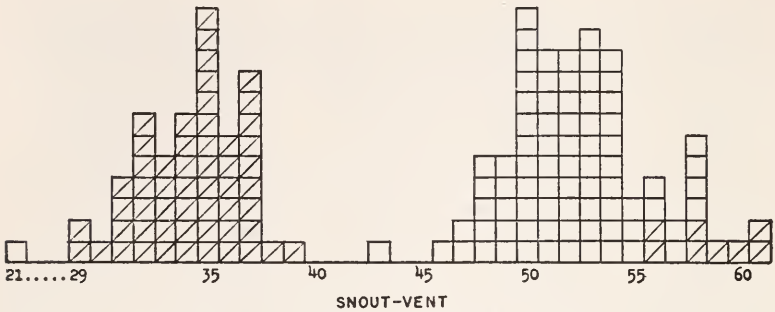

Figure 3. Frequency distribution—snout-vent length. Open squares indicate specimens collected July 1950. Squares with diagonals indicate specimens collected August 1952. Each square represents one individual.

mm in August 1952. The adults which reproduce in 1951 are products of the eggs of 1949. Since the 1950 collection did not interfere with deposition of eggs in 1949, nor with the newly metamorphosed individuals from these eggs, adults would be present to reproduce in December 1951. Egg deposition occurred and the larvae transformed in June or July. The August 1952 sample reveals a preponderance of this group of metamorphosed individuals.

No obvious explanation is available for the absence of a larger segment of the adults which bred in December 1951 from the August 1952 sample; however, differential habitat selection is known to occur in many terrestrial salamanders and may be a possible explanation in this instance.

References Cited

Bishop, Sherman C. 1943. *Handbook of Salamanders.* Comstock Publishing Company, Ithaca, pp. 1-555.

Brimley, C. S. 1896. Batrachia found at Raleigh, N. C. *Amer. Nat.*, 30: 500-501.

---------- 1939. The amphibians and reptiles of North Carolina. *Carolina Tips* [Elon College, N. C.], 2: 18.

Carr, Archie F., Jr. 1940. A contribution to the herpetology of Florida. *Univ. Fla. Stud., Biol. Sci. Ser.*, 3: 1-118.

Chaney, Allan H. and Clarence L. Smith. 1950. Method for collecting mapturtles. *Copeia*, 1950: 323-324.

Fisher, Helen T. and A. Richards. 1950. The annual ovarian cycle of *Acris crepitans* Baird. In *Researches on the Amphibia of Oklahoma*, Univ. Okla. Press, Norman, pp. 129-142.

Francis, Eric B. T. 1934. *The Anatomy of the Salamander.* The Claredon Press, Oxford, pp. 1-381.

Goin, Coleman J. 1950. A study of the salamander, *Ambystoma cingulatum*, with the description of a new subspecies. *Ann. Carg. Mus.*, 31: 299-320.

McCurdy, Harriet M. 1931. Development of the sex organs in *Triturus torosus*. *Amer. Jour. Anat.*, 47: 367-403.

Parker, Malcolm V. 1948. A contribution to the herpetology of western Tennessee. *Jour. Tenn. Acad. Sci.*, 12: 20-30.

Pope, Clifford H. and Sarah H. Pope. 1949. Notes on the growth and reproduction of the slimy salamander, *Plethodon glutinosus*. *Fieldiana*, 31: 251-261.

Sinclair, Ralph M. 1951. Notes on recently transformed larvae of the salamander *Eurycea longicauda guttolineata*. *Herpetol.*, 7: 68.

Tinkle, Donald W. 1952. Notes on the salamander, *Eurycea longicauda guttolineata*, in Florida. *Field and Lab.*, 20: 105-108.