THE UNIVERSITY OF KANSAS
SCIENCE BULLETIN

VOL. XXXIV, PT. II] FEBRUARY 15, 1952 [No. 11

Geographic Variation in the Lizard *Eumeces anthracinus*

BY

PHILIP W. SMITH AND HOBART M. SMITH

ABSTRACT: Based on a study of 187 specimens of *Eumeces anthracinus* the authors recognize two subspecies, *anthracinus anthracinus* and *anthracinus pluvialis*. The former is distributed chiefly in the northern Appalachian Mountains, the latter having a wide range in the southern Appalachian Mountains, and west of the Mississippi River from eastern Kansas and Missouri south to northern Louisiana.

In 1946, one of us (H. M. Smith, 1946a, pp. 87-88) pointed out that the range of the coal skink, *Eumeces anthracinus* (Baird), appeared to be discontinuous, consisting of three geographically distinct populations: an eastern one extending from New York to Georgia, a second one in the Ozark Uplands, and a third in extreme southern Alabama and Mississippi. Attention was called to the fact that juvenal lizards from the Ozark area were known to differ in color and pattern from those in the Appalachian Mountains. The juvenal markings of the Alabama-Mississippi populations, however, were unknown. Tentative retention of the name *pluvialis* (Cope, 1880) was suggested for the southern and western populations, pending examination of the young lizards from the Alabama-Mississippi area and detailed comparison of specimens from the various portions of the known range.

We have recently examined all the material readily available and find that some of the above statements require revision. Two races are involved, differing in scutellation as well as in color and pattern of the juvenal lizards. Specimens from many localities between the areas previously known to be inhabited have been taken in recent years, however, indicating the range of the species to be more nearly continuous from New York to Kansas than indicated in the recent handbook of lizards (Smith, 1946b). Moreover, our data

show that specimens from the southern Appalachians are indistinguishable from Ozark specimens but are distinct from those in the northern Appalachians.

Our study is based on 187 specimens, slightly more than twice the number available to Taylor at the time of his admirable generic revision (Taylor, 1936) and from considerably more than twice as many localities. We are indebted to the following museum officials and collectors for the privilege of examining preserved material in their charge: S. C. Bishop, C. M. Bogert, B. C. Brown, F. R. Cagle, D. M. Cochran, A. F. Cook, H. Dowling, E. R. Dunn, J. A. Fowler, N. E. Hartweg, R. L. Hoffman, R. T. Hoskins, H. K. Gloyd, A. L. Loveridge, M. G. Netting, A. I. Ortenburger, G. L. Orton, C. H. Pope, E. C. Raney, K. P. Schmidt, and E. H. Taylor. We are also indebted to Drs. D. F. Hoffmeister and H. H. Ross for critical perusal of the manuscript. Abbreviations for the sources of material studied are as follows:

AMNH	American Museum of Natural History
ANSP	Academy of Natural Sciences at Philadelphia
BCB	Bryce C. Brown
CAS	Chicago Academy of Sciences
CM	Carnegie Museum at Pittsburg
CNHM	Chicago Natural History Museum
CU	Cornell University Museum of Natural History
FC	A. Fannye Cook
INHS	Illinois Natural History Survey
KU	University of Kansas Museum of Natural History
MCNP	Mammoth Cave National Park
MCZ	Museum of Comparative Zoology at Harvard
OU	University of Oklahoma Museum of Natural History
RLH	Richard L. Hoffman
TU	Tulane University Museum of Zoology
UIMNH	University of Illinois Museum of Natural History
UMMZ	University of Michigan Museum of Zoology
UR	University of Rochester Museum of Natural History
USNM	United States National Museum

The species was first described by Baird (1850, p. 294) from North Mountain near Carlisle, Pennsylvania. Cope (1875, p. 45) was the next to contribute to the knowledge of the lizard, recording the range of the species as "Pennsylvania to Texas, in mountains". Two years later in his address to the American Philosophical Society (Cope, 1877, p. 64), the same author mentions receiving a specimen of a variety of *Eumeces anthracinus* from Mobile, Alabama. Three years later (Cope, 1880, p. 19, footnote) this was described as the type of a new species, *Eumeces pluvialis*. Burt (1928, p. 50) expressed doubt of the validity of the latter species

and referred all Kansas specimens to *Eumeces anthracinus*. Taylor (*op. cit.*), having extremely few eastern specimens, was unable to separate the two forms and he also regarded Cope's name as a synonym. Clausen (1938, p. 6) mentioned differences in juvenal coloration and pattern and later Smith (1946a, *loc. cit.*) resurrected *pluvialis* as a subspecific name for the southern and western populations for reasons outlined in our introductory paragraph.

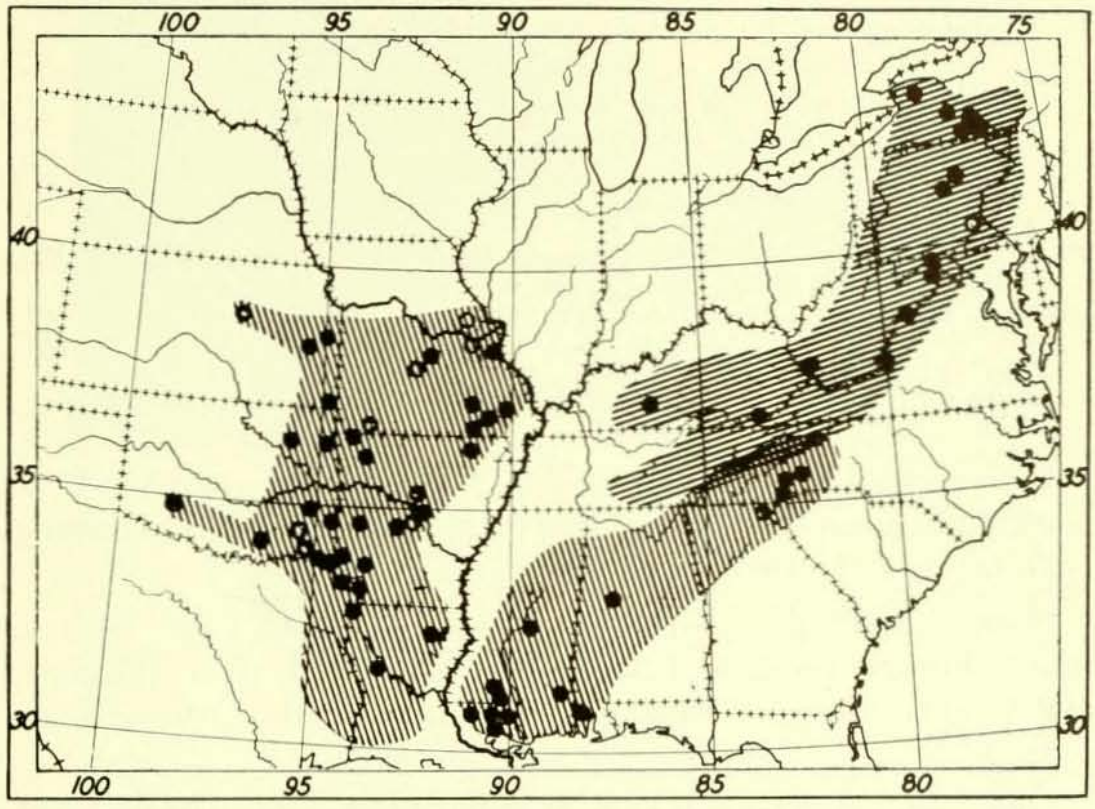


FIG. 1. Distribution of the subspecies of *Eumeces anthracinus*. Solid dots indicate specimens examined, open circles indicate literature records. Lines extending southwestward indicate the range of *E. a. anthracinus;* those extending southeastward indicate the range of *E. a. pluvialis*. Extension of the conjectured range (the hatched area) into areas from which no records are available is based upon apparent availability and accessibility of presumably suitable habitat. The presumed area of intergradation occupied by nearly exactly intermediate populations is indicated by the zone of overlapping (crossing) lines.

Eumeces anthracinus (Baird)

Diagnosis. A medium-sized skink of the *anthracinus* group of *Eumeces*, characterized by absence of postnasals, possession of a single postmental, moderately well-developed limbs which usually overlap when adpressed, a dorsolateral and lateral light line enclosing a dark brown stripe extending the length of the body, median light stripe if present not forking on head at neck, 23-30 scale rows, dorsal scales not widened.

KEY TO SUBSPECIES

1. Scale rows 23-26, av. 24.5, usually (81.1%) 25 or fewer; a continuous light line through posterior supralabials, or at least no evidence of spotting; frequently 7-6 supralabials or less (68.5% toward north, 47% toward south); usually no evidence of longitudinal dark stripes or rows of spots between dorsolateral light lines (66%); color and pattern in juveniles as in adults, *a. anthracinus*

Scale rows 24-30, av. 27.6, usually (99%) 26 or more; supralabials light-centered, sutures dark; usually (94.5%) 7-7 supralabials or more; usually one or more longitudinal dark stripes or rows of spots between dorsolateral light lines (65%); body of juveniles dark with stripes obscure or absent. . . . . *a. pluvialis*

Eumeces anthracinus anthracinus (Baird)

Plestiodon anthracinus Baird, Journ. Acad. Nat. Sci. Philadelphia, vol. 1, p. 294, 1850 (North Mountain, near Carlisle, Cumberland Co., Pennsylvania).
Eumeces anthracinus, Cope, Ann. Rep. U. S. Nat. Mus. for 1898, pp. 661-663, 1900 (part); Taylor, Univ. Kan. Sci. Bull., vol. 23, pp. 373-387, 1936 (part).
Eumeces anthracinus anthracinus, Smith, Univ. Kansas Publ. Mus. Nat. Hist., vol. 1, no. 2, p. 87, 1946.

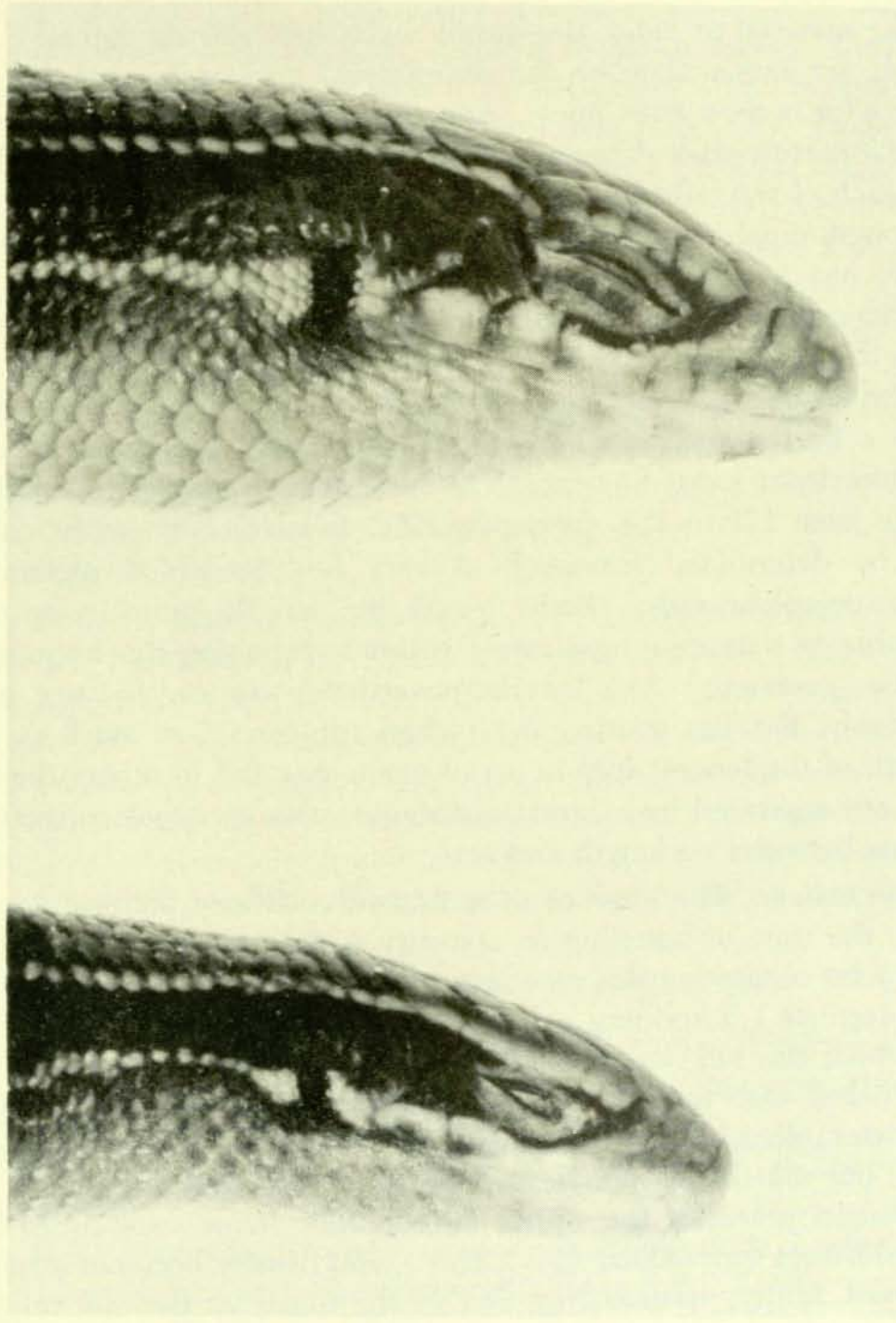
Type specimens. Five cotypes (USNM no. 3138) are in the U. S. National Museum, all in very bad condition. No data concerning collector or date of collection are available.

Range. Central and western New York from Lake Ontario south through montane Pennsylvania, Maryland, West Virginia, and Virginia to central Kentucky and northwestern North Carolina (Fig. 1).

Diagnosis. A subspecies of *E. anthracinus* with a broad, conspicuous black or brown lateral stripe bordered above and below with narrow light lines, the lower continuous through ear to the elevated loreal scales; six (51%) or seven supralabials; 23-26 (average, 24.5) scale rows at midbody; one (26%) or two (8%) pairs of dark lines or rows of dots between dorsolateral light lines; juveniles with markings much like adults.

Variation. Of 54 specimens examined, all are typical in the presence of a single postmental and the absence of postnasals. The number of scale rows at midbody varies from 23 to 26 with the following frequencies: 23, one; 24, thirty-two; 25, five; 26, nine. No geographic cline is evident in this feature of scutellation. In the number of supralabials, however, New York series show a higher frequency of specimens with a reduced number of supralabials. Thirty-eight specimens from New York show the following

variation: 7-7, 31.5%; 7-6, 10%; and 6-6, 58.5%. Sixteen specimens from the southern Appalachians (Pennsylvania to Central Kentucky) yield the following percentages: 7-7, 53%; 7-6, 14%; and 6-6, 33%. Slightly more than half the available specimens of this race thus possess six supralabials on each side of the head. Infralabials



Pl. LXXV. Lateral views of the head and neck of a specimen of the two subspecies of *Eumeces anthracinus*. Upper, *E. a. pluvialis*, UIMNH 16332, five miles east of Baxter Springs, Cherokee Co., Kansas, snout-ear length 8.8 mm. Lower, *E. a. anthracinus*, CU 3335, Connecticut Hill, Tompkins Co., New York, snout-ear length 7.5 mm.

are usually 6-6, occasionally five or seven on one side. Subdigital lamellae vary from 11 to 14.

The ground color dorsally is usually brown but approximately one fifth of the available specimens are light green. Most of the latter are large adults. The lateral stripes are most often dark brown or occasionally black in preserved specimens. In about 66% of the material at hand, the dorsal scales between the lateral dark bands are immaculate or the dorsolateral dark stripes are edged only with narrow light lines. Approximately 26% of the specimens have a narrow dark stripe or longitudinal row of dark spots bordering each of the light lines medially, and 8% have an additional pair of longitudinal rows of dark spots down the middle of the back. None has a middorsal light stripe. In almost all the available specimens the mental and adjacent scales are conspicuously lighter than the other head and ventral scales.

The largest specimen examined is 65.5 mm. from snout to vent with a head length of 11.2 mm. Several other specimens exceed 60 mm. from snout to vent. The head length/body length ratios range from 17% to 21%, averaging 19%. Relative tail lengths could not be determined inasmuch as very few preserved specimens have complete tails. Body length/leg length ratios were impossible to determine accurately without damaging the frequently brittle specimens. Leg lengths nevertheless appear to vary considerably, the legs overlapping (when adpressed) as much as the length of the longest toes in many specimens and in others the toe tips are separated by as great a distance. No apparent correlation occurs between leg length and sex.

Discussion. The absence of a marked color and pattern change from the time of hatching to maturity is an apparently significant character separating this race from the following subspecies. Clausen (*op. cit.*) describing a hatchling states: "It was 45 mm. long, of which the tail was 20 mm., and had the same pattern as the adult, but with the tip of the nose and sides of the head orange, the back olive black bordered by a narrow yellow stripe on each side, the side bands and legs deep black, and the tail blue." In preserved juveniles the upper lateral light stripe extends to the anteriormost supraocular (Pl. LXXV), and usually becomes obscure in most adults, disappearing first in the males as the jaw regions become orange or red.

The lower lateral light stripe provides another reliable character. It is interrupted only at the anterior edge of the ear or not at all,

and is readily discernible on the sides of the head of some of the largest specimens studied (60 mm. or more from snout to vent). Less than ten percent of our material is so mottled that the lower lateral head stripe is indistinguishable.

Material examined. Forty-five specimens, as follows: KENTUCKY.—*Bell Co.* (CAS 13904); *Edmonson Co.*: Mammoth Cave Ridge (MCNP 104). MARYLAND.—*Alleghany Co.* (ANSP 9433-4). PENNSYLVANIA.—*Clinton Co.*: Renova (USNM 38197); *Clearfield Co.*: Karthaus (CM 6). NEW YORK.—*Genesee Co.*: Bergen (CU 3718, 2552); *Ontario Co.*: Hemlock Lake (UR 978); *Tioga Co.*: 1 mi. N Candor (CU 2310); Prospect Valley (CU 2589, 2374, 2499 [4], UR 7609); *Tompkins Co.*: Caroline (CU 603); Connecticut Hill (CU 2311, 2540, 3577, 3616 [3], 1874, 3355, 3694, 2338, 3335 [3]); Slope above Mich. Creek (CU 2612); ¾ mile up valley from Danby Pond (CU 2541); Newfield Twp. (CU 2551 [2], 2239 [2]); Prospect Valley (UIMNH 15119); near Willseyville (CU 3161); 1½ mi. E Willseyville (UR 7278). VIRGINIA.—*Alleghany Co.*: Clifton Forge (RLH 419); 3 mi. NW Clifton Forge (RLH 71). WEST VIRGINIA.—*Hampshire Co.*: near Slanesville (CM 18358); *Logan Co.*: 2 mi. E Mallory (CM 16099); *Pendleton Co.*: 2 mi. above Franklin (CM 15482).

Other localities. Baird (*loc. cit.*) records the species from North Mountain, near Carlisle, Cumberland Co., Pennsylvania (type locality), and Clausen (1938, pp. 3-7) from Chemung Co., New York. Apparently the subspecies may be expected in the state of Tennessee, although records from there are not now known. Specimens are much to be desired from that state and also from Virginia, where intergradation with *E. a. pluvialis* presumably occurs. It is possible, although perhaps not probable, that the species occurs also in Ohio.

Eumeces anthracinus pluvialis Cope

Eumeces pluvialis Cope, Bull. U. S. Nat. Mus., no. 17, footnote p. 19, 1880 ("near Mobile, Alabama").
Eumeces anthracinus pluvialis, Smith, Univ. Kansas Mus. Nat. Hist. Misc. Publ., vol. 1, no. 2, pp. 87-88, 1946.
Eumeces anthracinus, Burt, Trans. Acad. Sci. St. Louis, vol. 26, no. 1, pp. 49-51, 1928 (part); Taylor, Univ. Kansas Sci. Bull., vol. 23, pp. 373-387, 1936 (part).

Type specimen. Cope's original type specimen (collected by Dr. Joseph Corson) has apparently been lost. Taylor (*op. cit.*) designated USNM no. 75291 (the only topotype then extant) as neotype of *E. pluvialis*. The latter specimen was collected by H. P. Löding.

Range. Western North Carolina to extreme northeastern Georgia and westward to southeastern Kansas and northeastern Texas (Fig. 1).

Diagnosis. A subspecies of *Eumeces anthracinus* differing from the typical subspecies by the greater number of scale rows at midbody (24-30, average 27.6); supralabials light-centered, sutures pigmented; seven supralabials (94.5%); body color dark in juvenal lizards; and dorsal markings frequently present between lateral dark bands.

Variation. Three of the 142 specimens examined (KU 8808, KU 23615, and MCZ 29313) are atypical, possessing two postmental scales (the presence of a single postmental is considered the most reliable single specific character). The specimens are remarkably similar in dorsal pattern and scutellation to occasional specimens of the southern races of *Eumeces septentrionalis.* In all three of the atypical *E. a. pluvialis,* however, the anterior postmental is very short (approximately 1/5 the length of the posterior scale). Other characters (see discussion under Phylogeny) reliably allocate the specimens with their proper species. Moreover, two of the three aberrant specimens (KU 8808 and MCZ 29313) are from Arkansas, which is east of the known range of *E. septentrionalis.*

The number of scale rows at midbody ranges from 24 to 30 with the following frequencies: 24, one; 25, none; 26, twenty-three; 27, six; 28, fifty-five; 29, three; and 30, eight. The one specimen with 24 scale rows (USNM 75291) is the neotype designated by Taylor. Selection of an aberrant specimen as neotype is unfortunate; but as has been pointed out, USNM 75291 was the only topotype available at that time. In head pattern and number of supralabials the neotype agrees with other western specimens. Of the 112 specimens from which scutellation data could be taken, 105 have seven supralabials on each side, five have six on a side, and two have eight on each side. Infralabials are almost invariably six on each side. Subdigital lamellae range from 12 to 16. The frontonasal varies considerably in size, perhaps averaging somewhat larger in this race than in the former subspecies but the difficulty in measuring relative size renders it useless as a key character.

Ground color dorsally in adults and subadults is brown or light green as in the preceding subspecies but the dorsal scales between the lateral dark bands are more often marked. Chief pattern types and their percentages are as follows: dorsal scales immaculate or inner surfaces of lateral bands margined with narrow light lines, 35 percent; a narrow longitudinal dark stripe or row of black dots

bordering the medial edge of each light line, 27 percent; four narrow longitudinal dark stripes or rows of black spots, 5 percent; and a middorsal light stripe from occiput onto base of tail, 33 percent.

The largest specimen examined is 64.8 mm. from snout to vent with a head-length of 12 mm. A number of other specimens exceed 60 mm. in snout-vent length. Head length/snout-vent length ratios in adults range from 17 percent to 22 percent, averaging 20 percent. Variation in leg length seemingly parallels that in *Eumeces anthracinus anthracinus* with no apparent sexual correlation.

Discussion. Coloration and pattern of living juveniles have not been adequately described. Gloyd (1928, p. 120) and Burt (1928, p. 49) both describe the black color and blue tails. Gloyd also mentions the red tint on the chin and sides of the head. Newly hatched preserved specimens have light infralabials, rostral, mental, and postmental, all in sharp contrast to the dark body color; seven conspicuous light spots along the supralabials; white loreals; a white dash on the supraocular; a small light spot at the anterior edge of the ear; a light spot on each internasal; and a crescent-shaped light mark on each frontonasal (Pl. LXXV).

These light spots (presumably red-orange in life) are apparently lost in the following order: frontonasals, internasals, loreals, supraoculars, anterior edge of ear, and anterior supralabials. The light spots on the posterior supralabials, although losing their contrast as they become gray, gray-green, or red (in males), are still evident in large adults. They are separated by pigmented labial sutures, thus providing a ready character to separate this from the typical subspecies. Somewhat larger juveniles (30-35 mm. from snout to vent) retain the conspicuous light-centered supralabials but exhibit the body pattern and color of the adult lizards. The middorsal light stripe does, however, appear to be most frequent in this age group, often being obscured in the larger specimens.

Although the ontogenetic change in color and pattern (the general obscuring of the light spots on the head accompanied by an increasing sharpness of the lineate body pattern) is rather gradual, it is nevertheless distinctive compared with the remarkably close resemblance of juveniles and adults of the typical subspecies. The black body color noted by Burt and Gloyd in Kansas hatchlings may have been over-emphasized by them and others, as may also have been the distinctive linear pattern noted by Dowling (1950, p. 235) in an Alabama specimen, since our own fresh material (SE Missouri) exhibits neither extreme but does show longitudinal

stripes, when proper lighting is used, despite the very dusky ground color.

Remarks. A series of eight eggs laid in captivity by a specimen of *E. a. pluvialis* from 1 mile north of Greer, Oregon Co., Missouri (UIMNH 15122), varied at deposition from 7 mm. to 7.8 mm. in width, and 12 mm. to 13 mm. in length. The width at hatching had increased to 11-12 mm., the length to 16.2-18 mm. Of special interest is the fact that whereas the length increased rather uniformly throughout the developmental period, the width increased as much

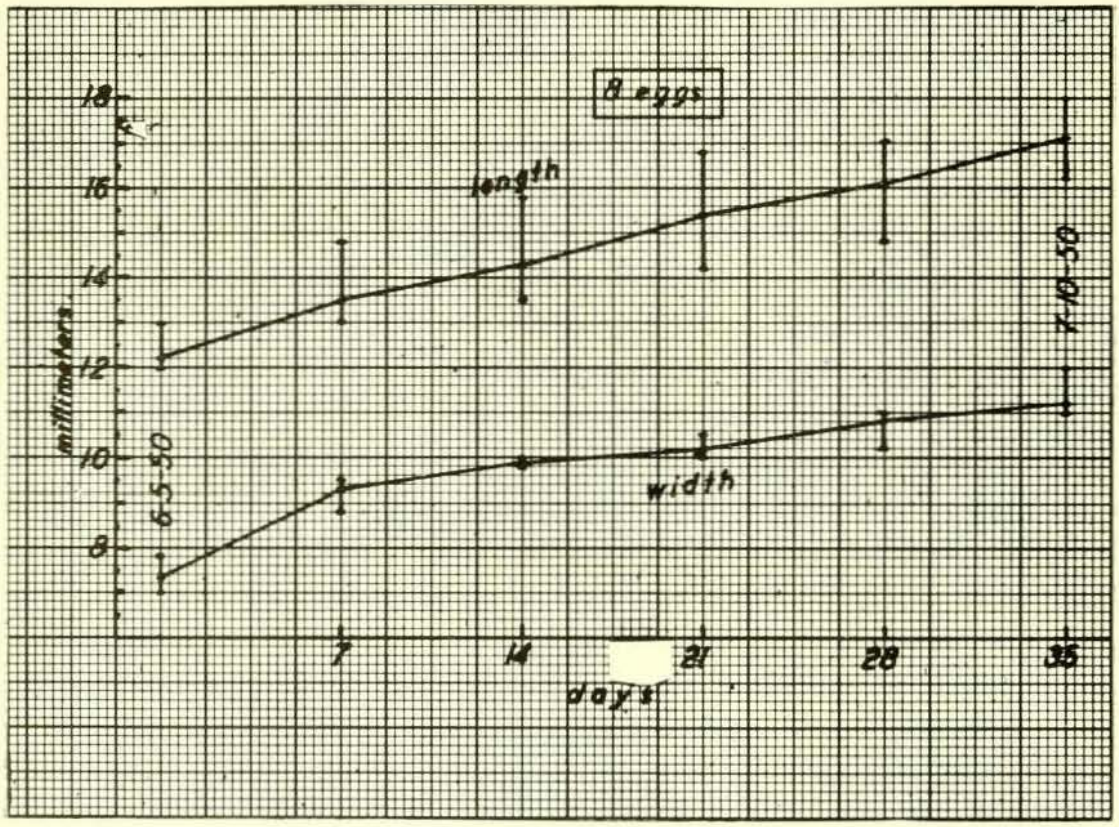


FIG. 2. Post-depositional changes in dimensions of 8 eggs of *Eumeces anthracinus pluvialis*. Range of variation is shown by vertical lines; averages are connected by a continuous diagonal line.

in the first seven days as it did during the ensuing 28 days before hatching. The accompanying graph (Fig. 2) depicts these changes.

Material examined. One hundred and forty-two specimens, as follows: ALABAMA.—*Mobile Co.:* Mobile (USNM 75291, neotype); *Tuscaloosa Co.:* 8 mi. NE Tuscaloosa (UMMZ 98631, 98633). ARKANSAS.—*Benton Co.:* 2½ mi. N Sulphur Springs (UMMZ 60112, INHS 5024-5); *Garland Co.:* Hot Springs (CNHM 29166-71); *Hempstead Co.:* (UMMZ 84174); *Lafayette Co.:* (KU 8803-9); *Lawrence Co.:* Imboden (AMNH 65797; CM 4708; KU 8219, 8221-3, 8229; MCZ 29312-8; TU 4969-70, 4973-4, 4981, 4989; UR

1422 [3], 45); 5 mi. SW Imboden (KU 8225-8, 8230, 8952-3, 8840); *Madison Co.:* Combs (USNM 118516); *Montgomery Co.:* 3 mi. W Oden (USNM 99545); *Pulaski Co.:* NW Little Rock (CM 25136, 25158); 10 mi. NW Little Rock (KU 22895); *Sevier Co.:* DeQueen (CNHM 3514). KANSAS.—*Anderson Co.:* (KU 742); *Cherokee Co.:* 4½ mi. E, ½ mi. N Baxter Springs (UIMNH 15120; KU 24413); 7 mi. E Baxter Springs (KU 23615); 5 mi. E Baxter Springs (UIMNH 15120, 16332); 2½ mi. W Galena (AMNH 44929-31); 3 mi. S Galena (KU 23029); 2 mi. N Ellerville (UIMNH 15123); *Dickinson Co.:* (KU 744); *Franklin Co.:* (KU 8217; UMMZ 68453 [5], 66924, 100864); *Miami Co.:* (UMMZ 68450-2 [7]); 3 mi. E Fontana (UIMNH 15568). LOUISIANA.—*Caddo Pa.:* Gayle (KU 8212); 7 mi. W Plain Dealing (TU 3744-5); Rodessa (TU 739); *East Feliciana Pa.:* 3 mi. W Clinton (TU 10672); *Natchitoches Pa.:* Steep Hill Creek (KU 24577); *Ouachita Pa.:* Monroe (TU 4977); *St. Tammany Pa.:* 5 mi. S Enon (TU 5908); *Tangipahoa Pa.:* Fluker (TU 4817); *Washington Pa.:* 10 mi. W. Bogalusa (TU 4821). MISSISSIPPI.—*Greene Co.:* Gaines Creek (UR 2470); *Leake Co.:* 12 mi. SE Carthage (CAS 6280); *Lincoln Co.:* 2½ mi. NE Summit (USNM 116457); *Pike Co.:* (FC 2054). MISSOURI.—*Carter Co.:* near Van Buren (UMMZ 68936); *Jefferson Co.:* Pevely (USNM 56905); *Miller-Pulaski Co. line:* Rubidaux Creek (UMMZ 68744); *Oregon Co.:* 1 mi. N Greer (UIMNH 15122, 16333-40); *Shannon Co.:* Current River (UMMZ 90465); *Wayne Co.:* Sam A. Baker State Park (UMMZ 95818). NORTH CAROLINA.—*Buncombe Co.:* Asheville (UIMNH 15121); *Heywood Co.:* Pisgah Forest (UMMZ 52583; MCZ 12821); *Transylvania Co.:* Looking Glass Creek (USNM 61309). OKLAHOMA.—*Adair Co.:* 5 mi. S Kansas (UMMZ 81379); *Bryan Co.:* near Durant (OU 9352); *Tulsa Co.:* Tulsa (UMMZ 97446); *Le Flore Co.:* 3½ mi. NE Page (OU 16739); 5 mi. E Page (OU 26917); *Latimer Co.:* 1 mi. N Wilburton (OU 11498, 11703-4, 11711); 2 mi. NE Wilburton (OU 11659); 2 mi. NW Wilburton (OU 11559); 2½ mi. N Wilburton (OU 11268, 11329); 2½ mi. N, 1½ mi. E Wilburton (OU 11096, 11233-4); *McCurtain Co.:* near Idabel (OU 23566, 23568); Beavers Bend State Park (OU 26037); 14 mi. SE Broken Bow (OU 17288, 17349); 14 mi. E Broken Bow (OU 17567-8). TEXAS.—*Bowie Co.:* W and SW Maud (BCB 5754).

Other localities. Specimens have been recorded from the following localities not represented by specimens examined. ARKANSAS.—*Faulkner Co.:* 7 mi. W Conway (Dellinger and Black,

1938, p. 15); *Saline Co.:* (Taylor, *op. cit.*, p. 386). GEORGIA.—*Rabun Co.:* Mountain City (McCauley, 1940, p. 50). MISSOURI.—*Barry Co.:* Rockhouse Cave (Taylor, *op. cit.*, p. 386); *Franklin Co.:* (Hurter, 1911, pp. 142-143); *LaClede Co.:* (Hurter and Strecker, 1909, p. 23); *Warren Co.:* Warrenton (Hurter, 1911, pp. 142-143). OKLAHOMA.—*Comanche Co.:* Wichita Mts. (Ortenburger, 1926, p. 138); *Pushmataha Co.:* (Ortenburger, 1926, p. 95).

This subspecies apparently is to be expected in South Carolina, Tennessee, and Illinois, although records from those states are not now known. Specimens are much to be desired from these and from certain other states, especially North Carolina, Georgia, Alabama, and Mississippi.

Intergradation. The recognition of intergrading specimens is rather difficult as a result of the overlapping nature of subspecific characters and the fact that seldom is there more than one specimen available of this uncommon lizard from a critical locality. We believe that when possible (other things being equal) the boundary line between the two subspecies in the intergrading areas should be that indicated by transition in the color, pattern, or some other quite obvious feature, although other characters may not be intermediate. We have arbitrarily selected the condition of the supralabial markings as the feature by which specimens (or populations, when adequate series are available) from intermediate areas are allocated. In this feature two of the four available specimens from western North Carolina (MCZ 12821 and UMMZ 52583) are intermediate. The remaining two specimens, although mottled on the posterior supralabial region, appear much closer to *E. a. pluvialis.* All four specimens have 26 scale rows at midbody whereas 75% of a random sample of the subspecies would be expected to have 27 or more scale rows. Regrettably, we have not been able to locate the specimen reported from Rabun County, Georgia (McCauley, 1940, p. 50). The single specimen available from central Kentucky (MCNP no. 104) is rather puzzling, possessing 26 scale rows at midbody and showing a tendency toward darkening of the labial sutures. Until a series is availale, however, we regard the Kentucky specimens as *E. a. anthracinus.*

Phylogeny and zoogeography. Phylogenetic speculations regarding two subspecies often are not warranted. In the present case we are tempted to suggest that *Eumeces anthracinus pluvialis* is the more primitive form, inasmuch as (1) a median light stripe occurs frequently in half-grown specimens (occurrence of five

stripes is undoubtedly an ancestral condition for members of the four-lined group), (2) there are more numerous scale rows, and (3) there are more numerous supralabials.

Of interest is the extraordinary similarity mentioned previously of *Eumeces septentrionalis* (especially *E. s. pallidus* and southern *E. s. obtusirostris*) and *E. anthracinus pluvialis*. The similarity extends to scutellation as well as pattern and color. The two species differ most conspicuously in the number of postmentals (one in *E. anthracinus*, two in *E. septentrionalis*) and also in the relation of the lateral light line to the ear (passing through the ear in the former, above in the latter), in extent of light area on ventral surface of the head (mental area only in the former, entire area in the latter), and in width of the subcaudals (relatively wide in the former, narrow in the latter). The similarities are sufficient in number, however, to indicate (1) a close relationship of the two species, and (2) an apparent derivation of *E. anthracinus* from ancestors similar to *E. s. obtusirostris*.

Throughout most of its range *E. a. pluvialis*, despite a certain apparent flexibility of choice, seems to be restricted fairly closely to humid habitats of coniferous, oak, or mixed oak-coniferous forests in hilly terrain. Virtually all of the available area covered by such forests, excluding zones eliminated by obvious temperature and/or humidity factors, are inhabited by the subspecies. Exceptions will be accounted for in the following discussion. In Kansas specimens are found in oak-hickory woods of creek slopes; in Missouri and Arkansas the same and the oak-pine habitat (Shantz and Zon, 1924) are occupied in and near the Ozark plateau, almost wholly south of the Missouri River. In neither state has the species been found in the eastern bottomlands. In Texas, Louisiana, Mississippi, and Alabama the species seems to be wholly restricted to the longleaf pine habitat.

It may be assumed that temperature limits the northward dispersal of *E. a. pluvialis*. Westward dispersal is obviously limited in central Kansas and Oklahoma by the tall grass prairie, although the species apparently extends up certain river valleys far into this otherwise unfavorable region. The record for Dickinson County, Kansas, is an example of such extension. The one from Wichita Mts., Oklahoma, may be another example, but it is open to grave doubt inasmuch as the specimen on which the record was based cannot now be found. Possibly it actually represented the confusingly similar *E. septentrionalis obtusirostris*.

In eastern Texas the westward limit of range apparently does not reach the prairie. Although the entire eastern quarter of Texas (oak-pine and oak-hickory) appears to be a suitable habitat, the species has not been found there. The failure of *E. a. pluvialis* to expand its range westward in Texas may be due to the occurrence in that area of an apparent competitor, *E. septentrionalis*, whose range is overlapped nowhere to any degree by that of the adjacent *E. anthracinus*.

On the east the range of *E. a. pluvialis* is apparently restricted by the extensive bottomlands of the Mississippi Valley, which may provide a barrier across which the species does not and has not passed (north of Louisiana). In Louisiana the subspecies has been enabled to cross the valley of that river, and subsequently to extend its range eastward to the Appalachian Mountains, probably because of the Pleistocene alterations in the Mississippi river channels.

The range of *E. a. anthracinus* appears to be limited to the chestnut-chestnut oak-yellow poplar association, which covers vast areas north of Georgia and west of the Mississippi. Fingers or spots extend the range into western New York in suitable areas surrounded by the much more extensive and apparently unsuitable beech-maple habitat. To the east the form is apparently limited by the bottomlands of the Ohio and Tennessee rivers, which seemingly prevent infiltration into otherwise suitable areas of Ohio, eastern Kentucky, and eastern Tennessee. To the south the subspecies meets *E. a. pluvialis*.

The point of contact of the ranges of these two forms is the most perplexing problem presented by their distribution. It might be expected that the area of intergradation would coincide with an obvious ecotone, but such is not the case. The most obvious break in environmental conditions is in Georgia, for the chestnut-chestnut oak-yellow poplar habitat there meets the long-leaf pine habitat. It would be reasonable therefore to expect Georgia and North Carolina specimens to resemble the northern individuals, but they do not. They appear to represent more or less typical *E. a. pluvialis*. We believe it a foregone conclusion that some differences in environment were at least passively instrumental in effecting the differentiation of the two subspecies, producing an at least partial isolation. Since there is no correlation in the present area of contact (at least in the more obvious environmental factors such as vegetation, temperature, soil, and humidity as depicted in available maps), we assume that both subspecies formerly occupied more

restricted areas, and that *E. a. pluvialis* has, for reasons unknown, spread more rapidly than *E. a. anthracinus* and entered the habitat of the latter before *E. a. anthracinus* expanded fully within the habitat available to it.

The Mississippi River valley apparently bisects the range of *E. a. pluvialis*. The isolation has not as yet, apparently, been instrumental in facilitating differentiation of taxonomically distinguishable populations. There is reason to believe, moreover, that other sets of populations, of both subspecies, are as widely separated as the pair indicated on the map (Fig. 1). The hiatus depicted in the map is, however, virtually a certainty; the others are not obvious and can be verified, if they exist, only by much more extensive investigation.

We do not assume that postulations here made are necessarily correct. A full explanation of the distribution of this species and its subspecies will require extensive field work. Entirely too few facts are known at present to permit dogmatic conclusions regarding range, habitat, and phylogeny.

LITERATURE CITED

BAIRD, S. F.
1850 Descriptions of four new species of North American salamanders, and one new species of skink. Journ. Acad. Nat. Sci. Philadelphia, vol. 1, pp. 292-294.

BURT, C. E.
1928 The lizards of Kansas. Trans. Acad. Sci. St. Louis, vol. 26, no. 1, pp. 1-81.

CLAUSEN, R. T.
1938 Notes on Eumeces anthracinus in central New York. Copeia, no. 1, pp. 3-7, figs. 1-2.

COPE, E. D.
1875 Check-list of North American batrachia and reptilia; with a systematic list of the higher groups, and an essay on geographical distribution. Bull. U. S. Nat. Mus., vol. 1, pp. 1-103.
1877 On some new and little known reptiles and fishes from the Austroriparian region. Proc. Amer. Philos. Soc., vol. 17, no. 100, pp. 63-68.
1880 On the zoological position of Texas. Bull. U. S. Nat. Mus., no. 17, pp. 1-51.

DELLINGER, S. C., and J. D. BLACK
1938 Herpetology of Arkansas, Pt. I. The reptiles. Occ. Papers Univ. Ark. Mus., no. 1, pp. 1-47.

DOWLING, H. G.
1950 A new southeastern record for the coal skink. Copeia, 1950, no. 3, p. 235.

GLOYD, H. K.
1928 The amphibians and reptiles of Franklin County, Kansas. Trans. Kansas Acad. Sci., vol. 31, pp. 115-141.

HURTER, JULIUS
1911 Herpetology of Missouri. Trans. Acad. Sci. St. Louis, vol. 20, pp. 59-274, pls. 18-24.

HURTER, JULIUS, and JOHN K. STRECKER
1909 Amphibians and reptiles of Arkansas. Trans. Acad. Sci. St. Louis, vol. 18, pp. 1-27.

MCCAULEY, R. H.
1940 A record of Eumeces anthracinus from Georgia. Copeia, 1940, no. 1, p. 50.

ORTENBURGER, A. I.
1926 Reptiles and amphibians collected in the Wichita Mts., Comanche county, Oklahoma. Copeia, no. 155, pp. 137-138.
1926 A report of the amphibians and reptiles of Oklahoma. Proc. Okla. Acad. Sci., vol. 6, pp. 89-100.

SHANTZ, H. L., and RAPHAEL ZON
1924 Atlas of American agriculture. Part 1. The physical basis of agriculture. Section E. Natural vegetation. U. S. Govt. Printing Office, 29 pp., 60 figs.

SMITH, H. M.
1946a The systematic status of Eumeces pluvialis Cope, and noteworthy records of other amphibians and reptiles from Kansas and Oklahoma. Univ. Kansas Publ. Mus. Nat. Hist., vol. 1, no. 2, pp. 85-89.
1946b Handbook of lizards. Comstock Publ. Co., Ithaca, N. Y., xiv + 557 pp., 135 pls.

TAYLOR, E. H.
1936 A taxonomic study of the cosmopolitan scincoid lizards of the genus *Eumeces*, with an account of the distribution and relationships of the species. Univ. Kansas Sci. Bull., vol. 23 (1935), pp. 1-643, figs. 1-84, pls. 1-43.