

Article XII.—A REVIEW OF THE NORTH AMERICAN GENUS
OF LIZARDS *HOLBROOKIA*

BY KARL PATTERSON SCHMIDT

Plates LVIII to LX

The taxonomy of the North American lizards of the genus *Holbrookia* Girard offers one of the most interesting and difficult problems in North American herpetology. The American Museum of Natural History is in possession of extensive series of the species of *Holbrookia* acquired primarily through the interest and efforts of Miss Mary C. Dickerson, former Curator of the Department of Herpetology. These have been accumulated by purchase from San Antonio, Texas; by purchase from Mr. R. D. Camp of collections from Brownsville, Texas, and the Huachuca Mountains, Arizona; from department expeditions of Ruthven (1906) and Dickerson (1912); and by gift from Mr. Charles Lewis Camp of specimens collected in northern and central Arizona while connected with an expedition of the Museum of Paleontology of the University of California.

In addition to the American Museum material, the United States National Museum, through the kindness of Dr. Leonhard Stejneger, has loaned extensive collections of *Holbrookia* from Mexico and Arizona for comparative study.

The identification of this material has necessitated an examination of the genus, with considerable changes in the current views, which are primarily those of Stejneger (1890), Cope (1900), and Stejneger and Barbour (1917). Advance diagnoses of two new species and a new subspecies of *Holbrookia*, and a key to the species of the genus as understood by me, have already been published in a preliminary paper (1921, Amer. Mus. Nov., No. 22). It is the purpose of the present paper to complete the description of the new forms and to present the facts on which conclusions involved in the key to the species are based. Mr. C. L. Camp has kindly permitted me to insert his field notes on the two forms collected by him in Arizona in 1921. Field observation on the habits of all the species of *Holbrookia* are much to be desired and will throw light in turn on the taxonomic problems. Various notes by Strecker in his papers on the herpetology of Texas form the most important source of information I have found on life histories. It is hoped that the publication of a preliminary revision may facilitate the investigation of the numerous remaining problems in the distribution of the species to which I have called attention below.

The study of *Holbrookia* is attended by the greatest difficulty. There is scarcely a character employed for the distinction of the species which is not of a comparative nature, often differing in the sexes, so that it is practically necessary to have good series of the several species in hand at the same time in order to distinguish them. The present material is insufficient in many cases for more than a tentative conclusion as to specific limits. As far as possible, I have endeavored to remedy the want of definite characters by establishing the limits of variation in each form for the tail-length, the length of the hind leg, the number of ventral scales from collar to anus, and the number of femoral pores in the series available for study. A careful examination of the tabulation of these characters, together with the geographical limits proposed for the species, will probably be of more value for the determination of the species than the key, which can not be relied upon for critical specimens of the more closely allied forms.

The forms recognized by me are the following:

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| 1. <i>Holbrookia texana</i> (Troschel) | 6. <i>Holbrookia maculata maculata</i> Girard |
| 2. <i>Holbrookia propinqua</i> Baird and
Girard | 7. <i>Holbrookia maculata flavilenta</i> Cope |
| 3. <i>Holbrookia elegans</i> Bocourt | 8. <i>Holbrookia maculata campi</i> Schmidt |
| 4. <i>Holbrookia pulchra</i> Schmidt | 9. <i>Holbrookia maculata approximans</i>
Baird |
| 5. <i>Holbrookia lacerata</i> Cope | 10. <i>Holbrookia dickersonæ</i> Schmidt |

All of these except the last are found within the limits of the United States.

I have not attempted a full bibliography, chiefly on account of the past uncertainty in the identification of the species. An accurate arrangement of the references under the proper specific headings would require a re-examination of the material on which the literature of the genus is based, and this is not at present possible. The present paper is to be regarded primarily as the result of the study of the material in my hands, and it is hoped that further studies of the distribution of the species may follow. Under each species I have cited the original description and the status assigned to it by Stejneger and Barbour in the 'Check List of North American Amphibians and Reptiles,' 1917.

For the present purpose, the genus may be sufficiently defined as the North American iguanid lizards with undifferentiated head plates, fine uniform dorsal scales, no dorsal crest, a well-defined denticulate collar preceded by a transverse fold, imbricate supralabial scales, a long series of femoral pores, and a concealed tympanum. All of the species have normally two or more lateroventral black spots more or less surrounded

by blue, and a spotted dorsal coloration, with two or four longitudinal rows of large dorsal spots (sometimes confluent transversely) darker than the ground color.

The relations of *Holbrookia* with the allied iguanid genera are not considered in the present paper.

KEY TO THE SPECIES

1. Tail flat with broad black ventral bands; lateroventral black marks placed far back, continued dorsally above the lateral fold. (Central Texas to south and central Arizona.) *texana*.
Tail rounded; no black bands beneath tail (small black spots in one species); lateroventral marks more anterior, not present dorsally 2.
2. Tail longer than the body in both sexes 3.
Tail shorter than the body in the female, usually also in the male 5.
3. Dorsal scales very small, convex or keeled; a distinct area of supraocular granules between the enlarged supraoculars and the frontals; tail very long; dorsal spots usually indistinct. (Southern Texas.) *propinqua*.
Dorsal scales larger, flat; no distinct small supraoculars between the frontals and the central supraoculars; dorsal spots usually (not invariably) distinct, sharply outlined 4.
4. Size large, habitus robust, body frequently exceeding 60 mm.; femoral pores usually 12 or more. (Lower altitudes, Tucson, Arizona south along west coast of Mexico through Sinaloa.) *elegans*.
Size smaller, habitus slender, body less than 60 mm.; femoral pores usually less than 12. (High altitudes, above 5000 ft., Huachuca Mts., to Nogales and Bisbee, Arizona.) *pulchra*.
5. Subcaudal black spots usually present; scales flat, not tubercular in large specimens; dorsal spots very sharply defined, often digitate behind. (Coahuila, Mexico, southern and central Texas, possibly to Kansas.) *lacerata*.
Dorsal spots rarely sharply defined; no subcaudal black spots; scales keeled or tubercular in large specimens 6.
6. Three lateroventral black spots entirely surrounded by a blue patch. (Southern Coahuila, Mexico.) *dickersonæ*.
Two or three lateroventral black spots, often margined with blue, but no extensive blue patch *maculata*-7.
7. Snout somewhat pointed, labials narrow, elongate; usually three or four scales between the enlarged nasals; a mid-dorsal light stripe usually and two dorsolateral and two lateral light stripes frequently present. (Wyoming and Nebraska, south to Texas.) *maculata maculata*.
Snout more truncate, labials shorter, wider, and more oblique to the horizontal; usually two or three scales between the enlarged nasals; no mid-dorsal light stripe 8.
8. Usual dorsal pattern indistinct, replaced by small irregular light and dark spots; ground color very pale. ("White Sands" of southern New Mexico.) *m. flavilenta*.
Large dark dorsal spots present, ground color darker 9.

9. Tail shorter, .42-.50 of total in male, .42-.48 in female; hind leg shorter, .72-.83 in male, .65-.78 in female. (Northern Mexico, southern Arizona, southern New Mexico.).....*m. approximans*.
 Tail longer, .48-.51 in male, .46-.50 in female; hind leg longer, .79-.86 in male, .77-.88 in female. (Central and northern Arizona, probably the Colorado Plateau.).....*m. campi*.

GENERAL REMARKS ON THE DISTRIBUTION OF THE GENUS

The more general features of the distribution of the genus offer some interesting considerations. *Holbrookia* is obviously directly related to *Callisaurus*, from which it differs only in the concealed tympanum and with which it agrees in general features of color pattern and scutellation. In a general way, the ranges of *Holbrookia* and *Callisaurus* are complementary, overlapping only in a narrow area in Arizona and Sonora. Most of the species of *Holbrookia* have a complementary arrangement. The *maculata* group, which may be distinguished by the convexity of the dorsal scales, occupies the Mexican Plateau and extends northward into Arizona, New Mexico, western Texas, and the Great Plains. Two species have a peripheral distribution bordering the range of *maculata*, *lacerata* on the eastern border, *elegans* on the western. *Holbrookia pulchra* occupies the higher altitudes in the mountains of the southern border of Arizona, surrounded by *maculata approximans* on the mesas at the foot of the mountains. The range of *Holbrookia dickersonæ*, in southern Coahuila, is imperfectly known but may prove also to border that of *maculata*. *Holbrookia propinqua*, in southern Texas, occupies another area on the border of the range of *maculata*, practically to the exclusion of other forms. Finally, the range of *Holbrookia texana* has apparently no relation to that of the other species, occurring in a broad belt from central Arizona to central Texas and Nuevo Leon.

The great extent of the ranges of *maculata* with its several subspecies and of *texana* is striking when compared with the limited areas occupied by all of the remaining forms and may be taken to indicate the present dominance of *maculata* and *texana* and the decline of the remaining forms, which appear to have been forced toward the borders of the range of the genus.

CRITICAL LIST OF SPECIES

Holbrookia texana (Troschel)

- Cophosaurus texanus* TROSCHER, 1852, Arch. Naturg., I, (1850), p. 389, Pl. VI (actually published in 1852).
Holbrookia texana STEJNEGER AND BARBOUR, 1917, 'Check List of N. Amer. Amph. Rept.,' p. 49.
Holbrookia maculata approximans (part) RUTHVEN, 1907, Bull. Amer. Mus. Nat. Hist., XXVII, p. 526.

This species, the most distinct in the genus, is immediately distinguished by the conspicuous broad black bands on the under surface of the flattened tail, which is carried curled up when running. In the field, it is difficult or impossible to distinguish it from a *Callisaurus*. It is further characterized by the posterior position of the lateroventral black spots which are long and frequently continued well up on the dorsal surface.

Holbrookia texana ranges from central Texas to central Arizona. Strecker (1915, Baylor Bull., XVIII, No. 4, p. 17) defines its ranges in Texas, where it is apparently abundant in the Trans-Pecos region and sporadic in the eastern portion of its range.

The record of the synonymous *H. affinis* from Sonora by Baird (1859, 'U. S. Mexican Boundary Survey, Reptiles,' p. 8) is an early indication of the occurrence of *H. texana* in the western part of its range. Van Denburgh (1896, Proc. Cal. Acad. Sci., (2) VI, p. 339) records it from Fort Lowell in southern Arizona. In a later paper (1913, Proc. Cal. Acad. Sci., (4) III, p. 399) the same author records it from the Catalina Mountains, north of Tucson, and from Cave Creek, Maricopa County. Specimens in The American Museum of Natural History from near Kirkland, Arizona, collected by C. L. Camp, July 5, 1921, appear to be the most northwesterly record for the species. In New Mexico, it is said not to range north of Socorro (Herrick, Terry and Herrick, 1899, Bull. Sci. Lab., Denison Univ., XI, p. 123). In Mexico, it ranges south to Monterrey in Nuevo Leon, and Lerdo in Durango (Gadow, 1905, Proc. Zool. Soc. London, p. 213).

In the western part of its range, specimens of *texana* have a somewhat higher number of femoral pores, and Strecker (1909, Baylor Bull., XII, p. 12) has called attention to a striking difference in coloration (in life) between specimens from Brewster County, Texas, and those from central Texas. It is probable that two fairly distinct subspecies of *texana* will be recognizable when sufficient material from all parts of its range is examined.

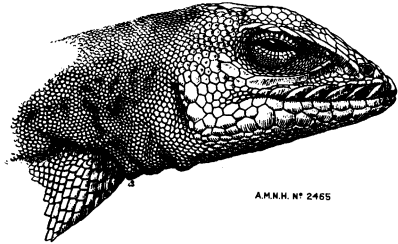


Fig. 1. *Holbrookia texana*, head from the side; A. M. N. H. No. 2465, Catalina Mts., Ariz. $\times 2$.

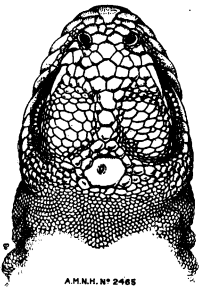


Fig. 2. The same, from above.

July fourth and fifth, 1921, were spent at Kirkland, Arizona. On the afternoon of the fifth I found *Holbrookia texana* abundant among the rocks and bushes in sandy ground along the south side of the sandstone cliffs just south of town. Often these lizards would climb onto stones and the lower ledges of the cliff as if to get a better view of the pursuer. A peculiar thing was that out of a considerable number of individuals seen (perhaps twenty) only two were males—easily distinguished by their much larger size and more striking coloration. It is possible that polygamy may occur in this species. (C. L. C.)

Holbrookia propinqua Baird and Girard

Plate LVIII

Holbrookia propinqua BAIRD AND GIRARD, 1852, Proc. Acad. Nat. Sci. Phila., VI, p. 126; STEJNEGER AND BARBOUR, 1917, 'Check List N. Amer. Amph. Rept.,' p. 49.

This species is satisfactorily defined by Cope (1900, Rept. U. S. Nat. Mus., 1898, p. 289, fig. 31). The coloration is often very nearly uniform, the dorsal spots very indistinct. There may be three or four lateroventral black spots, three specimens out of nineteen having more than two. The dorsal scales are very small, smaller than in any other *Holbrookia*; the tail is longer than in any other species; and the number of femoral pores is higher.

The range of this species is curiously restricted. The limits of the range given by Strecker (1915, Baylor Bull., XVIII, p. 18) are Refugio and San Antonio, west to the Pecos and south to the Rio Grande. The American Museum of Natural History has large series from San Antonio, Brownsville, and Padre Island (opposite Brownsville) in Texas. There seems to be no valid Mexican record of *propinqua*,¹ and it would be highly interesting to verify the limitation of its distribution by the Rio Grande. In large series received through several years from San Antonio, the only species of *Holbrookia* recorded were *propinqua*. *H. propinqua*, therefore, practically occupies its specific area to the exclusion of other members of the genus.

The records of *propinqua* from west Mexico (Boulenger, 1885, 'Cat. Lizards Brit. Mus.,' II, p. 208, and Garman, 1887, Bull. Essex. Inst., XIX, p. 131) doubtless refer to specimens of *H. elegans*.

Holbrookia elegans Bocourt

Holbrookia elegans BOCOURT, 1874, 'Miss. Sci. Mex. Rept. Batr.,' p. 164, Pl. xvii, bis, fig. 8, 8a; COPE, 1900, Rept. U. S. Nat. Mus., 1898, p. 286.

Holbrookia maculata approximans (part) RUTHVEN, 1907, Bull. Amer. Mus. Nat. Hist., XXIII, p. 525.

Holbrookia thermophila BARBOUR, 1921, Proc. N. England Zool. Club, VII, p. 79.

¹U. S. N. M. No. 58446, labeled simply Chihuahua, J. Hurter, may be a juvenile *propinqua*.

Considerable confusion has existed in the records of *Holbrookia* from western Mexico. Specimens in The American Museum of Natural History and the United States National Museum from the type locality of *elegans* (Mazatlan, Sinaloa, Mexico) agree excellently with the original description. The excellent figure given by Bocourt shows the character of the supraoculars to which Barbour (*loc. cit.*) has called attention in describing *H. thermophila*, i.e., the absence of small granular scales between the enlarged supraoculars and the frontals. Cope, by placing *elegans* in the section of the genus with tail shorter than body, in spite of the fact that the tail of the type was stated to be reproduced, contributed to the confusion.

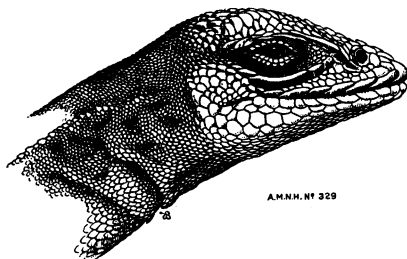


Fig. 3. *Holbrookia elegans*, head from the side; A. M. N. H. No. 329, Tucson, Ariz. $\times 2$.

H. elegans is characterized by large size and robust habitus; the dorsal scales are flat and smooth; the scales between the enlarged frontals and the enlarged supraoculars are large, scarcely differentiated from either; the tail is round, longer than head and body in both sexes, without spots inferiorly; the femoral pores are fewer than in *propinqua*, considerably more than in *Holbrookia maculata approximans* or *H. pulchra*.

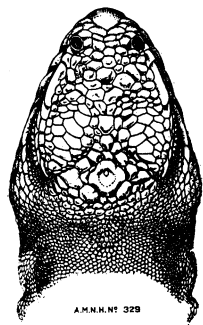


Fig. 4. The same, from above.

I am unable to find specific differences between the specimens from Sinaloa and topotypes of *H. thermophila* from Guaymas, Sonora, nor between these and specimens collected by Ruthven and Dickerson west of Tucson. Dr. Thomas Barbour has kindly placed a paratype of *H. thermophila* in the collection of The American Museum of Natural History, and he has elsewhere recorded his concurrence with my conclusion that it is identical with *H. elegans* (1921, Proc. New England Zool. Club,

VII, p. 113). The spots are slightly less sharply outlined in the northern specimens, especially on their anterior border, otherwise they are practically identical.

Holbrookia elegans ranges from Escuinapa, Sinaloa, to Tucson, Arizona, along the west coast of Mexico. Specimens in the United States National Museum come from near Mazatlan, Bacubirito, and

Rosario, Sinaloa, and Batamotal, Sonora; in The American Museum of Natural History are specimens from Escuinapa and Mazatlan, Sinaloa, Guaymas, Sonora, and from Tucson, Arizona. This distribution is almost exactly paralleled by that of *Uta lateralis* Boulenger, which does not, however, reach the Arizona border.

Holbrookia pulchra Schmidt

Plate LIX

Holbrookia pulchra SCHMIDT, 1921, Amer. Mus. Nov., No. 22, p. 1.

DIAGNOSTIC CHARACTERS.—A slender, medium-sized species, allied to *H. elegans*, with tail considerably longer than the body, the hind leg averaging about four-fifths of the body length; dorsal scales flat; ventral scales large, 59 to 70 from collar to anus; femoral pores few, average 11.6; dorsal spots usually sharply defined, the dorsal and lateral series often confluent, enlarged supraoculars and frontals separated by scales not much smaller than either.

RANGE.—Huachuca Mountains of southern Arizona, east of Nogales.

TYPE.—A. M. N. H. No. 14777; Carr Canyon, 5200 ft.; Huachuca Mountains, Arizona; May 14, 1919; R. D. Camp.

DESCRIPTION OF TYPE.—

Habitus slender, with tail longer than the body and long limbs; head scales flat, the scales between the enlarged supraoculars and the frontals about half as large as either; dorsal scales flat, smooth; ventral scales large, sixty from collar to anus; about eight pointed scales on each half of the collar, which is notched on the midline; labials elongate, keeled; femoral pores 11–12.

Color above dark grayish brown with a prominent series of darker spots, sharply defined posteriorly, on each side of the vertebral line; nine spots from the neck to the base of the tail; two more pairs of spots on the base of the tail, followed by five median spots; a series of lateral dark spots, similar to the dorsal spots, on each side; two prominent black lateroventral bars on each side, midway between axilla and groin, surrounded by light blue; venter entirely light; throat with a reticulation of heavy dark lines.

MEASUREMENTS OF TYPE.—Length, 120 mm.; body, 56 mm.; tail, 64 mm.; tail/total length, .53; foreleg, 28 mm.; hind leg, 47 mm.

NOTES ON PARATYPES.—

The variations in measurements are incorporated in the table below. The degree of development of supraocular granules between the enlarged supraoculars and the frontals is highly variable, some specimens approaching the *elegans* type, some nearly like *propinqua* in this respect (U. S. N. M. Nos. 14749 and 19432). The coloration is variable. In A. M. N. H. No. 14740, the dorsal and lateral spots are united, forming wavy transverse lines separated only on the vertebral line. In many specimens, the dorsal spots are reduced to U or W-shaped lines, and may be more numerous from neck to rump (12 in A. M. N. H. No. 14736). Between this type and specimens (of both sexes) with a perfectly uniform olive-gray dorsum there are numerous intermediates with faint dorsal spots. The lateral spots in the type are margined with blue. In several male paratypes, the spots are placed in a vivid blue area covering half the distance between the axilla and groin. Three specimens have three distinct black lateroventral bars on each side. The dorsal spots are usually very distinct in

small specimens (A. M. N. H. No. 14741 forms an exception) somewhat outlined posteriorly with light spots.

Fifty-four specimens in The American Museum of Natural History, and twenty-one in the United States National Museum form the type series of this species. Specimens in the American Museum come from the following localities: Bisbee, Arizona (A. M. N. H. Nos. 307-312, 9039-9040); Hunter, Miller, Carr, Moore and Montezuma Canyons, 4600-6200 ft., Huachuca Mountains, Arizona, April 14-June 20, 1919, (A. M. N. H. Nos. 7776-7779, 7792-7799, 14593-14594, 14597, 14701, 14703-14709, 14713-14714, 14719, 14721-14722, 14733, 14736-14737, 14739-14744, 14749-14750, 14781, 14783, 14788, 14894). Specimens in the United States National Museum are from Nogales, Arizona (Nos. 16980, 17227-17233 and 46980); Mexican Boundary (Nos. 19371-19373 and 19432); Tucson (No. 13973). Fort Buchanan (No. 5025); Fort Huachuca (No. 14749) and "Mexico" (Nos. 47423-5).

It is evident that this species has been confused with *Holbrookia maculata approximans*, to which I have referred a large series of specimens in part from the same localities. Stejneger (1890, N. Amer. Fauna, No. 3, p. 109) has apparently included specimens of both *pulchra* and *approximans* under the latter, and I believe that the character used by him to distinguish *approximans*, the more posteriorly situated lateroventral spots, is derived from specimens of *pulchra*. The description of *approximans* given by Cope (1900, Rept. U. S. Nat. Mus., 1898, p. 297) is evidently based on specimens of *pulchra*, except for the portions copied from Baird's notes. The original description of *approximans* states distinctly that the tail is shorter than the body; "the light blue areola" scarcely indicates the extensive blue patch of *pulchra*, and the type locality, Lower Rio Grande, corresponds well with the specimens from northern Mexico which I have referred to *approximans*. The eastern limit of the range of *pulchra* so far determined is Bisbee, Arizona, and I do not believe it will be found to enter the Rio Grande drainage.

When the Huachuca Mountain specimens of *Holbrookia* are separated into two series, the long-tailed, flat-scaled *pulchra* and the short-tailed, tubercular-scaled *maculata approximans*, a difference in altitudinal distribution is shown. *H. pulchra* ranges from 4600 feet to 6200 feet, but there is only one specimen from the lowest altitude, all the rest coming from above 5000 feet. *H. m. approximans* ranges from 4300 feet to 6200 feet, with but only one specimen from the highest level, nine from about 5000 feet, near the mouths of canyons, and forty-four from localities on the mesa, one or two miles from the mouths of the canyons, at 4300 to 4400 feet.

Holbrookia pulchra is most closely allied to *H. elegans*, whose northward range into Arizona has been indicated above. It is not improbable that *pulchra* may ultimately be referred to subspecific rank as a sub-

species of *elegans*, as the chief characters which distinguish the two forms are size and number of femoral pores, with a somewhat different range in coloration. I am not at present able to determine whether the ranges of *H. elegans* and *pulchra* are contiguous.

Holbrookia lacerata Cope

Holbrookia lacerata COPE, 1880, Bull. U. S. Nat. Mus., No. 17, p. 15.

Holbrookia maculata lacerata STEJNEGER AND BARBOUR, 1917, 'Check List N. Amer. Amph. Rept.,' p. 49.

I have examined six specimens of this species in the United States National Museum. Although I fully agree with Stejneger (1890, p. 110) as to the difficulty of distinguishing certain *H. lacerata* from *H. maculata maculata*, I regard *lacerata* as specifically distinct. The most distinctive color characters, the presence of subcaudal black spots in both sexes, and the absence of lateroventral black spots in the male are not invariable; two of the seven specimens before me lack the subcaudal spots and the lateroventral spots are absent in two specimens, faint in two, and distinct in two. Most specimens are characterized by perfectly flat, smooth scales, considerably larger than in *maculata maculata*; but one large specimen (U. S. N. M. No. 46697) from Sabinas, Coahuila, Mexico, while agreeing exactly in coloration with *lacerata*, has the small tuberculate scales of *maculata maculata* or *maculata approximans*. The flat scales seem to relate *lacerata* to the *elegans-pulchra* group of *Holbrookia*. It is possible that, although genetically distinct from *maculata*, it may occasionally hybridize with it, as the specific distinctions in *Holbrookia* are admittedly close.

The distribution is interesting and somewhat uncertain. Specimens recorded by Cope from Neosho, Kansas, were previously referred to *H. maculata maculata* by Stejneger (1890, *loc. cit.*). Authentic localities in Texas are in three groups: (1) Crockett County, southwestern, near the lower Pecos; (2) Kerr, Kendall, and Bexar Counties, southeastern; (3) and McLennan, Erath, and Comanche Counties, northeastern. I have noted a specimen from Coahuila, Mexico, above.

From the evident rarity of this species and the widely separated localities in which it has been found, I infer that it is a species declining in numbers. It is interesting that the range of *lacerata* borders that of *maculata* on the east from Kansas to San Antonio, from which it might be inferred that *lacerata* was formerly a great plains' species, being crowded out by the dominant *maculata maculata*, which has probably spread northward on the plains with the arrival of the present climatic conditions.

Holbrookia maculata maculata* GirardHolbrookia maculata* GIRARD, 1851, Proc. Amer. Soc. Adv. Sci., IV, p. 201.*Holbrookia maculata maculata* STEJNEGER AND BARBOUR, 1917, 'Check List N. Amer. Amph. Rept.,' p. 48.

There is, fortunately, no uncertainty as to the identity of the typical subspecies of *Holbrookia maculata*. The type locality, opposite Grand Island, Platte River, Colorado, is sufficiently near the northern boundary of the range to preclude any possibility of confusion with the subsequently described related forms.

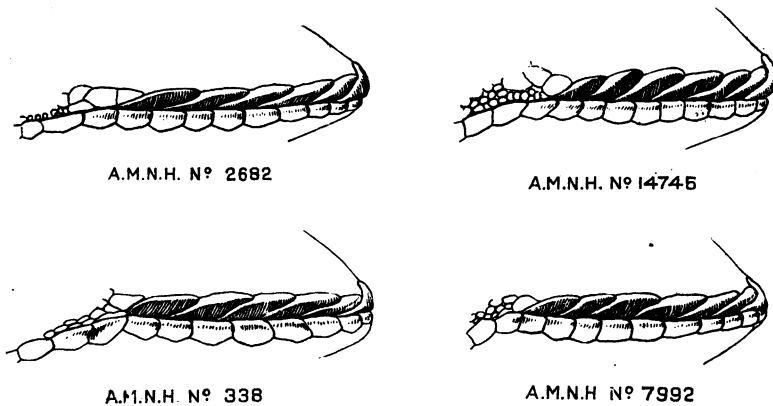


Fig. 5. Labial scales of the four subspecies of *Holbrookia maculata*. A. M. N. H. No. 2682, *Holbrookia maculata maculata*, Wilson County, Kansas; A. M. N. H. No. 338, *H. m. flavilenta*, White Sands, Alamogordo, New Mexico; A. M. N. H. No. 14745, *H. m. approximans*, Huachuca Mountains (4900 ft.), Arizona; A. M. N. H. No. 7992, *H. m. campi*, Adamana, Arizona. The shorter contact of the labials with the labial border allows room for six labials in the latter two, compared with five in the two former.

Holbrookia maculata is in general characterized by a short tail, a character which distinguishes it fairly well from all of the species of *Holbrookia* except *lacerata* and *dickersonæ*. From *lacerata* it is distinguished by the tubercular, subcarinate scales and the coloration; from *dickersonæ* by the absence of the blue lateral patches in which the latero-ventral black markings of that species are placed.

The characteristic coloration of the subspecies *maculata maculata* has been noted by Cope (1900, p. 293); there is usually a fairly distinct light mid-dorsal line and two dorsolateral lines, separating the dorsal series of markings, which thus appear to lie in a broad band of ground color. This color character separates it from the other subspecies of *maculata*.

In all of the subspecies of *maculata*, the females usually have distinct lateroventral spots. In a series of nineteen females of *m. maculata* from Colorado (A. M. N. H. Nos. 1453-1471), ten have two spots on each side, four have two on one side and three on the other, five have three on each side, and one has three on one side and four on the other.

Structurally, *m. maculata* is distinguishable from *m. approximans* and *m. campi* by having more slender and elongate upper labials, which are usually fewer in number. From *m. approximans* and *m. campi* and *m. flavilenta* as well, it is distinguished by a tendency to have smaller scales on the upper surface of the snout, usually three or four scales between the enlarged supranasals, while the other three subspecies usually have two or three internasal scales.

The distribution of this subspecies is well defined at the north, where it is the only *Holbrookia*. It is primarily a Great Plains form, occurring in southern Wyoming and all of Colorado east of the Rocky Mountains, ranging east into the adjacent parts of Nebraska and Kansas, and south into Oklahoma and northern Texas. Strecker (1915, Baylor Bull., XVIII, p. 17) defines the eastern border of its range in Texas by means of Wichita, Parker, and Bexar Counties. From his description of specimens from the plains region, Hockley, Yoakum, and Garza Counties (1909, Baylor Bull., XII, p. 12), it is evident that *m. maculata* is the typical *Holbrookia* of the Llano Estacado. The specimens from Brewster County, discussed under the same heading (*loc. cit.*), are noted as different from the plains form. It is possible that the Trans-Pecos *Holbrookia maculata* is really *approximans*. It is equally possible that *flavilenta* of southern New Mexico is the subspecies inhabiting the Rio Grande valley and will not prove to be confined to sandy areas as I have provisionally supposed (below).

***Holbrookia maculata flavilenta* Cope**

Holbrookia maculata var. *flavilenta* COPE, 1883, Proc. Acad. Nat. Sci. Phila., p. 10.

Holbrookia maculata flavilenta RUTHVEN, 1907, Bull. Amer. Mus. Nat. Hist., XXIII, p. 525.

Stejneger (1890, N. A. Fauna, No. 3, pp. 109-110) has (provisionally) applied the name *flavilenta* to the race of *Holbrookia maculata* which occupies the northern portion of the plateau region, including northern Arizona and western New Mexico, distinguishing it from *approximans*, which borders its range on the south, by the more posteriorly situated lateroventral spots in the latter subspecies.

The original description of Cope, repeated in the revision of 1900 (Rept. U. S. Nat. Mus., 1898, p. 292) of "dorsal spots obscure or wanting,

back yellow speckled" applies exactly to a series of six specimens collected by Ruthven at Alamogordo, New Mexico, about one hundred miles east of the type locality (Lake Valley, New Mex.). Specimens from the Colorado Plateau do not have this coloration, or have it only exceptionally; and to this plateau form I have applied a new name.

The labials of the six specimens of *flavilenta* collected by Ruthven are decidedly more elongate than those of *m. approximans*, and in this respect they approach *m. maculata*. In correlation with this character, the number of upper labials, counted to include the last one which exceeds the adjacent lower labial in size, is less than in *m. approximans* or *m. campi*, which usually have six labials. In the six *m. flavilenta*, five labials occur nine times, six labials three times. In *m. campi*, five occur six times, six occur fourteen times.

From Ruthven's account of the occurrence of *flavilenta* at Alamogordo, it is nearly, if not entirely, confined to the peculiar habitat conditions of the White Sands, where he found it to be abundant, while it was not collected in any other habitat association. It would appear that the sands offered more favorable conditions for the local *Holbrookia*, and, as it were, attracted them from the surrounding areas. If similar habitat conditions are found at Lake Valley, *flavilenta* may be considered as a permanent adaptive color variety occurring in the more or less isolated areas where loose sands prevail.

Pending further investigation of this extremely interesting case, I prefer to restrict the name *flavilenta* as above.

***Holbrookia maculata approximans* Baird**

Plate LX

Holbrookia approximans BAIRD, 1858, Proc. Acad. Nat. Sci. Phila., p. 253.

Holbrookia maculata approximans STEJNEGER AND BARBOUR, 1917, 'Check List N. Amer. Amph. Rept.,' p. 48.

Under this name I have included a somewhat variable assemblage of *Holbrookia* from the Mexican Plateau and a very uniform series of fifty-eight specimens from the Huachuca Mountains, Arizona.

Stejneger (1890, N. Amer. Fauna, No. 3, p. 109) distinguishes *approximans* + *flavilenta* from *maculata* by the greater truncation of the snout, the greater width, height, and obliqueness of the labials (with which is correlated an increased number of labials), and the reduced number of scales on the snout. These characters distinguish the *approximans*, and *campi* of the present paper, *flavilenta* occupying an intermediate position. The latter character may be defined by means of the number of scales between the enlarged nasals. These average 2.5 in

ninety-six specimens of *approximans*, 3.0 in ten *campi*, 2.8 in eight *flavilenta*, and 3.5 in thirty-eight *maculata*, i.e., the internasals are usually either two or three in *approximans*, usually three in *flavilenta* and *campi*, and either three or four in *maculata*.

In both the form of the labials and the size of the internasals, *approximans* and *campi* are more closely related *inter se* than to *maculata*. *Holbrookia m. approximans*, the most widely distributed, most southern, and most variable subspecies, is probably to be considered the stock from which *maculata* and *campi* have become differentiated.

The reasons for distinguishing *flavilenta* have been stated above. From *campi*, *approximans* as here restricted (by the exclusion of the Huachuca *pulchra* and the Tucson *elegans*) is distinguished by differences in the tail length and the length of the hind leg, especially in the females (see table of variation below).

The most striking variation within the series of *approximans* is the greater number and frequently the indefiniteness and smaller size of the dark dorsal spots in the specimens from the Huachuca Mountains. A single specimen, U. S. N. M. No. 30824, from between Ojos del Diabla and Rio Santa Maria, Chihuahua, is very much larger, longer-tailed, and longer-legged than any other specimen in the series examined (fifty-four Mexican specimens and fifty-eight Arizonan). It is probably simply an unusually old and large male of *approximans*.

The series at hand contains specimens from Jesus Maria, southern San Louis Potosi (U. S. N. M. No. 47163, E. W. Nelson), Berriozobal, southern Zacatecas (U. S. N. M. Nos. 46867-8, Nelson and Goldman), Guanajuato (U. S. N. M. Nos. 9894, 9903, A. Dugés), and Durango (A. M. N. H. Nos. 1416-1418, J. H. Batty). These records probably define approximately the southern limits of the range of *approximans*. It is abundant in Chihuahua and Coahuila, and doubtless also in parts of Sonora and Nuevo Leon. In the southwestern United States, the only records which I can verify are those from the lower altitudes in the Huachuca Mountains. Brown (1903, Proc. Acad. Nat. Sci. Phila., p. 545) regards *Holbrookia maculata* at Pecos, Texas, as *m. maculata*. Southwestern Texas and southern New Mexico should be the area of intergradation between *m. approximans* and *m. maculata*. Bailey (1913, N. Amer. Fauna, No. 35, p. 34) records *Holbrookia maculata*, *H. approximans*, and *H. flavilenta* as characteristic of the Upper Sonoran Life Zone in New Mexico, obviously without discrimination, and it is evident that a study of the New Mexican *Holbrookia* will clear up the status of the four subspecies of *maculata* at present known. It is probable that

another Mexican subspecies related to *approximans* will be recognizable when sufficient material is at hand. *Holbrookia propinqua*, recorded from the Lower Sonoran of New Mexico by Bailey (*loc. cit.*, p. 20), is probably *H. m. approximans*, as *approximans* was formerly so identified by Cope (see Stejneger, 1890, N. Amer. Fauna, No. 3, p. 109).

***Holbrookia maculata campi* Schmidt**

Holbrookia maculata flavilenta (non Cope) STEJNEGER, 1890, North Amer. Fauna, No. 3, p. 109.

Holbrookia maculata campi SCHMIDT, 1921, Amer. Mus. Nov., No. 22, p. 1.

DIAGNOSTIC CHARACTERS.—Characters of *Holbrookia maculata*. Distinguished from *H. m. maculata* by coloration, which resembles that of *approximans*, and by the fewer, wider and more oblique upper labials, also as in *approximans*; distinguished from *m. flavilenta* by the same characters; distinguished from *m. approximans* by the longer tail and hind leg, especially of the female; tail/total length varies from .46 to .50 in ♀ *m. campi*, averaging .48, .42 to .48 in ♀ *m. approximans*, averaging .44; length of leg/body length ranges from .77 to .88 in ♀ *m. campi*, averaging .83, .65 to .78 in ♀ *m. approximans*, averaging .71.

RANGE.—Probably the southern part of the Colorado Plateau in northern Arizona. Apparently not reaching Utah on the north, possibly entering New Mexico to the east. It is expected that it will be found to intergrade with *m. approximans* in central Arizona.

TYPE.—A. M. N. H. No. 7990; ♂, about 8 miles N. W. of Adamana, Apache County, Arizona; June 21, 1921; Charles L. Camp.

DESCRIPTION OF TYPE.—

Habitus of *Holbrookia maculata* with a rather stout body; tail usually shorter than the body; a short, wide, and high head; limbs rather long; dorsal scales small, distinctly convex; scales on the head numerous, with two rows of transversely enlarged supraoculars, enlarged scales on the snout, a very large occipital in contact with the median series of larger scales between the eyes; three scales between the enlarged supranasals; six enlarged and keeled upper labials which are set at a considerable angle to the horizontal; ventral scales much larger than the dorsals, in transverse rows, of which there are sixty-two from collar to anus; seven or eight enlarged scales in each half of the collar; femoral pores 12–13.

Ground color above slate gray, with two series of large dark dorsal spots, about eight on the body with two pairs more on the base of the tail; sides with numerous small yellow dots, a few of which extend dorsally among the dark markings; venter creamy white with two very distinct black spots on each side, the first half-covered by the adpressed elbow, very narrowly margined with blue.

MEASUREMENTS OF TYPE.—Total length, 101 mm.; body, 53 mm.; tail, 48 mm.; tail/total length, .48; arm, 25 mm.; leg, 42 mm.

NOTES ON PARATYPES.—

The series of ten specimens, four males and six females, is very uniform in coloration and in structural characters. The variation in measurements is shown in the table below. The internasal scales are uniformly three, while in *Huachuca approximans* they are two in 50 per cent of the specimens examined.

The specimens recorded by Stejneger (1890, *loc. cit.*) as *Holbrookia maculata flavilenta* came from about a hundred miles west of the present locality, but there is no reasonable doubt that they are the same form. He distinguished them from *approximans* in southern Arizona, doubtless with a considerable proportion of specimens of *pulchra* in the series of *approximans* before him, as it is *pulchra* which has the more posteriorly placed lateroventral spots. I believe the form in northern Arizona to be most closely related to *approximans*, and to be fairly distinct (especially in the character of the labials) from *flavilenta*.

The plains, mesa and sparsely vegetated "bad-lands" in the "Petrified Forest" areas south of the railroad at Adamana, Arizona are slightly higher in elevation than some areas to the north, and northwest, farther down the course of the Little Colorado River. Desert conditions become increasingly prevalent as one passes northward from the slopes of the White Mountains into the Painted Desert area north of Holbrook.

Most of the time in the field (three weeks, June-July 1921) was spent at the Blue Forest, six miles south of Adamana. Only a single *Holbrookia* (No. 7986) was collected here. This specimen, the only one I saw in the vicinity, had been dropped near me by a small hawk which had killed the lizard by a severe blow on the back of the head.

During a single warm day (July 2, 1921) spent in the Carrizo wash, eight to fourteen miles northwest of Adamana, a large number of *Holbrookia* were seen and a series was collected. All were taken near or under small bushes in the hot, flat ground immediately above the low banks of the wash. None were noted on the mesas and uplands above. The lizards by remaining motionless and lying close to the light-colored soil often made themselves inconspicuous. If approached carefully they could sometimes be captured in the hand. A female lizard which had been wounded, ran under my feet, and a male, seeing her actively squirming, became excited and seizing the back of her neck in his teeth, attempted copulation, twisting one hind leg around the tail and inserting one hemipenis from the right side. The female was nearly dead and the male allowed himself to be captured without attempting escape. (C. L. C.).

*Holbrookia dickersonæ*¹ Schmidt

Holbrookia propinqua (part) COPE, 1900, Ann. Rept. U. S. Nat. Mus., p. 289.

Holbrookia dickersonæ SCHMIDT, 1921, Amer. Mus. Nov., No. 22, p. 2.

DIAGNOSTIC CHARACTERS.—A large, stout bodied species, with a slightly flattened tail equal to or slightly shorter than the body; snout very obtuse; dorsal scales small, slightly convex; small granular scales between the enlarged supraoculars and the frontals; labials very short and at a high angle with the horizontal, strongly keeled, strongly projecting; femoral pores 9-13; coloration of *H. m. approximans*, but with three lateroventral black spots entirely surrounded by a patch of blue, which is equally distant from axilla and groin and covers more than half the distance between.

RANGE.—Known only from Castanuelas and Alamos de Parras in the state of Coahuila, Mexico.

¹Named for Miss Mary C. Dickerson, former curator of the Department of Herpetology, American Museum of Natural History.

TYPE.—U. S. N. M. No. 2668A¹; Castanuelas, Coahuila, Mexico; Lieutenant B. Couch, U. S. A.

DESCRIPTION OF TYPE.—

Habitus stout, head moderate, snout obtuse; tail slightly flattened, equal to the length of the body; hind leg about four-fifths the length of the body; head scales normal, slightly convex, the largest frontals somewhat larger than the enlarged supra-oculars, separated from them by a patch of small granular scales; labials large, short, set at a high angle with the horizontal, strongly keeled, strongly projecting; dorsal scales nearly flat, more convex on the sides; ventral scales 82 from anus to collar; femoral pores 9–9.

Ground color above light grayish brown, with a double dorsal series of dark spots, which are rounded or somewhat emarginate behind, less distinctly defined on their anterior border; eight pairs of spots on the back, followed by three pairs on the base of the tail, behind which they are confluent as faint crossbands; an obscure lateral series of dark spots on each side interspaced with small light spots; entire ventral surface white, except for dark gray mottling on the throat and a broad blue patch on each side below the lateral fold; the blue patch extends about halfway to the mid-ventral line, nearly to the groin posteriorly, a little further from the axilla anteriorly; three black spots on each side in the blue patch, not sharply defined, the anterior just behind the adpressed elbow, the middle one largest, the posterior merely indicated as a round spot; limbs with dark spots or bands above.

MEASUREMENTS OF THE TYPE.—Length, 116 mm.; body, 58 mm.; tail, 58 mm.; tail-length, .50; foreleg, 30 mm.; hind leg, 46 mm.

NOTES ON PARATYPES.—The type series of six specimens, U. S. N. M. Nos. 2668 and 2664, shows little variation. Only two specimens have a complete tail, indicating a somewhat greater fragility than in *H. maculata*. In the larger specimens, the dorsal scales are much more tubercular. In one specimen, the dorsal color pattern is obscured anteriorly by an increase and invasion of the small light lateral spots.

I believe this species to be directly related to *Holbrookia m. approximans*, from which it is distinguished by its coloration and proportions. The specimens on which this species is based are listed under *Holbrookia propinqua* by Cope (1900, p. 291), a species from which it is very distinct.

¹U. S. N. M. No. 2668 covering four male specimens, I designate the type by means of a lettered tag A.

COMPARATIVE TABLE OF VARIATION IN THE SPECIES OF *Holbrookia*

		Total Length			Length of Body			Tail/Total Length			Length of Hind Leg Body Length			Number of Ventrals Collar to Anus			No. of Femoral Pores on Each Side		
		No. Spec.	Extremes	Mean	No. Spec.	Extremes	Mean	No. Spec.	Extremes	Mean	No. Spec.	Extremes	Mean	No. Spec.	Extremes	Mean	No. Spec.	Extremes	Mean
<i>Holbrookia</i>	♂																		
	♀																		
<i>texana</i> {	♂	6	122-151	143	13	57-70	63	6	.52-.57	.54	13	.82-.93	.87	13	71-88	79	13	10-19	14.4
	♀	6	113-132	123	6	53-63	58	6	.51-.55	.53	6	.82-.93	.89	6	77-81	80	10	10-16	13.4
<i>propinqua</i> {	♂	18	100-140	123	19	43-59	52	18	.56-.61	.58	19	.77-.93	.82	19	67-87	76	19	13-19	16.2
	♀	25	99-127	115	25	43-56	49	25	.51-.61	.55	25	.71-.91	.80	25	66-83	74			
<i>elegans</i> {	♂	4	116-151	137	8	54-67	61	7	.51-.58	.54	11	.71-.86	.80	9	61-76	68	11	11-15	13.4
	♀	6	114-137	127	9	53-65	60	6	.50-.53	.52	10	.70-.81	.76	10	64-75	67	10	12-15	13.0
<i>pulchra</i> {	♂	15	104-125	116	15	48-58	53	15	.51-.56	.54	15	.74-.87	.82	15	58-66	62	23	10-15	11.6
	♀	9	95-117	107	9	47-56	52	9	.50-.54	.52	9	.75-.83	.80	9	58-70	65	11	8-13	11.1
<i>lacerata</i> {	♂	4	92-134	106	4	45-65	54	4	.48-.51	.50	4	.71-.93	.79	4	64-75	68	4	12-16	13.7
	♀	1	108	108	2	53-60	56	1	.51	.51	2	.75-.80	.78	2	70-73	72	2	13-14	13.8
<i>maculata maculata</i> {	♂	7	95-107	101	8	48-58	52	7	.45-.50	.48	8	.67-.83	.77	8	67-80	70	10	10-14	12.2
	♀	25	80-105	93	25	42-58	50	25	.42-.49	.46	25	.64-.83	.72	15	63-73	67			
<i>m. flavilenta</i> {	♂	1	99	99	1	49	49	1	.51	.51	1	.84	.84	1	64	64	1	8-9	8.5
	♀	4	82-101	91	5	43-54	48	4	.46-.51	.48	4	.70-.82	.77	3	65-69	67	5	7-14	10.6
<i>m. campi</i> {	♂	4	90-111	98	4	44-54	50	4	.48-.51	.50	4	.79-.86	.84	4	62-69	66	4	11-14	12
	♀	6	79-92	85	6	41-47	44	6	.46-.50	.48	6	.77-.88	.83	5	62-70	65			
<i>m. approximans</i> {	♂	17	92-111	102	17	47-59	49	17	.42-.50	.48	17	.72-.83	.79	17	58-74	68	18	8-13	10.8
	♀	27	77-113	91	27	45-61	51	27	.42-.48	.44	27	.65-.78	.71	27	62-74	67	12	9-13	10.5
<i>dickersonæ</i> {	♂	1	116	116	5	47-72	59	1	.50	.50	5	.72-.87	.81	5	73-82	77	5	9-13	10.9
	♀	1	121	121	1	58	58	1	.48	.48	1	.72	.72	1	72	72	1	10	10

PLATES LVIII to LX

PLATE LVIII

Holbrookia propinqua. From left to right, A. M. N. H. Nos. 7685 ♀, 7686 ♀, 7688 ♂, 7687 ♀, 7689 ♂; 7670 ♂. San Antonio, Texas. Note the slender proportions of the species, and the spotted nuptial coloration of the males.

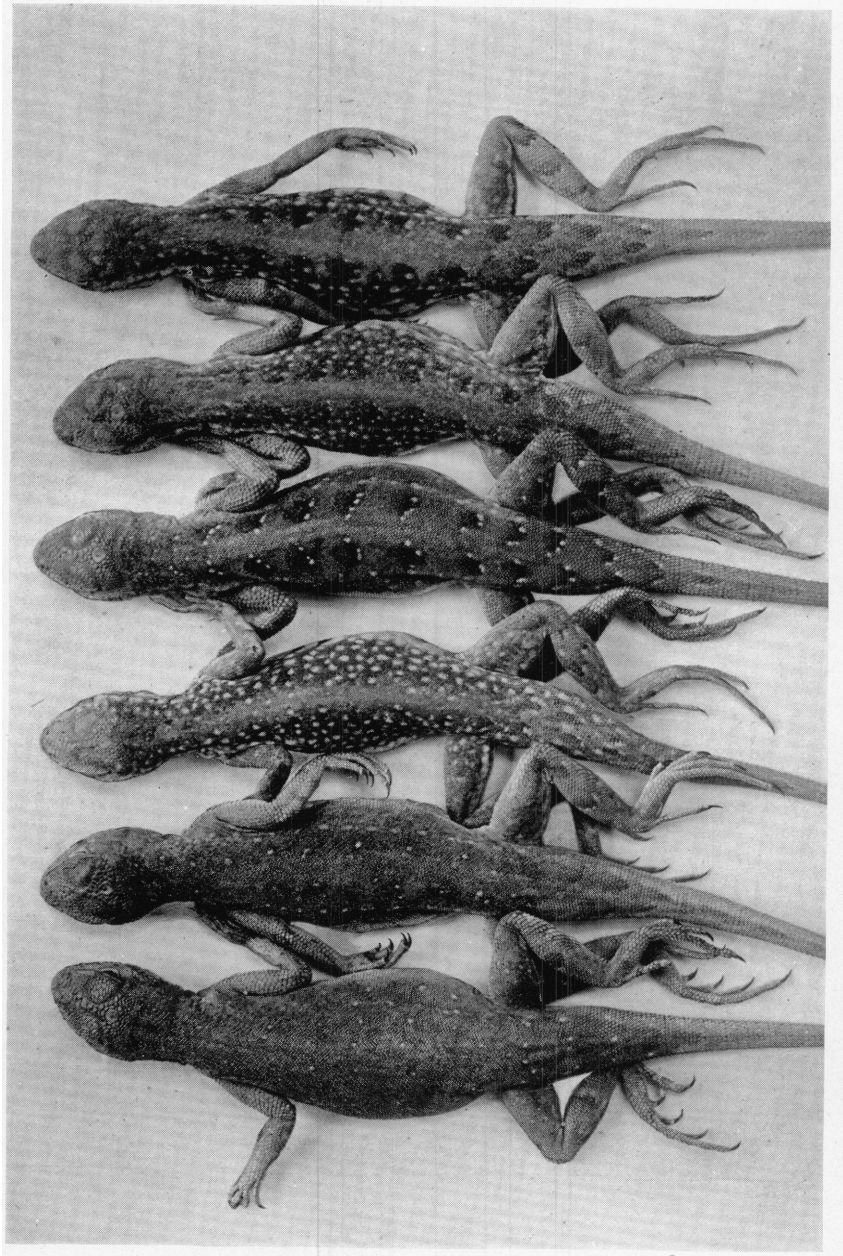


PLATE LIX

Holbrookia pulchra. From left to right, A. M. N. H. Nos. 14597 juv., 14713 ♂, 14705 ♀, 14701 ♂, 14894 ♀. Huachuca Mts., Arizona.



PLATE LX

Holbrookia maculata approximans. From left to right, A. M. N. H. Nos. 14787 juv., 14770 juv., 14732, ♂, 14759 ♀, 14746 ♂, 14715 ♀. Huachuca Mts., Arizona.



