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## Further Observations on Iverson's Blind Snake in Tamaulipas, Mexico

David L. Auth, Hobart M. Smith, Bryce C. Brown,  
David Lintz and David Chiszar

### Abstract

An additional series of seven specimens complement the six previously reported of *Leptotyphlops dulcis iversoni* in Tamaulipas, Mexico. Additional data and localities are reported for 59 *L. d. dulcis* from the same state.

Surprisingly few records exist for *Leptotyphlops dulcis* (Baird and Girard) in the northeastern state of Tamaulipas, Mexico, as indicated for example in Hahn (1979). He there indicated records for the Matamoros area of *L. d. dulcis*, and in the Gómez Farías and Tampico areas for *L. d. myopicus*. The only other notable records are of "*L. myopicus*" 6.4 km NW of Acuña in the Sierra de Tamaulipas (Martin et al., 1954), and of *L. d. iversoni* 36.5 km NE Jaumave (the type locality), 20.9 km NE Ignacio Zaragoza, and the vicinity of Llera (Smith et al., 1998).

Thus the existence of 67 unreported specimens of *Leptotyphlops dulcis* in the Strecker Museum of Baylor University (SMBU) from various localities in Tamaulipas is of special interest.

Among those 67 are seven representing *L. d. iversoni*, previously known from only the six types (Smith et al., 1998), as follows (all permanent SMBU numbers): 14549-51, 1.6 km E Llera, Bryce C. Brown, 24 March 1968, found under cover; 14552-3, Hda. La Clementina, 11.3 km W Ignacio Zaragoza, Bryce C. Brown, Alton Brown, and David Lintz, 25 December 1968, under rocks; and 14554-5, same locality, Brent and Alton Brown, 28 December 1968, dug from a cement pit. Most important, all lack supraoculars on both sides except one (14550) with one on one side. They consistently have a divided anterior supralabial on each side, 2-2 temporals, 14 scale rows on body, 10 on tail; 5 scale rows unpigmented on body, 3 on tail. The total length varies from 76 to 160 mm; the three largest (over 129 mm total length) have 210, 210 and 218 dorsals. The critical character of absence of the supraoculars is maintained in the total of 13 specimens now known on 22 of 26 sides.

In addition to these specimens, there are 60 *L. d. myopicus*, from the following localities (all permanent SMBU numbers): 9.7 km NW Chamal

(14409-10, 14531-2); Gómez Farías (8783-5, 13143-6, 14533-48); 0.8 km S Gómez Farías (11518-9); 1.6 km N Gómez Farías (11520); 1.6 km W Gómez Farías (8775); 2.4 km W Gómez Farías (8780, 8786); 3.2 km W Gómez Farías (8773, 8787-8); 11.3 km NW Gómez Farías (8779); Vado del Mado, a small village about 48 km W Soto la Marina (14396-14408); 0.5 km N Vado del Mado (8770, 8776); 6.4 km E Vado del Mado (8774); 17.1 km E Vado del Mado (8772); 56 km E Cd. Victoria (8771); 69.2 km E Cd. Victoria, Soto la Marina rd (8782); 78.9 km E Cd. Victoria (8372, 8777, 8781); 80.8 km E Cd. Victoria (8778). All 60 specimens have supraoculars on both sides, and one (8372) has only a single anterior supralabial on both sides (the rest have two on both sides).

The distributional pattern as now known of the three subspecies of *L. dulcis* in Tamaulipas (Fig. 1) remains uncertain to a considerable extent. How far south of the Matamoros area *L. d. dulcis* extends, or how far north *L. d. myopicus* extends, is not known. It is possible that the single specimen of the five from west of Soto la Marina with an undivided anterior supralabial indicates nearness of an area of intergradation. The range of *L. d. iversoni* appears to be completely surrounded by that of *L. d. myopicus*, to judge from records for the latter subspecies in Nuevo León (Hahn, 1979; SMBU 11521, Horsetail Falls, 22 mi. S Monterrey), and near Laguna Carrizo, 3.2 km S Acuña, Tamaulipas (Martin et al., 1954; UMMZ 101234, presence of both supraoculars and of 2-2 anterior supralabials confirmed by Greg Schneider).

### Acknowledgments

We are much indebted to the authorities of Baylor University for permission to study material in the Strecker Museum, and for facilities and amenities during our stay; to Greg Schneider for information on the critical specimen of *L. d. myopicus* in UMMZ from near Acuña; and to Deborah Aguiar for finalization of the map.

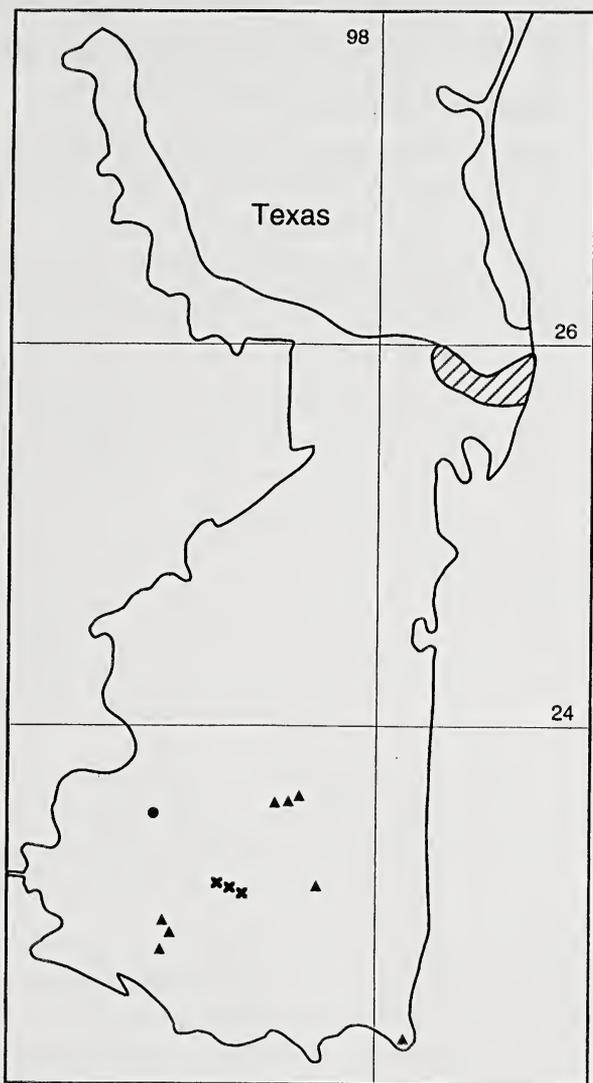


Fig. 1. Localities of record for *Leptotyphlops dulcis* in Tamaulipas. Triangles, *L. d. myopicus*; crosses, present records of *L. d. iversoni*; circle, type locality of *L. d. iversoni*; hatched area, localities of record for *L. d. dulcis* (Hahn, 1979). The northern triangles denote localities west of Soto la Marina and east of Cd. Victoria; the southwestern group denotes the Gómez Farías /Chamal area records; the central eastern triangle represents the locality near Acuha; and the southeastern one indicates Tampico (the syntypes). The crosses all indicate the localities near Llera and west of Ignacio Zaragoza.

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## The Prepublication History of the Name *Lampropeltis triangulum sinaloae* Williams, 1978, for the Sinaloan Milk Snake

Hobart M. Smith, Kenneth L. Williams and David Chiszar

### Abstract

One or more of the seven prepublication usages of the name *Lampropeltis triangulum sinaloae* Williams, 1978, may be regarded as fulfilling the minimal requirements for nomenclatural availability. In the absence of specific action by the International Commission on Zoological Nomenclature, we here propose that all such usages be regarded by common consent as unavailable for nomenclatural purposes.

Six subspecies of *Lampropeltis triangulum* (Lacépède) were formally described as new in an exhaustive taxonomic monograph of the species by Williams (1978): *andesiana*, *conanti*, *hondurensis*, *sinaloae*, *smithi* and *stuarti*. One of those names, *sinaloae*, appeared in print at least seven times before Williams' monograph appeared. Our purpose here is to review those usages in the context of their nomenclatural significance.

The earliest appearance of the name *sinaloae* in the nominal genus *Lampropeltis* was in an abstract of Williams' doctoral dissertation (Williams, 1970). The name was there an incontrovertible *nomen nudum*, however, completely lacking any "indication" whatever.

The second usage (Gillingham et al., 1975) was in an abstract of an oral presentation at herpetological meetings earlier that year. The only information recorded for *Lampropeltis triangulum sinaloae* was that "These snakes show the following three major divisions of courtship and copulatory behavior: tactile-chase, tactile-alignment and intromission and coitus. Although these phases follow a general colubrid pattern, careful analysis has shown specific differences." We opine that this account does not satisfy the requirement of Art. 13(c)(i) of the Code that a name be "accompanied by a statement that purports to give characters differentiating the taxon," because the differences mentioned are stated explicitly to be specific (hence pertaining to the species), not subspecific. It is furthermore not clear that behavioral patterns by themselves are acceptable under the Code as an "indication."

The third usage occurred in an article by Brecke et al. (1976: 394), in

which the mating behavior of *Lampropeltis triangulum sinaloae* was compared with that of another snake, *Elaphe obsoleta bairdi* (Yarrow). This usage appears to us to fail to qualify as an "indication" for the same reasons as the preceding.

The fourth and fifth usages (Slavens, 1976: 58; Smith and Smith, 1976: S-G-4) provide no information that could be construed as making the name thereby available; the first is a list of zoos exhibiting the subspecies, and the second is a bibliographic reference to Williams' 1970 usage of the name.

The sixth usage (Gillingham et al., 1977) presents the most compelling case for providing the essential "indication." The article, with the same abstract that appeared in 1975, gives details of the behavioral sequences previously mentioned, and depicts six different postures occurring in those sequences. These line drawings might be construed as providing an acceptable "indication" since they do show a little of the pattern and scalation. However, we regard this additional information as still insufficient to occupy the name, because no suggestion is made that what little structure is shown is distinctive. Without such a statement, even a photograph should not suffice to occupy a name.

The seventh usage (Murphy et al., 1978), published March 23; Williams' monograph appeared April 13) certainly would not occupy the name if the preceding accounts do not, since it merely mentions the mating behavior recorded for the subspecies.

Because of the existence of-at least these seven usages of the name *Lampropeltis triangulum sinaloae*, and perhaps others unknown to us, prior to the formal proposal of the name by Williams in 1978, workers in the future may well argue which usage properly makes the name available under the Code. Indeed, the question was submitted to the International Commission on Zoological Nomenclature in 1981. The response was that indeed some of the usages might well qualify for availability, but that action, if any, should not be taken on this individual case, but should take the form of revision of the Code, clarifying what constitutes an "indication."

In the meantime, we propose that all cited usages of the name *sinaloae*, in combination with the nominal genus *Lampropeltis*, prior to that of Williams (1978), be regarded by common consent as unavailable for nomenclatural purposes.

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We take this opportunity to reiterate the warning that names should never be used before their formal publication is assured.

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## Further Observations on a Merolepid (Partially Scaleless) Water Snake (*Nerodia sipedon*)

Hobart M. Smith, Eric T. Thiss and David Chiszar

### Abstract

A previously reported merolepid water snake (*Nerodia sipedon*) has divided ventrals, previously thought not to occur in merolepid viviparous snakes. Most ventrals are divided into four scales, some into three, and few are undivided. Some subcaudals also are divided into three or four scales. Two stillborn young from the same female, not known to have mated since birth, have much the same characteristics and are regarded as another probable example of facultative parthenogenesis.

A young merolepid *Natrix sipedon*, less than a year old, was reported and illustrated in color by Thiss (1993), and the same snake was figured in color by Bechtel (1995), but few details about it have been reported, other than pattern. Because of the rarity of the condition (Smith et al., 1996), we here provide additional information. The snake is now UCM 60580.

As reported by Thiss (1993), the snake in question was one of two merolepid snakes born in September, 1992, to a wild-caught gravid female taken in Cook Co., Illinois, by Brad Scialabba, in a litter that included at least 15 normal appearing snakes. One of the two merolepid snakes died before Thiss' report appeared, and its present whereabouts is unknown. The other merolepid neonate, however, was maintained in captivity by Thiss until it died in his absence approximately 30 June 1998.

By that time the snake had reached adult size (it now measures 935 mm in total length, 780 mm SVL, tail incomplete). In mid-1997 the snake gave birth to two still-born young, passed along with about 10 infertile ova, although the mother had not been bred. The snake was subsequently placed with normal males, but mating was never observed, and the female died before producing any more litters. The two neonates, fully developed but still tightly coiled, are now UCM 60581-2.

As noted by Thiss (1993), the mother, and the neonates as well, have some scales, hence none are truly scaleless. As in all other merolepid snakes, the only scales remaining are the ventrals, subcaudals and a few head scales. However, virtually all of the ventrals in these three snakes are divided, whereas

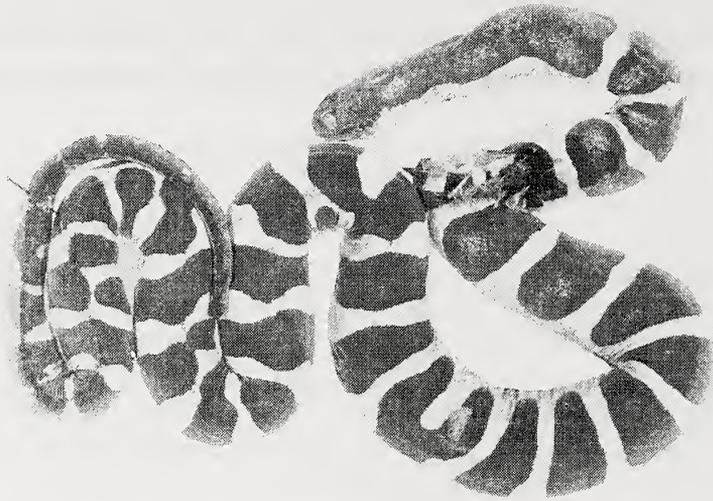


Fig. 1. Dorsal view of a merolepid *Nerodia s. sipedon*, UCM 60580. Note especially the broad longitudinal stripe on neck, and the mostly unbroken transverse blotches, unlike the normal pattern of the subspecies, but somewhat similar to that of *N. s. pleuralis*.



Fig. 2. Ventral view of the same snake as in Fig. 1. The divided ventrals are evident where the dark spots are in pairs or in fours.

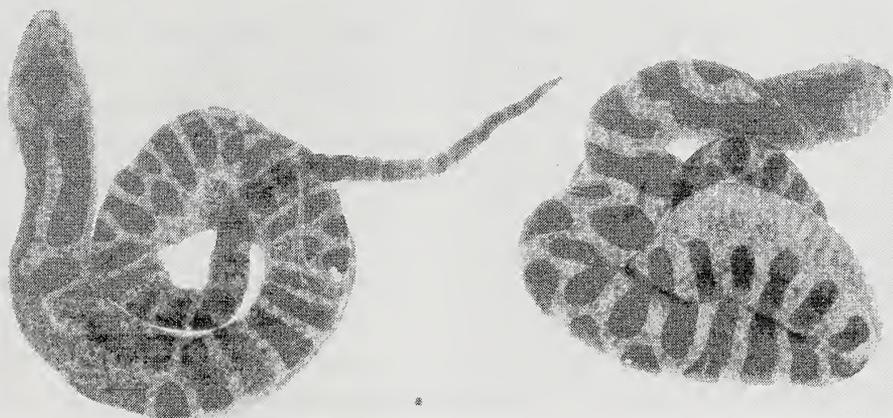


Fig. 3. Dorsal views of the two merolepid neonates born by UCM 60580. Note the considerable similarity of pattern to that of the mother.



Fig. 4. Ventral views of the same snakes as in Fig. 3. The markings are much less distinct in the less well developed neonate on the left (UCM 60582), perhaps as a product of incomplete development. Note its bulging left brille.

Smith et al. (1996) suggested that in viviparous examples the ventrals are not divided. That generality is therefore not valid.

Indeed, not only are most of the ventrals divided medially in all three examples, but in all three many of them have each half, or the half on one side, also divided. Thus many of the ventrals are divided into four parts. In all cases the lateral scales are smaller than the paramidventral ones. In the adult, the 134 ventrals are either entire (indicated by 1), divided medially (2), divided medially and on one side (3), or divided medially and on both sides (4), as follows: ventral 1(4), 2(3), 3(2), 4-12(1), 13(2), 14-15(1), 16-23(2), 24(3), 25-26(2), 27(3), 28(2), 29-30(3), 31-32(2), 33(3), 34-37(2), 38(3), 39-41(2), 42(3), 43-44(2), 45-46(3), 47-53(4), 54(2), 55-56(4), 57(3), 58-81(4), 82(3), 83-92(4), 93(3), 94-95(4), 96(3), 97-98(4), 99(3), 100-101(4), 102(3), 103-104(2), 105(3), 106-108(2), 109(4), 110-112(2), 113(3), 114-134, including anal(2).

In the adult, all of the subcaudals are divided, but about the terminal fourth of the tail lacks the scales; only a few have the right or left ends of the scales split from the more medial part. The rostral and mental are present, but rather more rounded than normal, and the nasal is recognizable. A brille appears to be present, but the only other scales are in the upper and lower labial region, where round or oval scales are scattered but seldom in contact with each other. A few small (<1 mm) corneous patches are scattered on neck.

One neonate (UCM 60581), more readily examined than the other, measures approximately 124 mm in total length, and the tail 41 mm. The long tail (33% of total length) suggests that it is not a female, as indicated for the species by P. W. Smith (1961: 258), with 25% being the maximum for females, 27% for males (McCauley, 1945, recorded much the same maxima for the populations of *N. s. sipedon* of Maryland and the District of Columbia, with 23% for females, 29% for males). With 60 subcaudals and 113 ventrals, as best they can be counted or estimated were they present, both figures are well below or on the low side of the normal range (58-80 subcaudals, the lower figures presumably female, and 135-149 ventrals, fide Smith, 1961; in MD/DC, fide McCauley, 1945, there are 56-74 subcaudals and 132-144 ventrals in females, 66-80 subcaudals and 133-145 ventrals in males). Neither count on the neonate is definitive, because the ventrals are irregular, somewhat compressed together, and the subcaudals are lacking toward the tip of the tail and could only be estimated were all present. Nevertheless the actual number is probably subnormal or low, as is the accurately countable 134 ventrals of the adult.

The scales on head and ventral surfaces of body and tail in both neonates are much as in the adult. Most ventrals are in four rows. On UCM 60582, the brilles are protuberant, and the subcaudal scales are present only near the base of the tail. Its tail measures 34 mm, hence suggests that the snake is a male.

The evidence is not conclusive, but it indicates that the neonates were produced by parthenogenesis, a phenomenon that has been confirmed in a number of other species of snakes, and is suspected also in certain lizards (Schuett et al., 1997, 1998; Chiszar et al., 1999). It is possible that the option of facultative parthenogenesis has evolved in at least some reptiles that occasionally fail to encounter mates; most if not all suspected cases occurred in animals kept isolated in captivity for several years. Presumably the phenomenon would not occur when mates are encountered within reasonable time limits. Its mechanism and origin remain intriguing problems.

There may be a relationship of the mechanism of facultative parthenogenesis in reptiles with that of obligate parthenogenesis in the burrowing, blind snake *Ramphotyphlops braminus*, the only known species of snake exhibiting obligate parthenogenesis. Of possible significance in this context is the idea that snakes originated from burrowing ancestors, an hypothesis originating with Walls (1942), elaborated by Gans (1975), and supported by Rieppel (1988).

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## The Distribution of *Sceloporus megalepidurus* and of Abdominal Semeions in its Genus (Reptilia: Sauria)

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Bryce C. Brown

*Abstract.* *Sceloporus megalepidurus pictus*, diagnosed by having prominent, dark-bordered abdominal semeions in males, is recorded from 9.7 km N Pachuca, Hidalgo, Mexico – a range extension of about 125 km northwest of the nearest record in central Puebla. The only previous record of the species for the state had not been allocated to subspecies, but is a female from nearby Lake El Chico, hence is here regarded as representative of the same subspecies as the preceding. The record from Teotihuacán Valley, state of México, was based on a single female previously allocated on geographic grounds to *S. m. megalepidurus*, diagnosed as lacking prominent abdominal semeions in males, but new geographic evidence now requires referral to *S. m. pictus*.

Males of most species of *Sceloporus* have prominent abdominal semeions; only eight species lack them, and in only two species are they absent in one subspecies, present in another.

A series of four *Sceloporus megalepidurus* from 9.7 km N Pachuca, Hidalgo, Mexico, taken 26 June 1964 by Bryce C. Brown and family, and in the Strecker Museum of Baylor University, Waco, Texas, includes two males (SMBU 12573, 12794), both of which possess prominent, dark-edged abdominal semeions, even in the small individual (SMBU 12794, 33 mm SVL). The other two specimens (SMBU 12574-5) are females which, as in all other females of the species, lack any evidence of abdominal semeions.

We regard these specimens as *S. m. pictus* because of the presence of prominent, dark-edged abdominal semeions in both males of the present series. However, previous records have indicated that *S. m. pictus* occurs south and southwest of the range of *S. m. megalepidurus* (Dasmann and Smith, 1974), whereas the Hidalgo locality is north (~125 km) of the nearest locality of record for *S. m. pictus* in central Puebla, and indeed is considerably north of the northernmost locality of record for *S. m. megalepidurus*, although to the west of the range of that subspecies.

The only other record of the species for the state of Hidalgo (Larsen and Tanner, 1974) is for "Lake El Chico" (BYU 36421), which is essentially the same locality as that for the SMBU series. The BYU specimen is a female and was reported as *S. megalepidurus*, as a species separate from *S. pictus*. In the absence of males, on geographic grounds it is here regarded as representative of the same subspecies as the SMBU specimens, not *S. m. megalepidurus*.

One other western specimen of *S. megalepidurus* (MCZ 133166) has been recorded (Dasmann and Smith, 1974), from "Station 85, hills E San Marcos, Teotihuacán Valley, México state." It was regarded in that work as representative of the nominotypical subspecies, but the single specimen is a female, hence unidentifiable to subspecies. On geographic grounds we here refer it to *S. m. pictus*.

The distributional picture (Fig. 1) that thus emerges from these identifications suggests that *S. m. pictus* inhabits relatively open terrain at relatively low altitudes, west of the higher altitudes inhabited by *S. m. megalepidurus*. However, the survival value of the presence or absence of prominent abdominal semeions remains to be determined. Both taxa appear to occur in semi-arid regions, where *S. m. pictus* was observed by Taylor (Smith, 1939) to be "confined to maguey plants, and extremely wary and difficult to extract." On the contrary, *S. m. megalepidurus* were readily caught by hand on "hills and lava beds, often under fallen yuccas, apparently not living on the plains" (Smith, 1939). The subspecies has been reported from altitudes as high as 10,000 feet on Mt. Orizaba (Smith, 1939).

Of special interest is the report (Flores et al., 1991:124) of two *S. m. megalepidurus* from El Carmen municipality, at the extreme eastern limit of Tlaxcala, and one *S. m. pictus* from the same locality. On what bases they were so identified is unknown, but in the absence of further information we regard all of them as *S. m. megalepidurus* on geographic grounds (Fig. 1). Adrian Nieto Montes de Oca (pers. comm.) concurs; actually the three cited museum numbers embrace six specimens, only one a male, which was referred to *S. m. megalepidurus*. So far as we are aware, the two subspecies differ tangibly only in the presence of prominent, dark-bordered abdominal semeions in male *S. m. pictus*, and their absence in *S. m. megalepidurus*. Smith (1939: 200) distinguished the two taxa as full species on the additional bases of number of dorsals, number of scales between the femoral pores series, and presence or absence of keels on the basal subcaudals in females. However, Dasmann and Smith (1974) provided data on 58 specimens not previously reported, and

found that the only possibly useful difference was in number of dorsals, 44-56 in *S. m. pictus* (mean 51), 52-63 in *S. m. megalepidurus* (mean 57). No reliable difference in keeling of the basal subcaudals in females was found, nor have we found it reliable in specimens subsequently examined.

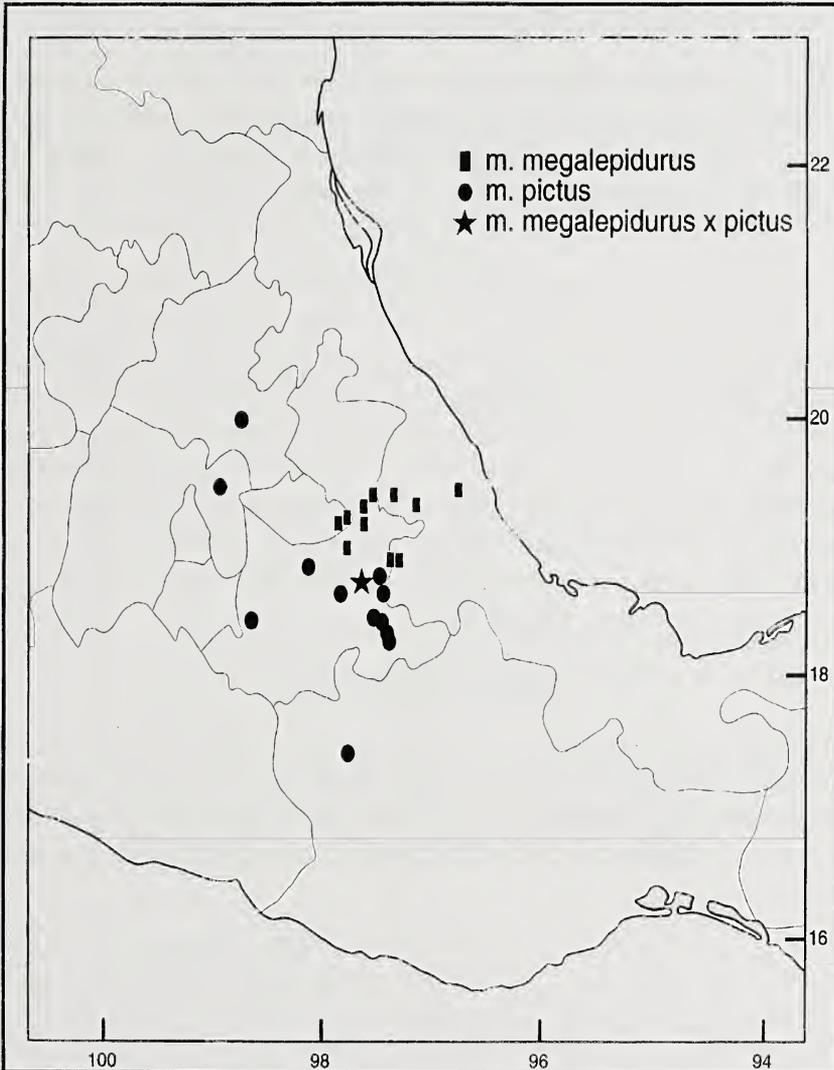


Fig. 1. Locality records for *Sceloporus megalepidurus*, adapted from Dasmann and Smith (1974). The Oaxaca record (2 mi W Yanhuitlán) is from Smith (1992), and the one from western Puebla ("Putla," presumably a misspelling of Puctla) is from Boulenger (1885).

Furthermore Dasmann and Smith (1974) reported intergrades between the two subspecies from 8 km SE Cd. Serdán, Puebla, so identified on the basis of irregular occurrence of semeions in males. We have examined part of that series again, and find that 2 of a total of 18 males have prominent, dark-bordered abdominal semeions, whereas the other 16 exhibit no evidence of them whatever. No other differences were detected between those with and those without dark-bordered semeions.

The critical SMBU specimens we here assign to *S. m. pictus* have 49-53 dorsals, within the range of both subspecies, which have a considerable overlap; 51-55 ventrals; 46-48 scales around body; 13-16 femoral pores; and 4-6 scales between the pore series. The problematic BYU female, and the one from the Teotihuacán Valley, have 56 and 55 dorsals, respectively.

If it is correct that these two taxa are valid and subspecies of the same species, as now appears to be the case, they are a rare exception to the general rule in *Sceloporus* that presence or absence of prominent abdominal semeions in males is species-constant. Relatively few species lack them: *S. chrysostictus*, *S. utiformis*, *S. virgatus*, and the five species of the *angustus* and *siniferus* groups (*S. angustus*, *S. carinatus*, *S. grandaevus*, *S. siniferus*, *S. squamosus*). They are peculiarly barred in the *pyrocephalus* group. Only in *S. megalepidurus* and *S. horridus* are they absent in one subspecies, present in another. Either species would be a fascinating subject for study of the factors of life style, if any, that favors one condition over the other.

### Acknowledgments

We are much indebted to José Rosado, Dr. David Lintz and Dr. Wilmer W. Tanner for the loan of specimens from MCZ, SMBU and BYU respectively, to Dr. Adridn Nieto Montes de Oca for information on MZFC material, and to Dr. Bryce C. Brown for the privilege of studying his extensive Mexican collections.

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**Variation and Intergradation of Northern and Southern Prairie Lizards in Southwestern Oklahoma: Designation of Neotype for *Sceloporus undulatus consobrinus*, from Quartz Mountain State Park, Kiowa County, Oklahoma**

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Abstract

Intergradation between *Sceloporus undulatus consobrinus*, the Southern Prairie Lizard, and *Sceloporus undulatus garmani*, the Northern Prairie Lizard is described for southwestern Oklahoma. A neotype for *S. u. consobrinus* is described from Quartz Mountain State Park, Kiowa County, Oklahoma.

Baird and Girard (1854: 237-239) described a new species, *Sceloporus consobrinus*, from a single specimen allegedly collected on June 6, 1852 by the expedition exploring the Red River (Marcy, R. B., and G. B. McClellan, 1854). No specific type locality was given, but on the basis of date has been assumed to be Suydam Creek [presently Timber Creek]. Stejneger and Barbour (1917: 53) originally restricted the type locality to Roger Mills Co., Oklahoma. Smith (1938: 11) questioned this, stating the expedition could not have reached this point at the rate they were travelling. Stejneger and Barbour (1939: 70) then restricted the type locality to Beckham Co., Oklahoma, near the confluence of the North Fork of the Red River and Suydam Creek. Webb (1970:331-332) further clarified the type locality, to "about four miles east-southeast of Sayre, near or at the confluence of Timber Creek and the North Fork of the Red River, Beckham County, Oklahoma". He stated that on modern maps there was no Suydam Creek, which presently is known as Timber Creek. He noted also (Webb, 1970: 186) that in Beckham County along Timber Creek, nearly topotypic individuals in the Museum of Natural History, University of Kansas (KU 84673-76) more closely resembled *S. u. garmani* than *S. u. consobrinus*. These specimens have been examined, and indeed do resemble *garmani*, and are not typical of the well-known phenotype of *S. u. consobrinus*. Photograph of these near topotypes (Fig. 10) was provided by R. G. Webb. Even these show dorsal color variation, with the one individual (on right) showing seven separate dorsal paired spots in median dorsal area, whereas the other (on left) shows these spots surrounded by a light dark line just medial to the dorsolateral light stripe.

Applegarth (1969) reviewed the type localities, coloration, and ranges of *S. u. consobrinus*, *S. u. garmani*, *S. u. tristichus*, and *S. u. erythrocheilus*. His intergrade area (*S. u. consobrinus* X *garmani*) is the same as in this paper. Our study is based upon relatively few specimens from the vicinity of Quartz Mountain State Park in the collection of the Oklahoma State University at Stillwater.

The specific route followed by the expedition is quite important, and is summarized from Foreman (1937), who interpreted and often corrected errors of Marcy and McClellan (1854). The most flagrant error was placement of the One Hundredth Meridian about fifty miles east of the proper meridian (Foreman, 1937: 31 and map in report). This restricted neotype locality is near the expedition route (Fig. 1).

The expedition proceeded up the North Fork of the Red River of Oklahoma, and from May 28-31 passed between the Wichita Mountains and the North Fork. Encampment on May 30 was "not far from the present town of Mountain Park, Kiowa County, near Twin Mountain" (Foreman, *ibid.*, p. 34). On May 31 it passed over Elk Creek; "camp today is southwest of Hobart" (*ibid.*, p. 35). On June 1 it passed Mount Webster, now known as Tepee Mountain (southeast of Lugert) and descended to the junction of Elm Fork and the North Fork of the Red River. Marcy reported Elm Fork as "Salt Fork," because its water was quite unpalatable. Modern maps show this stream as Elm Fork. Early maps call it Marcy's Creek, or Marcy's Fork of the Red River. Applegarth (1969: 24; after McCoy, 1961) diagrams one locality on Elm Fork as an intergrade locality of *S. u. consobrinus* X *garmani*, which is within the intergrade area on Fig. 1 in this paper. On May 31-June 1 Marcy's party was just east of the present Quartz Mountain State Park. Marcy remarked he could not leave the Wichita Mountains "without a feeling of sincere regret", because of the beauty of the terrain.

On June 3 the expedition crossed the North Fork (Foreman, *ibid.*, p. 41) to the west bank, proceeded northward, and on June 6 again crossed the North Fork to the north bank. After about ten miles they came to a large creek, which Marcy named Suydam Creek after his friend J. R. Suydam of New York City, who accompanied the expedition (Foreman, *ibid.*, p. 44; Marcy and McClellan, 1854: 25). The original holotype of *S. u. consobrinus* was recorded as collected on June 6, 1852 (Baird and Girard, 1854: 209).

The range of *S. u. consobrinus* (Cope, 1900: 377; Smith, 1938: 10; Smith, 1946: 217) is south of that of *S. u. garmani*, which occurs from Oklahoma northward through the Great Plains to South Dakota. So interpreted, *S. u. consobrinus*



Fig. 1. Map of central Oklahoma with localities, Beckham, Greer, Kiowa, Jackson and Harmon Counties; ---- = Pathway of expedition of Marcy and McClellan. G= *S. u. garmani*; C= *S. u. consobrinus*; CXG = *S. u. consobrinus X garmani* intergrade. N= neotype locality at SOAARR Camp, Quartz Mountain State Park. T= Timber Creek (original type locality of *S. u. consobrinus*).

has been consistently regarded as the taxon occurring southward from southwestern Oklahoma through western Texas and westward across southern New Mexico to southeastern Arizona, thence southward into northern Mexico.

The term "semeion" (introduced by Smith et al., 1991: 5) is derived from a Greek word meaning "flag or signal," and designates patches of color that lizards and other vertebrates display during courtship or aggressive behavior. The term interabdominal semeion area (IASA) is here introduced to indicate the ventral area between the black borders of the abdominal semeions. The IASA is here counted in scalerows at mid-body, and color is described. The IASA is considered important in many species and subspecies of *Sceloporus*. The term "total ventral count" is also here introduced as the number of scales or scalerows counted just beside the ventral median line from (but not including) postmentals to edge of vent. Small scales inside the vent are often exposed in specimens, but these are not part of the total ventral count. One of us previously used total ventral count (Bell, 1954: 33), but called it ventral scale count. "Ventral scales," or ventral count as originally defined (Smith, 1939: 26), began at a line between the anterior margins of the shoulders, and ended at the edge of the vent. Total ventral count has the advantage of beginning at a specific scale.

The original type specimen of *Sceloporus consobrinus*, USNM 2855, has been destroyed (Jones, 1926: 1) and a neotype is described below. The catalogue of the National Museum of Natural History has "type destroyed" in the right margin of entry USNM 2855. "It is not dated, but the handwriting is that of E. D. Cope" (Ronald Crombie, Dept. of Amphibians and Reptiles, USNM, pers. comm.). Original type description omits sex, but the femoral pores are described as "conspicuous." Elongated blue patches are described on the sides of the abdomen, and enlarged male postanal scales, typical of males (Smith, 1946: 16; Cope, 1900: 332) are shown on (Baird and Girard, 1854: 13-14, Fig. 10, Plate X).

Males of *S. u. consobrinus* usually have conspicuous medial black borders at least two scalerows wide on the ventral abdominal semeions. Gular semeions are paired blue spots usually surrounded by black. Females have smaller femoral pores, and usually no ventral abdominal semeions (except for faint ones in occasional specimens), and occasionally small blue paired gular semeions.

Fixation of the name *S. u. consobrinus* is permitted by Article 75 of the International Rules of Zoological Nomenclature, third edition. We here also

follow Art. 72h, and Art. 75(d)(5) in having the neotype type locality (Quartz Mountain State Park, Kiowa County, Oklahoma) as near as possible to the area of the original type locality, consistent with the very extensive usages and understanding of applications of the name for nearly 150 years, thereby also assuring the continuation of the name *S. u. garmani* Boulenger, 1882: 761, for over 100 years. The neotype type locality is about thirty miles southeast of the original holotype type locality at Timber Creek, Beckham County, Oklahoma. A number of series were taken in the Park in both Kiowa and Greer counties, Oklahoma. Numerous specimens of *S. u. consobrinus* from the Wichita Mountains exist (McCoy, 1961:84).

### Description of Neotype

Oklahoma State University (OSU) No. R5284, field tag PNW (Pattie N. White), vicinity of junction of North Fork of Red River, and Elm Fork, R20W, T4N, S34; Southern Oklahoma Adolescent Alcoholics Rehabilitation Ranch (SOAARR), Quartz Mountain State Park, Kiowa County, Oklahoma.



Fig. 2. Dorsal aspect, OSU R5284, male, (Neotype), *S. u. consobrinus*, SOAARR Camp, Quartz Mountain State Park, Kiowa Co., Oklahoma. 53 mm. SVL.



Fig. 3. Ventral aspect, OSU R5284, male, (Neotype), *S. u. consobrinus*, SOAARR Camp, Quartz Mountain State Park, Kiowa Co., Oklahoma. 53 mm. SVL.

SVL 53 mm; tail length 71 mm; dorsal count 38; total ventral count 65; femoral pores, 12 (right), 13 (left); 4 scales between medial ends of femoral pore series. Prominent paired dorsolateral stripes, each about one scale wide, lateral to mid-dorsal area; dorsolateral stripes extending from just above each ear opening onto base of tail. Mid-dorsal area about  $6\frac{1}{2}$  scales wide with paired lateral dark spots posteriorly, but with such spots confluent anteriorly; black stripe  $2\frac{1}{2}$  scales wide, laterad to dorsolateral stripe; narrow light lateral stripe  $1-1\frac{1}{2}$  scalerows wide below black stripe, beginning at ear opening and extending to the hind leg; 1-2 dark scalerows between light lateral light stripe and blue of abdominal semeion, which is about three blue scalerows wide, with medial black borders two to three scalerows wide; black border of blue abdominal semeion extending posteriorly onto groin and anterior surface of hind limb. Eight scalerows ventrally between black borders on IASA at mid-body; IASA, chest and ventral thighs whitish, heavily suffused with small dark flecks. Gular semeions black, each with small blue central spot, each spot with about five scales completely blue. Nuchal pouch black with black bar extending onto proximal end of forelimb. Five auricular

scales on each side. Four postrostrals, four internasals; six supraoculars on each side with posterior two supraoculars on each side contacting frontoparietals; lateral light stripe originating below each eye, extending posteriorly over auriculars, and continuing laterally on body. Twenty lamellae on right fourth hind toe, twenty-one lamellae on left fourth hind toe. Enlarged postanal scales, lateral postanals larger than medial postanals. Paired postmentals in contact.

### Variation and Intergradation

The major diagnostic color differences between these subspecies concern the ventral abdominal and gular areas of the males. Typically, *S. u. garmani* males have blue abdominal semeions with narrow medial black borders one scalerow or less wide. These narrow black borders are usually continuous, with opposing borders never in contact, and are best seen with a low power stereoscope. Examinations of *S. u. garmani* by the naked eye, or without stereoscopes have apparently led some to erroneously state that this subspecies has no black borders on the blue abdominal semeions in males. Black borders may be inconspicuous, particularly if the specimen is a juvenile, or is faded due to improper preservation. *S. u. garmani* males usually have a wide immaculate IASA, whereas male *S. u. consobrinus* have a narrower IASA, which is often heavily flecked with black, and conspicuous continuous black borders at least two scalerows wide on the abdominal semeions. Opposing black borders occasionally are wide and may merge at one or more points in some specimens.

*S. u. garmani* males usually have faint, or no gular semeions, and rarely have the gular areas showing black or blue spots. *S. u. consobrinus* males usually have a pair of conspicuous black-bordered blue gular semeions. The black borders of the gular semeions often meet medially, such junction varying from a narrow isthmus to a more broad union.

McCoy (1961: 83) described a pair of specimens two miles west of Reed, Greer County, as representative of an intergrade population. Reed is about three miles south of Elm Fork, and about twenty miles west of Quartz Mountain State Park. The specimens had black-edged abdominal semeions, typical of *S. u. consobrinus*, "with the gular area only faintly suffused with dark color as in *S. u. garmani*." These subspecies occur at numerous localities in central Oklahoma. Non-intergrade selected specimen localities on the range map (Fig. 1) are from McCoy (1960, 1961): *S. u. consobrinus*: Harmon Co., 3 miles W Vinson; 1 mile N Hollis; Jackson Co., near Elmer; *S. u. garmani*: Beckham Co.,

Sayre; Elk City; Mayfield.

Quartz Mountain State Park surrounds the junction of Elm Fork and the North Fork of the Red River: Greer Co., – west bank, Kiowa Co., – east bank. Quartz Mountain is elevated about 500 ft. above the prairie, and is on the western border of Lake Altus, which is impounded by Altus Dam.

The following intergrade specimens are all from Quartz Mountain State Park. Six specimens (OSU R5441, R5443-7) (four males, two females) strongly resembling *S. u. garmani* are from Greer Co. near the Park Lodge, west of Lake Altus. Dorsal and ventral aspects of R5443 are on Figs. 4 and 5. Snout-vent lengths are smaller: 37, 41, 42, 43, 46, 47 mm.

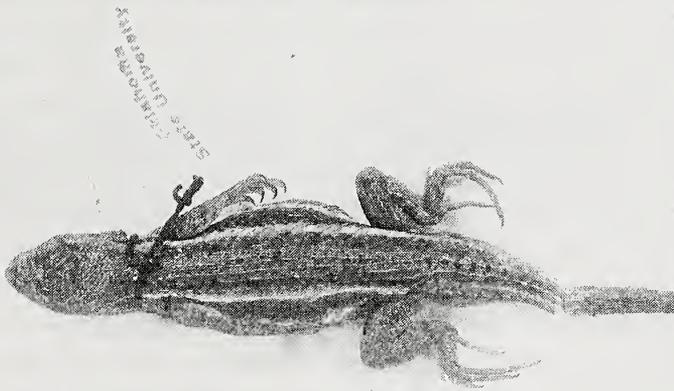


Fig. 4. Dorsal aspect, OSU R5443, male, Quartz Mountain State Park *S. u. consobrinus* X *garmani* intergrade resembling *S. u. garmani*, Greer Co., Oklahoma. 47 mm. SVL.



Fig. 5. Ventral aspect, OSU R5443, male, Quartz Mountain State Park *S. u. consobrinus* X *garmani* intergrade resembling *S. u. garmani*, Greer Co., Oklahoma. 47 mm. SVL.

Two specimens from Greer Co. (OSU 4856, OSU 5334) seem to be intergrades. The two specimens from Kiowa Co. (OSU 5284 -neotype, and OSU 5440) from Kiowa Co. are identified as *S. u. consobrinus*. Dorsal and ventral aspects of R5440 are on Figs. 6 and 7, and IASA is lighter than on the neotype (OSU 5284). R4856 is on Figs. 8 and 9. This latter group from Greer and Kiowa counties has larger snout-vent lengths of 58, 53, 60, and 55 mm. This slight SVL difference is typical of these two subspecies. These groups are described below.

In the intergrade group resembling *S. u. garmani*, the blue of the abdominal semeions is two to four scalerows wide in the males, and the black borders are one to one and one-half scalerows wide. The females (R5441, R5446) and two of the males (R5444 and R5445) have either immaculate white gular areas or with just a few darkly pigmented areas. A third male (OSU 5443) (Figs. 4 & 5) has small *black* paired lateral gular semeions, and the fourth male (OSU 5447) has small *blue* paired lateral spots in the gular semeion. The spots (semeions) are far apart in both the third and the fourth male. The male with the blue spots (OSU 5447) has two blue scales in each gular semeion, which presumably represents the intergrading influence of *S. u. consobrinus*. No males have extensive black in the gular areas. The IASA of the four males varies from 8-12 white scalerows wide at midbody. In these four males the black borders of the abdominal semeions are one to one and one-half scalerows wide. Scale counts of these six specimens from Greer Co. were dorsal count 40-44, mean 41.5; total ventral count 65-72, mean 69.67; total femoral pore count 25-29, mean 27. In the intergrade group from Greer Co. resembling *S. u. consobrinus*, one male (OSU R4856)(58 mm SVL) strongly resembles the *consobrinus* phenotype, and is from northwest of the Lodge on the western border of Lake Altus. One female (OSU R5334) (60 mm SVL) from Greer Co., west of Lake Altus, shows no subspecific color differences, but is larger than the intergrades resembling *S. u. garmani*. The group (*S. u. consobrinus*.) from Kiowa Co. includes the two males from the SOAARR Camp., the neotype (OSU R5284)(53 mm SVL), and (OSU R5440) (55 mm SVL).

The neotype shows the typical coloration of *consobrinus*, having large blue gular semeions completely surrounded by black. Six blue scales in the right gular semeion and ten blue scales in the left semeion are at least 50% blue.

The blue of the abdominal semeions is two to three scalerows wide, with black borders three scalerows wide. The IASA of the neotype is eight scalerows wide at midbody and is heavily flecked with black (Figs. 2-3).

The other male (OSU R5440) (Figs. 6 & 7) has gular semeions of paired blue scales, with one blue scale on each side surrounded by black. Black borders of the abdominal semeions are two scalerows wide, and the blue of the semeions are each two to three scalerows wide. The IASA is twelve scalerows wide and is nearly immaculate white. OSU R5440 resembles R5447 from Greer Co., but the latter has no black surrounding the blue spots in each gular semeion, and only two blue scales in each semeion are 50% or more blue. R5440 has considerable black around the small blue spots. These two (R5284 and R5440) Kiowa Co. specimens have scale counts of dorsal count (38, 45), mean 41.5; total ventral count (65, 74), mean 69.5; and total femoral pore count (25, 28), mean 26.5.

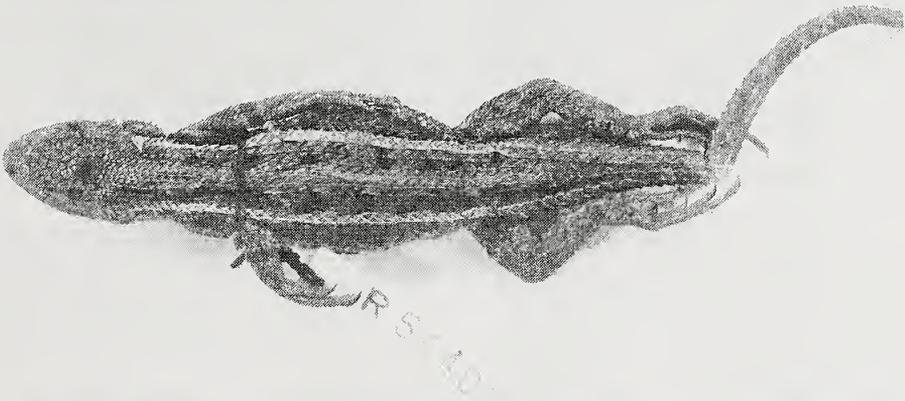


Fig. 6. Dorsal aspect, OSU R5440, male, Quartz Mountain State Park S. *u. consobrinus* Kiowa Co., Oklahoma. 55 mm. SVL.

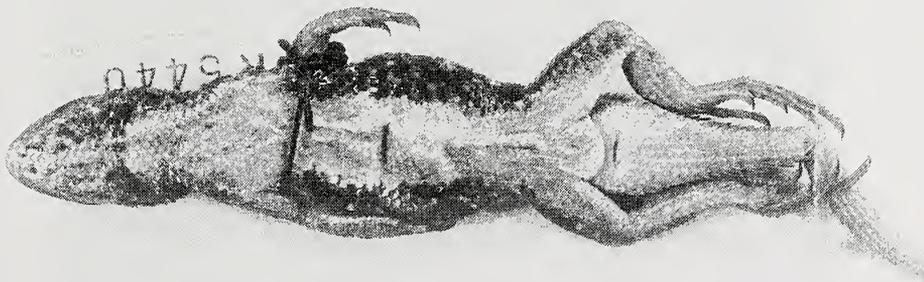


Fig. 7. Ventral aspect, OSU R5440, male, Quartz Mountain State Park S. *u. consobrinus* Kiowa Co., Oklahoma. 55 mm. SVL.

Intergradation as here interpreted occurs in a very narrow zone across Quartz Mountain State Park in Greer Co. Judgment of this is based upon coloration and SVLs and not upon standard scale counts. The north-south range formed by Quartz Mountain, Williams Peak, and King Mountain does not seem to be a geographic barrier between these two subspecies. However, more specimens from this area should certainly contribute to an understanding of the nature of the intergradation regarding color.

Proper technique is *very* important to effect preservation of the blue color, which is quite susceptible to fading if specimen is left in formalin for more than a day. Injection of a 1/10 dilution of commercial formalin is quite preferable to mere immersion. Specimens should be rinsed of formalin in less than a day, and then placed in 70% alcohol. There should be no or minimal fading of the blue color, providing that they are not exposed to strong continuous light. Identifying certain subspecies with faded blue semeions is quite frustrating, particularly if the blue semeions are diagnostic features.

It is well-known that Dr. Joseph R. Slevin, now deceased, a former curator at the California Academy of Science, would not allow specimens he collected to touch formalin. His aversion to formalin was such that when he could not get ethyl alcohol from the Academy for field trips, he relied on moonshine whiskey (pers. comm. to E. L. Bell).



Fig. 8. Dorsal aspect, OSU R4856, male, Quartz Mountain State Park *S. u. consobrinus* X *garmani*, intergrade resembling *S. u. consobrinus*, Greer Co., Oklahoma. 58 mm. SVL.

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Fig. 9. Ventral aspect, OSU R4856, male, Quartz Mountain State Park *S. u. consobrinus* X *garmani*, intergrade resembling *S. u. consobrinus*, Greer Co., Oklahoma. 58 mm. SVL.



Fig. 10. Former near-totypes of *Sceloporus undulatus* from Timber Creek, Beckham Co., Oklahoma; this was the first type locality of *S. consobrinus*, but these resemble *S. u. garmani*. (see text). Photos courtesy of R. G. Webb.

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## Book Review

**J. ALAN HOLMAN – Pleistocene Amphibians and Reptiles in Britain and Europe- 1998- Oxford- (Oxford Monographs on Geology and Geophysics No. 38) - Oxford University Press- 254 pp., 46 figs. - book size: Royal 8vo (25 cm x 16 cm)- cloth bound- ISBN 0-19-511232-6 - US\$ 65.00 [in English]**

The author has produced a badly needed sequel volume on the Pleistocene herpetofauna of Britain and Europe, which follows the format of his previous volume on "Pleistocene Amphibians and Reptiles in North America," published in the same series as monograph number 32, in 1995, and reviewed in *Herpetozoa* in 1996 and *American Scientist* during the same year. This book dealing with herpetofauna of Great Britain and Europe is the first major work relating to European herpetofauna.

The major focus of the book is on the herpetofaunal record during the interval of postglacial megafaunal extinctions. During this period an almost worldwide extinction of megafauna occurred, resulting in the extinction of more than 200 mammalian genera, (large land mammals), and several species of birds having taken place by the end of the epoch of 10,000 years ago. Palaeobatrachidae was the only herpetofaunal genera that became extinct in Europe during this period, with an additional single species of anuran, and three species of Lacertidae becoming extinct during this same period. The author felt that the giant Lacertas (*Lacerta goliath*, *L. maxima* and *L. siculimeltensis*) which were restricted on several oceanic islands near Europe possibly became extinct from human introductions of non endemic plant and animal species.

The 'Bistiary' consists of some 109 pages, and represents the major portion of the text, containing much valuable data on families, genera, and species found within Britain and Europe. The author provides needed illustrations for identification of genera, and species. While keys are not provided for identification of fossil genera or species, it would be difficult in presenting reliable keys, as material varies from vertebrae, Ilia, Ilium, carapacial bones, dentary bones, which would make reliable keys extremely difficult.

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*News and Notes*

The final chapter compares the Pleistocene herpetofauna of Britain, Europe and North America. The author recognizes Britain, and Europe as having a depauperate Pleistocene fauna, which has carried over into modern times. This has been attributed to the extremely harsh inter-glacial periods that occurred throughout Europe, whereas in North America warm air masses from the Gulf Coast contributed to a milder climate in areas as near as 150 km from the ice front (Holman and Richards, 1993).

In summary, this is a highly useful book, with the most current literature having been cited, along with forthcoming literature. The introduction implies that the book is intended for college students, and it certainly will be a vital tool in the library, although I somehow feel it is actually geared more for the specialist in paleoherpetology.

The author should be highly commended, and has certainly earned the gratitude of his colleagues for providing this sequel volume.

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Received 30 August 1999

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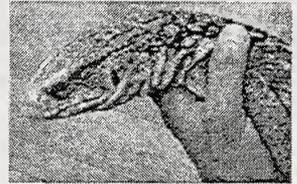
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30 JUNE 2000

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The third Wednesday of every other month, 7:30 p.m. at the Baltimore Zoo's Reptile House (except August and September due to The Mid-Atlantic Reptile Show). The Department of Herpetology meets informally on all other Wednesday evenings at the NHSM at 8:00 p.m.

## The Occurrence of a Malformed Leopard Frog (*Rana sphenocephala*) from Florida

For more than 250 years, reports of amphibian malformations have been widespread (Northern Prairie Wildlife Research Center, 1997). Potential causes of malformations or atypical development are chemicals (Maden, 1993; Harmon *et al.*, 1995; Ouellet *et al.*, 1997), and trematodes (Sessions and Ruth, 1990). There have been four previous reports of amphibian malformations from Florida, a cricket frog (*Acris gryllus*) in 1969 from Levy Co. (Christman, 1970), a leopard frog (*Rana sphenocephala*) in 1954 from Jackson Co., an unidentified treefrog (*Hyla sp.*) in 1991-92 from Highlands Co., and a Cuban treefrog (*Osteopilus septentrionalis*) in 1997 from Broward Co. (Northern Prairie Wildlife Research Center, 1997). Here we report the fifth overall occurrence of an amphibian malformation from Florida, including the second of the Florida leopard frog (*Rana sphenocephala*) from approximately 750 km south of the previous reported specimen.

On 3 December 1970, a malformed Florida leopard frog (*Rana sphenocephala*) was collected by M. L. May at the Collier-Seminole State Park, Collier Co., FL, and was deposited in the Florida Museum of Natural History, University of Florida (UF 112078). This specimen has a total of nine limbs, with six radiating out of the left shoulder girdle. The cause for this malformed

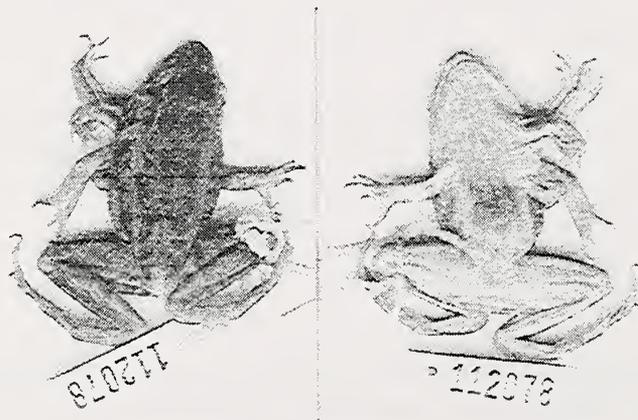


Fig. 1. Malformed leopard frog (*Rana sphenocephala*) from Collier Co., Florida.

frog is presently unknown, however, it is the first known case of an amphibian malformation in southwestern peninsular Florida.

We thank M. A. Nickerson, R. Owen and F. W. King for review of this manuscript.

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## Some Aspects of the Population Ecology of the Giant Toad *Bufo paracnemis* (Anura, Bufonidae) in Northeastern Argentina

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### Introduction

The giant toad *Bufo paracnemis* occurs in the arid lands of Bolivia, Paraguay, Brazil and Argentina (Ceí, 1980), and probably evolved in the Chaco habitat through speciation from an ancestral marinus form from the Guiana shield (Ceí, 1968; 1972). Modern Argentine *Bufo paracnemis* is restricted to Chacoan northeastern Argentina, reaching as far south as 32° S in Entre Ríos. This species had an extended southern distribution in the Upper Pliocene (Báez & Yané, 1979).

*Bufo paracnemis* and *B. marinus* are the world's largest toads. Adult *B. marinus* average 100-150 mm SVL with a maximum known size of 230 mm (Zug & Zug, 1979). Adult *B. paracnemis* are usually larger on average (150-190 mm), with a maximum record of 210 mm SVL (Ceí, 1980); however, it is important to remember that the taxonomy of both species in Argentina has been thoroughly confused in the past (Freiberg, 1941).

Though *Bufo paracnemis* is commonly found in the wild and frequently associated with human dwellings, little is known about its ecology (Yanosky, 1989). Ceí (1980) reported that *B. paracnemis* is not found in the dry season.

In a wildlife refuge in northeastern Argentina, *B. paracnemis* occurs with three smaller species of *Bufo*: *B. fernandezae*, *B. pygmeus*, and *B. granulosus major*, and a large number of other amphibians (Yanosky *et al.*, 1993). Gallardo (1979) suggested a predatory position for this species in Chacoan foodwebs because of its size and its potential predation on other amphibians.

Local tanneries have discovered that tanned *Bufo paracnemis* skins may be profitable in the international skin trade (Yanosky, 1989). In the classroom, *Bufo paracnemis* is a model specimen for physiological studies in Argentina. The skin trade and classroom use may represent a local threat for natural populations if these practices are widespread.

Our goal was to obtain data on movements, activity patterns, breeding cycle, and growth from a natural population of this giant toad.

### Material and Methods

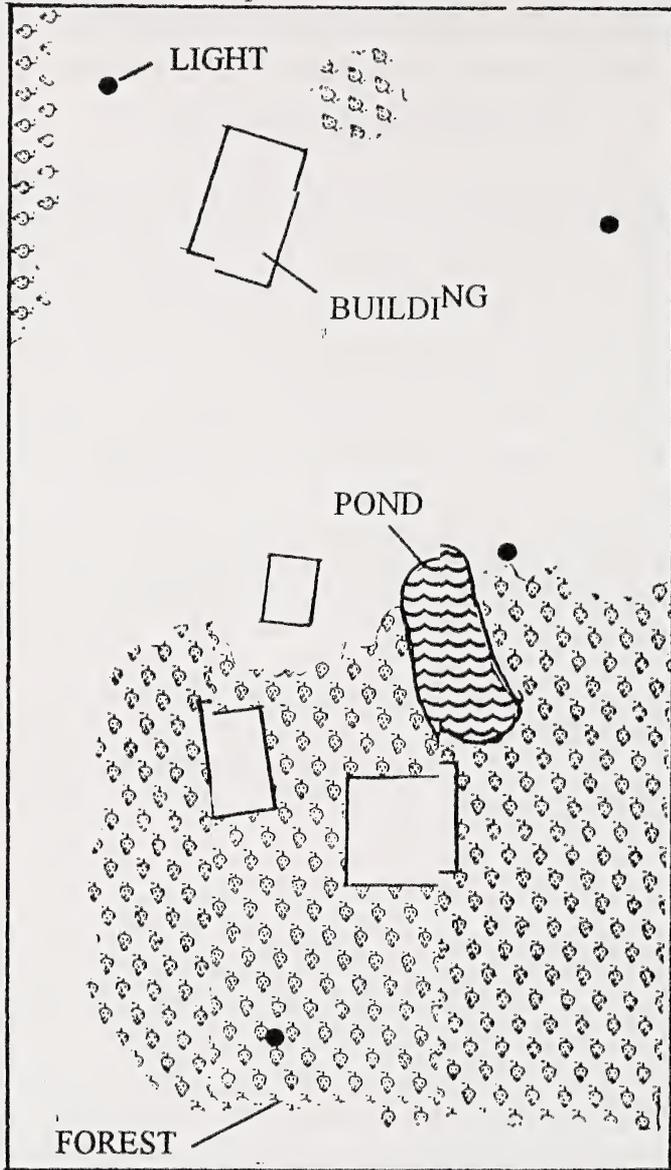
*Bufo paracnemis* commonly occurs in the province of Formosa, north-eastern Argentina (Yanosky *et al.* 1993). Adult males are distinguished from females by the presence of hard, black nuptial pads on the fingers of males and by a conspicuous release call when grasped on the dorsum. The toad population utilized for this study is located on the grounds of the El Bagual Biological Station, within El Bagual Reserve (26°10'53"S, 58°56'39"W), approximately 110 km southwest of the city of Formosa (Fig. 1). El Bagual Reserve is characterized by marshes and shrubby savannas interspersed with various woody stages.

Annual rainfall varies between 100 and 200 cm, with minimum records in August and maximum in March-April. Though rains occur all year, a seasonal dry period usually occurs from May to October. The average annual ambient humidity is 74% and the average temperature is 22°C (range -2°C - 45°C).

From the beginning of the study, ponds were periodically checked for tadpoles and metamorphosed toadlets. Mating calls and rainy days were also recorded. Marked adult toads were measured a minimum of 18 times during the study to provide growth rates.

Each toad over 40 mm SVL was individually marked with a microchip, injected subcutaneously in the abdomen with a sterilized syringe and #12 gauge needle. Passive integrated transponders (PITs) are inert 0.7 g elements measuring 2 mm x 12 mm, encased in transparent glass material; activated by low frequency radio signals (e.g. reader); that transmit an alphanumeric code to the reading system. PITs provided us with an effective method for marking caiman hatchlings; further comments on this marking system may be found in Camper and Dixon (1988), and Dixon and Yanosky (1993).

A total area of 0.1 ha, including the buildings, was surveyed nightly for active toads from 10 November 1993 to October 1994. Toads were detected with the aid of flashlights, were hand caught, and brought to the laboratory. Snout-vent length (SVL), body weight, and sex were recorded. Nightly surveys were conducted at least 20 times per month, usually two hours following darkness (ca. 2000-2200 hs). As each toad was captured, air temperature and location were recorded.



### EL BAGUAL RESEARCH STATION

*Fig. 1. Study area location within the El Bagual Ranch. The 0.1 ha area (200 x 500 m) surveyed for toads includes buildings (squares), an artificial pond (wavy lines), lights (dots) and forest areas (tree shading). Remaining areas are mowed natural grasses.*

The El Bagual research station grounds are actively used by *B. paracnemis* because of four outdoor pole lights and other scattered external building lights. Although toads tended to concentrate around lights, they did not totally confine their activities to brightly lighted areas. The grounds included natural grasses and small forested areas, as well as small ornamental plants, potted plants, small ponds surrounded by scattered trees, and board walkways (fig. 1). The grass immediately surrounding the buildings was frequently mowed, leaving an edge effect with unmowed natural grasslands.

Activity was recorded during the entire wet season (November through March) as the inverse of the activity index ( $1/AI$ ) of individual toads by counting the mean number of days between consecutive observations (Fox, 1978) rather than the number of days on which a toad was observed. This was done to avoid underestimating the activity of toads that were observed frequently but only for a short period (e.g. few weeks). Commonness was defined as the frequency of occurrence for each toad and was calculated as  $C = 1/AI \times 100 / AI_{MAX}$ ,  $1/AI$  being the inverse activity index and  $AI_{MAX}$ , the maximum value of inverse activity index recorded for the toad population. Analysis of activity was restricted to those toads recaptured at least four times during the study period.

From 5 January to 14 February, 17 evening surveys were conducted hourly (1800 to 0300 hours) to estimate evening activity of toads. An occasional 0400 to 0600 hrs survey was conducted to evaluate all-night toad activity. Each evening the survey required 30-45 minutes. After each survey, the position of each toad was plotted on a map similar to Fig. 1. Home-range areas were estimated by minimum convex polygon method, based on all the positions observed. The polygon was scale measured and extrapolated to actual meters in the study area.

In the early months of 1994, night surveys were repeated following the dry season, and 1993-94 residents were classified either as present or absent. Survival estimates were based on the repeated sampling of marked animals (Turner, 1977).

Population size was estimated by three methods: 1) Schnabel or "estimated mean," 2) Schumacher-Eschmeyer or "regression;" and 3) Seber or "non-estimated mean" with the calculation of confidence intervals for estimates (Krebs, 1989; Telleria, 1986). All estimates of population size from mark-recapture studies are known to have biological as well as sampling errors, which often cause incorrect population estimates. However, our sampling

method is similar to the studies of the cricket frog (Pyburn, 1958) and the marine toad (Zug & Zug, 1979), which revealed comparable population estimates. The use of these three methods provided somewhat independent means for comparisons of the estimates.

For all three methods, an important assumption is that the population is closed. In reality all natural populations are open. We did not violate this assumption because we analyzed data in short periods of time. Mortality is assumed to be the same in marked and unmarked parts of the population. Recruitment is assumed to occur; however, to avoid the bias of recruitment, sampling must occur over short time intervals. There was no indication of juvenile recruitment in the present population even though nearby breeding courses were heard and amplexing individuals were observed during the study. Toadlets outside of the study area were marked and released but were never recaptured in the study area. Finally, systematic and periodic sampling of the same area provide adequate estimates of population size when assuming uniform mixing of marked and unmarked animals and that all toads are equally catchable.

Standard univariate statistical tests were performed and  $\alpha$  was set at 0.05.

### Results

Thirty-one *Bufo paracnemis* were marked in the study area. Fourteen of these (45%) were recaptured less than four times, thus they were not included in the analysis of activity. These 14 *Bufo paracnemis* consisted of seven males and seven females, five adults and nine juveniles, with an average SVL of 122.21; SD = 29.34 mm (range = 85-175 mm) and a body weight of 204.61 SD = 137.16 g (r = 57-505 g). Seventeen *B. paracnemis* were recaptured more than four times from 10 November 1993 through March 1994. We did not sacrifice any of the females for an examination of their oviducts to determine sexual maturity. We assumed an artificial limit of 100 mm SVL for maturity of females (similar sizes for males with horny nuptial toe pads), similar to *Bufo marinus* (Zug & Zug, 1973). Therefore our sample is made up of 12 males and five females. Even though the male toads were twice as numerous as the females, there was no statistically significant size difference ( $\chi^2 = 3.87$ ; dF = 1;  $P > 0.2$ ).

### Movements

In 63.1% of the toad captures, there was no second capture. These toads may have been moving through the area, stopped to feed under the lights, and then moved out of the study site.

### Hourly Activity of Marked Toads

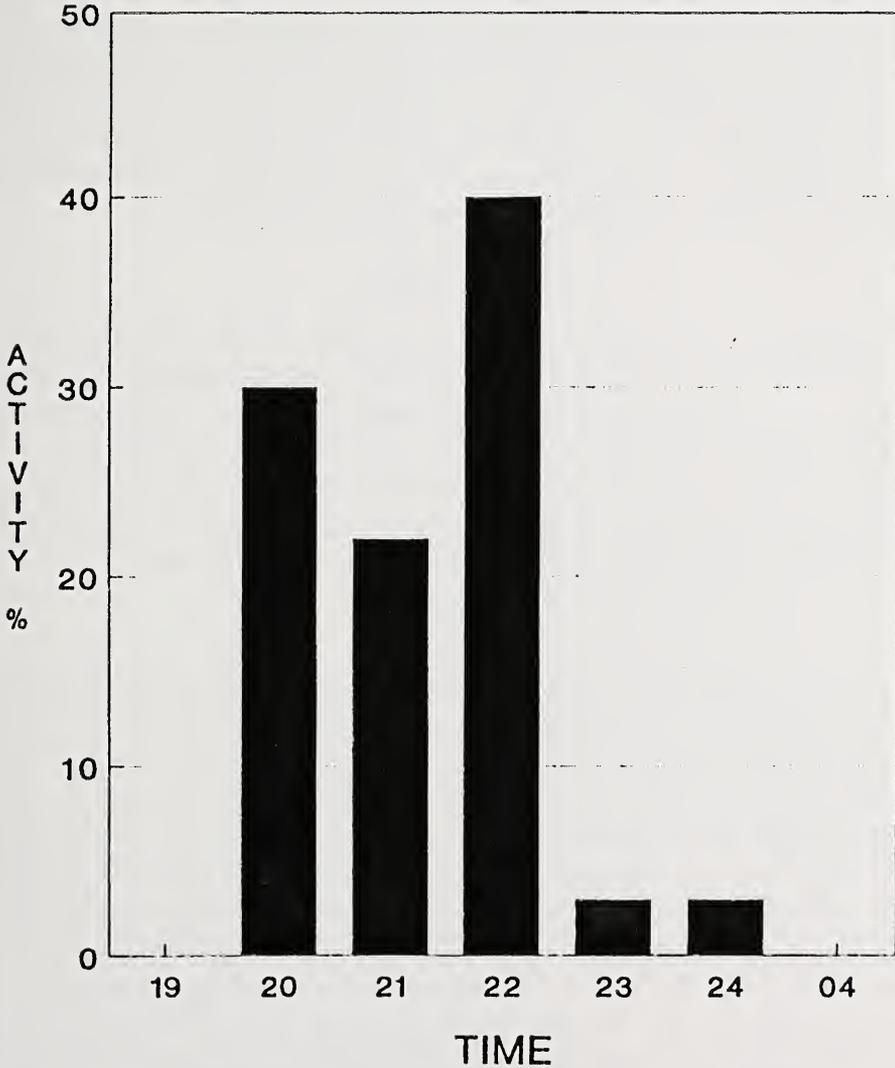


Fig 2. Hourly activity of marked toads summarized at seven day intervals during the study period.

Seventeen toads were recaptured 452 times. Of these, 105 recaptures provided enough distance between individual movements per hour to provide an average movement of 5.79 m/h; SD = 5.84 m/h (range 0 - 25.23). On six (15.4%) recaptures toads had not moved from the original place of capture (0 m/h). This suggests that 84.6% of the recaptured toads changed their feeding sites during single evenings. While hourly records were collected there was an opportunity to obtain information on evening activity (Fig. 2). Activity begins after dusk at approximately 2000 hrs and usually lasts until 2400 hrs. A few toads were occasionally active past midnight, but no toads were found active from 0400 to 0600 hrs. This suggests that following twilight, toads became active and feeding was accomplished during the first hours of activity. Of all toads present at our site, 30 % were captured at 2000 hours, 21 % at 2100 hrs, 40 % at 2200 hrs, and 9 % during the remaining hours. However, no significant differences were detected among toads captured at 2000, 2100, and 2200 hr (Friedmann = 2.32; dF = 2; P = 0.313).

### Commonness

Greatest frequency of occurrence was shared by two adult males (table 1, no. 19 and no. 9), that were captured 46 and 55 times, respectively, with an average activity index of nearly 0.5. Both males were present throughout the study period. An adult female (no. 22), adult male (no. 10), and a juvenile female (no. 13) followed in percent of occurrence >50%. Female no. 22 was first captured almost a month into the study, while male no. 10 and female no. 13 left the area by January-February and were never recaptured.

### Home Ranges

Home ranges were calculated based on daily locations (feeding sites) for 15 toads (Table 2). Home ranges were obtained with a minimum of 7 points and a maximum of 46 points on maps for each individual toad. A home range of 749.33 m<sup>2</sup>, SD = 570.795 was found to be the average for the 15 toads sampled. Smallest home range was 92.51 m<sup>2</sup> (adult male) and the largest home range was 2612.26 m<sup>2</sup> (female). The home range data was based on the daily locations of three juveniles, three females and nine males. Home ranges were larger for larger animals (Table 2) ( $r = 0.38$ ;  $r^2 = 0.144$ ;  $P = 0.162$ ). A positive relationship ( $r = 0.577$ ;  $r^2 = 0.33$ ;  $P = 0.049$ ) was found between distance moved and home ranges. This suggests that larger toads move more than smaller toads, thus larger toads have access to more surface area, which gives rise to larger feeding home ranges. Home ranges among adult females, males and juveniles were not significantly different (Friedmann = 4.29; dF = 2; P = 0.117).

Table 1. Commonness as a measure of activity (Inverse of the Activity Index, AI) with corresponding recaptures, standard deviations, ranges, and commonness of toads recaptured more than 4 times during the study.

Toad	recaptures	I/AI	SD	range	Commonness
19	46	0.45	0.81	0-04	100.00
09	55	0.49	1.12	0-06	91.93
22	37	0.54	0.87	0-03	83.42
10	40	0.77	1.25	0-04	58.50
13	26	0.80	1.60	0-06	56.31
06	7	0.86	0.69	0-02	52.56
08	32	0.93	2.06	0-09	48.44
30	14	1.07	1.82	0-06	42.10
12	12	1.08	1.67	0-06	41.71
04	18	1.16	2.33	0-10	38.83
07	28	1.25	1.46	0-04	36.04
05	34	1.32	2.32	0-10	34.13
16	24	2.04	3.35	0-14	22.08
18	21	2.52	2.50	0-09	17.88
27	16	2.75	5.19	0-21	16.38
31	6	4.80	7.53	0-18	09.38
01	5	6.40	6.02	0-15	07.04

### Size Relationships

*Bufo paracnemis* adults reach 1 kg. Weight/length data for *B. paracnemis* of 30-70 mm SVL is lacking (Fig. 3a), but may be postulated from the data.

Table 2. Home ranges of 15 *Bufo loaracnemis*, including SVL, sex, age, average movements, and number of recaptures.

Toad #	sex	age	SVL (mm)	recapture rate	home range (m <sup>2</sup> )	average movement (m)
27	M	Ad	128	16	92.51	6.00
06	—	Jv	82	07	325.68	—
30	F	Ad	185	14	388.12	5.64
12	—	Jv	115	12	433.32	—
16	M	Ad	175	24	486.82	7.31
19	M	Ad	160	46	496.52	10.07
10	M	Ad	184	40	604.07	6.64
13	—	Jv	112	26	733.58	11.06
09	M	Ad	181	55	749.69	9.67
08	M	Ad	156	32	754.54	6.65
04	M	Ad	129	20	780.25	—
05	M	Ad	136	35	878.78	4.67
18	F	Ad	197	21	931.77	5.60
07	M	Ad	187	28	969.09	5.23
22	F	Ad	194	37	2,612.26	1.79

Weight-length regression is shown in Fig. 3b. Few data were available to estimate size differences between sexes, but weight and length for both sexes were positively associated, ( $r^2$  male = 0.81,  $n = 48$ ;  $r^2$  female = 0.85,  $n = 16$ ) as shown in Fig. 4, suggesting heavier males for a given SVL. However, because of adult status, growth rates were very low. The regression modelling showed a low positive association between SVL and growth rate (mm/day) ( $r = 0.137$ ;  $r^2 = 0.19$ ;  $P = 0.586$ ) with constant = 0.772 ( $P = 0.05$ ) and size = -0.002 ( $P = 0.586$ ).

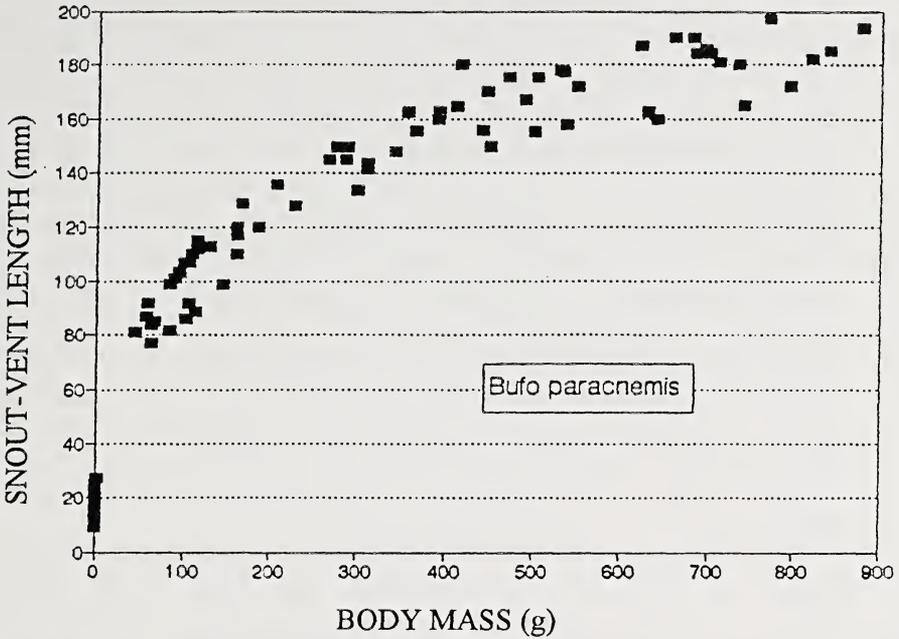


Fig. 3a. Snout-vent length (mm) and body mass (g) relationships for all ages of *Bufo paracnemis*.

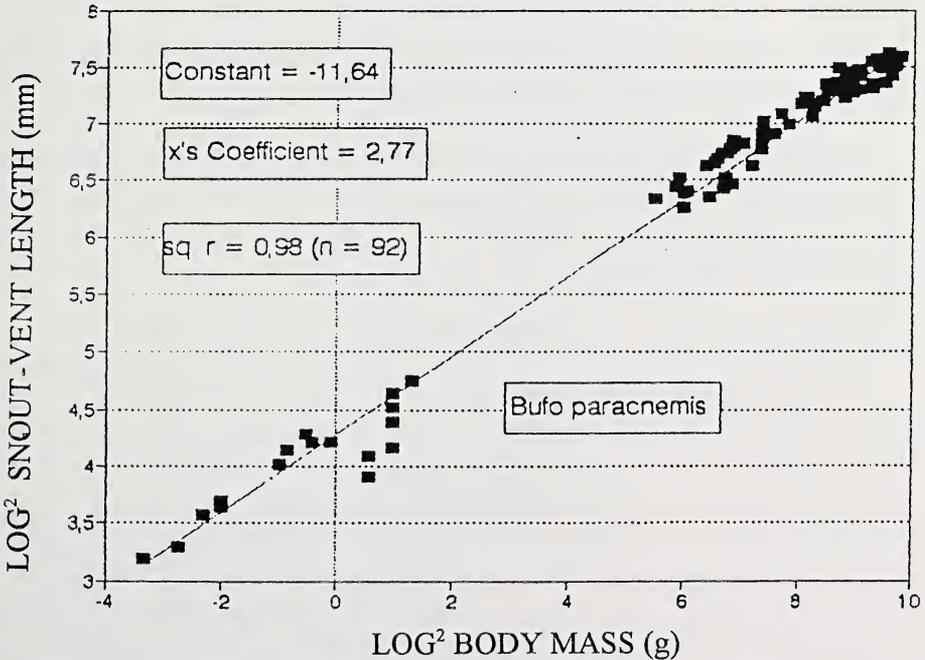


Fig. 3b. Log, transformed data and regression analysis for data on SVL-mass relationships.

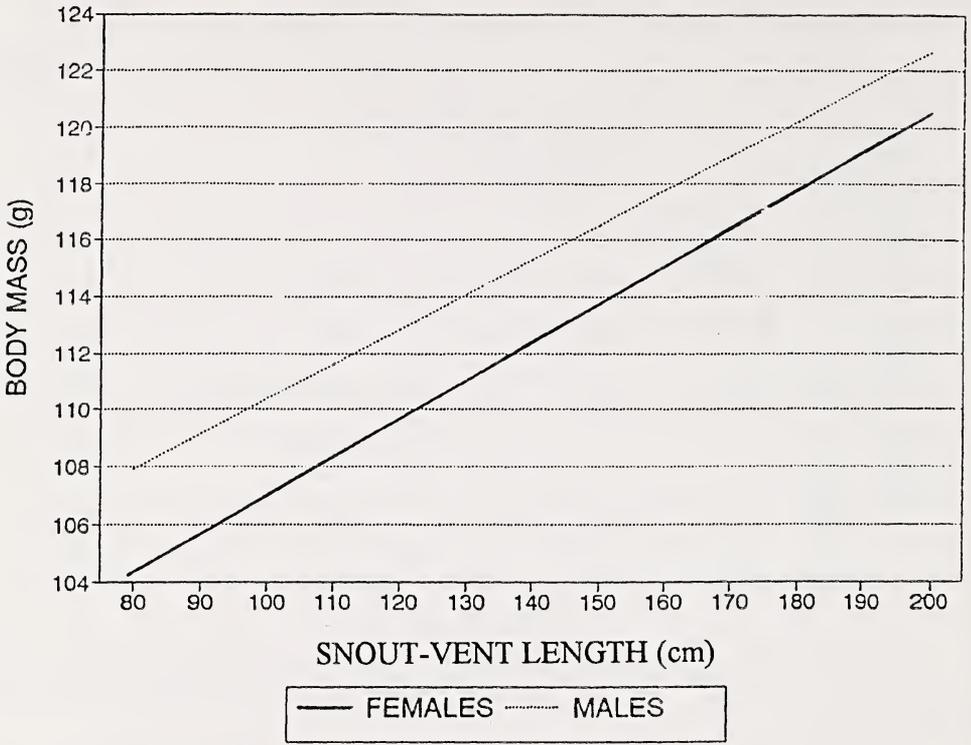


Fig. 4. Theoretical regression lines for body mass vs snout-vent length relationships in juvenile and adult *Bufo paracnemis* of both sexes.

Weight loss during the dry season (aestivation period) was estimated from data taken from three resident toads that remained in the area. When first found following aestivation, these animals had lost  $16.68 \pm 6.93$  % of body weight ( $r = 10.7 - 24.28$ ).

### Reproduction

Breeding choruses of *B. paracnemis* are loud enough to be heard at great distances. A chorus was heard 500 m north of the study area on 13 and 14 November 1993. The male toads chorused throughout the day, at dusk and first hours of night. Choruses were heard again on 5 February 1994 in a stream area 100 m south of the study area. Coincidentally with choruses on 13 November, night searches revealed no adults, and only a juvenile remained at the study site. Again, on 5 February, adult toads were absent from the study area, suggesting that the adults moved to the breeding site. Two to three days following the breeding chorus adult toads reappeared in the study area (Fig.

5). On 22 and 23 October 1994, choruses were heard 100 m east of the study area during daylight, dusk and night. This event coincided with a 160 mm rainfall, the first heavy and abundant rain that flooded most of the study for post winter 1994. Males call from the ground and among grass clumps no higher than 50 cm in the vicinity of water bodies. Choruses were always heard following heavy rains. The first rain of 103.5 mm occurred on 12 November with scattered showers on the two following days (3 mm). Choruses heard on 5 February coincided with 66 mm of rainfall over a three day period.

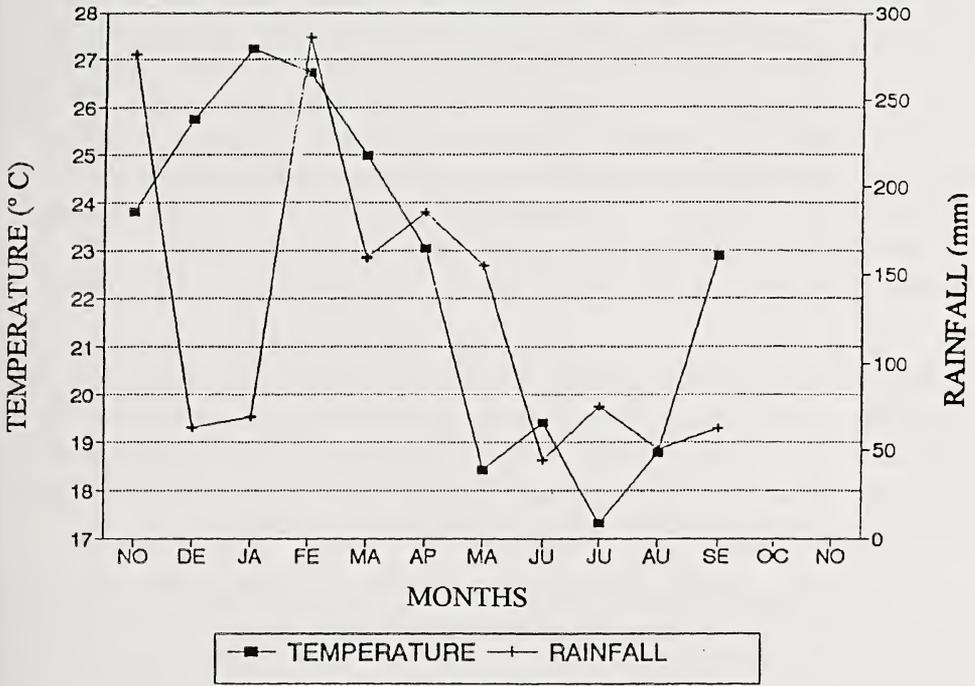


Fig. 5. Monthly averages of rainfall and temperature for the sampling period from the study site.

### Metamorphosis

On 15 and 28 December 1993, toadlets were found dispersing from a pond in the study area. The two week gap represents two breeding periods between two periods of rainfall. Toadlets from 15 December were significantly ( $t = 7.28$ ;  $dF = 8$ ;  $P < 0.05$ ) larger ( $18.06 \pm 1.24$  mm SVL;  $n = 5$ ; range 16.1 - 19.4), than those of 28 December ( $11.26 \pm 1.66$  mm SVL;  $n = 5$ ; range = 9.2 - 12.9). The reason for the differences in metamorphosing size is unknown.

The latter group agrees with metamorphic size of 10-12 mm given by Cei (1980). Although night surveys were not done prior to 10 November 1993, no heavy rains occurred and the only chance this species had to mate was probably the heavy rain of 12 November. Assuming oviposition occurred on 14 November, this yields a larval period of 34 days, agreeing closely with a larval period of 32 days for *Bufo marinus* (Zug and Zug, 1979).

### Activity

Seventeen toads were used for estimating activity levels. Summary Results are summarized in Table 1. Seven *B. paracnemis* had an activity index < 1, meaning that they were active almost every day of the sampling period. This group of seven toads was composed of three adult males of 160, 165, and 184 mm SVL, three juveniles and one adult female of 170 mm SVL. One adult male was recaptured a total of 55 times. Six toads were recaptured >50% of the maximum of 55 times. Lower variability in inverse activity index based on deviations from the mean were obtained for three toads with < 100%, four toads with < 150%, and highest variability was 228% for an adult male.

Toad presence was relatively constant over the entire wet season or until mid February (Fig. 5), when both rainfall and ambient temperature abruptly decreased. During April and May, the study site contained only 3 active toads (males nos. 9 and 19 and female no. 22). In August and September, temperature increased (Fig. 6) but rainfall remained low and no toads were active. Toads were again active in October after a four month dry season.

Three previous residents were recaptured in October, (two from May), and one after a nine month absence. During October toads were seen hidden in ground holes four times over several days. The toads did not move and were especially inactive during nights of high insect biomass around the outdoor lights of the study area.

Relationships between number of toads, amount of rainfall and ambient temperature (Fig. 5) show no association ( $r^2 = 0.013$ ,  $n = 116$ ,  $P = 0.23$  and  $r^2 = 0.234$ ,  $n = 115$ ,  $P = 0.23$ ). General information from the data suggests that toad activity doesn't occur below 19°C ambient temperature and that toads are active on hot nights on which temperatures may reach 32°C. The upper limits of activity have not been recorded. A 32° temperature at 2100 or 2200 hrs is usually associated with a daytime maximum temperature of over 40°C, and toads are active. Toad activity seems to be related to soil and ambient humidity conditions. Increases in ambient temperature during the dry sea-

son did not increase toad activity. During rainy nights, toad activity was reduced, probably due to poor insect activity.

### Population Estimates

Nine *B. paracnemis* were captured on the first night of the study. The number of individually marked toads reached 29 on the 30th night. Following the next 80 night surveys, the sample size was increased by two toads, bringing the total to 31 (Fig. 6). This figure shows that in the first 30 days almost the entire toad population within the study area was marked. The maximum number of marked and/or unmarked toads captured on any night was 12.

Three methods were used for estimating densities of *Bufo paracnemis*. Both Schnabell's and Bailey's method independently yielded an average density of 27 toads with a 95% confidence interval of 24-30 specimens (SD = 1.28).

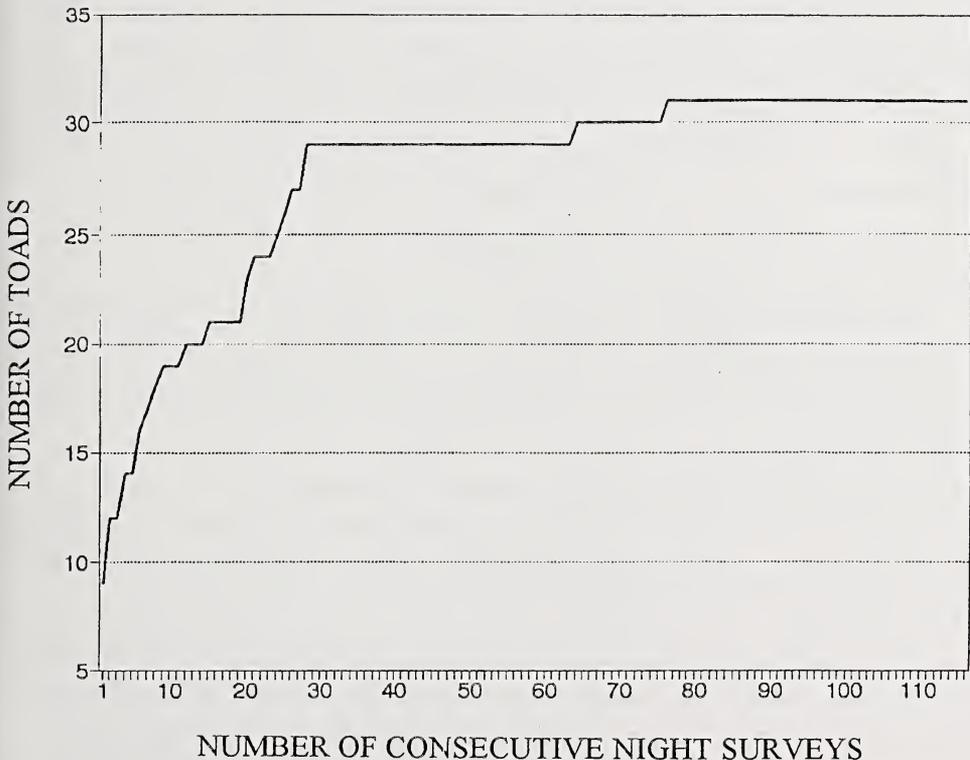


Fig. 6. Cumulative number of toads sighted for the consecutive night surveys performed at El Bagual study area.

The regression method yielded an average density of 28 toads with a 95% confidence interval of 27-30. Estimated density for *Bufo paracnemis* in the 0.1 ha study area statistically occurred between 24 and 30 individuals. This suggests 2400 to 3000 ind/ha. The weight data for 64 individuals show an average *B. paracnemis* weighs  $357.48 \pm 234.5$  g, suggesting a total toad biomass between 295 and 704 kg/ha.

At the end of February only 12 toads were active in the study area and following the dry season only 3 of the 12 (25%) remained. Because of the disparity in sample sizes, an averaging of the survival rates would be meaningless. Annual survivorship of the adult toads is postulated to be 25%. Whether there is 75% mortality of adult toads is unknown. Some may have moved from the study site and still may contribute reproductively to the population. However our sample of the metapopulation did not show signs of increase due to juvenile recruitment.

Eight toads appeared for one night, stayed one night and disappeared the next night, never to appear again. Five of them were juveniles, two adult females and one adult male. Eight other toads, six juveniles and two males, were marked and appeared daily until December 1993, and then disappeared. The appearance/disappearance of the toads suggests emigration may be the reason for their absence and ephemeral presence in the study area. However, predation likely occurs on all life stages, from larvae through adults.

### Discussion

Data have not been obtained on sexual maturity but if *Bufo marinus* can be used as a species of similar size and weight, female *B. marinus* are expected to reach maturity at 90-100 mm and males after 85 mm (Zug & Zug, 1979).

Using the above data, *Bufo paracnemis* in our study are heavier than *B. marinus*. Zug & Zug (1979) have reported a maximum weight of nearly 600 g. for *B. marinus*. The adult males in the present study ranged from 185-740 g X 376.9, and females from 391-840 g, X 430.8.

Zug and Zug (1979) sex ratio data suggest that adult *B. marinus* females were more abundant than males. In the *B. paracnemis* population studied, males were twice as numerous as females. In adult anurans, there may be a preponderance of one sex over another, and males often appear to outnumber females in terrestrial species. This fact is determined by environmental

conditions surrounding each population and does appear to be species-specific (Zug and Zug, 1979). During observations on reproduction, only three breeding periods were recorded, based on male vocalizations. These major reproductive efforts appear to coincide with heavy rains as mentioned earlier. These data suggest that *B. paracnemis* probably mates opportunistically and breed throughout the year when conditions are optimal. Adjacent populations may have different breeding periods depending upon heavy rains at the local level. However, because reproductive choruses were heard only three times, it suggests that *Bufo paracnemis* does not have an extended breeding period as reported for *B. marinus* (Zug & Zug, 1979).

Interviews with local settlers indicate that *Bufo paracnemis* is the most abundant anuran species. However, the close association of this giant toad with the man-made landscape has created the impression that they are extremely abundant and ubiquitous animals. Drift fences installed in different areas of El Baqual Ecological Reserve have captured most anuran species and the three other species of *Bufo* in the reserve. However, in a year of drift fence sampling, neither toadlets, juveniles nor adults of *Bufo paracnemis* have been captured. The *Bufo paracnemis* population estimates presented here represent a population within a manmade landscape, favored by the presence of increased biomass of prey items because of outdoor lights.

Activity data clearly indicate that these toads are not active for the entire night. Most toads appear and stay at a feeding site, or move among different feeding sites, for one to three hours after dusk, and then disappear for the night, and in many cases, for several successive nights. This short foraging period may be associated with outdoor lights that act as insect attractants, thus facilitating the search of prey. In the wild, the search for prey may be extended longer into the night in order to find and consume sufficient prey. Some toads remain hidden in holes in the ground for several days without moving, suggesting that they are digesting large amounts of food taken during a particular night.

Mortality and emigration may account for undetected toads, but it is also possible that immigration may equal emigration rates. We have confirmed predation upon *Bufo paracnemis* adults by *Caiman latirostris*. These toads were taken while in the water, and the same predator has been reported for *B. marinus* (Pope, 1955). Smaller *B. paracnemis* have been observed in stomach contents of *Tupinambis teguixin* (Mercolli & Yanosky, 1994), and tegu lizards have demonstrated a preference for this prey (Yanosky *et al.*, 1993). Another confirmed predator of juvenile *Bufo paracnemis* is *Waglerophis merremi*. Possi-

bly other snakes in the area, such as *Helicops leopardinus* and *Leptodeira annulata*, may consume *B. paracnemis*, and are cited as predators on *B. marinus* by Zug & Zug (1973).

The ecology of *Bufo paracnemis* makes it a particularly interesting species for study and if its population numbers are high, it may be a "keystone" species because of its size and trophic level. A declining population due to the skin trade may have a cascading effect on the food web.

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## Note on Two Specimens of *Phrynops Vanderhaegei* Bour, 1973 (Testudines: Chelidae) from Formosa (Northeastern Argentina)

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### Abstract

First record of *Phrynops vanderhaegei* for the province of Formosa, north-eastern Argentina; extending its range from the province of Misiones. The record is based on two specimens (male, female) captured in Lindo Creek at the El Bagual Ecological Reserve. Description of the specimens and habitat are given.

### Introduction

The genus *Phrynops* as presently recognized comprises ten species distributed exclusively in South America and Trinidad (Pritchard, 1979). *Phrynops vanderhaegei* is considered as a species by Bour & Pauler (1987). However, Wermuth and Mertens (1977) considers it a race of *P. tuberculata*, and McDiarmid and Foster (1987) believe it to be a subspecies of *P. gibbus*, respectively). Little knowledge is available for the majority of the members of the genus and *Phrynops vanderhaegei* is known only for eight localities (Iverson, 1992).

*Phrynops vanderhaegei* occurs in the Paraguay and Brazil basins of the Parana and Paraguay rivers (Freiberg, 1981; Pritchard & Trebbaeu, 1984). This species was not included in the turtle fauna of Argentina (Freiberg, 1977) until Iverson (1992) cited this species for Santa Fe, based on an unconfirmed identification of a specimen housed at Hamburg Museum (ZMH R-1025). Since the above specimen did not have a confirmed identification, Waller & Chébez (1987) doubted the species presence in Santa Fe, Argentina, but confirmed its presence in the province of Misiones.

The present report extends the species range into the eastern Chaco region of southeastern Formosa, Argentina. Our two specimens were captured from Lindo Creek, El Bagual Ecological Reserve, northeastern Argentina (26°10'53"S, 58°56'39"W). All drainage patterns within the reserve are influenced by the Bermejo River, a tributary of Paraguay River.

### Turtle Description

REB-21451: Male, total length from tip of snout to tip of tail (head and neck extended) 212 mm; straight carapace length 117 mm, curved 123 mm; straight carapace width 91 mm, curved 106 mm; plastron length 112 mm; plastron width 77 mm, height 31 mm; neck + head 86.6 mm; head length 30 mm, head width 22 mm (19.6% of carapace length); weight 172 g.

REB-21452: Female, total length from tip of snout to tip of tail (head and neck extended) 225 mm; straight carapace length 162 mm, curved 177 mm; straight carapace width 115 mm, curved 151 mm; plastron length 145 mm, plastron width 100 mm, height 48.3 mm; neck + head 114.1 mm, head length 36 mm, head width 28 mm (17.5% of carapace length); weight 390 g.

Based upon Iverson's (1992) key, the specimens are easily assigned to *Phrynops vanderhaegei* because the head width is less than 20% of carapace length; the jaws without dark bars, and there is a medial groove present on the carapace (Iverson, 1992). Based upon a published color description by Cei (1994), the diagnostic coloration is adequate only for our female which has the dark pigmentation on the plastron restricted from the pectorals to femorals. The whole plastron is grey and without pigment in the male.

Cei (1994) reported a carapace length of 27 cm. Our specimens are considerably smaller and may represent juveniles or subadults.

### Habitat

Our specimens were captured while walking along the bank of Lindo Creek during an extensive flood in the autumn of 1992. Lindo Creek is a small, narrow, silt laden stream flowing through closed-canopy forest which eventually empties into the Paraguay River. The current is relatively slow (maximum recorded 3.7 m<sup>3</sup>/s). During extensive rainy periods, Lindo Creek rises out of its banks and floods onto neighboring grasslands. Rocks are absent from the area and leaf-litter covers the substrate to a considerable depth. The fish fauna is composed of approximately 40 species (Azpelicueta & Yanosky, 1992).

Temperature in the region fluctuates between 44°C to -2°C, with an average annual temperature of 22-23°C. Though rain occurs year round, it is more abundant in the summer. Occasionally, a dry period is present during winter and spring.

The banks of Lindo Creek contain such grasses as *Paspalum intermedium*, *Panicum prionites*, and *Tessaria integrifolia*, while emergent vegetation consists of *Thalia multiflora*, *Cyperus giganteus*, *Typha sp.*, and *Juncus sp.* Other aquatic plants occur in deeper water (depth > 0.5 m), such as *Sagittaria montivoidensis*, *Pontederia cordata*, *Eichhornia crassipes*, *Pistia stratiotes*, *Lemna sp.*, *Hymenachne amplexicaulis* and *Echinodorus grandiflorus*.

### Behavior in Captivity

After capture, both specimens were maintained in a wet area with natural vegetation. They spent much of the time hidden beneath submerged under brush and leaf litter. This turtle is highly aquatic and rarely seen during the daytime. Both specimens were primarily active at night, frequently leaving the water and hiding among dried vegetation in the enclosure. We set a number of funnel traps in creek areas using different types of baits but never captured this species. Several hours were spent in the field during daylight hours in search of basking turtles but we failed to find a single individual. Based on its reported carnivorous diet (Ceï, 1994) and the meat baits we utilized, we suspect that this species is not common.

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## Notes and Observations on Body Size in an Unusually Large Western Diamondback Rattlesnake, *Crotalus atrox* (Baird and Girard, 1853)

Size records for the western diamondback rattlesnake (*Crotalus atrox*) have been debated by numerous biologists. However, few argue against the fact that *C. atrox* is one of the largest rattlesnakes in North America, and is only exceeded in size by the eastern diamondback rattlesnake (*Crotalus adamanteus*). Conant and Collins (1998) gave a maximum total body length (TBL) of 213 cm for the western diamondback rattlesnake. Other authors, such as Coborn (1991) and Phelps (1989) reported a maximum length of 210 cm. Campbell and Lamar (1989) suggested that *C. atrox* over 120 cm (TBL) are frequently encountered, and those over 180 cm (TBL) are extremely rare. They, as well as Ernst (1992), concur with the measurements reported by Conant and Collins (1998). However, Tennant (1985) suggested that several huge western diamondbacks from the lower Rio Grande Valley measured over 228 cm, but this was not confirmed through museum specimens. These sizes might be explained by the snakes being over stretched after death, and their lengths are exaggerated after being hung-up for photographs.

A larger *C. atrox* than that recognized by Conant and Collins (1998) was kept at the Eastern Illinois University Vivarium, Charleston, Illinois until its death in March 1989, where it died of an intestinal complication. The male was originally collected in April 1985 by F. Joe Fasig along the Cimarron River at a rattlesnake roundup in Okeene, Blaine Co., Oklahoma.

The linear measurements for the specimen did not differ before or after death as measured using the string technique (Dr. M.A. Goodrich pers.comm.), thus suggesting that the animal did not grow significantly during its captivity. This point is difficult to confirm, since this specimen was troublesome to manipulate when it was alive. However, at its death the specimen measured 220 cm TBL, 231 cm STR (snout to tip of rattle), 205 cm SVL (snout to vent length), 33 cm maximum girth, and weighed 12.3 kg. Its rattle had 41 segments and this may indicate an older individual, since specimens with 30 or more rattle segments are rare.

Whether this specimen represents size maxima for the species or is just a captive anomaly, it is one of the largest *Crotalus atrox* every recorded (Dr. M.A. Goodrich; T.L. Vandeventer; and D. Bright pers.comm.). The preserved

specimen is currently in the Scrogg's Museum collection at Eastern Illinois University, Department of Biological Sciences, Division of Herpetology.

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## Notes on Eggshell Type of the Spotted Turtle, *Clemmys guttata*: Geographic Variation or Differences in Definition?

Ewert (1979) presented three general classifications of eggshells in chelonians. These are 1) parchment, 2) brittle, and 3) hard-expansible shelled eggs (see Ewert 1979 for complete descriptions). A great amount of confusion appears in the literature regarding eggshell types.

Ernst (1970) described spotted turtle eggs in Pennsylvania as having soft leathery shells. However, the eggshells obtained in Illinois (1992-1993 and 1997) and Virginia (1994-1997) appeared different. In Illinois, all eggs were elliptical and white with slightly pliant shells that were neither a typical soft leathery shell nor a hard brittle shell. The eggs obtained in Virginia were elliptical, white and hard, similar to that of *Kinosternon*; however, they were not considered brittle. Eggshells in both populations were best categorized as a variation of the "hard-expansible" shell type. Ewert (1979) suggested that *Clemmys guttata* eggs can vary between the parchment and hard-expansible eggshell types, and within each type, there can be considerable variation (from pliable to hard). The later was not documented due to small sample sizes; however, my observations, in general, concur with those of Ewert.

Hard expansible type eggshells are not commonly mention in the literature for *C. guttata*. Ewert (1979) suggests that both parchment and hard-expansible eggshell types can occur within different populations of the same species. Also, the flexibility of the eggshells may vary between females of the same population, and eggshells may harden after ovaposition and during incubation. Hence, hard-expansible eggs behave unlike brittle shelled eggs and will flex slightly during incubation, and their harder shells, at first glance, have lead to general confusion with brittle shelled eggs. At present there have been no published accounts suggesting *C. guttata* as having brittle shelled eggs.

The primary difference in eggshell characterization with *C. guttata* is probably because Ernst described spotted turtle eggs before Ewert's (1979) introduction of the term "hard-expansible." Although these differences may be superficial, this should be furthered studied to eliminate the possibility of geographic differences in eggshell type among spotted turtle populations. Also, the variation within populations may be of interest to researchers. Often variation is limited to morphological measurements and other biological

aspects are overlooked (Laemmerzahl, 1990). In closing, if geographic variation is not found to exist, concerning eggshell type, then researchers are asked to conform to Ewert's (1979) general definition of "hard-expandible".

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I thank my advisors Dr. Edward O. Moll (Eastern Illinois University), Dr. Carl H. Ernst (George Mason University), and David Mauger (Will County Forest Preserve District) for their encouragement and allowing me to conduct this research. Dr. Carl H. Ernst and Penni Jo Wilson reviewed the manuscript and offered words of encouragement. Jennifer Ross and Ken Mills provided assistance in the field.

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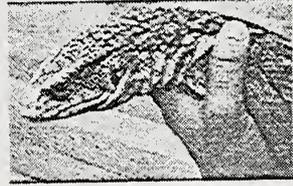
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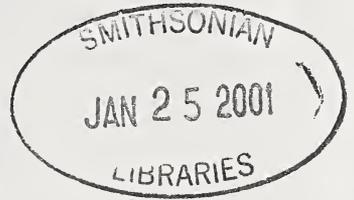
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## The Status of the Subspecies of *Calliophis Maculiceps*

Merel J. Cox

### Abstract

Current literature recognizes several subspecies of *Calliophis maculiceps*. Examination of 49 specimens reveals that each of the subspecies is inadequately characterized and does not have a distinct geographical range. It is concluded that none of the subspecies are valid. Three subspecies and two species have been synonymized with *Calliophis maculiceps*.

### Introduction

The genus *Calliophis* Gray, 1834 comprises a group of small fossorial, elapid Asian snakes often referred to as Coral Snakes. Its species range from the Western Ghats in India, east throughout the remainder of South Asia into Southeast Asia as far as Sumatra and then north through southern China and Taiwan into the Ryukyu Islands of southern Japan. Because of their secretive nature they are not frequently encountered and, therefore, little is known of them.

McDowell (1987) recognized the Maticorinae, containing *Maticora* plus *Calliophis maculiceps* and *Calliophis nigrescens*. The diagnostic feature of *Maticora sensu stricto* is presence of an extended venom gland. With the inclusion of the two species of *Calliophis* the subfamily appears to represent only an intermediate grade between McDowell's Calliophiinae and "euproteroglyphs". It shares with euproteroglyphs lack of a coronoid process and insertion of some fibres of the levator anguli oris muscle on the venom gland. With the calliophiinae it shares a Harder's gland which "extends back over the lateral surface of the levator anguli oris" in contrast to the euproteroglyphs in which the gland is confined to the orbit. This leaves *Maticora sensu lato* and the Maticorinae with no special distinguishing feature. It may be that they are not natural groups and the lack of defining characters is not problematic. However, McDowell's paper lacks the basis of an explicit phylogenetic analysis and has not been followed by most later workers (Cox, 1991; Manthey & Grossman, 1997; Zhao & Adler, 1993; Cox et al., 1998). While recognizing the need for further studies on this genus, I prefer to retain *maculiceps* in the genus *Calliophis* for the purposes of this paper.

*Key words:* *Calliophis maculiceps*, subspecies, Southeast Asia, variety.

*Calliophis maculiceps* Günther (1858) was described as an Elaps based upon two syntypes received from the East Indies Zoological Society, type locality = East Indies. Boulenger (1896) designated the female (V204, C24) as the lectotype. Although not labeled as the type, BMNH 58.4.20.6 clearly fits Günther's description of the adult specimen, which subsequently was designated as the lectotype by Boulenger, type locality = East Indies.

The lectotype is a female with (Dowling, 1951) 205 ventrals, a divided anal scale, and 21 pairs of subcaudals. There are seven supralabials with the third and fourth contacting the eye; one preocular; and two postocular scales, both of them contacting the anterior temporal. One anterior temporal is in contact with two posterior temporals. Of the seven infralabial scales, the first five contact the anterior chin shields. Opposite ventral number five, dorsal scale rows two and three fuse to give 13 rows of scales to the vent. There are six rows of dorsal scales on the tail to subcaudal number 11 and four rows to the end of the tail.

The type specimen has two rows of black spots on the dorsum that diminish in size posteriorly. No trace of a vertebral stripe is present on the trunk or tail. There are two complete black bands around the tail, the broad anterior band crosses the vent and a narrower band is about half way down the tail; the tail tip is black. There are seven large black spots and some smaller spots irregularly distributed on the subcaudal scales.

### Results

A total of 49 specimens, mostly from Thailand but also specimens from Myanmar, Laos, Cambodia, and Vietnam, were examined. A summary of the findings follows in Table 1.

### Specimens Examined

#### **British Museum of Natural History**

Thailand: 1914.1.27.3, Lopburi; 1914.1.127.2, Kanburi; 1968.827, Hup Bon, Chon Buri; 1969.828, Hup Bon, Chon Buri; 1968. 829, Hup Bon, Chon Buri; 1938.8.7.45, Kho-si-chang, Chon Buri; 1968.825, S. W. Siam; 1968.821, Nong Khor, Chon Buri; 1968.823, Lang Suan, Chumpon; 1987.1153, S. Thailand; 1987.1152, Sai Yok camp, Kanchanaburi; 1974.5195, Hup Bon, Chon Buri; 58.4.20.6, type; 87.2.1.23, Nong Kai Ploi; 68.826, SW Siam; 74.5196, Khao Ronpilun, Nakhon Si Thammarat; 38.8.7.57, Mewang Forest, N. Siam; 1976.2282, Phuket; 68.820, Siam; 1988.821, Nong Khor, Chon Buri; 1968.822,

Sriracha, Chon Buri; 1968.823, Lang Suan; 1968.824, Prae; 1987.1152, Sai Yok Camp; 1953.1153, S. Thailand; 1987.1154, Nakhon Nayok.

Burma: 68.4.3.33, Rangoon.

Cochinchina: 1920.1.20.269.

Vietnam: 38.8.7.58, Saigon

**Field Museum of Natural History**

Thailand: 178427; 178446, Pattani; 178428, Chiang Mai; 178379, Chon Buri; 180060, Nakhon Rachasima; 178381; 180057; 180058; 180059.

**The Thai National Reference Collection**

Thailand: 7490; 7937; 3338; 1140; 1138; 1144; 1143; 1137; 1145; a specimen not numbered.

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Thailand: One unnumbered specimen

**Museum of Comparative Zoology**

Vietnam: 5979, Cochin; 178811, Cochin

Pigmentation varied considerably. A dark stripe extended partially along or the length of the vertebral ridge on four specimens or as a complete

*Table 1. Scallation Characteristic of Calliophis maculiceps*

Supralabials	Infralabials	Oculars	Temporals
2:2:3 (25)	5:3 (24)	1:2 (28)	1+2 (27)
2:2:2 (1)	5:2 (1)	1:1 (2)	1+1 (4)
2:3:3 (1)	5:4 (1)	--	--
2:2:4 (1)	4:3 (1)	--	--
Ventrals	Means	Subcaudals	Means
169-222 (43)		20-31	
Males 169-195 (14)	178.14	Males 22-31 (15)	27.8
Females 174-222 (14)	193.50	Females 20-27 (19)	23.1

or incomplete faint stripe on 15 specimens. A series of small dots extended along the vertebral scalerows on 17 specimens and there were no markings in this area on six specimens. Some specimens had only small dark spots on the sides of the body (11), others had a mixture of small and medium spots(4), others only medium (3), and others both small and large spots(4). Dark spots were absent on four specimens. Most specimens had two tail bands around the tail but five had only one, and four had none. Subcaudal pigmentation varied from mostly black (11) to mostly white (1) with seven specimens having a checkerboard pattern.

### Discussion

A subspecies is a population of a species that is separated geographically from other populations and exhibits an identifying characteristic. The geographic distribution of the dorsal patterns found on the specimens examined in this study is presented in Figure 1. The distribution of vertebral and dorsal patterns of pigmentation is variable across the entire range of *Calliophis maculiceps*; a single pattern form does not occur alone in any portion of the range. Specimens with both mostly black and nearly equal proportions of black and white caudal pigmentation were found in Chon Buri Province in southeast Thailand as well as in Kanchanburi Province in western Thailand. Pigmentation is the sole criterion upon which most authors have based their proposed new subspecies. However, pigmentation has proven to be an unreliable characteristic upon which to base subspecies of *C. maculiceps*.

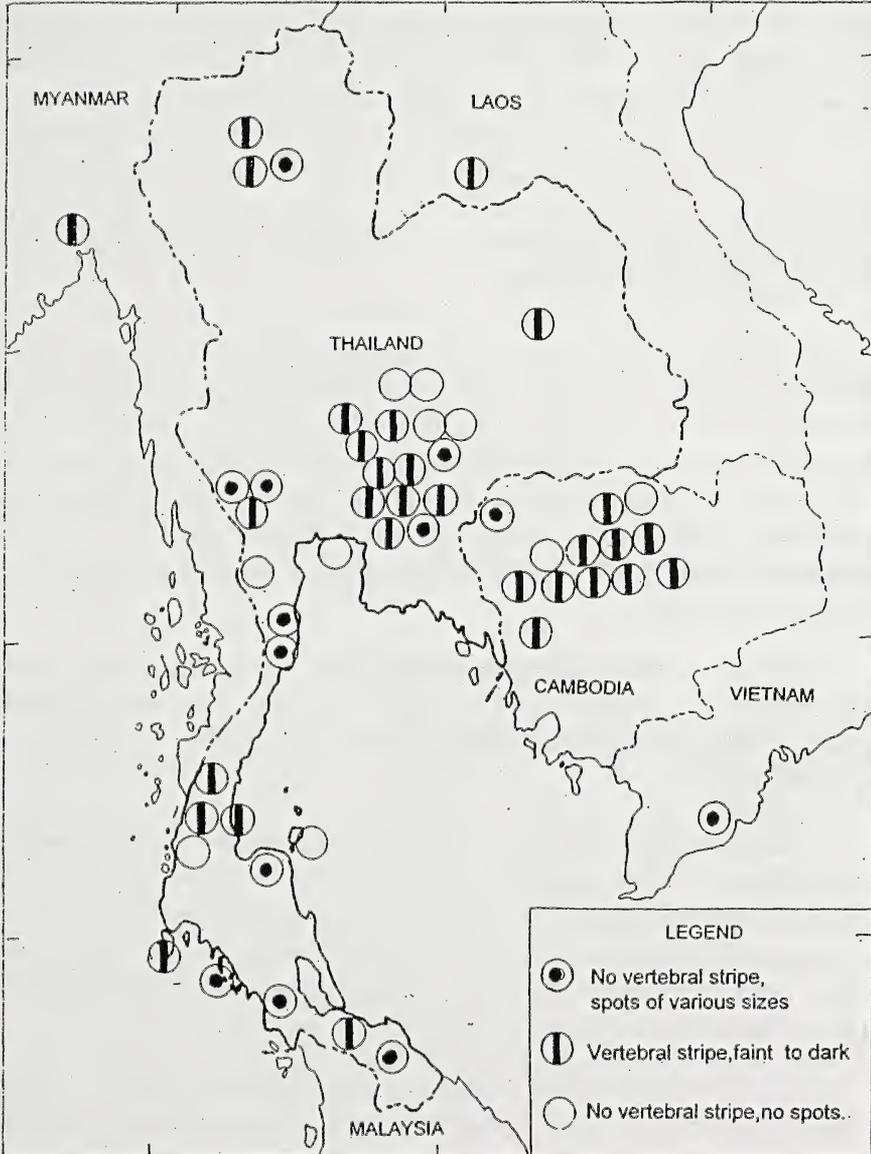
Variation in scalation does not indicate any geographic significance. The minor variations noted in supralabial formulas occurred in specimens from Rangoon, Myanmar as well as Hup Bon, Chon Buri Province, Thailand. Variations in the numbers of infralabials appeared on specimens from Rangoon; Nong Khor, Chon Buri Province, Thailand; and Cochinchina. The specimen from Rangoon had 1+1 oculars on one side and the specimens with more than 200 ventrals ranged from Rangoon, Myanmar in the north to Phuket, Thailand in the south, and Roi Et, Thailand in the east. The number of ventral or temporal scales was considered diagnostic in some cases, either singly or in combination with pigmentation. Two specimens from Nakhon Ratchasima, Thailand had 1+1 temporals on the left side. Only two subspecies and a species were based entirely or in part on scalation.

The original description of *Elaps atrofrontalis* Sauvage (1877) cannot be distinguished from Günther's original description of *Calliophis maculiceps*. Golay (1993) distinguished it from all other subspecies by the absence of a

black vertebral stripe, the presence of two black rings on the tail, and the ventrals ranging from 173-182.

Malcolm Smith (1915) discussed two specimens of *Calliophis maculiceps* collected in Nong Kai Ploi and Paknampo, Chon Buri Province, Thailand

### CALLIOPHIS MACULICEPS, DISTRIBUTION OF DORSAL PATTERNS



which he referred to as "a new colour variety, *univirgatus*" because of the absence of dorsal spots and the presence of a conspicuous black vertebral line extending the length of the body and tail. In 1943 he dropped taxonomic recognition of the variety when he referred to *univirgatus*, in parenthesis, under Form II, "known only from Central and S. E. Siam". Thus, Malcolm Smith gave some credence to the color variety being localized geographically. Klemmer (1963) recognized *univirgatus* as a subspecies of *Calliophis maculiceps*, presumably based upon Smith's description of the pattern, and named the type locality as Nong Kai Ploi Thailand in 1963. Because *univirgatus* was pre-occupied by *Elaps univirgatus*, he proposed the substitute name *Calliophis maculiceps smithi*. Taylor (1965) was apparently unaware of Klemmer's publication when he proposed the substitute name *Calliophis maculiceps malcolmi*, also citing the type locality as Nong Kai Ploi. He distinguished it on the basis of having one anterior temporal and it touching three supralabials; the ventrals being plus or minus 184; the subcaudals ranging 21-31; the presence of a median black vertebral line; and the absence of black spots on the body. Golay (1985) synonymized it with *smithi*.

*Calliophis hughi* Cochran (1927) was distinguished from *Calliophis maculiceps* by its much higher number of ventrals (285) and its lack of black dorsal spots and from "Smith's *maculiceps univirgatus*" by its higher ventral count and the absence of a black vertebral stripe. Cochran (1927) also noted only one posterior temporal in her description, but she didn't mention it as a distinguishing characteristic. Campden-Main (1969) recounted the ventral scales on the holotype and found them to number 186, well within the range of *Calliophis maculiceps*.

*Calliophis maculiceps punctulatus* Bourret (1934) was based on fewer ventrals (182) than *maculiceps* and the presence of only one posterior temporal. Golay (1985) synonymized *punctulatus* with *atrofrontalis*, as did Toriba in Golay et al. (1993).

A black vertebral stripe is present on *Calliophis maculiceps michaelis* Deuve (1960), but Deuve described this subspecies as differing from Smith's *univirgatus* by having more than 200 ventrals and by the presence of black spots under the tail. Golay (1985) distinguished this subspecies from all of the others by the presence of a black vertebral stripe and from *smithi* by the presence of black spots under the tail.

Thus, it can be seen that none of the described subspecies of *Calliophis maculiceps* represent a population that is separated geographically from other

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populations, nor do they exhibit distinct identifying characteristics.

*Calliophis maculiceps* (Günther, 1858)

*Elaps maculiceps* GÜNTHER 1858. Type locality: "East Indies." Type: BMNH, 58.4.20.6; *Calliophis maculiceps* GÜNTHER 1859; *Calliophis maculiceps maculiceps*, BOURRET 1936; *Maticora maculiceps* McDOWELL 1987; *Maticora maculiceps maculiceps*, GOLAY 1993.

*Elaps atrofrenalis* SAUVAGE 1877. Type locality: Cochinchina. Type: Lost; *Maticora maculiceps atrofrenalis* GOLAY 1993.

*Calliophis maculiceps* var. *univirgatus* M. A. SMITH 1915. (non *Elaps univirgatus* Günther 1858. Type locality: Nong Kai Ploi. Type : BMNH 1946.1.17.81; *Maticora maculiceps* var. *univirgatus*. GOLAY 1993.

*Calliophis hughii* COCHRAN 1927. Type locality: Koh Tao, Gulf of Siam. Type: USNM, 072307. *Calliophis maculiceps punctulatus* BOURRET 1934. Type locality: Cambodia. *Calliophis maculiceps atrofrenalis* GOLAY 1985; .

*Calliophis maculiceps michaelis* DEUVE 1960. Type locality: Mekong, Laos. Type: MNHN, 1985-397; *Maticora maculiceps michaelis* GOLAY 1993.

*Calliophis maculiceps smithi* KLEMMER 1963; *Maticora maculiceps smithi*, GOLAY 1993.

*Calliophis maculiceps malcolmi* TAYLOR 1965; *Maticora maculiceps malcolmi* GOLAY 1993.

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## The Lizard *Sceloporus rnerriarni* in Chihuahua, Mexico

Julio A. Lemos-Espinal, David Chiszar and Hobart M. Smith

### Abstract

Ninety-eight specimens of *Sceloporus merriami* taken about 65 airline km SSE of Ojinaga, Chihuahua, Mexico, near Corralitos, are typical representatives of *S. m. longipunctatus*, previously reported from the same general area but without documentation. The specimens previously reported of the species, from the Río Conchos about 100 airline km NW of the present collection sites, apparently represent a different subspecies, here named *S. rn. williamsi*. Variation in external morphology of the new series is summarized, and attention called to the unique (in the genus) presence of granules between the dorsal and lateral nuchal scales, and on sides of body; to the closer approach to the anus in females than in males of the enlarged subcaudals; to the unique inguinal semeions of females, and the probable independent control of two parts of the semdions of this species, one part occurring in both sexes, the other part only in males; and the unique equal development of gular semeions in both sexes.

The first record of *Sceloporus merriami* Stejneger from Chihuahua (Smith et al., 1963) was based on a series of eight specimens from the canyon walls of the lower Río Conchos and its tributaries near El Fortín and El Alamo, Chihuahua (about 50 airline km west of the Río Bravo del Norte at Ojinaga; Fig. 1), obtained by Kenneth L. Williams, Edward O. Moll, Francois Vuilleumier and John E. Williams on their epochal canoe trip down the Río Conchos in 1962. These specimens were referred provisionally in the original report to *S. m. merriami*, but Olson (1973), in his review of the species, left them unallocated to subspecies because of paucity and ambiguity of material. However, in his later review (1979), he plotted eight localities in Chihuahua, apparently including the Río Conchos material, for *S. m. longipunctatus*, without documentation. We here provide analyses of 98 specimens that confirm not only the occurrence but the identity of *S. m. longipunctatus* in Chihuahua.

The 98 specimens here reported were all collected by JLE and are from about 100 km SE of the Río Conchos localities. All clearly represent *S. rn. longipunctatus* Olson. They are from Manuel Benavides, Sierra Azul, 1200m (19°6'52.5"N, 103°55'37.6"W), taken 27 August 1999 (JLE field nos. 4163-97,

4206, 4210-6) and 2 September 1999 (JLE 4330-66), and Puente Nuevo Lajitas, Paso de San Antonio, 6 km SE Manuel Benavides, 1060m (29°5'27.7"N, 103°51'16.3"W), 3-4 September 1999 (JLE 4371-7, 4382-93) (Fig. 1), all taken by JLE. At these localities this was the most abundant lizard species, easily observed on the cliffs and boulders of the canyons. Half of the specimens are to be deposited in the UCM, and half in UBIPRO (Unidad de Biotecnología y Prototipos) of UNAM.

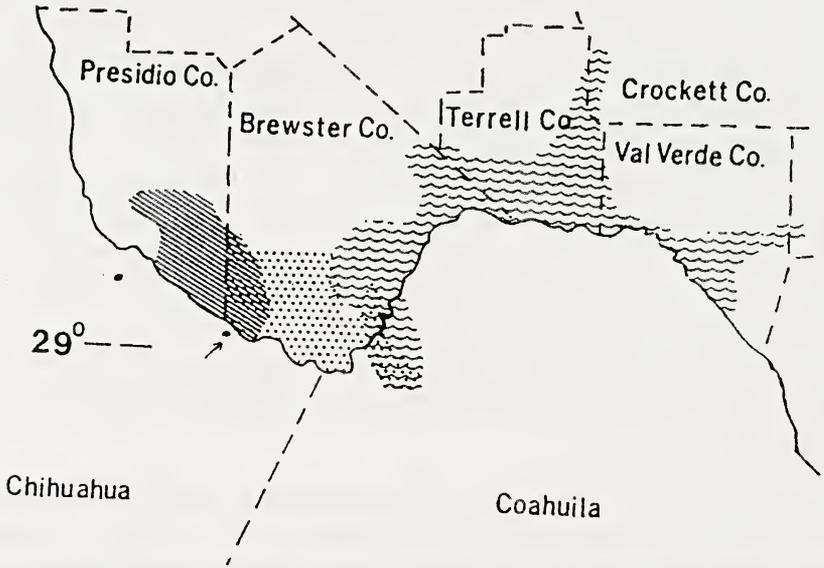


Fig. 1. Distribution of the northern subspecies of *Sceloporus merriami* (adapted from Olson, 1973: 117, fig. 1). Wavy lines, *S. m. merriami*; straight lines, *S. m. longipunctatus*; dots, *S. m. annulatus*. The range of *S. m. australis* is isolated in southern Coahuila and is not shown. The arrow points to the two localities, represented by a single dot, for *S. m. longipunctatus* in Chihuahua, as here reported. The other dot indicates the two localities where *S. m. williamsi* is known to occur.

This sample is clearly different from *S. m. merriami* in labiomental contact with first infralabial (Fig. 2) in only 6% (11 of 196 sides) vs 93% (Olson, 1973); dorsals 56 or more in only 11% (11 of 88) vs 98% (Olson, 1973); caudal rings usually complete ventrally vs usually absent ventrally; and gular bars prominent and extensive vs posterocentrally restricted and weak.

The present series differs also from *S. m. annulatus* Smith in having the abdominal semeions usually separated throughout their length (38 of 43, 88%, vs 22% fide Olson, 1973), the dark caudal rings pale bluish ventrally vs usu-

ally brownish, and the paravertebral dark spots usually extended laterally vs squarish in shape.

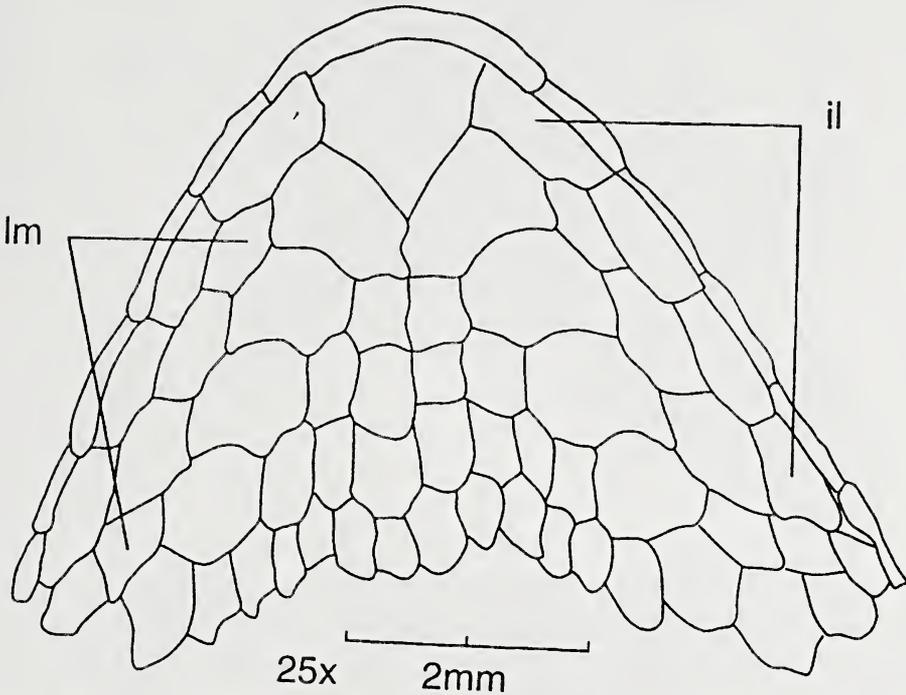


Fig. 2. Chin scales of *S. m. merriarni*, showing a labiomenal scale (lm) contacting the first infralabial (il) on each side. Drawn from UCM 14568, Big Bend National Park, Brewster Co., Texas. This condition occurs in 93% of *S. m. merriarni* and 68% of *S. m. williamsi*, but in only 6% or less of all other subspecies.

From *S. m. australis* Williams, Smith and Chrapliwy the present series differs most conspicuously in usually having the paravertebral dark spots extended laterally vs rounded; gular bars relatively broad vs narrow; and dorsal scales usually (85%) 51 or more (75 in 88) vs 26% (Williams et al., 1960).

In all diagnostic respects the present series conforms with *S. m. longipunctatus* Olson, which is known from numerous localities across the Río Bravo del Norte in Presidio Co., Texas, east of the collection sites of this series (Olson, 1973). Noteworthy variation includes the following, in addition to the preceding comparisons.

Labiomentals reaching postmental, but not the first infralabial (Fig. 3), in 41 of 196 sides (21%), reaching first infralabial in 11 of 196 sides (6%), and

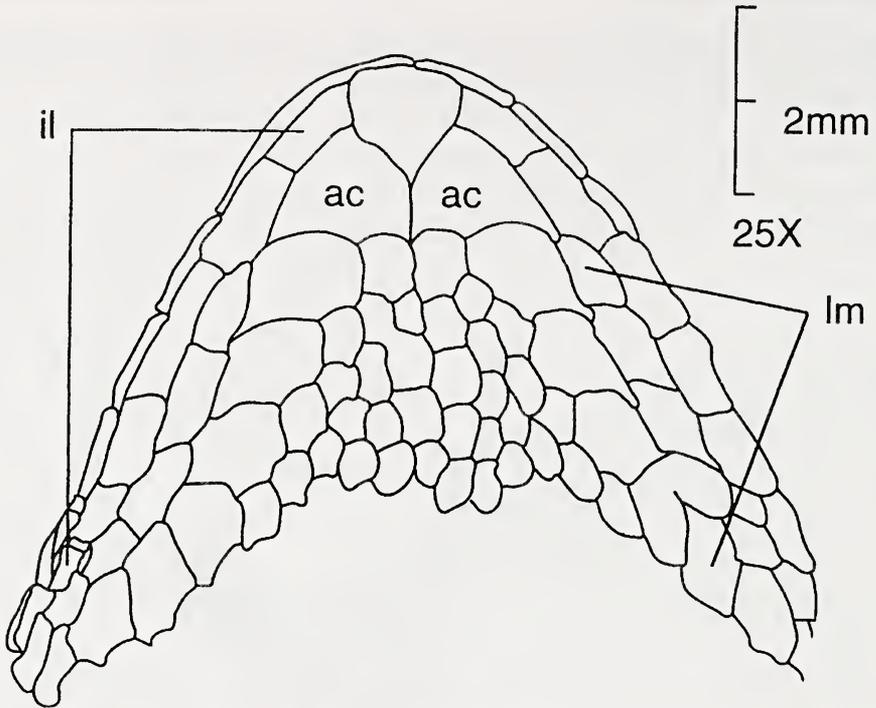


Fig. 3. Chin scales of *S. m. longipunctatus*, showing the labiomenal scales (lm) failing to reach either the first infralabial (il) or the anterior chinshield (ac) on one side (right of animal), and reaching only the anterior chinshield on the other side. Drawn from JLE 4165, Sierra Azul. Data are at present available on the frequency of contact of anterior chinshields and labiomenals only for the series of 103 here reported.

reaching one or the other in 27%; prefrontals invariably separated by one (94) or more (4) azygous scales (Fig. 4); frontal not divided at all in one, only an anterior corner split off in four, anterior half longitudinally split in 34 (Fig. 4), anterior half not divided at all in 39, 1/6 to 1/3 of an anterior corner split on anterior half in 10, and anterior half split into 3 parts in 2; frontoparietals 1-1 in 49, 1-2 in 26 (Fig. 4), 2-2 in 22, in contact medially (Fig. 4) in all 98 except one with an azygous scale medially, and 2 with a contact of frontal and interparietal; in 8 there is a partial separation of the frontoparietal scales medially by a small azygous scale; in 2 the interparietal intrudes between the frontoparietal and parietal on both sides; dorsals 47-61 ( $M=52.9$ ,  $N=88$ ); femoral pores 22-30 on a side ( $M=25.4$ ,  $N=116$ ); scales between pore series 0-5 ( $M=2.5$ ,  $N=94$ ). One or two supernumerary pores, included in the pore counts, occur at the median end of the femoral pore series on one side or the other, or on both sides, in 17 of 48 males (35%), and in 26 of 45 females (58%).

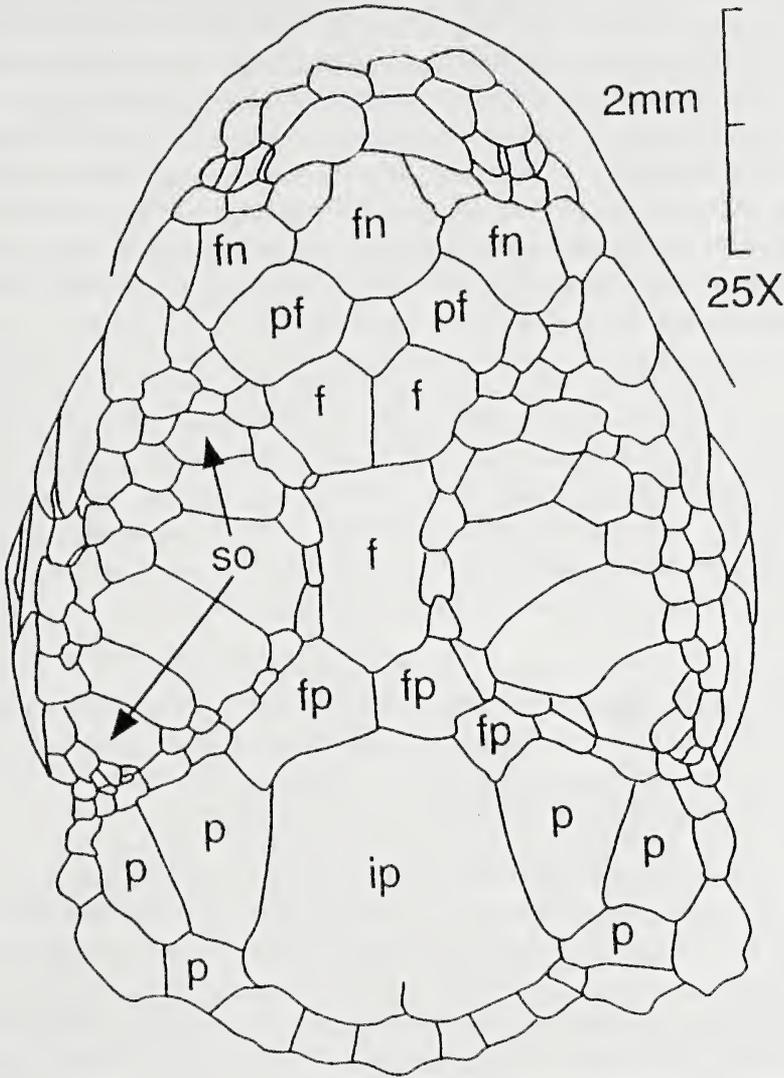


Fig. 4. Dorsal head scales of *S. m. longipunctatus*, drawn from JLE 4192, Sierra Azul, and exemplifying frequent conditions of the frontonasals (fn, three, always entire, in contact), prefrontals (pf, always separated by one, rarely more azygous scales), frontal (f) divided into anterior and posterior halves, and the anterior half divided into right and left halves), frontoparietals (fp) single on one side, two on the right, in contact medially (they are about as frequently single as double, but are rarely [3%] separated medially). Other scale arrangements (p, parietal; ip, interparietal; so, enlarged supraoculars) as shown are more or less typical of the species.

The paravertebral dark spots (see Olson, 1973: 121, Fig. 2) are comma-shaped (extended laterally) in all but 3 of 98, although in 4 they are weakly extended; all 7 exceptions are females. The five males in which the abdominal semeions are in contact medially are relatively large, measuring 48, 51(2), 52(2) and 53 mm S-V; the contact zone is very short in 3, and extends the full length of the semeions in 1. However, the semeions are separate in all others, including 12 measuring 48-52 mm S-V. All measuring less than 30 mm S-V (8) lack abdominal semeions completely, and all but one (34 mm S-V) measuring 30 mm or more (including two at 30 mm and two at 31.5 mm) have at least faint ones. All others measure 35 mm or more.

The abdominal semelons appear to develop more or less steadily throughout life in males, once they appear at about 30 mm S-V length. They are initially widely separated medially (6 scales or more), but approach each other medially with increasing age, eventually coming into contact at least narrowly in about a third of the largest males. The gular semeions, however, are well developed at hatching in both males and females, and increase in size and intensity but little as the animals mature.

The smallest individual, a female, measures 19 mm S-V; the smallest male is 23 mm S-V. The males appear to reach a slightly greater S-V length (53 mm) than females (50 mm); 10 males are 50 mm or more in S-V length, only 2 females. The relative sizes of the two sexes conform with Fitch's (1978) findings for *S. m. annulatus* and "*S. merriami*" from Texas.

It is of considerable interest that this species exhibits a feature possibly unique in the genus, and that has not received previous attention so far as we are aware: the presence of granules between the scales on the dorsal and lateral surfaces of the neck, and on the sides of the body. They are more easily discerned on the present, well-preserved, injected and mostly intact material than on other specimens in less admirable condition. The anterior dorsals often appear up-edged rather than lying flat, because of the presence of the granules between them. The character may have considerable phylogenetic significance.

It was also discovered that in this species not only is the absence of a pair of enlarged postanal scales diagnostic of females, but in that sex the large subcaudal scales extend forward almost to the anus, whereas in males they are separated from the enlarged postanals by several (about 6) rows of small scales. The postanal area of small scales, surrounding the enlarged postanals in males, is much more extensive in males than in females, and is as diagnos-

tic of sex as the enlarged postanals themselves.

The approximate geographic range of *S. rn. longipunctatus* in Chihuahua is suggested by the map in Olson (1979). The localities plotted were not identified, however. The only specimen of the species from Chihuahua in the museums we have canvassed is MSB 21246 from Fern Canyon, Sierra Ponce. That locality is part of the Santa Elena Canyon complex on the Río Bravo del Norte, a short distance north of the localities represented by the large series reported here. The specimens reported by Webb (1982) from extreme north-eastern Durango were not identified to subspecies but would be *S. m. longipunctatus* if Olson's (1979) range estimates are approximately correct.

It is clear, however, that the samples from near the Río Conchos collected by Williams et al. (Smith et al., 1963) are not *S. m. longipunctatus*, and represent a previously unrecognized subspecies, and five other specimens from that area plotted by Olson (1979) are the same. How closely the ranges of the two subspecies are approximated is at present uncertain. The new material of *S. m. longipunctatus* here reported came from localities about 100 km SE of the Río Conchos localities.

The Río Conchos material differs from the adjacent subspecies *S. m. longipunctatus* in several ways. Among them is

(1) the more numerous dorsals, 58-66 (M=62; N=12) vs 47-61 (M=53; N=88, present material), with 100% 58 or more vs 4 in 88 (5%); (2) labiomentals reaching anterior chinshield, first infralabial or mental in 79% (19 of 24) vs 27% (52 of 196 sides); and (3) in the absence of distinct, comma-shaped dark spots in paravertebral rows vs their presence.

The Río Conchos material differs from the more remote *S. m. annulatus* and *S. m. australis* in the same first two ways as it differs from *S. m. longipunctatus*.

As noted by Smith et al. (1963), the Río Conchos material agrees with *S. m. merriami* in dorsal scale count, and in the high frequency of labiomental contact with first infralabial or anterior chinshield (although lower, at 69% vs 93%). The two taxa differ only in coloration, so far as we can determine. All of the radiating gular bars of the Río Conchos series, both males and females, are dark blue (much as illustrated in Smith, 1939: pl. 1, or in Smith, 1946: 191, for *S. m. annulatus*), whereas in *S. m. merriami* the anterior bars are pale blue and the only parts with dark blue pigment are posterocentral in position,

somewhat patchlike (as illustrated in Smith, 1946: 189). Also, the caudal dark rings are clearly evident ventrally in the Río Conchos series, not in *S. m. merriarni* (see Smith, 1946:189).

We accordingly here name the Río Conchos population

*Sceloporus merriarni williamsi*, subsp. nov.

*Holotype*. UIMNH 52378, El Fortín, 51 airline km straight west of the Río Grande at 29°35'40"N, 31 August 1962, taken by the party of Kenneth L. Williams, Edward O. Moll, François Vuilleumier and John E. Williams. Paratypes. Twelve, including three topotypes, UIMNH 52377, 52379-80, same data as holotype. Four others, UIMNH 52381-4, are from El Alamo, 6.2 km E of El Fortín, 1-2 September 1962, same collectors as for the holotype. Five others (REO 4095-9) are from 33.4 mi W Ojinaga, 19 May 1974, R. Earl Olson collector.

*Diagnosis and Definition*. A member of the species *S. merriarni*, having granular lateral scales and a rudimentary structural gular fold immediately preceding foreleg. Different from all other subspecies of *S. merriarni* in having a combination of numerous dorsal scales, 58 or more; usually (79%) the lorilabials contacting first infralabial, mental or anterior chinshield; gular bars all dark blue, radiating well away from center of throat; caudal dark rings evident ventrally, distinct dorsally.

*Description of holotype*. An adult male, 50 mm S-V, tail 58 mm, complete but regenerated.

Head scales more or less normal for the species; 5 postrostrals between lorilabials; 3 pairs of internasals; 3 large frontonasals, in contact; two prefrontals, separated by a small azygous scale; frontal divided into anterior and posterior sections, both entire; 2 frontoparietals, in medial contact; one large parietal on each side, flanking a still larger interparietal; 5-5 enlarged supraoculars, separated from median head scales by a complete row of small scales, and from 5-5 superciliaries by 1-3 rows of small scales; canthals 2-2, anterior contacting lorilabials; no subnasal; nasal contacting lorilabials; latter contacting rostral, in a single row except 2-3 in rear loreal and anterior subocular areas; 4th supralabial below middle of eye. Five infralabials to below middle of eye; labimentals ending anteriorly in broad contact with 1st infralabial; anterior chinshields in medial contact, second pair separated by two pairs of small scales.

Dorsals 61; tiny granules separating virtually all scales on body, even the granular laterals, except for the ventrals; femoral pores 25-26, with one supernumerary pore at the medial end of one series; 3 interfemoral pore scales.

Dark blue bars radiating from a longitudinal median unpigmented gular streak to the chinshields and enlarged postchinshield scales; abdominal semeions separated medially by 2-4 rows of whitish scales, extending from near axillary level to groin level, but not entering either; the semeions appear purplish from near axilla to a third their length from groin level, but the rear third and a medial border 4 scales wide dark blue or black; lateral limits of the semelons coincide with a protruding, granular fold extending from near axilla to near groin. Dorsal and lateral surfaces nearly uniform yellowish gray with a very faint paravertebral series of small, rounded, slightly darker spots each covering about 4 scales; limbs faintly banded; a black slash in front of foreleg insertion, partly hidden under skin folds, extending dorsally and weakly only to near the enlarged dorsal scales; a few dark rings weakly evident both dorsally and ventrally on base of tail, but rest regenerated and unicolor brownish.

*Variation.* The entire type series consists of 6 males and 7 females, the latter varying from 30.5 to 45mm S-V, the males 43 to 50mm. All females exhibit the strange, dark blue (or black) inguinal streak on each side, which appears to correspond with the lateral border of the rear extremity of the male semeion. It would be fascinating to know what signal role, if any, these unique semeions have in females. Concomitantly, it appears that there must be at least two independently controlled components of the abdominal semeions in this species, one part expressed in both sexes, the other limited to males. The species is also peculiar in having the gular semeions occurring in both sexes, whereas they are limited to males in most others.

No sexual dimorphism is evident otherwise in scalation or coloration. The dorsals varied from 58(1) to 66(1) among the paratypes, other counts being 60(2), 61, 62 (2), 63(2) and 64.

The labiomentals reached the first infralabials on both sides in all four from El Fortín, but in only 3 of 8 sides in the four from El Alamo (on one side of one they reached the anterior chinshield). Of the five from 33.4 mi W Ojinaga, the labiomentals reach the first infralabial on four sides, the anterior chinshield on three sides, and fail to contact either on one side. The anterior part of the frontal was divided in four. The prefrontals were separated by an azygous scale in all but one with contact of the frontal and median frontonasal.

The femoral pore series were separated medially by 2-5 scales, usually (6) three, four occurring once (one indeterminate). The femoral pores were 25-30 on a side (one of each extreme, mode of 28 with six). Seven paratypes exhibited 1-3 supernumerary pores on the median end of each pore series, suggesting a selective advantage of maximal pheromone production.

Color and pattern were much the same on the paratypes as on the holotype. Those with an intact tail have distinct dark rings dorsally, less distinct ventrally.

*Comparisons.* See paragraphs introductory to the description.

*Remarks.* In spite of the wide separation of the geographic ranges of *S. m. merriarni* and *S. m. williamsi*, their fundamental similarities, as compared with the other three races of the species, suggest early separation from an ancestral population, one going west, the other east, as the Big Bend of the Río Grande was encountered in northward migration from more southern areas. Such a migration was postulated by Olson (1973). At present, the eastern derivative, *S. m. merriarni*, occupies the easternmost limits of the range of the species, and the western derivative, *S. m. williamsi*, occupies the westernmost limits. The area between those extremes, and to the south, is now occupied by three racial taxa of probable common origin, but separate from that of the western and eastern populations. Genetic analyses may, or may not, confirm these inferences, based on phenotypy.

The subspecies here proposed is named in honor of Kenneth L. Williams, leader of the expedition on which the types were collected, former student, lifetime friend, eminent herpetologist and fellow instructor.

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## Descriptive and Phylogenetic Considerations for *Sceloporus maculosus*

*Sceloporus maculosus* has been occasionally reviewed since its description by Smith (1934), but little mention has been made of pattern and color. Samples are from populations of Durango's boulder-strewn canyons and roughlands.

A male (REO 4140) from 1 mi. N Picardias, Durango is (in life) medium brown dorsally with numerous yellowish-green spots; ventrally, throat barred with powder blue on white ground; extensive large black spots on chest, and bold black bars under forelimbs; belly-patches separated (2-3 scales), blue towards mid-venter with light brown to ochraceous at sides; tail grayed with some indication of barring.

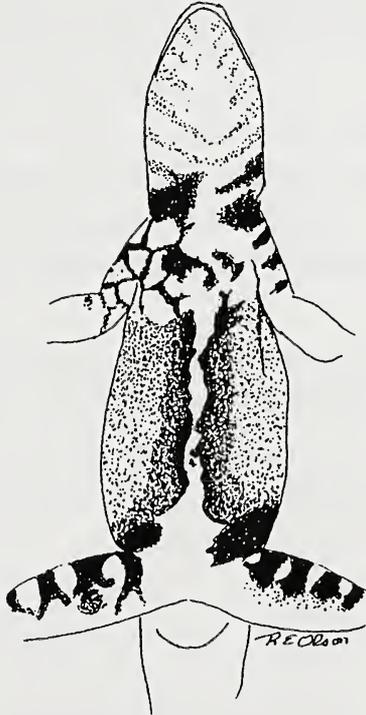


Fig. 1 Male *Sceloporus maculosus* (REO 4140) from 1 mi. n Picardias, Durango, Mexico.

A female (REO 4134) from 9.8 mi. SW Picardias shows slaty gray dorsally with a tinge of tan, small, suffused paravertebral spots, and other scattered small black spots; fine black line from nasal rearward behind eye back above ears to shoulder; ventrally, the throat as in male, remainder entirely whitish.

Similarities of *maculosus* with other members of *Sceloporus* have been considered by Smith (1946), who suggested the descendance of monotypic *maculosus* and *merriami* species groups from *Urosaurus*, and Purdue and Carpenter (1970, 1972), Carpenter (1978) showing display similarities of *maculosus* with *merriami* note male ventral pattern, habitat, and pattern of search behavior.

Male ventral pattern and color especially in adults males as described above, are strikingly similar to that of *merriami* (Olson, 1973) as to be initially confusing. Further, both lizards inhabit lower portions of rocky hill-sides, especially where extensive shaded retreats are available, about the surfaces of which search and movement occur rather conservatively. Neither is wide-ranging in daily activity, remaining within close range of structural retreat, near which, also, basking takes place.

These similarities, then, are of interest in a phylogenetic sense, as is the factor of ecological equivalency in these geographically separated taxa, with potential historic position of divergence in highlands east of Bolson de Coahuila (Olson, 1974).

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## The Little Striped Whiptail (*Cnemidophorus inornatus*) in Chihuahua, Mexico (Reptilia: Sauria)

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### Abstract

At least two subspecies of *Cnemidophorus inornatus* occur in Chihuahua: *C. i. heptagrammus* to the east, and *C. i. chihuahuae* in the central part of the state. They differ from each other in extent and distinctness of the vertebral light stripe, and in the number of scales in a row between the paravertebral light stripes.

Although Wright and Lowe (1993) recently reviewed the subspecific taxonomy of *Cnemidophorus inornatus* throughout the range of the species, they had relatively little material from the state of Chihuahua, Mexico. Their conclusions in part were questioned by Lemos-Espinal et al. (1994) and by Walker et al. (1996) relative to the Chihuahua populations of *C. i. heptagrammus*. Lemos-Espinal et al. (1997) added the subspecies *C. i. llanuras* to the number of subspecies in Chihuahua but in error, inasmuch as the three specimens (UCM 58574-6) from 1 km N Ascensión actually represent *C. uniparens* and the one from 15 km NNE EL Sancho (UCM 58477, erroneously reported there and in Lemos-Espinal [1994] as UCM 36190, a field number) is referable to *C. i. chihuahuae*. Thus the taxonomy of this species in Chihuahua as well as elsewhere merits review on basis of new material.

Thirty-one specimens collected by JLE in eastern and central Chihuahua, 4 in 1998 and 27 in 1999, and 170 specimens from Chihuahua in the University of Colorado Museum (UCM), throw considerable light upon the validity and distribution of the subspecies of *C. inornatus* in Chihuahua. The 1998-9 material, bearing JLE field numbers, is accompanied by altitude and GPS determined coordinates, and is destined to be shared more or less equally by UCM and UBIPRO (Unidad de Biotecnología y Prototipos) of the Universidad Nacional Autónoma of Mexico City. We assign the specimens examined to subspecies as follows.

*C. i. heptagrammus* (31): JLE 2593, 3752, Cañón del Pegüis (29°32'1.4"N, 104°47'39.4"W), 1090m, 8 & 10 July; JLE 2646-8, Ejido Guadalupe (31°12'24.5"N, 106°15'20.5"W), 1655m, 11 July; JLE 3759-61, 3782-3, Ejido Ojo del Carrizo

(29°58'27.5"N, 105°15'45.8"W, 82 km N Coyame), 1459m, 12-13 July; JLE 3790-1, km 34 on rd from Coyame to Ojo del Carrizo, 13 July; JLE 3805, Lomas El Berrendo, km 42 on rd from Coyame to Ojo del Carrizo, 14 July; JLE 3920, km 40 E Moctezuma, Arroyo El Pujido, Puerto El Gallo (30°8'2.0"N, 106°4'56.4"W), 1559m, 21 July; JLE 4230, Rancho Agua Zarca (29°52'39.3"N, 105°26'1.4"W), 1510m, 29 August; JLE 4263-4, Rancho La Bambita (30°17'41.5"N, 105°26'53.8"W), 1460m, 30 August; JLE 4276-9, grassland near Cerros Tres Castillos (29°54'41.8"N, 105°42'13.7"W), 1260m, 31 August; JLE 4282, Cerros Tres Castillos (three small rocky hills in the middle of a huge prairie), ~ 1.5-2.5 km SW of locality for JLE 4276, 31 August; JLE 4294, Rancho Charco de la Yegua (29°53'49.1"N, 105°18'26.1"W), 1420m, 31 August; JLE 4315-8, grassland near Cerros Santa Anita (29°40'14.1"N, 105°19'13.6"W), 1 September; UCM 18723, Cd. Juárez, T. P. Maslin, 6 May 1960; UCM 37794-5, 83 km N Villa Ahumada, Hy 45, J. M. Walker, R. L. Holland and R. L. Brown, 13 June 1966; UCM 58466, Rancho El Jonuco, sand dunes ~15 rd km WSW El Vergel (a sign 20 km S Samalayuca on Hy 45), 11 July 1995. All of the above except as noted were collected by JLE during the summer of 1999.

*C. i. chihuahuae* (175, all from Chihuahua except four, UCM 37880-3, from Durango): JLE 4057-8, 4078-9, racetrack (equine) 5.0 km W Jiménez on the Hy to Hidalgo del Parral (27°7'57.4"N, 104°58'20.4"W), 2272m, 28 July; UCM 12547-52, Hy 45 50 mi N Cd. Chihuahua, 22 June 1959, T. P. Maslin, C. C. Smith, K. Beargie and H. Beargie; UCM 12553, 12558, 12560, 12562, 12564-5, same except 21 June 1959; UCM 22679-80, 22683-6, 22688-9, 22691-2, 22695-22711, 22713-5, 22717, 22719-22, 22724, 22726-31, 22-733-6, 22739-43, 22745-50, 36286-8, 7 June 1961, T. P. Maslin et al.; UCM 37796-8, 15 mi S Cd. Chihuahua, 14 June 1966, J. M. Walker, R. L. Holland and R. L. Brown; UCM 37799-800, 1.1 mi S Conchos, 16 June 1966, same collectors; UCM 37801-3, 7 mi S Jiménez, 16 June 1966, same collectors; UCM 37804—36, 37877-9, 12.5 mi S Jiménez, 17 June 1966, same collectors; UCM 37837-40, 17.6 mi S Jiménez, 16 June 1966, same collectors; UCM 37841-57, 37858-76, 20.1 mi S Jiménez, 17 June 1966, same collectors; UCM 49781—3, 49785-8, 7 mi N Jiménez, 31 May 1972, T. P. Maslin; and UCM 58477, 15 km NNE El Sancho (31°10'N, 106°44'W), 29 September 1993, JLE. The Durango specimens are UCM 37880-1, 17.7 mi N Bermejillo, 18 June 1966, J. M. Walker, R. L. Holland and R. L. Brown; UCM 37882-3, 9.6 mi N Bermejillo, same date and collectors.

The data taken on these 206 specimens were limited to size, pattern and the average number of granules (PV) in a row at midbody between the paravertebral light lines. These are features that were utilized by Wright and

Lowe (1993) in their analysis of geographic variation in *C. inornatus*, but we did not take data on the other scale characters that they analyzed, because they were not evidently significant, whereas PV and pattern obviously were.

*Cnemidophorus inornatus heptagrammus* Axtell

Twenty-nine of the 31 specimens of this subspecies here reported all have a sharply defined vertebral stripe; in two it is dim. In one (JLE 4282) it is divided for its full length, but is still sharply defined. However, in every specimen it is divided on the rear of the head, and in eight the division is continued onto the neck but no farther. Noteworthy also is the occurrence of at least slightly greater pigmentation of the vertebral stripe, as seen under a microscope, than in the other light stripes (which are free of pigmentation other than white), in all but three of the series.

In every specimen the median light stripe extends the full length of the body.

The SV length varied in this series from 29 to 64 mm, and only seven (23%) measured 60 mm or more. Only six measured 43 mm or less, and all others 50 mm, or more. A usual life span of two years or less is suggested.

The PV count varied from 8 to 16 ( $M=11.5$ ,  $N=31$ ). Only 10% (3) fall below 9.

*Cnemidophorus inornatus chihuahuae* Wright and Lowe

Of the 175 specimens here reported of this subspecies, only 9% have a sharply defined vertebral stripe; in all others it is absent, faint or diffuse. The pigmentation of the vertebral stripe is relatively heavy in all but four, with only slight pigmentation. Most (59%) have a full length vertebral line; it is either absent (9) or confined to the neck or anterior half or three-quarters of the body in the remainder. In no specimen is the vertebral line divided except on the head.

The SV measurements varied from 42 to 64 mm, but only two measured 60 mm or more. The absence of smaller individuals is presumably a product of concentration of collecting dates in spring and early summer (see dates above).

The PV count varied from 3 to 13 ( $M=7.6$ ,  $N=170$ ), and 89% fall below 9.

## Comparisons

Although the variation reported by Walker et al. (1996) in a series of *C. inornatus* from two localities near the Rio Conchos about halfway between Ojinaga and Cd. Chihuahua (well within the range of *C. i. heptagrammus* as here interpreted, Fig. 1), was interpreted as casting doubt upon the validity or distribution of some of the subspecies recognized by Wright and Lowe (1993), the data presented here make it plain that at least two very distinct subspecies of *C. inornatus*, for which we adopt the names *C. i. chihuahuae* and *C. i. heptagrammus*, occur in Chihuahua.

In the material here assigned to *C. i. heptagrammus*, the vertebral light line is always complete, and is nearly always sharply defined. The PV count is seldom (10%) less than 9, and the maximum SV length is 64 mm, although in our series of 31 seven (23%) measured 60 mm or more.

On the contrary, in the material here assigned to *C. i. chihuahuae*, the vertebral light line is complete and sharply defined in only 9% of the specimens, and is often absent or incomplete (41%). In addition, the PV count is usually (89%) less than 9. The maximum SV length is the same as in *C. i. heptagrammus*, but only 1% of the 175 examined measured 60 mm or more.

These differences are borne out in the 31 specimens from the El Pueblito area reported by Walker et al. (1996), in which the PV count varied from 8-16 ( $M=11.6$  in 16 seven-striped specimens, 14.7 in 14 eight-striped ones), and all but two (unicolor ones) had a complete vertebral stripe. The SV lengths varied 44-63 mm. These features place that population in *C. i. heptagrammus*, and the locality falls well within the limits suggested here. The features they reported that raised questions were the frequency (45%) of division of the vertebral line (producing 8-lined individuals), the occurrence of seven rather dim supernumerary lines in one eight-striped specimen, and the occurrence of two unicolor specimens. The combination of those three features (excluding the 7-striped specimens) is characteristic of *C. i. inornatus*. However, the infrequent occurrence of any of those conditions in *C. i. heptagrammus*, in Chihuahua or elsewhere, suggests that their occurrence in the El Pueblito area is anomalous, although worthy of further investigation.

As indicated in the accompanying map (Fig. 1), the geographic range of *C. i. heptagrammus* at ~40 km E Moctezuma (JLE 3920) comes quite close to that of *C. i. chihuahuae* in the vicinity of Gallegos. The distance between the northernmost record of *C. i. chihuahuae* at 15 km NEE El Sancho and the nearby

record of *C. i. heptagrammus* at Rancho El Jonuco is even less, at about 25 km. In neither case is there any indication of intergradation. What physiographic feature separates the ranges of the two subspecies remains to be determined, but it could well be a difference in humidity, higher toward the west near the foothills.



Fig. 1. Distribution of the subspecies of *Cnemidophorus inornatus* in Chihuahua, Mexico. Dots represent localities from which specimens have been examined in the present study. The triangle indicates the localities represented by material reported by Walker et al. (1996).

The use of the name *C. i. chihuahuae* for the western of these two subspecies is predicated on the basis of inclusion in our concept of its range of all of the range envisioned by Wright and Lowe (1993) for the subspecies when the name was proposed. The major change in our concept over the original is inclusion of the populations around Jiménez in *C. i. chihuahuae* rather than in *C. i. heptagrammus*, as Wright and Lowe (1993) had them. They had insufficient material to be certain, whereas the large series at hand leaves no doubt of subspecific allocation.

Although the known ranges of *C. i. heptagrammus* and *C. i. chihuahuae* are dichopatric so far as known at present, parapatry and concomitant intergradation are highly likely. Furthermore, the ranges of variation in the characters that distinguish them overlap significantly. Accordingly we do not now regard them as separate species.

The description of *C. i. llanuras* in Wright and Lowe (1993) is, however, very similar to that of *C. i. chihuahuae*, and their projected ranges are almost contiguous as well as similar in habitat. It is possible that the two nominal subspecies are consubspecific. Should that prove to be the case, as first revisors we here choose *C. i. chihuahuae* as having priority over *C. i. llanuras*.

The name *llanuras* has frequently been misspelled *llanurus*. However, Wright and Lowe (1993) consistently spelled the name the same way (*llanuras*) throughout their review. The name was derived from the plural Spanish word *llanuras*, hence constituted a noun in the nominative case, in apposition with the generic name. Such names, however, cannot be accepted under the Code as plurals — only in the singular number. Therefore the name is here emended to *C. i. llanura*.

Acknowledgments. We are much indebted to Dr. Harry L. Taylor for his counsel relative to *Cnemidophorus* literature and knowledge, and to the authorities of the University of Colorado Museum (Dr. Alan deQueiroz, Rosanne Humphrey, Dr. Shi Kuei Wu) and the Department of EPO Biology (Dr. Robert Eaton, chairman) for facilities essential for this study.

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*HMS and DC: Museum, EPO Biology and Psychology, University of Colorado, Boulder, Colorado 80309-0334, U.S.A. JLE: Laboratorio de Ecología, Unidad de Biotecnología y Prototipos, Escuela Nacional de Estudios Profesionales Iztacala, UNAM, Apartado Postal 314, Avenida de los Barrios, s/n, Los Reyes Iztacala, Tlalnepantla, Estado de México, 54090 México.*

## Book Review

### Field Guide to Amphibians and Reptiles of Illinois

by Christopher A. Phillips, R. A. Brandon and E.O. Moll, Illinois Natural History Survey Manual (8):xii-xv + 282 p. Champaign, Illinois. ISBN:1-882932-04-8. Cloth. US \$19.95.

Not since Philip W. Smith published his monographic study on the Amphibians and Reptiles of Illinois in 1961, has a major work on the herpetofauna of Illinois appeared. The Smith monograph was the first state monograph using both excellent illustrations, and distribution maps, along with complete ecological, distributional, and historical information, which has served as a guideline for future state monographs.

The present volume is the eighth publication in a series of publications in a general series on the flora and fauna of Illinois. The other volumes covered Illinois wild flowers, shrubs, land snails, mammals, mussels and the most recent on long-horned beetles. Each volume in this series of field guides, are compacted into a pocket guide volume, which can easily be carried in the field.

Like the preceding volumes, this small book is an excellent practical guide for the general public to aid in identifying the 102 species of amphibians and reptiles that live within the boundaries of Illinois. It is organized in a manner that makes it easy for one with little or no prior knowledge. Basic information is presented on their biology and life history, as well as a brief account on the species that are listed as endangered or threatened under the State's Endangered Species Protection Act. This is followed by a short discussion on regulations for collecting and keeping herptiles, along with remarks on mortality and habitat improvement. There is also a short section on "Geologic and Climatic History of Illinois," which discusses how climatic changes had played an important role in former distribution and abundance of species within the state, although this has drastically changed due to the activity of man. This is followed by a glossary of terms, and an illustrated key to amphibians and reptiles of Illinois, using only the common names for identification.

After the key, individual species accounts cover the 102 species within

*News and Notes*

the state. The accounts are condensed, containing brief sections on identification, similar species, subspecies recognized within the state, short description, habitat, natural history notes and status. The serious reader might have desired additional information in these account but what is presented is concise and accurate, and the purpose of this book was not for presenting complete life history accounts, but only as a field guide, which has been extremely well fulfilled in this volume.

The book is exceptionally well organized and planned, and beautifully illustrated by Mike Redmer. I was especially impressed with the indications of county records known only prior to 1980. It is an excellent indicator of the decimation not only of amphibians, which have been getting most of the attention in that context in recent decades, but reptiles as well. One is as alarming as the other. The absence of recent records does not necessarily indicate disappearance, because very little attempt has been made to monitor occurrence once recorded. The abundance of such indications, however, is sobering in implication, because in most cases they exceed post-1980 records.

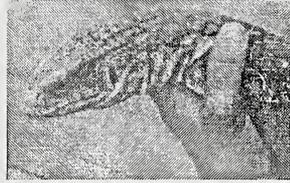
After the individual species accounts are a short section discussing species of questionable occurrence in Illinois. This includes three species, *Ambystoma tremblayi*, *Terrapene carolina triungus* and *Cemophora coccinea*, which are considered introductions or of doubtful occurrence. A short section on additional reading is followed by an index of common and scientific names which closes out this excellent volume.

Overall the text is without error, except on pages 15-16 which has one sentence which has been duplicated. Despite this minor error this is a very excellent book that admirably fulfills its purpose. The authors should highly be commended for their effort. I would highly recommend This publication for both layman and professional alike.

Harlan D. Walley, Department of Biology, Northern Illinois University, Dekalb, Illinois, 60115.

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# NOTES FROM NOAH

*The Northern Ohio Association of Herpetologists*

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## Roger Conant State Nature Preserve?

Letters are Needed!

Using state income tax checkoff funds, the Ohio Department of Natural Resources, Division of Natural Areas and Preserves, has recently purchased a 75-acre parcel of land in Ashtabula County as its latest nature preserve. This site was acquired primarily because a population of the Eastern Massasauga Rattlesnakes (*Sistrurus catenatus catenatus*), a state of Ohio endangered species, resides within its borders. Visiting this preserve will require a permit from the Division.

Because of Roger Conant's prominence in the field of herpetology and his devotion to the reptiles of Ohio, it would be entirely fitting to name the state's first (and probably only) snake preserve in his honor. I would like to try to convince state officials to name the preserve after the 91-year-old herpetologist and I need your help.

I need letters in support of this idea. If you are willing to write a letter, below are some key points you may want to highlight:

- From 1929-1935, on his own time and using personal funds, Roger and his volunteer helpers surveyed the state's reptiles and visited 87 of Ohio's 88 counties. Nine years after its inception, his study was published by the American Midland Naturalist as a 200-page book titled *Reptiles of Ohio*. In 1951, the work was revised and expanded with new data, adding almost 100 additional pages. From the start of this project in 1929, to the end with the publication of the revised edition in 1951, Roger Conant devoted 22 years of his life to *Reptiles of Ohio*. This survey was acclaimed by the then dean of American herpetologists, Karl P. Schmidt of the Field Museum of Natural History in Chicago as "a model of state herpetology" and remains a valuable record of the distribution of Ohio's reptiles.

*If your mailing label has "Jun 00" in the upper right-hand corner AND the dues-due box on the back of this newsletter is checked, your dues are due within 30 days. Please submit the membership form (or a facsimile thereof) on the next-to-last page.*



News and Notes

- The vehicle used by Roger Conant in the six years of field work was a Chevrolet sedan purchased for \$1,000. That sum was the award given to him by the state of Ohio as compensation for the loss of his thumb after the attending physician had bungled the treatment for a rattlesnake bite which had occurred at the Toledo Zoo.
- *Reptiles of Ohio* served as the catalyst for a group of enthusiastic young men interested in herpetology. In the late 1950s this group organized themselves into the Ohio Herpetological Society and Roger Conant served as their long-term, unofficial adviser. The OHS grew and eventually evolved into the Society for the Study of Amphibians and Reptiles, the largest organization in the world devoted to this group of animals.
- Dr. Conant is the author the *Field Guide to Reptiles and Amphibians of Eastern and Central North America*, in the Peterson series, which has sold a half million copies and is the best selling book in herpetology.

Address your letters to: Stu Lewis, Chief, ODNR, Division of Natural Areas and Preserves, Fountain Square, Columbus, OH 43224. Please mail the letters to me by July 15. I will then put them together into a nomination package and send to Columbus.

Please contact me if you have questions or need additional information.

Raymond Novotny  
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 welcome.



## Society Publication

Back issues of the Bulletin of the Maryland Herpetological Society, where available, may be obtained by writing the Executive Editor. A list of available issues will be sent upon request. Individual numbers in stock are \$5.00 each, unless otherwise noted.

The Society also publishes a Newsletter on a somewhat irregular basis. These are distributed to the membership free of charge. Also published are Maryland Herpetofauna Leaflets and these are available at \$.25/page.

## Information for Authors

All correspondence should be addressed to the Executive Editor. Manuscripts being submitted for publication should be typewritten (double spaced) on good quality 8 1/2 by 11 inch paper with adequate margins. Submit original and first carbon, retaining the second carbon. If entered on a word processor, also submit diskette and note word processor and operating system used. Indicate where illustrations or photographs are to appear in text. Cite all literature used at end in alphabetical order by author.

Major papers are those over five pages (double spaced, elite type) and must include an abstract. The authors name should be centered under the title, and the address is to follow the Literature Cited. Minor papers are those papers with fewer than five pages. Author's name is to be placed at end of paper (see recent issue). For additional information see *Style Manual for Biological Journals* (1964), American Institute of Biological Sciences, 3900 Wisconsin Avenue, N.W., Washington, D.C. 20016.

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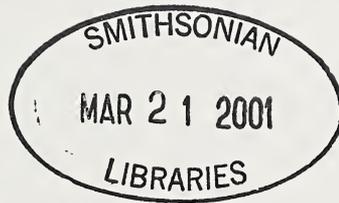
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# Maryland Herpetological Society

DEPARTMENT OF HERPETOLOGY

THE NATURAL HISTORY SOCIETY OF MARYLAND, INC.



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***Meetings***

The third Wednesday of every other month, 7:30 p.m. at the Baltimore Zoo's Reptile House (except August and September due to The Mid-Atlantic Reptile Show). The Department of Herpetology meets informally on all other Wednesday evenings at the NHSM at 8:00 p.m.



## Diet of *Gambelia wislizenii* from Chihuahua, México

Julio A. Lemos-Espinal, Geoffrey R. Smith, Hobart M. Smith, and  
Royce E. Ballinger

The longnose leopard lizard (*Gambelia wislizenii*) has a large geographic range that includes much of western North America, from Oregon and Idaho south to México (Stebbins, 1998). Much of our understanding of its ecology has come from studies from the parts of its range in the United States, and less is known of the Mexican populations (e.g. Tanner, 1987). In this note, we report on observations on the diet of *Gambelia wislizenii* from a population in Samalayuca, Chihuahua, México as part of a larger survey of the herpetofauna of Chihuahua (e.g., Lemos-Espinal et al., 1994, 1997).

### Methods

All specimens were collected in the Bolson Cabeza de Vaca in the Samalayuca Sand Dunes System, in north-central Chihuahua, México. Descriptions of the study area are available in Lemos-Espinal et al. (1994, 1997).

Lizards were collected by hand, noose or rubberband. Lizards were preserved shortly after collection. We later measured (SVL; to nearest mm) and dissected the lizards, making observations on the stomach contents. Diet items were identified to family where possible, and the percent of prey volume for each taxa was calculated for each stomach (volume estimated by volumetric displacement).

### Results and Discussion

We obtained the stomach contents of 12 *G. wislizenii* from our study site. All stomachs contained food items. The most common food items were orthopterans in the family Acrididae (see Table 1 for diet data). Orthopterans were also the most important diet component when percent volume was considered (Table 1). Of note is the presence of *Cnemidophorus tigris* remains in addition to arthropods (Table 1). Considering the contents of all stomachs pooled, the Simpson's Diversity index was  $1.69 \pm 0.21$  (range 1 to 2.67).

Our results for diet composition of *G. wislizenii* are similar to previous reports on the diets of other populations. In populations from the Great Basin Desert, orthopterans are the most prevalent component in the diet (although

Table 1. Diet composition of the stomach contents of 12 *Gambelia wislizenii* from Samalayuca, Chihuahua, México.

	Number of Items	Stomachs Con- taining	Mean Percent Volume $\pm$ 1SE
Orthoptera			
Acrididae	16	10 (83%)	56.2 $\pm$ 11.6%
<i>Cnemidophorus</i> <i>tigris</i>	3	3 (25%)	16.6 $\pm$ 9.3%
Coleoptera			
Carabidae	1	1 (8.3%)	0.25 $\pm$ 0.25%
Tenebrionidae	7		1.17 $\pm$ 1.17%
"Larvae"	2	2 (16.7%)	3.17 $\pm$ 2.74%
Mecoptera	2	1 (8.3%)	4.75 $\pm$ 4.75%
Hemiptera			
Cydnidae	1	1 (8.3%)	0.083 $\pm$ 0.83%
Odonata			
Protoneuridae	1	1 (8.3%)	4.58 $\pm$ 4.58%
Ephemeroptera			
Baetidae	2	1 (8.3%)	8.33 $\pm$ 8.33%
Diptera			
Sepsidae	4	2 (16.7%)	3.75 $\pm$ 2.69%
Mineral Material		1 (8.3%)	1.17 $\pm$ 1.17%

lizards are seen in the diet), whereas in populations from the Mojave and Sonoran Deserts, other lizards are the most prevalent component of the diet (Parker and Pianka, 1976). Insects are the most common prey item in Nevada (Tanner and Krogh, 1974). In Oregon, Acrididae (Orthoptera) make up a great proportion of the diet, and vertebrates are lacking (Whitaker and Maser, 1981).

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We would like to acknowledge indebtedness to CONABIO for support.

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## Pseudoleptodeira (Serpentes) in Chiapas, Mexico

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The status of *Hysiglena latifasciata* Günther (1894) was most recently analyzed by Dowling and Jenner (1987), who concluded that it represents a monotypic genus, *Pseudoleptodeira* Taylor (1939), rather than the more inclusive genus *Leptodeira* Fitzinger (1843) where Duellman (1958) placed it.

Nevertheless the known geographic range of *P. latifasciata* remains today as portrayed by Duellman, in Colima and the valley of the Río Balsas in Michoacán, Guerrero, Morelos and Puebla.

It is therefore a considerable surprise to find that Eizi Matuda, an internationally respected botanist long a resident of Chiapas, caught a specimen of that species near Escuintla on the Pacific coast of Chiapas, in November, 1940. That locality is some 650 km SE of the nearest present record for the species, in Puebla, and is near enough Guatemala (about 75 km) to suggest that it may occur there also.

The specimen, UCM 39702, is an adult female 495 mm in total length, tail 96 mm. Its scalation and pattern are completely typical of the species: pupil vertical; scale rows 21-23-17, the drop to 19 occurring at ventrals 104 (left, row 5 or 6 lost) and 110 (right, row 3 or 4), and to 17 at ventrals 130 (right, 4 or 5) and 136 (left, 5 or 6); two apical pits on smooth dorsal scales; ventrals 190; subcaudals 69; supralabials 8-8; infralabials 10-10; preoculars 2-2; postoculars 2-2; 9 dark bands on body, 3 on tail; rear maxillary tooth not grooved.

Although the range extension here reported approximately doubles the known span of records for the species, and involves a zoogeographic area distinct from those previously represented, we do not doubt the authenticity of the Chiapas locality. Dr. Eizi Matuda lived many years on his finca La Esperanza but a few kilometers from Escuintla, and was a scientist skilled in making accurate observations. One of us (HMS) had spent a month on his finca in 1940, collecting herps in the vicinity, and Matuda continued collecting for him a short time thereafter; never did a problem arise regarding locality data.

The arid Río Balsas Valley seems to be the center of abundance of the species, but it is known farther north, in Colima, as well as now farther to the

south. Perhaps most surprising is the absence of any evident geographic variation; the Chiapas specimen exhibits no extremes not found elsewhere.

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## A Third Report of *Sceloporus subpictus* (Reptilia: Sauria) from Oaxaca, Mexico

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Although described 35 years ago, *Sceloporus subpictus* Lynch and Smith (1965) of Pacific slopes of Oaxaca, Mexico, remains poorly understood. Only one other report of the species, from a second locality, has appeared (Webb and Baker, 1969), in which the separate validity of *S. cryptus* Smith and Lynch (1967) on Atlantic slopes of Oaxaca was questioned. At present, only nine specimens have been reported, assuming the validity of *S. cryptus*. Furthermore, the species-group to which both *S. subpictus* and *S. cryptus* belong is not certain; both were originally placed in the *megalepidurus* group, largely on the bases of apparent oviparity and configuration of certain head scales, whereas other authors (e.g., Wiens and Reeder, 1997) have placed them in the *formosus* group (which is viviparous) on the basis of general similarity.

Thus five previously unreported specimens, one from a third locality (although all are within 25 km of each other), all in the University of Colorado Museum, are of special interest. Four (UCM 41118-21) are topotypes, from near San Andrés Chicahuaxtla, taken by Thomas MacDougall, 17-18 May 1967. One (UCM 56471) is from Cerro Yucuyagua, 8 km SSE Tlaxiaco, 3125m, taken 24 June 1981 by Tom Boyer, Karen Prescott and John Spengler. The latter is a subadult female, 40 mm SV. The others are adults, the one male 51 mm SV, the three females 53-60 mm SV. In all five, the dorsals are 34-37, the femoral pores 13-17; a single pair of large internasals between frontonasals and postrostrals.

The adult females were all gravid; one dissected had 10 uterine eggs, the superficial ones 5-6 mm in diameter. The peritoneum is black. In the male, the chest and midabdominal area have mostly light areas with scattered black pigment between the lateral abdominal semeions and the extensively black throat. Although extensively discolored, the dorsal pattern of a narrow dorsolateral and lateral light stripe is discernible on each side, and a black vertical bar extending from shoulder to the dorsolateral light line.

Although Webb and Baker (1969) recorded a greater maximum SV length (64 mm) in *S. subpictus* than previously recorded (57 mm), nearly matching the maximum recorded for *S. cryptus* (65.5 mm), the Atlantic and Pacific populations remain distinct in the nearly completely black ventral surfaces

in the largest males of *S. subpictus*, never in *S. cryptus*. An apparent difference not previously noted is that in *S. subpictus* a horizontal light line, bordered above and below by a black line, traverses the posterior surface of the thigh; no such marking is described in *S. cryptus*. Although the two species are similar in scalation, size and basic pattern, differences not now apparent may be expected to exist in life; all of the material we have examined has been discolored by excessive immersion in formalin. The wide separation of the two populations, one on Atlantic slopes in the drainage of the Río Papaloapan, the other on Pacific slopes in the drainage of the Río Verde, strongly suggests that they are taxonomically distinct, as do the few morphological distinctions now apparent.

The presence of 10 oviductal eggs in the one female examined suggests that *S. subpictus* is oviparous, inasmuch as related viviparous species (*S. formosus*, *S. malachiticus*) tend to have fewer (3-9; Fitch, 1970). Furthermore, Webb and Fugler (1969) reported that the female they caught July 20-30 was pregnant; most viviparous species would have given birth to their young by that time. Hence the present evidence is that both *S. subpictus* and *S. cryptus* are oviparous, and hence belong to the *megalepidurus* group rather than with the viviparous *formosus* group. They also have large internasals, as is characteristic of the *megalepidurus* group, but not the *formosus* group.

Nevertheless the *formosus* and *megalepidurus* groups appear to be closely related. Of interest is the common possession of a prefrontal concavity, little or not evident in most groups of the genus.

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## Some Enigmatic Identifications in Boulenger's 1897 *Sceloporus* Monograph (Reptilia: Sauria)

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### Abstract

Thirty specimens of *Sceloporus* from Mexico and Guatemala in The Natural History Museum, London, were reexamined to modernize their previous identifications as of Boulenger's 1897 monograph of the genus. The specimens we examined that he assigned to *S. acanthinus* proved to represent *S. f. formosus*, *S. f. scitulus*, *S. mucronatus omiltemanus* and *S. serrifer plioporus*; to *S. consobrinus*, *S. halli*; to *S. graciosus*, *S. jalapae*; to *S. ornatus*, *S. j. jarrovii*; to *S. scalaris*, *S. ochoterena* and *S. s. scalaris*; to *S. torquatus*, *S. m. mucronatus* and *S. t. torquatus*; to *S. undulatus*, *S. lunaei*; and to *S. variabilis*, *S. v. variabilis*, the latter of which are from an untenable locality (Jalisco). A few comments are added on the identity of a few other BMNH specimens of *Sceloporus* that were not reexamined.

It has long been evident that several species of *Sceloporus* (e.g., *S. torquatus*, *S. ornatus*, *S. consobrinus*, *S. spinosus*, *S. acanthinus*, *S. formosus*, *S. undulatus*, *S. graciosus*, among others) as recognized by Boulenger (1897) are composites of two or more species as they are at present understood. In some cases locality assures identity (e.g., *S. "undulatus"* from California is *S. occidentalis*), and in others the scale data are sufficient (e.g. *S. "spinosus"* with 2-2 femoral pores is *S. horridus*). In many cases, however, reexamination is necessary to assure current identity.

However, the failure of Boulenger to give catalog numbers for his material has made it difficult to reassign it, even though he recorded locality, collector, sex and nine characters for most specimens. Thus many of his identifications remain of uncertain validity. It is also evident that not all of the specimens in The Natural History Museum (formerly British Museum [Natural History], for which the long-accepted acronym BMNH is still retained) at the time that Boulenger wrote were included in the monograph.

With the helpful cooperation of the authorities of The Natural History Museum, we recently reexamined 30 specimens of *Sceloporus* from Mexico and Guatemala with particularly vexing Boulengerian identifications. The results are noted in the following.

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*Sceloporus acanthinus* Bocourt sensu Boulenger

Twenty-five specimens were examined. Nos. 81.10.31.6-7 were cited by Boulenger (1897: 497) as a male and female from "S. Mexico, Godman," although currently they are catalogued from "Jalapa," Veracruz, taken by Godman and Hoege. Boulenger noted that Günther (1890) referred them to *S. torquatus*. Actually they represent two species. No. 81.10.31.6 is a female *S. f. formosus* with the marked prefrontal concavity, diagonal black shoulder slash and blue throat characteristic of the species. The data do not agree well with Boulenger's figures (in parentheses): (1) S-V 68mm (83mm); (2) head length to rear of parietal, 13mm (17mm); (3) head length to rear of ear, 16mm (20mm); (4) tibia, 14mm (19mm) (measured apparently the way Boulenger did, the full length of the shank); (5) 4th toe from base of 5th, 19mm (23mm), including claw; (6) dorsals, 30(26); (7) dorsals in a head length, 6(6); (8) scales around midbody, 36(36); (9) femoral pores, 14-14(16-17).

No. 81.10.31.7 is a badly faded and soft male *S. serrifer plioporus*, having no prefrontal concavity, numerous black and light marks on top of head, and the black anterior and posterior borders of the nuchal collar, characteristic of the subspecies (the light edges of the collar are not discernible, presumably faded). Data compared with Boulenger's (numbered sequence as above) again do not compare well: (1) 50mm(59mm); (2) 12.5mm(13mm); (3) 14mm(14mm); (4) 12mm(13mm); (5) 15mm(16mm); (6) 32(27); (7) 10(7); (8) 34(38); (9) 11-13(14-14).

The eight specimens (89.11.13.56-63) referred by Boulenger (1897) to *S. acanthinus* from Omilteme (=Omiltemi), Guerrero, collected by H.H. Smith (actually by Salvin and Godman, fide the current catalog), in reality represent *S. formosus scitulus*. They are typical of the subspecies, having 29-33 dorsals, a distinct prefrontal concavity, a black slash in front of arm insertion, and other pattern features characteristic of the subspecies. The only similar species in that vicinity is *S. adleri*, which occurs at higher elevations, has more dorsals and a distinct pattern.

The specimen cited by Boulenger (1897) from "Southern Mexico," taken by Godman, is now no. 81.11.13.110, and is a large female *S. f. formosus*. It has 27 dorsals, the typical prefrontal concavity, dorsals with bluish tinge, and a black shoulder slash.

Fourteen specimens currently labelled *S. acanthinus*, added to the collection after Boulenger's monograph (1897) was published, were examined.

Eight, nos. 1903.9.30.35-42, were taken by Hans Gadow in "Oaxaca." All upon reexamination prove to be *S. f. formosus*, except for no. 1903.9.30.40 a *S. mucronatus omiltemanus*. Both taxa are widely distributed in Oaxaca (Lynch and Smith, 1965; Smith and Lynch, 1967).

No. 1903.9.30.46 was also taken by Gadow, at Xometla, Varacruz, and is *S. f. formosus*.

The other five labelled *S. acanthinus* but not included in Boulenger's monograph (1897), nos. 1905.9.30.47-51, are from La Perla, Veracruz, on the slopes of Mt. Orizaba at 6,000 ft., taken by Gadow. All are typical *S. f. formosus*.

We did not examine no. 94.7.26.24-25, the specimens from Hda. Rosa de "Jericho," Nicaragua, one of which was listed by Boulenger (1897: 497), but it was identified by Darrel Frost in 1989 as *S. malachiticus*. Presumably the specimen listed by Boulenger (1897: 497) for Bebedero, Costa Rica, now no. 94.11.15.8, is the same.

#### ***Sceloporus consobrinus* Baird & Girard sensu Boulenger**

The specimen referred to this species by Boulenger (1885: 230) is no. 71.7.11.9, from "Putla, Mexico," collected by Boucard. Boulenger still regarded it as an example of *S. consobrinus* in his generic monograph (1897: 488), although it was mentioned rather incidentally. This specimen has been a thorn in the side of sceloporologists for over a century, having been cataloged as *S. undulatus thayeri*, assigned to *S. pictus* (Smith, 1939) and most recently (Smith and Lynch, 1967: 28) thought to be *S. subpictus*.

Upon examination, the specimen proves to be the third known example of *S. halli*, recorded previously only from the type, from San José Lachiguirí (Dasmann and Smith, 1974), and from one specimen from 7.5 mi SE Tamazulapan (Smith, 1992). All localities are in southwestern Oaxaca, an area poorly known herpetologically. Although described and subsequently accepted as a subspecies of *S. megalepidurus*, Wiens and Reeder (1997: 39) assigned the taxon to specific rank, with which we agree.

As Boulenger noted, the specimen is soft, and also somewhat faded and scarred in various places. It is a subadult female, 44 mm S-V, with 46 dorsals, 16-18 femoral pores, and apparently (area damaged) 4 interfemoral pore scales. It has been compared directly with the holotype. They have the same distinctive pattern, with a broad, dark brown (apparently black anteriorly) lateral stripe (3-4 scale rows) passing above ear to eye (narrower on

head), bordered dorsally by a light line; 10 scale rows between light lines at midbody; a large black area extending between arm insertion and lateral nuchal pocket, bordered above by a distinct, broad light streak separating it from the lateral dark line and curving ventrad posteriorly toward axilla, at the upper edge of which is a small black spot. All of these features are present in both the holotype and present specimen. There are two rows of supraoculars but the lateral row is of relatively small scales.

The identification of this specimen as *S. halli* makes it clear that its locality "Putla" is the city of that name in Oaxaca, to which area the species is presumably limited. Therefore the specimens from there obtained by the same collector and cataloged at about the same time, referred to *S. graciosus* by Boulenger (1885; in 1897 with the locality "Puebla," in error), are not from "Puctla," Puebla, as suggested by Smith et al. (2000) for the present specimen.

*S. jalapae* appears to be broadly sympatric with various members of the *S. megalepidurus* group. As similar as they are in size and gross appearance, their isolating mechanisms would be an interesting study.

#### *Sceloporus graciosus* Baird and Girard sensu Boulenger

Boulenger (1885, 1897) adopted Yarrow's (1875) emendation of Baird and Girard's *S. graciosus*. Cited by Boulenger (1897) were two specimens listed from "Puebla," collected by Boucard. The locality was a misinterpretation of Putla, Oaxaca, and the specimens are now nos. 71.7.10.7-8. They are the same specimens cited by Boulenger (1885) under *S. graciosus*, but with the locality correctly cited as Putla. They represent *S. jalapae*, lacking postrostrals and otherwise conforming with the diagnostic characteristics of the species. Their data correspond reasonably well with those given by Boulenger (1987: 508).

The other specimens cited as *S. graciosus* by Boulenger (1897: 508) include the holotype of *S. jalapae* (said to be from "Jalapa," although the species has never been confirmed to occur in that vicinity; the locality likely was merely a shipping point), formerly no. 81.10.31.5, now 1946.8.10.31. We have confirmed that the name is properly applied to the species currently so designated. The rest, not reexamined, include one from British Columbia, collected by Lord, cited by Boulenger (now accompanied by a question mark in The Natural History Museum catalog); it may actually represent some other species, because *S. graciosus* is not now known to occur in Canada, although

it comes close to British Columbia in Washington (Stebbins, 1985: map 87). Also, the locality may be in error. The other two specimens cited by Boulenger, from Hemet Valley, Sand Diego Co., California, would be expected to represent *S. vandenburgianus*, formerly regarded as a subspecies of *S. graciosus*.

#### *Sceloporus ornatus* Baird sensu Boulenger

Two specimens added to The Natural History Museum after Boulenger's monograph appeared, but again probably identified by him, were referred to this species. They are nos. 1900.7.12.7-8, from Meadow Valley, 7,000-8,000 ft., Chihuahua, Mexico, collected by Brimley. Both are referable to *S. j. jarrovii*.

#### *Sceloporus scalaris* Wiegmann sensu Boulenger

Six specimens were examined. Nos. 68.3.3.33-34 from Atlixco, Puebla, collected by Boucard, and 80.4.7.18-19 from Hacienda del Hobo ("bobo" fide Boulenger, 1897: 516) are all correctly identified as *S. s. scalaris*. All have two canthals on each side, and two postrostrals. However, two specimens not reported by Boulenger (1897) but likely identified by him were taken near Tierra Colorado, Guerrero, by Hans Gadow (nos. 1906.6.1.187-188). They represent *Sceloporus ochoteranae*, having no postrostrals and otherwise conforming with the diagnostic characters of the species.

#### *Sceloporus torquatus* Wiegmann sensu Boulenger

Three specimens from "Jalapa," Veracruz, collected by Godman and Hoege, are cataloged as 81.10.31.10-12, and all were undoubtedly seen by Boulenger. However, only one from "Jalapa" is listed (p. 480), in the group of specimens with two or three rows of supraoculars, all of which have more recently been entered as *S. poinsettii*. In addition, that specimen was recorded with 12-14 femoral pores, and the only one of the three with that number is 81.10.31.10, which, along with 81.10.31.11, represents *S. m. mucronatus*. Other data agree reasonably closely with those given by Boulenger.

The third specimen is a small individual, 36 mm S-V, and is the only one of the three that actually represents *S. t. torquatus*. It has a reticulated throat and large supraoculars although one is split on one side, two on the other; such a variation occurs in a small proportion of the subspecies (Smith, 1939: 565).

The other specimens listed by Boulenger in the same table we have not seen. They include nos. 87.1.4.4-5 and 94.10.29.3-4 from Duvall Co., Texas;

1946.8.30.13-17 (formerly 89.11.13.49-53), from "Omiteme," Guerrero, all syntypes of *S. mucronatus omiltemanus*; xxiii.67a from "Mexico;" and 56.4.9.7 from an unknown locality (now entered as "?California").

*Sceloporus undulatus* (Bosc & Daudin) sensu Boulenger

The single specimen examined is no 64.1.26.392, taken by O. Salvin in "Yzabal" (Izabal), Guatemala. It is typical of *S. lunaei* Bocourt. The locality lies within the known range of the species, which is however reported from very few specimens.

The present individual is an adult male, 73 mm SVL, with an incomplete tail. It has 36 dorsals, 13-16 femoral pores, 1-1 canthals, and 3-4 large supraoculars of which the anterior one contacts the frontal on one side (no others contact the median head scales). The dorsum is uniform light brown; there is no black collar per se; eight light brown scale rows on the nape lie between the lateral nuchal pockets, except that the lower half of each lateral row is black; a diffuse-edged light streak extends from the posterior subocular area through the ear opening to the lateral nuchal pocket; otherwise the area between orbit and arm, below the lateral row of the nuchal scales, is black, continuous with the black on throat; the black mark on the sides of the neck extends posteriorly above the axilla to the groin as a black lateral stripe. Ventrally, a narrow, black-flecked light streak extends from the middle of the chest down the middle of the abdomen to the groin level; otherwise the abdomen and throat are completely black ventrally. The ventral surfaces of the hind legs and tail are light, black-flecked; a narrow black line extends lengthwise on the rear surface of the thigh, bordered dorsally by a light line.

Although this species has been regarded at times as a synonym or subspecies of *S. acanthinus*, the two taxa are allopatric and markedly different in pattern (the latter with a narrow, black collar lacking light borders, complete or narrowly interrupted medially). The supraoculars are also larger and more frequently in contact with the median head scales in *S. acanthinus*.

*Sceloporus variabilis* Weigmann sensu Boulenger

The only particularly suspicious listing for this species in Boulenger (1897: 517) is five (nos. 90.2.4.18-22) from "North of the Río Santiago," Jalisco, taken by H.H. Smith. We had assumed that the identification was wrong, because the locality is far out of the range of the species. To our surprise, the specimens are all *S. v. variabilis*; we conclude that the locality is in error. The

data given in Boulenger agree reasonably well with the data we have taken on the same specimens. All have a postfemoral dermal pocket, the dorsals vary from 53-58, two have 2-2 cathals (three with 1-1), and the posterior lateral scales on the trunk are small relative to the size in the closely related species *S. teapensis*.

Coincidentally, another specimen of *S. v. variabilis* is purportedly (Auth. et al., 2000) from Jalisco (11 mi NW Chapala) in the Strecker Museum, Baylor University (BCB 13269). The two localities are close to each other, and if indeed there is a population of that species in that area, it surely was introduced. We regard both records for the present as erroneous.

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## New Data of the Geographic Ranges of *Sceloporus belli* and *S. undulatus* in Chihuahua, Mexico (Reptilia: Sauria)

Julio A. Lemos-Espinal, Hobart M. Smith and David Chiszar

### Abstract

Collections made in 1999 of *Sceloporus* in Chihuahua, Mexico, indicate that *S. belli* extends throughout the eastern part of the state south of the range of *S. undulatus speari* (which reaches the Río Bravo del Norte), and that *S. u. consobrinus* is not yet known to occur anywhere in the state.

During the summer of 1999 JLE collected 150 specimens of *Sceloporus belli* Smith, Chiszar and Lemos-Espinal and *S. undulatus speari* Smith, Chiszar, Lemos-Espinal and Bell in Chihuahua, Mexico, mostly in the eastern part of the state. These specimens extend the known range of *S. belli* almost to the eastern border, and provide the southwesternmost locality for the species, although well within the range projected by Lemos-Espinal et al. (1999). We now hypothesize that *S. belli* reaches the Río Bravo del Norte, excluding *S. u. consobrinus* from the eastern part of the state as was conjectured in Lemos-Espinal et al. (1999).

Furthermore, discovery of *S. u. speari* in the sand dunes near Rancho Bandejas suggests that its range also reaches the nearby Río Bravo del Norte, to the exclusion of *S. u. consobrinus* in that area. That distribution conforms with the range of *S. u. speari* in New Mexico as depicted by Smith et al. (1999).

The revised ranges as now understood of these two taxa are indicated in Fig. 1, modified from the map in Lemos-Espinal et al. (1999), depicting the known range of all members of the *undulatus* group of *Sceloporus* in Chihuahua.

Data on the new material follow. Although JLE field numbers are cited, over half of the specimens will be catalogued in the collection of the Laboratorio de Ecología, Unidad de Biotecnología y Prototipos, Escuela Nacional de Estudios Profesionales Iztacala, Universidad Nacional Autónoma de México; and the remainder will be catalogued in the University of Colorado Museum.

*Sceloporus belli*

One hundred and forty-five specimens were taken. Twenty-three of those are from the southern central part of the state, well within the projected range of the species (Lemos-Espinal et al., 1999). Five of those (JLE 4036-40) were taken from a rock fence between fields near Balleza, 800m from the gas station on the Puerto Justo highway, 1638m (26°55'48.3"N, 106°20'57.3"W). That locality is the westernmost recorded for the species in southern Chihuahua, about 150 km west of the nearest previous locality of record, near Jiménez. The other 18 (JLE 4059-76) were taken July 28 from fence posts (except one on mesquite) near Carril El Píal, a horse racetrack 5 km west of Jiménez on the Hidalgo del Parral highway, 2272m (27°7'57.4"N, 104°58'20.4"W).

in these southern central specimens, the greatest SVL (females in parentheses) was 72 mm (73 mm), the smallest 56 mm (56 mm), mean 63 mm (63 mm). The gular semeions are fused and show no medial division in all 11 males. In the 12 females, all but one (92%) have the dorsolateral light stripe invaded by the paravertebral dark bars; faint, diffuse, paired gular semeions are present in 4 (33%), none in 8.

The more "eastern" material, all from farther north, includes 122 specimens. Of those, 57 are from south of the Río Conchos: JLE 3476-80, 3586-8, 3590, 3598-3602, on rocks on Cerro La Cañada, near La Perla (=El Berrendo) (28°17'59.8"N, 104°33'5.0"W), 1621m, July 4-6; JLE 3603-4, 3616-8, 3634-42, 3662-5, 3704-6, on boulders (except one on a fence post) near Polvorillas (=Piedras Encimadas) (mostly at 28°47'36.2"N, 104°13'30.8"W), 1476m, July 6-8; JAL 3686-98, 3712-20, on mesquite at Llano El Nito (a plains area lacking boulders, ~1.5 km NW Polvorillas), July 8-9.

The remaining 65 specimens of the 122 from eastern Chihuahua are from north of the Río Conchos: JLE 3767, 3769-75, 3780, on buildings, fence posts and mesquite near Ejido Ojo del Carrizo (29°58'27.5"N, 105°15'45.8"W), 82 km N Coyame, 1459m, July 12-13; JLE 3786-7, 3806-29, 3851-62, on bushes, opuntias and yuccas at Lomas El Berrendo, km 42 of the Coyame-Ojo del Carrizo road (29°42'16.5"N, 105°19'34.9"W), 1633m, July 13-14; JLE 3844-5, km 38 on the same road (29°40'8.7"N, 105°19'10.9"W), 1510m, July 15; JLE 3801, km 20 on the same road (29°35'45.5"N, 105°13'15.0"W), 1522m, July 14; JLE 3917-8, on yuccas at Arroyo El Pujido, Puerto El Gallo, 40 km E Moctezuma, 1559m (30°8'2.0"N, 106°4'56.4"W), July 21; JLE 3923, on a fence post 24 km E Moctezuma on same road (30°10'0.0"N, 106°13'16.9"W), 1463m,

July 21; JLE 4219 on *Yucca elata*, Rancho La Paloma (29°47'42.4"N, 105°20'24.9"W), 1660 m, August 28; JLE 4221-3, on *Yucca elata* in grassland between Rancho La Paloma and Rancho El John (29°47'55.6"N, 105°21'43.7"W), 1570 m, August 29; JLE 4236-8 on *Yucca torreyi* at Rancho Agua Zarca (29°52'39.3"N, 105°26'1.4"W), 1510 m, August 29; JLE 4291-2, fence posts 1.5 km SE Rancho Agua Zarca (29°50'50.6"N, 105°24'46.2"W), August 31; JLE 4256, on *Yucca elata* on semistabilized sand dunes, Rancho La Bamba (30°5'11.7"N, 105°24'30.8"W), 1380m, August 30; JLE 4262, on *Yucca torreyi* at Rancho La Bambita (30°17'41.5"N, 105°26'53.8"W), 1460m, August 30; and JLE 4313, on a bush in grassland near Cerro Santa Anita (29°40'14.1"N, 105°19'13.6"W), September 1.

The 120 mature "eastern" specimens averaged slightly smaller than the southern central ones, due in part to having been collected (except for 11) earlier in the season. The difference was significant in males ( $t=2.35$ ,  $df=88$ ,  $P<0.05$ ), not in females ( $t=0.69$ ,  $df=51$ ,  $P>0.05$ ). The largest male had a SVL of 69mm (vs 72mm), the largest female 70mm (vs 73mm); the smallest male was 50mm in SVL (vs 56mm), the smallest female 54mm (vs 56mm); the mean male SVL ( $n=79$ ) was 59.5mm (vs 63mm), in females ( $n=41$ ) 61.8mm (vs 63mm). One eastern male had a completely (but narrowly, 2 scales) split gular semeion, fused in all others, but 53 (67%) showed a slight to a 75% split down the middle of the semeion (vs none;  $\chi^2=17.64$ ,  $df=1$ ,  $P=<0.05$ ). Sixteen of the eastern females had faint, diffuse, paired gular semeions, and 3 had distinct, small ones, for a total of 46% (vs 33%;  $\chi^2=0.63$ ,  $df=1$ ,  $P=>0.05$ ). Four females (10%) failed to have the dorsolateral light lines invaded by the paravertebral dark bars (vs 8%;  $\chi^2=0.02$ ,  $df=1$ ,  $P=>0.05$ ).

The differences here noted between eastern and south-central samples in size and partial split of the gular semeions merit further geographic analysis. Specimens from northwestern Chihuahua are even larger than the south-central ones (SVL M=68.1,  $n=24$  in males), but their gular semeions are frequently partially divided, as in the eastern samples (Lemos-Espinal et al., 1999).

A hatchling male (JLE 3771), 20mm SVL, was taken July 13 at Ojo del Carrizo; it had no ventral pigmentation but the typical female dorsal pattern. A hatchling female (JLE 4237) 26.5mm SVL, with a fully displayed female dorsal pattern, was taken August 29 at Rancho Agua Zarca.

The 63 adult specimens from north of the Río Conchos were taken at two different times: 52 July 12-21, and 11 August 28-September 1. The later

group averaged 4-5mm greater in SVL (males 61.5mm, n=7; females 65.5mm, n=4) than the earlier group (58mm, n=33; 61mm, n=19), suggestive of the rate of growth during that period.

Inasmuch as all specimens taken were mature, except for two hatchlings, it appears that reproductive maturity is reached the first year. Growth appears to continue into the second season and probably beyond, in order to reach the maximum SVL recorded (88mm in northwestern Chihuahua (Lemos-Espinal et al., 1999).

The three specimens (now UCM 60531-3) from near Coyame referred by Lemos-Espinal et al. (1999) to *S. u. consobrnus* are actually typical of eastern *S. belli*, which at that time was insufficiently sampled to permit proper identification. As noted previously, eastern specimens are distinctly different from western and southern central ones.

The present series of *S. belli* exhibits a rather striking unique feature in large males not noted before: the presence of a light blue spot in the center of each scale on the dark sides of the trunk. Some smaller males, nearing maximum size, exhibit similar light spots, but they are light brown, not blue. They may appear blue only in the second or later years, during the breeding season.

### *Sceloporus undulatus speari*

Five specimens were taken, including two (JLE 3875-6) from near the rest stop at km 307.65, 11.2 km S Samalayuca, Hwy 45, July 18; and three (JLE 3892-4) from yuccas on the sand dunes near Rancho Bandejas (31°18'0.3"N, 106°4'50.3W), 1170m, July 19. The first locality has been recorded previously (Smith et al., 1995), but the second extends the known range of the subspecies eastward close to the Río Bravo del Norte (Fig. 1). The three specimens from the latter locality are typical of the subspecies, with broad, well-defined dorso-lateral light stripes, and the paravertebral dark spots reduced in size to a single scale each, or less, sometimes connected longitudinally but not expanded transversely. The specimens were mature adults of small size, the pregnant female 63 mm SVL, the two males 49 and 52 mm.

### Acknowledgment

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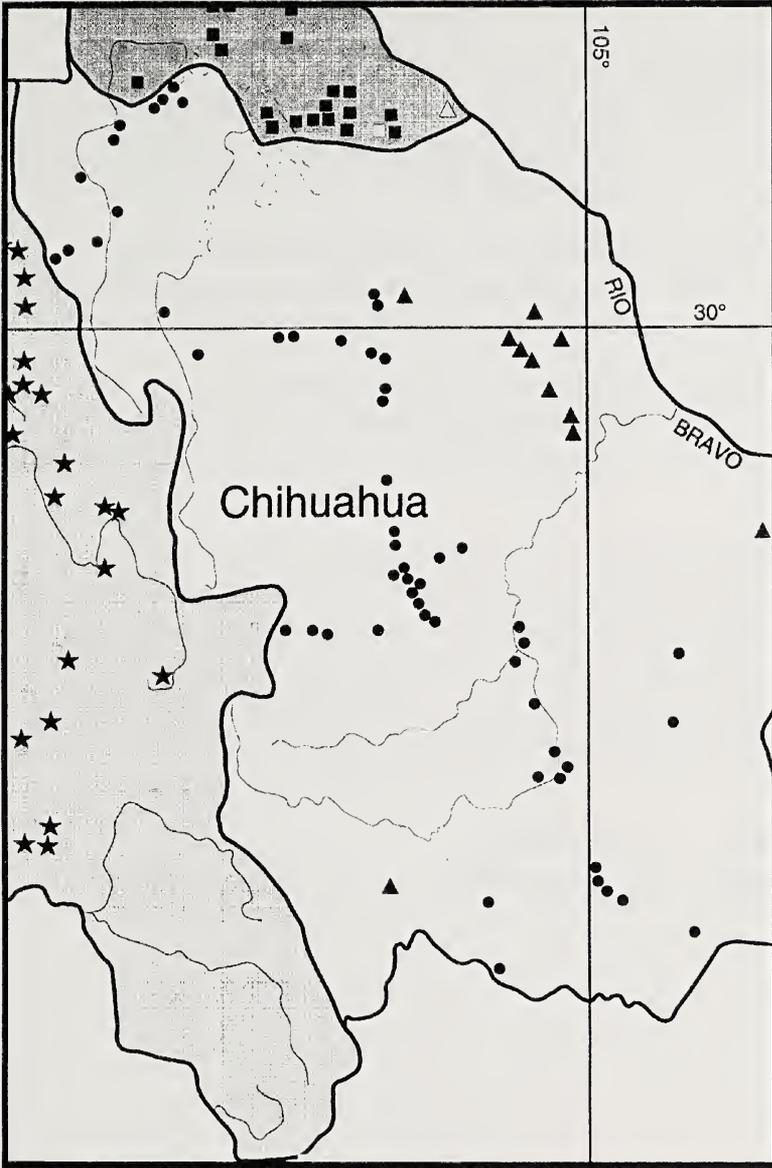


Fig. 1. Distribution of *Sceloporus belli* (lightest shading, round dots), *S. undulatus speari* (darkest shading, squares) and *S. virgatus* (intermediate shading, stars) in Chihuahua. Spots indicate localities from which specimens have been examined. In the range of *S. belli* and of *S. u. speari*, the triangles indicate records here reported for the first time. The hollow square in the range of *S. u. speari* indicates a locality of sympatry with *S. belli*. Map modified from Lemos-Espinal et al. (1999: 155, fig. 1).

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## Book Review

### **Fossil Snakes of North America, Origin, Evolution, Distribution, Paleoecology, 2000.**

J. Alan Holman, Indiana University Press, Bloomington. vii-xi + 357 pp.  
ISBN 0-253-33721-6. Cloth. US \$69.95.

Not since Charles W. Gilmore comprehensive study of North American fossil snakes in 1938, has anything comprehensible been published of such magnitude on the fossil snakes of North America. Rage (1984) reviewed the fossil snakes on a world wide basis, but not nearly as comprehensive as the present volume which covers a more restricted area.

The present volume opens with a historical account of the origin of snake, and the author feels that the origin still remains cloudy, although he does recognize *Pachyrachis*, *Lapparentophis* and *Dinilysia* from the Cretaceous as being the most primitive, and well studied. The author felt that intraspecific variability of individual cranial bones of snakes need further study, and would make an ideal project for an upcoming student in vertebrate paleontology.

The author describes the various cranial, and vertebrae elements which are of significance in identification of fossil snakes, which closely follows Szyndlar (1984). He feels that ribs are of little significance for present day identification. The key character for identification of fossil snakes relies on the vertebrae, and this characteristic is used throughout the volume, although the author cautions anyone without a large comparative collection of skeletal material at hand, should not try to identify fossil snakes on the basis of written descriptions alone.

Chapter two comprises some 214 pages providing detailed systematic accounts of the genera and species, with complete information on the allo-type, etymology, diagnosis of the holotype, revisionary notes and general notes on each species of fossil serpent within the United States. The book contains illustrations of diagnostic vertebrae and other criteria for the identification of presently living fossil snake taxa as well as the modern characteristics and ranges of these species.

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*News and Notes*

Chapter three provides a complete listing of North American fossil snake localities categorized in alphabetical order of provinces and state within each designated unit of geological time (Cretaceous, epochs of the Tertiary, and Pleistocene).

The author also provides 48 excellent color plate of living examples for most of the species cited within the text.

The book closes with an epoch-by-epoch discussion of the zoogeographic, paleoecologic, and evolutionary patterns in Mesozoic, Tertiary, and Quaternary North American fossil snakes. During the Pleistocene fossil snakes have indicated range adjustments to glacial advances and retreats, as well as the a remarkable evolutionary stasis of the group during this era. An epilogue dwells on the future of snakes in the modern world.

A unique aspect is the author provides not only an excellent bibliography, which is followed by a general index, taxonomic index, and also a site index which will be extremely helpful for anyone just interested in a specific state.

The major fault with this volume is that the author failed to provide a guide, or key for North American recent snake comparative osteology, which would be essential for the study of fossil material.

In summary, this is an excellent book, and one that few herpetologists and palaeontologists can do without.

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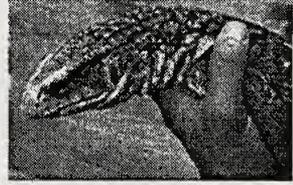
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THIS BOOK IS IN THE FORM OF A GALLERY GUIDE TO A REMARKABLE EXHIBIT OF ILLUSTRATED HERPETOLOGICAL books dating from the 16th to the 20th centuries. It results from a display arranged by the Kenneth Spencer Research Library of the University of Kansas on the occasion of the 1996 SSAR meeting held at the university. Books such as these, many of which have exquisitely handcolored illustrations by some of the greatest natural history artists, are today kept under lock and key in institutional libraries and therefore are scarcely known to most herpetologists, but the enthusiasm of the SSAR conference goes for the Kansas exhibit has encouraged us to make this printed version available. The author, Sally Haines, Associate Special Collections Librarian at the Spencer Library, is in charge of the natural history collections.

The bulk of this volume consists of full-color reproductions of illustrations from classic works together with extensive captions containing information about the authors, the artists, and the books. It is an iconography of herpetology and an essential part of the history of the field.

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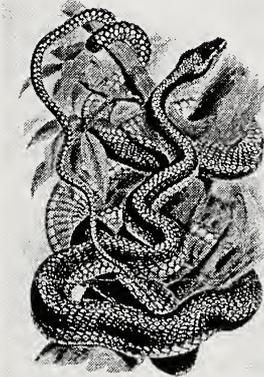
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## THE HERPETOFAUNA OF NEW CALEDONIA

by AARON M. BAUER and ROSS A. SADLIER

with French summaries by Ivan Ineich and 189 color photographs

NEW CALEDONIA, INCLUDING THE LOYALTY ISLANDS and an associated group of smaller islands and reefs, is a French territory located in the tropical Southwest Pacific equidistant from New Guinea, New Zealand, and Australia. This ancient group of islands supports one of the most highly endemic and species-rich herpetofaunas in the Pacific region. Among the 71 species of terrestrial reptiles, 86% are endemics, and most belong to endemic genera. Despite being only 2.5% the size of New Guinea, New Caledonia has 36% as many lizard species. In addition, the New Caledonian barrier reef system, one of the largest and most diverse in the world, is inhabited by a dozen species of seasmakes. Because of the diversity of its flora and fauna and the fragility of its habitats, New Caledonia is regarded as a biodiversity "hot spot," one of the earth's biologically richest and most endangered terrestrial ecoregions.

This book—at the same time a scientific monograph and a field guide—is the first modern review of the amphibians and reptiles of New Caledonia. It covers the frogs, family Hylidae (1 species), geckos of the families Diplodactylidae (20) and Gekkonidae (6), the Scincidae (42), snakes of the families Boidae (1), Elapidae (12, all marine), and Typhlopidae (2), and the sea turtles, Cheloniidae (3). Geckos and skinks, in fact, are the most numerous and dominant terrestrial vertebrates in New Caledonia. These two groups have undergone extensive generic and specific diversification, including the world's largest living geckos (*Rhacodactylus*) and more than a dozen genera of skinks including the giant skinks (*Phoboscincus*).

The authors, Aaron M. Bauer (USA) and Ross A. Sadlier (Australia) are both noted authorities on the Pacific herpetofauna. Their extensive field work in New Caledonia began more than 20 years ago. As a result of their research, numerous new genera and species of New Caledonian geckos and skinks have been described and named, but this book represents the first synthesis of their 20 years of study.

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- Systematic Accounts of Genera and Species: Keys; Synonymies; Descriptions; Distribution (spot map for each species); Natural History; Conservation Status; Remarks and Status
- Incidental Taxa, Taxa of Questionable Occurrence, and Those Erroneously Recorded from New Caledonia
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- Literature Cited and Bibliography of New Caledonian Herpetology (more than 1000 references)
- Gazetteer of Place Names; Index to Scientific Names

The 153 color photographs of animals depict nearly every species. There are also 36 photographs of New Caledonian habitats.

*Specifications:* 325 pages, 7 × 10 inches (18 × 22.5 cm), plus 189 color photographs of animals and habitats on 24 plates, 47 maps, 63 figures, and 4 tables. Clothbound. ISBN: 0-916984-55-9. To be published December 2000.

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## News and Notes

A New Book from the Society for the Study of Amphibians and Reptiles

# THE HERPETOFAUNA OF NEW CALEDONIA

by AARON M. BAUER and ROSS A. SADLIER

with French summaries by Ivan Ineich and 189 color photographs

NEW CALEDONIA, INCLUDING THE LOYALTY ISLANDS AND AN ASSOCIATED group of smaller islands and reefs, is a French territory located in the tropical Southwest Pacific equidistant from New Guinea, New Zealand, and Australia. This ancient group of islands supports one of the most highly endemic and species-rich herpetofaunas in the Pacific region. Among the 71 species of terrestrial reptiles, 86% are endemics, and most belong to endemic genera. Despite being only 2.5% the size of New Guinea, New Caledonia has 36% as many lizard species. In addition, the New Caledonian barrier reef system, one of the largest and most diverse in the world, is inhabited by a dozen species of seasnakes. Because of the diversity of its flora and fauna and the fragility of its habitats, New Caledonia is regarded as a biodiversity "hot spot," one of the earth's biologically richest and most endangered terrestrial ecoregions.

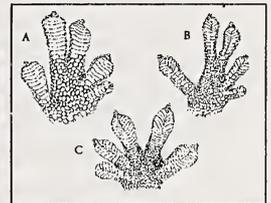
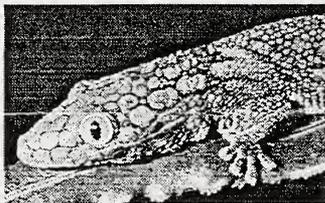
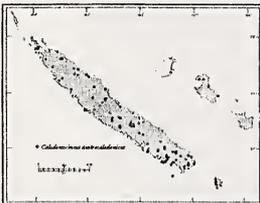
This book—at the same time a scientific monograph and a field guide—is the first modern review of the amphibians and reptiles of New Caledonia. It covers the frogs, family Hylidae (1 species), geckos of the families Diplodactylidae (20) and Gekkonidae (6), the Scincidae (42), snakes of the families Boidae (1), Elapidae (12, all marine), and Typhlopidae (2), and the sea turtles, Cheloniidae (3). Geckos and skinks, in fact, are the most numerous and dominant terrestrial vertebrates in New Caledonia. These two groups have undergone extensive generic and specific diversification, including the world's largest living geckos (*Rhacodactylus*) and more than a dozen genera of skinks including the giant skinks (*Phoboscincus*).

The authors, Aaron M. Bauer (USA) and Ross A. Sadlier (Australia) are both noted authorities on the Pacific herpetofauna. Their extensive field work in New Caledonia began more than 20 years ago. As a result of their research, numerous new genera and species of New Caledonian geckos and skinks have been described and named, but this book represents the first synthesis of their 20 years of study.

#### Organization of the Book

- Geography, Vegetation, Geological History, and Biogeography
- Ecological Patterns of Terrestrial and Marine Species
- Conservation
- Humans and the Herpetofauna, including a History of Scientific Studies
- Systematic Accounts of Genera and Species: Keys; Synonymies; Descriptions; Distribution (spot map for each species); Natural History; Conservation Status; Remarks and Status
- Incidental Taxa, Taxa of Questionable Occurrence, and Those Erroneously Recorded from New Caledonia
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All correspondence should be addressed to the Executive Editor. Manuscripts being submitted for publication should be typewritten (double spaced) on good quality 8 1/2 by 11 inch paper with adequate margins. Submit original and first carbon, retaining the second carbon. If entered on a word processor, also submit diskette and note word processor and operating system used. Indicate where illustrations or photographs are to appear in text. Cite all literature used at end in alphabetical order by author.

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Reprints are available at \$.07 a page and should be ordered when manuscripts are submitted or when proofs are returned. Minimum order is 100 reprints. Either edited manuscript or proof will be returned to author for approval or correction. The author will be responsible for all corrections to proof, and must return proof preferably within seven days.

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**BULLETIN OF THE**

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Volume 37 Number 1

March 2001

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The Maryland Herpetological Society  
Department of Herpetology, Natural History Society of Maryland, Inc.

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## ***Rhadinaea hesperia* (Serpentes) in Oaxaca, Mexico**

Hobart M. Smith, Mario Mancilla Moreno  
and David Chiszar

*Rhadinaea hesperia* Bailey is a rather widely distributed species of small, striped, opisthoglyph snakes endemic to Mexico and known to range from southern Sinaloa to central Guerrero and Morelos (Myers, 1974). It exhibits considerable geographic variation, prompting Smith (1942) to propose recognition of three subspecies. Myers (1974) examined considerably more material (50 specimens), and concluded that recognition of subspecies was premature, although geographic variation is considerable and only partly clinal.

Three specimens of the species in the University of Colorado Museum from Cerro San Felipe, Oaxaca, taken by Thomas MacDougall in February, 1968 (UCM 41192-3), and in 1971 (UCM 52584), extend the known range of the species some 305 km southeastward from the closest previous record (Cuautla) in Morelos (Myers, 1974: 66). This constitutes the first record for Oaxaca (Casas-Andreu et al., 1996). All three are males, the largest 411mm in total length, tail 150mm. The numerous ventrals (152, 157, 163), and the reduced number of subcaudals (105, 105, 110), conform with the counts given by Myers (1974: 84) for Guerrero and Morelos material of *R. hesperia*. The present subcaudal counts are lower than the minimum Myers (*loc. cit.*) cited of 110 for males, but he had none from Morelos. Female subcaudal counts are lower there (104) than elsewhere (109), hence the lower male subcaudal counts here recorded are consistent. No. 41192 is anomalous in having a total of 36 subcaudals entire. Other scale counts are normal for the species.

The pattern is virtually identical with that depicted by Myers (1974: 61) for Morelos specimens, particularly in the relatively very dark sides from the ends of the ventrals to the 5th scale row, where a narrow dark line marks the edge of the dorsolateral light stripe in the 6th scale row and the edges of the adjacent 5th and 7th rows. A narrow dark line is on the vertebral scale row, and a less distinct one on the 7th scale row, marking the lateral border of the median brownish area.

Topographically Cerro San Felipe, on the southern slopes of the Sierra de Ixtlán (or Aloapaneca), is more or less continuous with the northern slopes of the Sierra Madre del Sur in Morelos, and therefore the occurrence of morphological similarity in the samples of *R. hesperia* from those two areas makes

zoogeographic sense. Numerous other taxa are shared by both areas. Indeed, Myers (1974: 85) noted that "populations from the upper Río Balsas drainage, in the Sierra Madre del Sur of Guerrero and the Cordillera Volcanica of Morelos" all share a described suite of characters to which the holotype fits "in all particulars, and so the name *Rhadinaea hesperia hesperia* Bailey is applicable if subspecies are recognized."

It seems likely that a careful analysis of geographic variation in the species will discern valid subspecies, but at present they cannot be supported.

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Smith, H. M. 1942. Descriptions of new species and subspecies of Mexican snakes of the genus *Rhadinaea*. Proc. Biol. Soc. Washington 55: 185-192.

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## The Distribution of *Sceloporus acanthinus* (Reptilia: Sauria) and its Relationships

Hobart M. Smith, David Chiszar and Rosanne Humphrey

### Abstract

*Sceloporus acanthinus*, *S. stejnegeri* and *S. tanneri*, all apparently constituting a single superspecies, are compared in the light of four previously unreported specimens, including males, of the latter species, and of a review of literature records for *S. acanthinus*.

*Sceloporus acanthinus* Bocourt (1873) has been one of the most frequently misinterpreted species of the genus, primarily because of the paucity of material from throughout its geographic range. Although the name was properly allocated to a Pacific slopes species of Guatemala, and redescribed by Smith (1939), most subsequent applications of the name to populations elsewhere have been erroneous. Even in 1939 the presumed representatives of the species in El Salvador were known to exhibit marked differences from Guatemala populations, as agreed by Stuart (1971).

The only other agreed range extension reported beyond Guatemala has been in extreme southeastern Chiapas, near the Guatemala border, first by Smith (1949), although the name there used was *S. malachiticus acanthinus*. Stuart (1971) subsequently examined material from the same area in Chiapas, as well as elsewhere, and argued that *S. acanthinus* is allospecific relative to all other "malachite" species of the genus in Central America and adjacent Mexico, including *S. internasalis*, *S. malachiticus*, *S. smaragdinus* and *S. taeniochneis*.

As early as 1890 Günther erroneously reported the species from Xalapa (=Jalapa), Veracruz. Examination of those specimens (Smith et al., 2001) revealed that one represents *S. f. formosus* (another member of the same group as the "malachite" lizards), the other *S. serrifer pliporus*, a member of the *torquatus* group. Boulenger (1897) accepted Günther's identification as *S. acanthinus*, but erroneously stated that Günther had referred them to *S. torquatus*.

Then in 1905 Gadow erroneously reported the species from Cerro San Felipe, a few kilometers north of Cd. Oaxaca, and from Omiltemi, Guerrero.

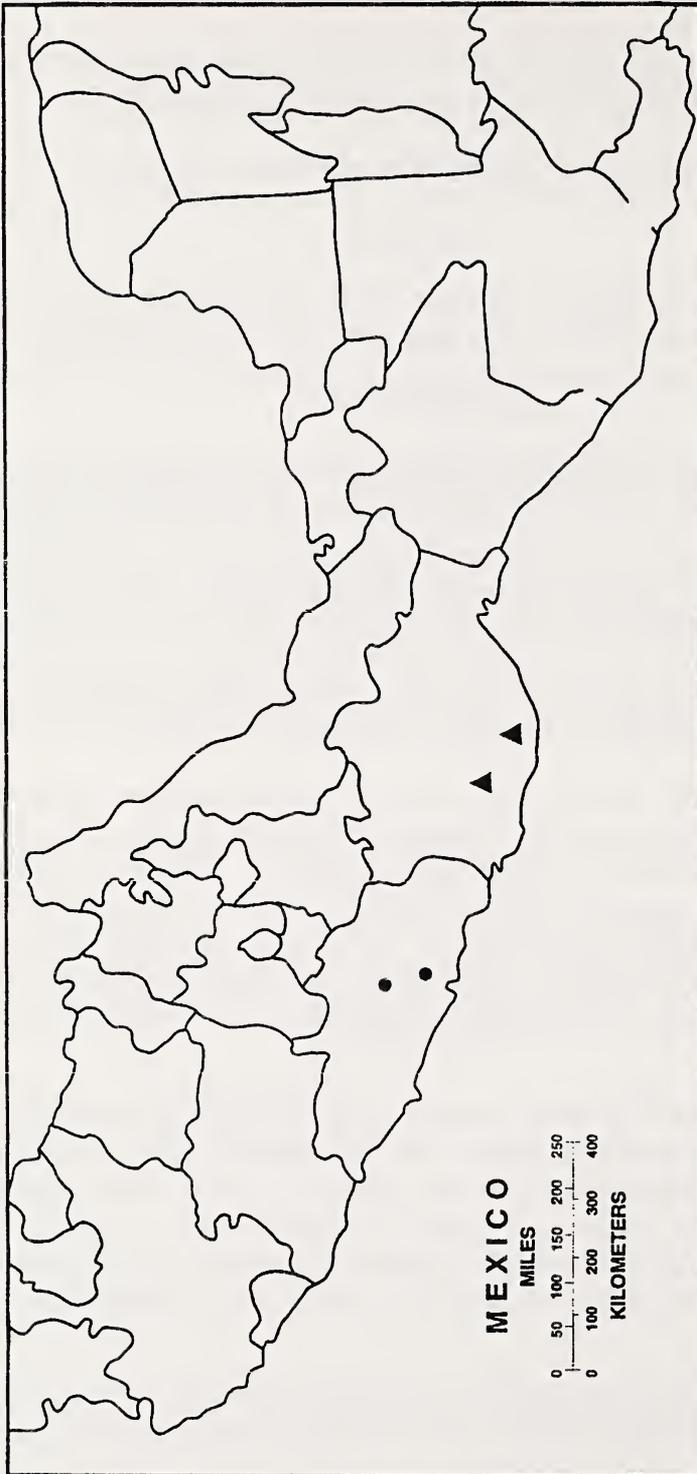


Fig. 1. Distribution of the members of the *Sceloporus acanthinus* superspecies. Two dots in the state of Guerrero, *S. stejnegeri*; two triangles in the state of Oaxaca, *S. tanneri*; shading in southeastern Chiapas, Guatemala and El Salvador, *S. acanthinus*. Base map courtesy Roger Conant.

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The 8 specimens from Oaxaca, are actually *S. f. formosus*, except for one *S. mucronatus omiltemanus* (of the *torquatus* group), and the 8 from Guerrero are all *S. formosus scitulus* (Smith et al., 2001).

In 1934 Ahl erroneously reported *S. acanthinus* from "Xochitempa, bei Chilapa," Guerrero. We have not seen that material but probably the species represented actually was *S. formosus scitulus*, the most widely distributed representative of the group in Guerrero. It could, however, represent *S. stejnegeri*, which is recorded from similar high altitude at Filo de Caballo, Guerrero (Saldaña de la Riva and Pérez Ramos, 1987).

Gaige (1936) and Pearse (1945) erroneously reported the species from Chichén Itzá. As noted by Smith (1939), that material represented *S. lundelli gaigeae* of the *lundelli* group (Wiens and Reeder, 1997).

Booth (1959) erroneously reported *S. malachiticus acanthinus* from Pueblo Nuevo Solistahuacán, northern Chiapas. No description was given, and we have not examined the reported material, but Stuart (1971) reported *S. internasalis* and *S. taenioconemis hartwegi* from the same locality. We presume the species represented by Booth's material was the former, which has a single row of large supraoculars – a distinguishing character of *S. acanthinus*.

Most recently, Smith and Williams (1963) erroneously reported *S. malachiticus acanthinus* from Río Mono Blanco, Oaxaca, near Cerro Baul. The large number of dorsals reported for their material (54-58) completely eliminates *S. acanthinus* from consideration. According to Stuart's (1971) revision (which did not take into account the Smith and Williams record), only *S. smaragdinus* would likely be represented by their material.

Part of the reason for confusion of *S. acanthinus* with other species of the *formosus* group is what at one time (Smith, 1939) was regarded as a unique feature of the species: very large supraoculars, the rear one or two in contact with the median head scales – a feature suggestive of the *spinatus* group, in which Smith (1939) placed the species. It has since then become apparent that the relatives of *S. acanthinus* are found in the similarly bluish ("malachite") *formosus* group, and that the enlarged supraoculars occur in a number of species of that group.

Smith and Larsen (1975), in describing *S. tanneri* of southern Oaxaca, proposed that that species, *S. stejnegeri* of southern central Guerrero and *S. acanthinus* constitute a single superspecies. All three species are widely iso-

lated but very similar in pattern, scalation and size. The Guerrero and Chiapas species occur at surprisingly diverse altitudes, from 150 to 1225m for *S. acanthinus* (Stuart, 1971), and 274m to 2175m for *S. stejnegeri* (Saldaña de la Riva and Pérez Ramos, 1987). Field notes of the collector, Thomas MacDougall, on previously unreported material of *S. tanneri*, indicates that it occurs at an intermediate altitude – 4,000'-5,000'.

The new material of *S. tanneri* is partly (UCM 52606) from the type locality, Santa Rosa, nr Lachao, dist. Juquila, Oaxaca; that specimen is of the same sex (female) as the two types, and is completely desiccated and discolored. It was taken in July, 1972 – later in the same year as the types. The other three specimens (UCM 39832-4) are all males, including two adults and one neonate, from north (5,000') and west (4,000') of Figueroa, dist. Pochutla, Oaxaca, Febr. 16, 1969. The adult males are discolored and stiff from overimmersion in formalin, but the neonate has retained its pattern, very similar to that depicted for the juvenile in Smith and Larsen (1975).

Inasmuch as males have not previously been reported for the species, we note that their ventral coloration is different from that of *S. acanthinus*, having the dark medial borders of the lateral abdominal semeions separated throughout their length, rather than united anteriorly, and failing to cross the chest to join the black collar around the neck.

The dorsals are 31 in the female, 37 in both adult males, and 36 in the neonate; they are consistently fewer in the three known females than in the three known males. The femoral pores are 15-15 and 16-17 in the adult males. The black nuchal collar, 2-3 scales wide on dorsal and lateral surfaces, is interrupted middorsally by a space 2-3 and two half scale rows. All 4 new specimens have 2-2 canthals and large supraoculars in a single row; the rear supraocular is broadly in contact with the median head scales in all three males, but not in the female.

Smith and Larsen (1975) distinguished *S. tanneri* from *S. acanthinus* in part by having two canthals instead of one, citing Stuart (1971) as authority for the latter species. Indeed Stuart's key does distinguish *S. acanthinus* and *S. smaragdinus* by "generally" having a single canthal, but by mistake; as amply evident elsewhere in the article, *S. acanthinus* generally has two canthals, as was recorded by Smith (1939). The supposed distinction in dorsal scale count is negated by the higher counts on the male *S. tanneri*, now leaving the differences between the two species in ventral male pattern and generally more numerous femoral pores (30-34) in *S. tanneri* than in *S. acanthinus* (24-30). It is

likely that comparisons of fresh material of both species would reveal other differences in pattern and coloration.

*S. stegnegeri* differs from both *S. acanthinus* and *S. tanneri* in having all of the supraoculars in contact with the median head scales, and in lacking dark medial borders on the abdominal semeions of males, fide Smith (1942). The supposed distinction from *S. tanneri* in number of dorsals does not exist in view of the large number here reported in males of the latter species.

### Acknowledgments

We are much indebted to Dr. Alan de Quieroz, Curator of Zoology in UCM, and to Dr. Robert Eaton, Chairman of the Department of EPO Biology, University of Colorado, for space and facilities; and to Deborah Aguiar for finalization of the map.

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## A Review of the Stripeless Snake (*Coniophanes lateritius*) Complex of Mexico

Paulino Ponce-Campos and Hobart M. Smith

### Abstract

Variation in *Coniophanes l. lateritius* Cope is reviewed, a new species, *C. sarae*, is described, and *Tachymenis melanocephala* Peters, formerly regarded as *C. l. melanocephalus*, is elevated to the rank of species, *C. melanocephalus*. Thus we interpret the *C. lateritius* complex to consist of three species, *C. lateritius*, *C. melanocephalus*, and *C. sarae*.

The most recent critical analysis (Wellman, 1959) of the exceptionally rare snake *Coniophanes lateritius* Cope recognized two subspecies, *C. l. lateritius* and *C. l. melanocephalus*. At the same time he recorded a specimen, referred to *C. l. lateritius*, from the Coalcomán region of Michoacán. However, he noted that the specimen was orange rather than red in dorsal coloration, and "might represent a distinct race living on the Pacific slopes of the Sierra de Coalcomán."

One of us (PPC) collected another specimen from the Coalcomán area which conforms with Wellman's specimen. We agree that the population of that area is taxonomically distinct from more northern populations, and here name it

### *Coniophanes sarae*, sp. nov.

*Coniophanes l. lateritius* (nec Cope), Wellman, 1959: 127-128.  
Michoacán Stripeless Snake

*Holotype*. Museo de Zoología, Facultad de Ciencias, UNAM (MZFC) 13030, from near Tehuantepec, municipality of Chinicuilá (18°42'07.7"N, 103°18'22.3"W), 1390m, Michoacán, collected by Paulino Ponce-Campos 1-5 July 1999.

*Paratype*. UMMZ (symbolic codes from Leviton et al., 1985) 118958, 12 mi S Arteaga, municipality of Arteaga, 884m, Michoacán, collected by John Wellman 23 June 1958.

*Definition and diagnosis*. A *Coniophanes* with 19 scale rows, a black head and unicolor body. Differing from both *C. lateritius* and *C. melanocephalus* in

having an orange dorsal coloration of the body, as opposed to bright red. Also differing from the former in lacking a black border posterior to the narrow light ring following the black head and neck, and in having melanophores evenly distributed on back and sides rather than being much more dense toward middorsum and tail. Additional differences from *C. l. melanocephalus* are the presence of numerous light spots on dorsum and sides of head (vs limitation to supralabials); a narrow light border, one scale long, posterior to the black head and neck (vs a light collar 4 scales long); absence of a light transverse line across gular region (vs presence); and separation of the black nuchal collar from the ventrals (vs contact).

*Description of holotype.* An immature female 125mm total length, tail 49mm; head length 7.8mm snout to rear edge of parietals; orbital diameter 1.3mm. Supralabials 7-7, 3rd and 4th in contact with orbit; infralabials 9-9; preoculars and postoculars 2-2; temporals 1-2 on each side; anterior chinshields contacting infralabials 1-4; posterior chinshields little more than half length of anterior chinshields, contacting 5th infralabial and corner of 4th; two scales between posterior chinshields; two pairs of scales between posterior chinshields and 1st ventral. Scale rows 19-19-17; 156 ventrals; anal divided; 85 pairs of subcaudals; no apical pits. Ninth scale row dropped at ventrals 96 and 101. Maxillary teeth 12-2 on each side, the two rear fangs with a lateral groove.

Iris dark brown; head black with small light dots on dorsal surface; black hood extending posterior to the parietals a length of 5 scales on the vertebral scale row, 5 on the paravertebral row, 5 on the paraparavertebral row, and ventrally to the 2nd dorsal scale row; a light nuchal collar one scale long bordering cranionuchal hood posteriorly, lacking a dark posterior border; an irregular, discontinuous light line through supralabials, curving ventrally to the ventrals, joining with the ventral end of the light nuchal collar. Ventral surface of head mostly light, but with numerous, circular black spots extending posteriorly to the 6th and 7th ventral scales, posterior to which they fade out and disappear. Dorsal surface orange, venter uniform cream; dorsal melanophores scattered uniformly and sparsely over sides and dorsum of body, not increasing in density either dorsally or posteriorly.

*Comparisons.* See Definition and diagnosis. Isolated as this population appears to be, by about 200 km from the nearest records for the species in Jalisco to the north, and Guerrero and Puebla to the south, its unique features, especially the orange color and even melanophore distribution over body and tail, justify recognition as a distinct species.

*Habitat.* The holotype was found under a fossil mollusc-laden limestone rock in a rocky field grazed by cattle in a partially cleared deciduous tropical forest. Pine forests occur at adjacent higher altitudes. On the basis of only two specimens taken at 884 and 1390m, the total vertical range of the subspecies is uncertain. However, *C. lateritius* (s.s.) is known from 16 to 1589m, and the vertical range of *C. sarae* may be much the same.

*Etymology.* *C. sarae* is an eponym honoring Sara M. Huerta-Ortega, staunch field companion, for her contributions to the knowledge of the herpetology and crocodile conservation in Jalisco.

*Remarks.* Inasmuch as the holotype of *C. lateritius*, from "Guadalajara," has been lost (Zweifel, 1959), Tanner and Robison (1960) designated a BYU specimen (indicated at one point as No. 12795, at another as 13793) as neotype, from 7.5 mi N Magdalena, Jalisco. Earlier, Zweifel (1959) argued that the original type locality of Guadalajara was merely a shipping point, and that the type specimen must have come from some lowland locality, because at that time the only precise records for the species were from lowlands. However, Tanner and Robison's (1960) record for near Magdalena, and McDiarmid's (1963) for Santa Clara, Jalisco, are both from altitudes comparable to that of Guadalajara. Therefore we conclude that the original type locality was as stated, although the type locality of the species is now that of the neotype.

*Variation in C. lateritius.* Inasmuch as we have seen all specimens now known to be extant, except one, of *C. lateritius*, the variation in the 12 specimens examined is of importance. The specimens are as follows. *Sinaloa*: 8 km SW San Ignacio (UTA 5561); 8 km N Villa Unión, 450' (KU 83401, LACM 28717). *Nayarit*: 19 mi W jct Hwy 15 and 46, rd to San Blas (LACM 9496); 2-10 mi E San Blas CAS 95760); 4 mi E San Blas (MVZ 79546); 4.5 mi E San Blas (UIMNH 82571); 6.7 mi. E San Blas, 400' (UMMZ 114539); Hwy 54 betw San Blas and Hwy 15 (UIMNH 62741). *Jalisco*: Puerto Vallarta (UIMNH 41439); nr Santa Clara (LACM 1822); 4.5 mi W Tenochtitlán, 4300' ["near Ameca"] (KU 80745). Another specimen, not examined and presumably in Northern Arizona University, was reported by Vaughan (1979) from Pánuco, Sinaloa. Ambía (1969) listed *Coniophanes l. lateritius* for Sonora, but gave no locality. The species may possibly range that far north, into the extreme southwestern part of the state. Wellman (1959) stated that *C. l. lateritius* ranges "from Nayarit southward to Michoacán," and on that basis Casas-Andreu (1982: 264) listed the species for Colima (state). However, there is no voucher for Colima, so far as

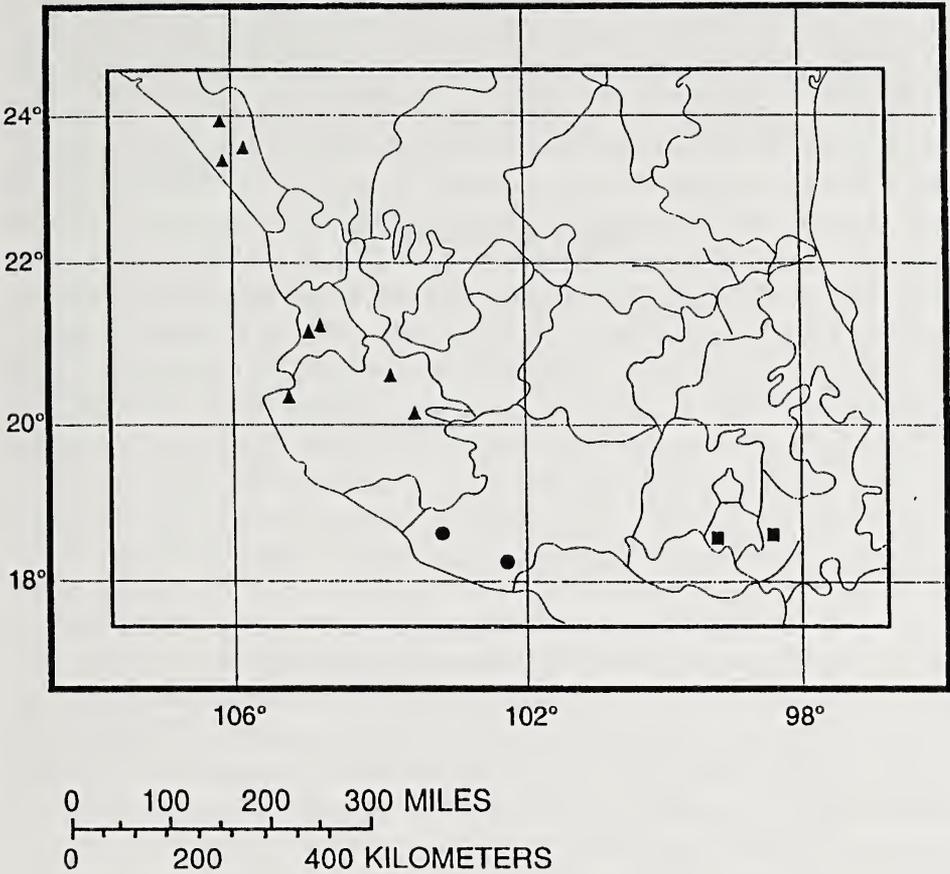


Fig. 1. Distribution of members of the *Coniophanes lateritius* complex. *C. lateritius*, triangles; *C. sarae*, round dots; *C. melanocephalus*, squares.

we are aware, hence we do not include that state in our concept of the range of the species.

Ventrals 137.5-148 (M=143.5, N=5) in males, 140-154 (M=147.3, N=6) in females. Subcaudals 91-95 (M=92.8, N=4) in males, 82-99 (M=88.3, N=4) in females. Scale rows 19-19-17, supraoculars 7-7 (3rd and 4th entering orbit), preoculars 1-1, postoculars 2-2, temporals 1-2-3, infralabials 1-4 contact anterior chinshields, 4-5 the posterior chinshields, in all. Scale row drop (9th row) at ventral 87-92 (M=90, N=8 sides) in males, 76-103 (M=89, N=10) in females. Two (3), 3 (8) or 4(1) rows of scales lie between the posterior chinshields and

the ventrals. Total length 343-396mm in 5 males, 250-595mm in 6 females, 4 exceeding the maximum total length in males. Tail/total length ratios .323-.326 in two males, .297-.344 (M=.315, N=4) in females. Melanophore concentration in all is distinctly and usually much greater posteriorly and toward middorsum than on lower sides, and is apparently correlated with the red color in the same areas, as is characteristic of the species. The black nuchal hood ends on each side at the 2nd scale row, except in one at the 3rd scale row, and extends posterior to the parietals a length of 6-8 scales on the vertebral scale row, 6-7 on the paravertebral row, and 5-7 on the paraparavertebral scale row. In all the light border posterior to the nuchal hood is one scale long and, with one exception (KU 8341 from 8 km N Villa Unión) black-edged posteriorly. Color notes recorded by Percy L. Clifton on the southernmost known specimen of the species (KU 80745, 4.5 mi W Tenochtitlán) state that the snake was "rusty red with black head, yellow neck band." The rusty appearance is a product of the dense melanophore distribution characteristic of the species. No tendency toward the characters of *C. sarae* is evident.

*The status of Tachmenis melanocephala.* As pointed out by Wellman (1959), the designation of EHT 5198 from Huajintlán, Morelos (not Guerrero as previously stated), 12 mi SW Puente de Ixtla, as the neotype of *C. lateritius* (Smith and Taylor, 1945), is invalid. That designation was made before it was realized that the specimen represented another taxon named *Tachymenis melanocephala* Peters (1870), which was then thought to be inseparable from and a synonym of *C. lateritius*.

This taxon is even rarer than *C. lateritius*, although no more so than *C. sarae*. Only two specimens assignable to *T. melanocephala* are known: the type, ZMB 6656 (Bauer et al., 1995), which appears to be lost (*op.cit.*), from "Puebla," Mexico (restricted to Matamoros, Puebla, by Smith and Taylor, 1950, on the basis of the statement in the introduction to Peters (1870:874) that the specimens were taken "aus den wärmeren Gegenden Mexicos (Matamoros u.a.O.[=und anderen Ort])," and the specimen first reported by Taylor (1941) noted in the preceding paragraph. The taxon was first recognized as valid, after the original description, by Smith and Grant (1958), who regarded it as a subspecies of *C. lateritius*. Subsequent workers have accepted that arrangement.

However, the two records known of the species are some 200 km southeast of the nearest records of the *lateritius* complex, represented by *C. sarae*. In view of that isolation, correlated with the numerous differences of

*C. l. melanocephala* from the other subspecies of *C. lateritius* see Diagnosis and Definition of *C. sarae*), we propose that it should be regarded as a species, *C. melanocephalus*. *C. sarae* is not in any way intermediate morphologically between *C. lateritius* and *C. melanocephalus* despite its intermediate geographic position.

### Acknowledgments

We are much indebted to the authorities of CAS, KU, LACM, MVZ, UIMNH, UMMZ and UTA for the loan of the material here reported; to Huerta y Cía., sponsor of our research group (Bosque Tropical); and to UCM and EPO Biology, University of Colorado, for provision of essential facilities. Individuals to whom we are indebted include, in Mexico, Sara M. Huerta Ortega, Bosque Tropical, Guadalajara; M. S. Eduardo Sahagún and Biól. David Ortiz Mendoza, FECENA, Universidad Autónoma de Guadalajara; Don Nicanor Mendoza Mendoz and his family, Puerto El Caimán, Michoacán; Dr. Adrián Nieto Montes de Oca, Facultad de Ciencias, UNAM; Drs. Rodolfo García Collazo and Julio A. Lemos Espinal, ENEP Iztacala, UNAM; Biól. Carlos J. Navarro S., CIAD, Mazatlán, Sinaloa; Biól. Rogelio Cedeño Vázquez, Ecosur, Quintana Roo; M. en C. Dolores Huácuz and Francisco Aguirre García, Universidad Michoacana de San Nicolás, Hidalgo; Biól. Roberto Luna Reyes and MVZ Luís Sigler, Instituto de Historia Natural, Chiapas. In the University of Colorado, individuals to whom we are indebted include Deborah Aguiar, who finalized the map; Dr. William E. Friedman, who photographed snakes for us; and Drs. Frank van Breukelen, Ruth Heisler and Mark Osadjan for computer aid.

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## Natural History Notes on the Southern Plateau Night Lizard, *Xantusia sanchezi*.

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### Abstract

We provide new data for *Xantusia sanchezi* on habitat, microhabitat, reproduction, neonate and adult size, altitude range, southern range limit of the genus and scalation. We propose that *X. extorris* is properly regarded as a full species. It shares with *X. sanchezi* earlier dates of parturition than in any other members of the *X. vigilis* complex, and may serve as an example of derivation of fall breeding in a group otherwise spring breeding.

### Habitat

*Xantusia sanchezi* was described recently from 8 adult specimens collected in mezquital surrounded by dry forest, under the bark of live mesquite trees (*Prosopis*) 4-5 km N Moyagua, Zacatecas (Bezy and Flores, 1999). Ponce and Huerta (submitted), registered the species from its only other known locality, near Guadalajara, Jalisco, at 1610m (as opposed to 1200m at the type locality), the southernmost known locality for the species (63.5km S Moyagua).

The first Jalisco specimen found, a female, was taken May 11, 1999, in oak forest with scattered trees and open areas with rock formations. The specimen was under a rock over a rock formation. A second specimen was found the same year in late October 1999, near where the first was found but at a lower altitude (~1530m). It was under the bark of a dead oak tree over rocks, in an area with much oak leaf litter. These observations extend the knowledge of habitat and microhabitat to include dead trees and oak forest. The behavior of these animals was much as described by Bezy and Flores (1999).

### Reproductive data

The first female had a SVL of 50mm (tail 39mm, partly regenerated), the second 50mm (tail 59mm, complete). The only reported adult size among the type material was of a male at 43mm SVL, tail 57mm.

Upon capture, three cream-colored areas were visible through the abdominal wall of the first female, which bore three neonates at night 14 days later, May 25. One born dead, now UCM 60551, had a SVL of 23mm, tail 22mm. The other two specimens, UAGM (Universidad Autónoma de Guadalajara, México) R-423-4, measured four days later, had a SVL of 22.5 and 22.4mm, tail 21.0mm and 24.1mm respectively.

### Scalation

The only scale characteristics that differ from the original description in the two adult females from Jalisco are: FTL 19 in one specimen, CAW 29 (one), V 36 (one), and DAB 41 (one).

### Remarks

Miller (1951) recorded that in the population of *Xantusia vigilis* occurring in Antelope Valley, Los Angeles Co., California, mating occurred in late May and early June, and parturition during September and the first half of October. In 148 cases, three embryos were born in only 4, two in 121, and one in 23 (Miller, 1954).

No comparable studies on the species elsewhere is known to us, and Miller's data have been widely accepted as exemplary of the species as a whole (e.g., Stebbins, 1985, who included August within the range of parturition dates). Webb (1965) also noted that in all observed cases one or two young were born in *X. v. extorris*.

On the contrary, there is a marked difference in the breeding cycle of the two taxa on the Mexican plateau, *X. v. extorris* bearing their young in "late May or early June" (Webb, 1965), and *X. sanchezi* bearing them at much the same time (present observations). Inasmuch as the gestation period is about three months (Miller, 1951) in *X. vigilis* and most other lizards, mating likely occurs in the fall of the year preceding parturition, assuming that it would not do so during the winter. Many other viviparous lizards have the same reproductive cycle, particularly those at relatively high altitudes (e.g. many *Sceloporus* species of Mexico), although the same reproductive cycle is commonly retained as viviparous groups radiate into low altitudes. On the contrary, because *Xantusia* is largely resident in arid habitats, the shift of fall breeding in *X. v. extorris* and *X. sanchezi* may be regarded as a derived specialization from spring breeding of the rest of the complex, and adaptive to the higher altitudes of the Mexican plateau.

Inasmuch as *X. v. extorris* is apparently completely isolated from all other populations of the *X. vigilis* complex, has a different reproductive cycle from all except *X. sanchezi*, and has categorical differences in scale characters from them (Bezy and Flores, 1999), it should be regarded as a full species, as originally proposed by Webb (1965). Whether three young in *X. sanchezi* as here recorded is normally produced in that species remains to be seen, but the single case is highly exceptional in the context of other taxa of the complex.

The proposed scenario is possibly supportive of the concept of derivation of the taxa of the Mexican plateau from taxa farther north, rather than from taxa of southern Baja California, as suggested by Bezy and Flores (1999). The intervening territory under the northern concept is more nearly favorable for spread of these animals than that under the southern concept.

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## The Occurrence of a Malformed Smallmouth Salamander (*Ambystoma texanum*) from Indiana

*Kenneth L. Krysko, Bonnie E. Eady, and Kareem R. Abdelfattah*

Since the 1740's reports of amphibian malformations have been reported (Northern Prairie Wildlife Research Center, 2000). Possible reasons for malformations and abnormal development are xenobiotic chemicals (Maden, 1993; Harmon *et al.*, 1995; Ouellet *et al.*, 1997), trematodes (Sessions and Ruth, 1990), and ultraviolet light and environmental stress (Northern Prairie Wildlife Research Center, 2000). There have been twelve previous reports of amphibian malformations in the state of Indiana (Table 1). Here we report an additional abnormal specimen from Indiana.

On 15 March 1980, a malformed smallmouth salamander (*Ambystoma texanum*) was collected by William Kern from a ditch on the east side of the Wabash River (R 9 W, T 13 N, NE 1/4 Sec. 33), Vigo Co., IN, and was deposited in the Florida Museum of Natural History, University of Florida (UF 120884). This specimen has an additional limb radiating out of the right shoulder girdle (Fig. 1). The cause for this malformed frog is presently unknown, however, it is the first known case of a smallmouth salamander abnormality from Indiana.

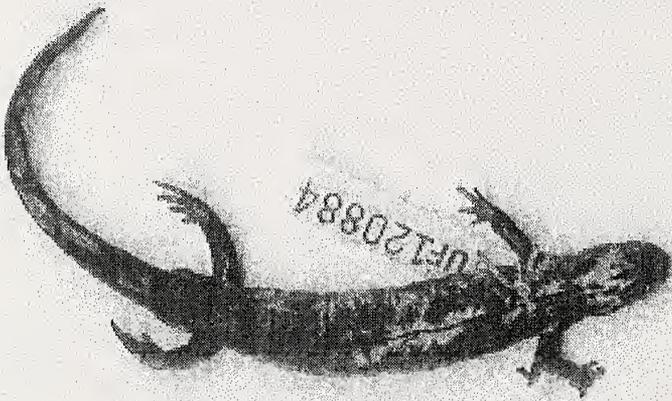


Fig. 1. Malformed Smallmouth salamander (*Ambystoma texanum*) from Vigo County, Indiana.

Table 1. Amphibian malformation from Indiana

<u>Common Name</u>	<u>Scientific Name</u>	<u>Year</u>	<u>County</u>
Unidentified Toad	<i>Bufo sp.</i>	1997	Brown
Southern Leopard Frog	<i>Rana sphenoccephala</i>	1997	Jackson
American Toad	<i>Bufo americanus</i>	1999	Johnson
Blanchard's Cricket Frog	<i>Acris crepitans blanchardi</i>	1999	Johnson
Chorus Frog	<i>Pseudacris triseriata</i>	1999	Johnson
Northern Leopard Frog	<i>Rana pipiens</i>	1999	Johnson
Fowler's Toad	<i>Bufo woodhousii fowleri</i>	1997	Knox
Green Frog	<i>Rana clamitans melanota</i>	1998	Lagrange
Cave Salamander	<i>Eurycea lucifuga</i>	1994	Monroe
Jefferson Salamander	<i>Ambystoma jeffersonianum</i>	1998	Monroe
Longtail Salamander	<i>Eurycea longicauda longicauda</i>	1997	Monroe
Bullfrog	<i>Rana catesbeiana</i>	1999	Switzerland
Smallmouth Salamander	<i>Ambystoma texanum</i>	2000 (this paper)	Vigo

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## A New Frog of the Genus *Eleutherodactylus* from the Island of Tobago, West Indies

Jerry D. Hardy, Jr.

Approximately thirty years ago my colleagues and I collected a small frog on the island of Tobago which we tentatively identified as *Eleutherodactylus cf rozei* Rivero, 1961, in spite of the fact that *E. rozei* was then known from only two localities in Estado Aragua, Venezuela, approximately 400 miles west of Tobago (Hardy, 1982, 1883).

*Eleutherodactylus rozei* was described on the basis of a single specimen from Curucuruma, Estado Aragua, Venezuela (MBUCV 2018). Subsequently thirteen frogs collected by William Beebe on 4 May 1946 at Rancho Grande, Estado Aragua, Venezuela (AMNH 70599-611) were identified as *Eleutherodactylus rozei*. In December, 1978, I collected and recorded additional specimens of the frog then called *E. rozei* at Rancho Grande. Lynch and La Marca (1993) re-examined Beebe's specimens of "*E. rozei*" and assigned them, along with several topotypes, to a new species, *Eleutherodactylus riveroi*.

The Tobago frog differs from *Eleutherodactylus riveroi* in size, call, and details of pigmentation, as well as in call site selection and calling posture. In recognition of their devotion to Tobago and its environment I am pleased to name the new species in honor of Patricia and Charles Turpin of Charlottesville, Tobago.

### *Eleutherodactylus turpinorum n. sp.*

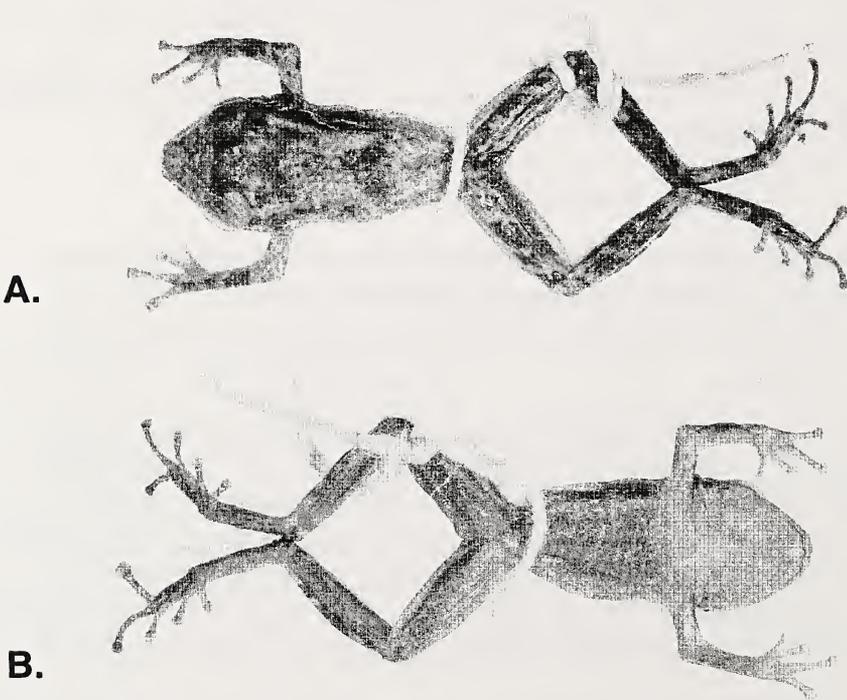
Holotype: USNM 227815, St. John Parish, 3.75 miles WSW of Charlottesville, on Northside (Bloody Bay) Road, at milepost 27.5, 22 December 1978, Alvin L. Braswell, J.D. Hardy, Jr., William M. Palmer, and David L. Stephan.

Paratypes: USNM 142723, St. George Parish, Mount Saint George-Castara Road, milepost 4.5-5.0, 10 April 1959, C. Carasco. USNM 192758 and 192759, St. John Parish, Charlottesville-Bloody Bay Road, vicinity of milestone 27 3/4, near Hermitage, above Corvo Point, 22 July 1971; USNM 195136-137 [same locality], 12 September 1972; USNM 195144-46 [same locality], 13 September 1972, all collected by R. G. Tuck, Jr. USNM 227802-8, St. John Parish, 3.75 miles WSW of Charlottesville, on North side (Bloody

Bay) Road, at milepost 27.5, 16 December 1978; USNM 227809 [same locality], 20 December 1978; USNM 227810-13 [same locality], 21 December 1978; USNM 227814, 227816-8 [same locality], 22 December 1978; USNM 227819-31 [same locality], 23 December 1978, all collected by Alvin L. Braswell, J. D. Hardy, Jr., William M. Palmer, and David L. Stephan. USNM 227832, John Parish, 3.75 miles WSW of Charlottesville, on North side (Bloody Bay) Road, at milepost 27.5, 30 March 1979, J. D. Hardy, Jr.

Diagnosis: (1) Skin of dorsum smooth, occasionally with small, indistinct tubercles on the upper eyelid, and, in some specimens, an obscure ridge of warts on the upper flanks; (2) skin of venter sometimes granular, at least peripherally (although this feature is not evident in preserved specimens); (3) Tympanum small, obscure; (4) supratympanic fold poorly developed; (5) Vomerine tooth patches small, behind internal nares, and well-separated medially; (6) Males with vocal slits; (7) Tubercles of fingers and toes well-developed, sometimes appearing to be joined by fleshy ridges; (8) Weakly-developed lateral keels on toes (not evident in all preserved specimens); (9) Toe disc large, noticeably broader than long; (10)

Figure 1. *Eleutherodactylus turpinorum*. The holotype, USNM 142723. A. Dorsal view. B. Ventral view.



Dorsum typically brown with highly variable patterns of darker or lighter brown (in life sometimes with greenish marbling or, perhaps, greenish throughout); (11) interocular bar prominent, obscure, or absent; (12) limb-bands well-developed, obscure, or absent; (13) in life gold spots in concealed surfaces of hind legs; (14) posterior surfaces of thighs uniformly brown or with small white open spots (gold in life); (15) ventral surfaces of chin, throat, and belly whitish with brown punctations which are sometimes arranged in discrete patches; (11) snout-vent length of males 11.9 - 18.8 mm (mean 15.3 mm, n=37); snout-vent length of females 20.3 - 26.8 mm (mean 24.3 mm, n=5); (12) Chromosomes  $2n=32$ ; (13) voice a single, barely audible click produced at 3470-3700 hz.

Description of the holotype: A male, snout-vent length 17.5 mm, tibia length 8.9mm, tympanum 0.72mm, eye length 2.9mm. Dorsum with three poorly defined dark blotches, the most posterior of which is bordered anteriorly by a distinct light cross-band. Interorbital bar sharply defined anteriorly, merging into the dark dorsal pigment posteriorly. Two poorly defined pale dorso-lateral stripes. Entire dorsal surface peppered with small, dark punctations. Flanks dark with oblique light areas. Canthal stripe broad, well-defined; cheek with two large blotches extending to jaw; supratympanic fold darkly pigmented. A single broad, dark band on each wrist. Upper anterior part of femur with four well-defined bands; upper posterior part of femur almost solid brown and with no indications of banding. Ventral surfaces with numerous, small, dark punctations throughout.

### Comparisons

*Eleutherodactylus turpinorum* is a much smaller frog than *E. riveroi*. Eight males of *Eleutherodactylus riveroi* in the USNM collection vary from 19.9 to 24.0mm (mean 22.4mm) in snout vent-length, while the snout-vent lengths of 37 males of *E. turpinorum* vary from 11.9 to 18.8mm (mean 15.3mm). Lynch and La Marca (1992) did not present measurements of all of the specimens of *Eleutherodactylus riveroi* available to them (16 types, but measurements for only five males and five females). Their largest male was approximately the same size as the largest USNM male (23.3mm compared to 24.0mm); but their smallest male was only 15.5mm in snout-vent length. They found a mean snout-vent length of 20.3mm for the five males which they measured (5.0mm greater than the mean length of males of *turpinorum*). I have measured five females from Tobago, but there is a

possibility that three of these specimens may represent an as yet undescribed species (see discussion under *Eleutherodactylus* sp. below). These five specimens have snout-vent lengths of 20.3 to 26.8mm with a mean of 24.3mm. Lynch and La Marca (1993) measured five females of *E. riveroi* from Rancho Grande in which snout-vent lengths varied from 29.8 to 35.8mm (mean 32.2mm). Although these data can not be statistically compared, there appears to be a very real difference in snout-vent length between females of *E. riveroi* and females of *E. turpinorum*.

The calls of *Eleutherodactylus riveroi* and *E. turpinorum* are very similar, but *E. riveroi* calls at a frequency range of 2270 to 2660 hz while *E. turpinorum* calls at a frequency range of 3470 to 3700 hz. There are also behavioral differences related to calling. Males of *E. turpinorum* occupy perch sites at or near the outer ends of low palm fronds and consistently call from a horizontal position. Males of *E. riveroi* recorded at Rancho Grande occupied perch sites on vertical surfaces (the limbless, lower portions of large tree trunks, or, in one case, the wall of a building) and consequently called from a vertical position.

Lynch and La Marca (1993) described the posterior surface of the thigh of *Eleutherodactylus riveroi* as "sometimes brown with pale spots" (p. 143) but also as having "bold markings": (p. 144). Their illustration of this feature (p. 140) shows darker pigment more-or-less continuous with the bands of the anterior portion of the thigh over a fairly open pale background. Although this is a variable character, most of the specimens of *E. turpinorum* have the posterior of the thigh more-or-less uniform brown in contrast to the blotched appearance in *E. riveroi*.

In five of the thirty-nine type specimens of *Eleutherodactylus turpinorum* there is a broad well-defined mid-dorsal pale stripe extending from the snout posteriorly between the eyes and along the mid-line on the body. This stripe may continue to the groin or may end about three fourths of the distance to the groin. In two of the paratypes there is a very thin, well-defined mid-dorsal hairline of pale pigment extending from the snout to the groin. These pattern variations were not reported by Lynch and La Marca (1993) in their description of *Eleutherodactylus riveroi*, and were not evident in any of the eight specimens from Rancho Grande which I examined.

Several other Venezuelan *Eleutherodactylus* seem similar to *E. turpinorum*. *Eleutherodactylus reticulatus*, *E. bicumulus*, and "*Eleutherodactylus*

sp. nov." (see Lynch and La Marca, 1993) lack vocal slits (present in *E. turpinorum*). *Eleutherodactylus rozei* (the single specimen of which, according to Lynch and La Marca, may be a juvenile of *E. reticulatus*) has prominent tubercles over the eye, finely tuberculate skin over the head, and uniformly brown ventral surfaces.

Two other species of *Eleutherodactylus* occur on Tobago: *E. urichi* and *E. charlottevillensis*. In life *E. urichi* has a band of electric-blue pigment in the upper eye and bright red pigment in the concealed surfaces of the hind legs. In preserved specimens the blue eye pigment remains visible as greyish mottling in the upper part of the eye (and is therefore a uniquely useful character for identifying preserved specimens of this species). Additionally, in *E. urichi* the belly is conspicuously granular, the tympanum is large, the supra-tympanic fold is well-developed and usually marked with numerous tiny but clearly defined orange punctuation, and the toe disc are more-or-less round when viewed from below (not laterally expanded as in *E. turpinorum*). *Eleutherodactylus charlottevillensis* is a much larger frog with a very loud, distinctive trill-like call. Preserved specimens can easily be identified by the finely granular skin of the dorsum, and the plain white chest and abdomen from which dark punctuation are consistently absent. Unlike *Eleutherodactylus charlottevillensis* and *E. urichi*, *Eleutherodactylus turpinorum* appears to be crepuscular. Males begin calling just before sunset and continue calling for approximately one hour.

*Eleutherodactylus* sp. (the green *Eleutherodactylus* of Tobago): In 1975 while working along the Charlotteville-Bloody Bay Road, I collected three unusual specimens of *Eleutherodactylus*. Although these frogs were taken in an area where numerous *E. turpinorum* were calling, they were not associated with the palm-frond habitat. Two were perched five or six feet above the ground on the branches of small shrubs; one was actively hopping about on the forest floor. These frogs were noticeably larger than males of *Eleutherodactylus turpinorum* (snout-vent lengths 22.5mm, 25.9mm, and 26.8mm). In life they were predominately green above, and had gold pigment in the concealed surfaces of the hind legs. I later established, through dissection, that at least one of these specimens was female. Based on the presence of gold pigment on the hind legs, the fact that small patches of green pigment occur in some males of *E. turpinorum*, and the large size of the specimens in question, I concluded that they were all females of *E. turpinorum*.

Unfortunately, these three specimens were inadvertently discarded (along with major herpetological and ichthyological collections from throughout the Lesser Antilles) and are no longer available for study. Although I feel confident enough in my identification of these now-missing specimens to have included them in my snout-vent length data for females of *Eleutherodactylus turpinorum* (see above), my associate, Heinrich Kaiser, believes that they may represent an as yet undescribed species. Dr. Kaiser collected a single specimen of the green *Eleutherodactylus* and, on the basis of this specimen, concluded that 1) the new species does not call, and 2) the new species has two less chromosomes than *Eleutherodactylus turpinorum*. Unfortunately, as with my three specimens, Dr. Kaiser's single specimen now also appears to be lost (Kaiser, pers. comm). It should be noted that three of the paratypes of *Eleutherodactylus riveroi* (AMNH 70599-602) were described as being "mossy-green" in life (Lynch and La Marca, 1993).

### Specimens examined

*Eleutherodactylus riveroi*: USNM 228147-52, Venezuela, Aragua, Rancho Grande, Estacion Biologica Henri Pittier, 28 December 1978, Jerry D. Hardy, Jr. USNM 259162, Venezuela, Aragua, Rancho Grande, Estacion Biologica Henri Pittier, 1100 meters, 14 May 1986, USNM 259163 [same locality], 29 May 1986, both collected by Alfred L. Gardner and Mary E. Candee.

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## Nomenclature of the Earth Snakes (*Adelphicos*) of the *A. quadrivirgatus* Complex

Hobart M. Smith, David Chiszar and Mario Mancilla Moreno

### Abstract

*Adelphicos quadrivirgatus* is proposed as a complex consisting of three species: *A. quadrivirgatus*, containing two subspecies, *A. quadrivirgatus* and *A. q. newmanorum*, *A. sargii* and *A. visoninus*. The latter is reported for the first time from the state of Oaxaca, Mexico.

*Adelphicos quadrivirgatus* has been recorded from two localities in the state of Oaxaca: Pochutla (Smith, 1942) and Hwy 185, 8.5 km S Oaxaca-Veracruz state line (Cadle, 1984). The first was assigned to the subspecies *A. q. quadrivirgatus*, whereas the second was not identified subspecifically.

Therefore six additional specimens of the species from various localities in the state of Oaxaca are of special interest. All are in the University of Colorado Museum (UCM), as follows: 12 de Julio, Mixe district (39891-21); Mixe district (52516, probably from near 12 de Julio); Palomares, Juchitán district (49321); Las Muelles, Palomares, Juchitán district (39893); and Vista Hermosa, Ixtlán district (39894, 52385). All were collected by Thomas MacDougall.

These six specimens all conform with the characteristics of the subspecies *A. q. quadrivirgatus*, an essentially Central American subspecies heretofore known no nearer Oaxaca than eastern Tabasco. All lack a middorsal dark stripe, the third infralabial is present, the anterior chinshields fail to reach the lip, and the subcaudals are 36-40. *A. q. quadrivirgatus* has a middorsal dark stripe, no third supralabial, anterior chinshields reaching lip, and subcaudals 32-36. The two taxa are reported (Smith, 1942) to differ markedly in number of hemipenial spines, but all of the present specimens are females.

On the basis of these specimens, it seems likely that Cadle's (1984) report from nearby in Oaxaca also represented *A. q. visoninus*.

Wilson and Meyer (1985) argued that no subspecies of *A. quadrivirgatus* should be recognized until they are better documented than is now the case. Yet the difference between *A. q. newmanorum* and *A. q. quadrivirgatus* on the one hand and *A. q. sargii* and *A. q. visoninus* on the other in presence of ab-

sence of contact of the anterior chinshields with the labial border is categorical so far as is known (present in the former, absent in the latter). In addition the number of hemipenial spines is categorically different in *A. q. visoninus* (with 52 spines) as compared with *A. a. quadrivirgatus* and *A. q. sargii* (with 26-28 spines). It is true that the distribution of *A. quadrivirgatus* as depicted in Smith (1942), splitting or overlapping that of *A. q. visoninus*, is contrary to expectation for subspecies.

On the contrary, that distribution, plus the categorical difference that exist among these taxa, complies well with the concept of specific rank. We therefore here regard the *quadrivirgatus* complex of *Adelphicos* as consisting of three species: *A. quadrivirgatus*, with two subspecies, *A. q. quadrivirgatus* Jan and *A. q. newmanorum* Taylor, differing in ventral counts, with only a slight overlap as shown by Martin (1955), *A. sargii* (Fischer), and *A. visoninus* (Cope).

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## A New *Geophis* (Reptilia: Serpentes) From Southern Veracruz, Mexico

Gonzalo Pérez-Higareda, Hobart M. Smith and Marco A. López-Luna

### Abstract

The specimens previously reported as *Geophis semidoliatus* from the Los Tuxtlas area of southern Veracruz, Mexico, represent an endemic new species, *G. juliai*. The geographic range of *G. semidoliatus* is limited to central western Veracruz and adjacent parts of the states of Hidalgo, Puebla and Oaxaca.

### Resumen

Los ejemplares de la región de Los Tuxtlas, del sur del estado de Veracruz, México, antes referidos a *Geophis semidoliatus*, en realidad representan una especie nueva, *G. juliai*. La distribución de *G. semidoliatus* está limitada a Veracruz central-oeste y tierras adyacentes de los estados de Hidalgo, Puebla y Oaxaca.

Four specimens of *Geophis* in the herpetological collection of the Estación de Biología Tropical Los Tuxtlas, UNAM (UNAM-LT) with black dorsal blotches on a red background, resembling and formerly identified as *G. semidoliatus*, are from the region of Los Tuxtlas, southern Veracruz. There are widely isolated from other records of that species farther north, and prove to represent a previously unrecognized taxon that we here name

### *Geophis juliai*, sp. nov.

*Geophis semidoliatus* (nec Duméril, Bibron and Duméril): Flores-Villela, et al. 1987: xxiv (key to the herpetofauna of Los Tuxtlas, Veracruz); Pérez-Higareda et al., 1987: 16 (list of the herpetofauna of Los Tuxtlas, Veracruz).

### Holotype

UNAM-LT 2775, adult male, from the Estación de Biología Tropical Los Tuxtlas (EBTLT), 150m, 10 August 1984.

### Paratypes

UNAM-LT 2776, an adult male, topotype, taken 4 July 1984, and two adult females; one, UNAM-LT 2920, a topotype, was taken 14 September 1985,

the other, UNAM-LT 2948, 17 September 1985, El Ariete, Bastonal, Sierra de Santa Marta, 600m. All collected by herpetologists at EBTLT.

### Definition

A member of the *semidoliatus* group (Downs, 1967), distinguished from other groups by the combination of absent anterior temporal, 15 dorsal scales rows, a supraocular on each side, pattern of dorsal blotches or crossbars, and subcaudals 19-34.

### Diagnosis

Differing from other members of the *semidoliatus* group by the combination of 6 supralabials, internasals separate, subcaudals 19-30, light interspaces between dark marks medially usually 3 or more scales in length, and dorsal black marks blotchlike, more or less oval, instead of bandlike, with anterior and posterior edges more or less parallel.

### Description of holotype

Internasals present, about 1/4th size of prefrontals; latter contacting orbit; supraocular smaller than orbit; no preocular; postoculars 0-2; loreal narrow, elongate, its contact with orbit about 1/2 diameter of latter; 6 supralabials, 3rd and 4th entering orbit, 5th broadly in contact with parietal and separated from orbit, 4th twice as high as long, a tiny scale on one side at junction of suture between 2nd and 3rd supralabials at the loreal; 6-7 infralabials, first four in contact with anterior chinshields, 4th also in contact with posterior pair; latter about half size of anterior pair; latter separated from mental by contact of the 1st infralabials.

Dorsal scales weakly keeled posteriorly; 143 ventrals, 28 subcaudals; ana entire. SVL 280mm, tail 34mm.

Ground color red above, with 22 black blotches excluding the nuchal collar; latter 8 middorsal scales long, separated from parietals; black blotches 4-6.5 scales long medially, 1-3 on first dorsal scale row, and touching ventrals; light interspaces 2-4 scales long at midline, mostly 3, and median rows there with black posterior edges; head black from rostral to middle of parietals, the color extending laterally over the first three infralabials and part of the 4th, and over the anterior chinshields and part of the posterior pair.

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### Variation

Head scales essentially as in the holotype, except no tiny scale between supralabials and loreal; postoculars 1-1 in all three paratypes, although in no. 2848 they are fused with the supraoculars; and infralabials 6-6 in two, 7-7 in one paratype.

Dorsal black blotches 21-22 on body, 4-5 on tail; ventrals in paratype male 143, in females 152 and 155; subcaudals 27 in paratype male, 21 and 26 in females. SVL and tail length, respectively, in paratype male 294mm and 41mm; in females, 328mm-155mm, and 32mm-18mm.

### Comparisons

The member of the *semidoliatus* group most like *G. juliai* is *G. semidoliatus*, from which the former differs most conspicuously in having (1) 6 supralabials, (3rd and 4th entering orbit), vs 5 (3rd entering orbit); (2) dorsal dark marks blotchlike, with rounded anterior and posterior edges, vs crossbands, anterior and posterior margins more or less parallel; and (3) the dark blotches mostly touching the edges of the ventrals, vs mostly ending on the 2nd dorsal scale row, or upper part of 1st, not usually contacting ventrals (Figure 1).

### Distribution

Known only from the tropical rain forest in the region of Los Tuxtlas, southern Veracruz, México, where it is probably endemic.

### Etymology

The specific name honors Prof. Jordi Juliá Zertuche, who dedicated his life to the study of medical herpetology and died as a consequence of a snake bite.

### Remarks

Although presumably this species is restricted to the Los Tuxtlas area, it has been necessary to check peripheral records of *G. semidoliatus* not covered in Downs' (1967) monograph. The earliest is that of Peters (1870) for Izúcar de Matamoros, Puebla. That locality is in the upper valley of the Río Balsas on Pacific slopes; it is highly unlikely that *G. semidoliatus* occurs there. Furthermore, no other species of *Geophis* resembling *G. semidoliatus* is known, except *G. russatus*, to occur in that vicinity (Downs, 1967). However, the latter

is known only from a separate drainage system SE of Izúcar de Matamoros. Peters' specimen very likely represents an unnamed species.

Cope (1887) recorded the species from Zacualtipan, Hidalgo; Gadow (1908) from La Raya, Oaxaca; and Minton and Moreno (1988) from 12 km NE Xicótepec de Juárez, Puebla. Although all three are from states where Downs (1967) did not record *G. semidoliatus*, there is no reason to doubt the accuracy

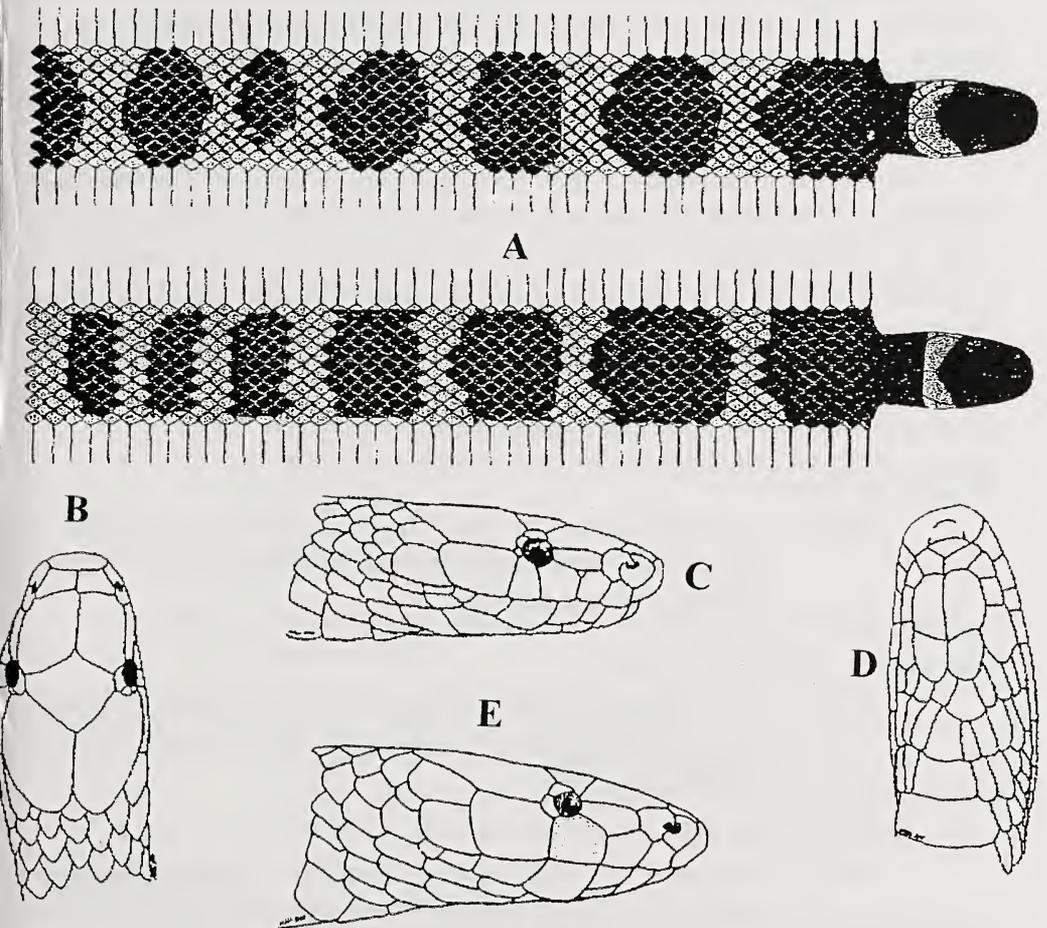


Figure 1. A, dorsal pattern of *Geophis semidoliatus* (below, from FCBA-UV 0043, Colonia Augustín Millán, mpio. Córdoba, Veracruz), and of the holotype of *G. juliai* (above). B, C, D, head scales of the holotype of *G. juliai*. E, lateral view of head scales of *G. semidoliatus*, from FCBA-UV 0043, as in A.

of their identification, because all are closely bunched with records from adjacent Veracruz.

On the contrary, the records for the species from Yajalón (Alvarez del Toro, 1982) and Lacanja-Chansayab (Góngora-Arones, 1987), Chiapas, are far from the known range of the species, and have been assigned to *G. laticinctus* (Johnson, 1979).

Thus the geographic range of *G. semidoliatus* as now known is limited to central western Veracruz and adjacent parts of the states of Hidalgo, Puebla and Oaxaca. The only previous records of *G. juliai* are those noted in its synonymy.

### Acknowledgments

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## Catalogue of the Herpetological Collection of the Queen Saovabha Memorial Institute, Thai Red Cross Society, Bangkok. Part I. Snakes (except Elapidae and Viperidae)

*Lawan Chanhome, Olivier S.G. Pauwels, Piboon Jintakune and Patrick David*

### Abstract

An overview of the Queen Saovabha Memorial Institute (Thai Red Cross Society, Bangkok) involvements in snake venom research and other herpetological activities is presented. A catalogue of all snake specimens (except Elapidae and Viperidae) deposited to date in the herpetological collections of the Institute is provided, with locality data when available. The collection notably includes an albino *Cylindrophis ruffus* (Laurenti, 1768), a specimen of the Natricine species *Amphiesma khasiense* (Boulenger, 1890), which was not yet recorded from Thailand, several specimens of *Pareas macularius* Theobald, 1868 from Nakhon Si Thammarat Province, which represent a major range extension southwards for this species, and several record-sized *Xenochrophis flavipunctatus* (Hallowell, 1860).

*Key words: Red Cross, Thailand, Serpentes, catalogue, Cylindrophis ruffus, Amphiesma khasiense, Pareas macularius, Xenochrophis flavipunctatus.*

### Introduction

The history of the Queen Saovabha Memorial Institute (QSMI) Snake Farm dates back through the initiative of Dr Leopold Robert, the first director of the QSMI during 1917-1925, who received financial contribution from foreigners residing in Thailand for the construction of the first buildings. H. M. Queen Sawang Vadhana, then president of the Thai Red Cross Society, inaugurated the Snake Farm on 22<sup>nd</sup> November 1923. It is now the second largest such facility in the world (next to that in Sao Paulo, Brasil).

The Snake Farm serves for the public education about Thai snakes and their biology. The daily live snake shows at the Snake Farm attract every year thousands of visitors and is worldwide known. The Snake Farm moreover includes a Snake Museum in which miscellaneous Thai snake species are represented; illustrations of the Museum were given notably by Yodsuksa (1995).

Since the 1920's the main mission of the Snake Farm is to keep Thai venomous snakes for extracting their venom for the production of antivenom (see Puranananda, 1956). For the needs of the production of antivenom, the QSMI currently operates a large horse farm located near Hua Hin in Prachuap Khiri Khan Province. The horses are immunized with specific snake venom from King Cobra (*Ophiophagus hannah*), Monocled Cobra (*Naja kaouthia*), Banded Krait (*Bungarus fasciatus*), Siamese Russell's Viper (*Daboia russelii siamensis*), Malayan Pit Viper (*Calloselasma rhodostoma*), and White-lipped Green Pit Viper (*Trimeresurus albolabris*), and then regularly provide plasma for purified monovalent antivenom. The efforts of the QSMI to produce and improve snake antivenoms have been recognized internationally.

Dr Chalodem Puranananda, director of the QSMI from 1945 to 1970, was actively working on venomous snakes (see Puranananda, 1956, 1957), as does the present director, Prof. Visith Sitprija (see bibliography). QSMI scientists always used to provide working facilities to Thai students working on their degrees (see Panichayakul, 1967; Cherdchu, 1975; Mahantasanapong, 1991; Noonarong, 1995; Niyomwan, 1997, 1999; Sakwiwatkul, 1999).

The scientific team of QSMI has actively published, and often worked in close cooperation with other institutions and universities on snake venom research (see notably Ganthavorn, 1969; Tu & Ganthavorn, 1968; Tu et al., 1967; Chaiyabutr & Sitprija, 1999; Chaiyabutr et al., 1994, 1996a&b; Chanhom et al., 1998, 1999; Khow et al., 1996a&b, 1997a&b; Onrat et al., 1993; Pakmanee et al., 1993, 1996, 1997a&b, 1998a&b; Patanaargson et al., 1998; Pratanaphon et al., 1997; Pochanugool et al., 1996; Sitprija & Chaiyabutr, 1999; Warrell et al., 1986; Wilde et al., 1996), snake bite treatment (Benyajati & Puranananda, 1963; Chaiyabutr et al., 1985; Pochanugool et al., 1994, 1997a&b, 1998; Sitprija, 1980; Sitprija & Boonpucknavig, 1977, 1980, 1983; Sitprija et al., 1971, 1982, 1987; Thamaree et al., 1994, 2000; Wilde, 1987), and venomous snake systematics (Wester et al., 1995, 1997). In October 1999, the fifth Asia-Pacific Congress on Animal, Plant and Microbial Toxins, held at Pattaya, Thailand, was organized jointly by the QSMI and the Chulalongkorn University (Bangkok); numerous contributions to snake toxinology were presented by QSMI staffs and collaborators (Chaiyabutr, 1999; Chanhom et al., 1999a&b; Khow et al., 1999; Laothong & Sitprija, 1999; Ratanabanangkoon et al., 1999; Sakwiwatkul et al., 1999; Sapsutthipas et al., 1999; Suteparuk & Pakmanee, 1999; Tantawichien et al., 1999; Thamaree et al., 1999a&b).

The most recent activity of the QSMI Snake Farm is the snake breeding

program which was initiated in 1994. Its main purpose is to cease purchasing wild-caught snakes and to breed healthy snakes in captivity for good quality venom production. This activity naturally led to research concerning husbandry, diet and diseases of snakes (Chanhome, 1998; Chanhome & Jintakune, 1993, 1997; Chanhome et al., 2000; Cox & Chanhome, 1996; Salakij et al., 2000). This breeding facility currently maintains about 500 specimens representing 20 species of poisonous and non-poisonous snakes.

As an additional contribution to the knowledge of the Thai snake fauna, a systematic herpetological and batrachological collection, containing mainly snakes but also lizards, turtles and amphibians, was initiated at the QSMI by Mr Piboon Jintakune in the eighties. The collection includes numerous prepared snake hemipenes which were used in the work of Jintakune (1985), and the snakes served as a basis reference for the elaboration of the book of Jintakune & Chanhome (1995). Our aims in the present publication of the catalogue of this collection are twofold. The first one is to signal to Thai and foreign scientists, physicians and students involved in researches on snakes that an important reference collection is accessible to them at the QSMI. Second, this catalogue will also encourage them to deposit in this collection Thai specimens used in their studies, which will consequently remain available for further works and verifications. The attribution of collection numbers will allow searchers to specify in their published works the QSMI access numbers of the specimens used. Currently the QSMI collection contains about 1200 Reptile specimens, of which nearly 400 are listed in the present paper. All specimens were examined and reidentified by us. The next sections of the catalogue (Part II: Elapidae and Viperidae; Part III: Amphibia, Chelonii and Lacertilia) will be presented in forthcoming publications.

### Synopsis of the collection

Until we initiated the cataloging in 1998, the specimens were unnumbered. We attached to all specimens a label with the abbreviation Q[SMI] followed by a number. However, many specimens were already accompanied by an original orange or yellow plastic label, hand written in Thai or English by P.J., which was attached to the neck of the jar. When such labels were present, their content is here reproduced in English between quotation marks; words added by ourselves, such as "Province", are placed in square brackets. When we reorganized the collection, the original label was attached to the specimen, or to one of the specimens included in the jar. New QSMI numbers were of course individually given to every specimen, even incom-

plete, except in a few cases duly mentioned. The dates written on the original labels often follow the Buddhist calendar; for the conversion, one should know that year 2000 in the Christian calendar corresponds to year 2543 in the Buddhist calendar. A detailed list and description of the originally labelled prepared hemipenes present in the collections are given in Jintakune (1985: 62-67). A selection of specimens among those listed hereafter is exhibited in the Snake Museum within the Snake Farm. Many specimens were secured by P.J. at the Siam Farm, a company of wildlife trade which has now disappeared. All specimens except those belonging to exotic taxa (here marked with an asterisk \*) were either collected in Thailand or reported as such.

#### Abbreviations:

H=posterior part of the body and tail with everted hemipen(i)(e)s;  
N=newborn specimen.

#### Family Typhlopidae

*Ramphotyphlops braminus*: QSMI 1 ("23/3/2541"), QSMU 2-5

#### Family Acrochordidae

*Acrochordus granulatus*: QSMI 51, QSMI 247 ("0523"), QSMI 364 ("Samut Prakan [Prov.], 10/2/2528"), QSMI 396 (H)

*Acrochordus javanicus*: QSMI 52-53, QSMI 370

#### Family Uropeltidae

*Cylindrophis ruffus*: QSMI 48 (only head and tail), QSMI 258, QSMI 361 (albinos, Nonthaburi, Nonthaburi Prov., 12/1998), QSMI 362 (Bang Khaen, Bangkok Prov., 16/10/1999), QSMI 363 (Nonthaburi, Nonthaburi Prov., 1999), QSMI 387-88 ("Siam Farm, 1/12/2527")

#### Family Xenopeltidae

*Xenopeltis unicolor*: QSMI 45 (with everted hemipenes), QSMI 46 (H, "Xe. uni. 2"), QSMI 47, QSMI 255-56 ("5/2527"), QSMI 315 (H), QSMI 394 (H)

#### Family Boidae\*

*Constrictor constrictor*\*: QSMI 38

*Gongylophis conicus*\*: QSMI 36 ("India, 12/2/1990")

### Family Pythonidae

*Liasis amethystinus*\*: QSMI 37 ("Siam Farm, 24/9/2527, from Australia")

*Morelia viridis*\*: QSMI 392

*Python brongersmai*: QSMI 34-35 (adults), QSMI 50 (pelvic belt, "Siam Farm"), QSMI 268-70 ("Siam Farm, 10/2526", heads only); see Shine et al. (1999) for the status of this taxon previously regarded as a subspecies of *Python curtus*.

*Python molurus bivittatus*: QSMI 6 (egg with embryo, "4/2527"), QSMI 7-23 (N), QSMI 49 (pelvic belt, "Siam Farm"), QSMI 260-64 ("4/27"), QSMI 411 (skin in alcohol)

*Python reticulatus*: QSMI 24-28 (N), QSMI 29-30 (heads only), QSMI 31-33 (N), QSMI 39-44 (heads only), QSMI 88 (11 eggs, "Snake Farm, 21/3/40"), QSMI 266, QSMI 267 (head only), QSMI 425 (head only)

### Family Colubridae

*Ahaetulla nasuta*: QSMI 195-97 ("4/2527"), QSMI 244, QSMI 378

*Ahaetulla prasina*: QSMI 205, QSMI 374-375 ("Siam Farm, 3/9/2527")

*Amphiesma khasiense*: QSMI 273 (Phu Luang, Research Station area, Loei Prov., 22/5/1998, road-killed) (See note below)

*Amphiesma stolatum*: QSMI 155 ("Siam Farm, 4/2527")

*Aplopeltura boa*: QSMI 237-39, QSMI 240 ("2/2527"), QSMI 241 ("Nakhon Si Thammarat [Prov.], 8/8/1990"), QSMI 271

*Boiga cyanea*: QSMI 146

*Boiga cynodon*: QSMI 149-52 ("Siam Farm, 24/9/2527"), QSMI 153, QSMI 245-46, QSMI 371, QSMI 410

*Boiga dendrophila*: QSMI 67-72, QSMI 73 ("13/8/2526"), QSMI 74 ("born 8/8/39, dead on 27/10/41, female"), QSMI 75 (H), QSMI 76 (H, "B. den. 1"), QSMI 77 (H, "B. den. 3"), QSMI 78 (H, "B. den. 5"), QSMI 79 (H, "B. den. 6"), QSMI 154 (2 embryos, QSMI, 2/3/2541), QSMI 243 (H), QSMI 365, QSMI 407, QSMI 616-18 (head and neck only)

*Boiga drapiezii*: QSMI 144 ("Nakhon Si Thammarat Prov., 1995"), QSMI 145 ("Thung Song, Nakhon Si Thammarat [Prov.], 18/6/1996"), QSMI 206-10, QSMI 227, QSMI 242, QSMI 367-69 ("4/2527"), QSMI 619 (head and neck only)

*Boiga jaspidea*: QSMI 147-48

*Boiga multomaculata*: QSMI 143 ("Siam Farm, 24/9/2527"), QSMI 294, QSMI 318, QSMI 377

*Boiga nigriceps*: QSMI 87 ("Thung Song, Nakhon Si Thammarat, collected on 22/12/2538, dead on 13/10/2540, male"), QSMI 141 ("Siam Farm, 6/2527"), QSMI 142

*Cerberus rynchops*: QSMI 259 ("shrimp farm, Samut Sakhon Prov., 15/12/[25]25")

*Chrysopelea ornata*: QSMI 115-29, QSMI 360 (4 eggs with embryos, "Bang Khun Non, [Bangkok Prov.], 7/2526"), QSMI 372-73 ("Siam Farm, 13/8/26, 5/11/[25]27")

*Chrysopelea paradisi*: QSMI 130, QSMI 376

*Dendrelaphis cyanochloris*: QSMI 379

*Dendrelaphis pictus*: QSMI 200-02 ("5/2527"), QSMI 203-04 ("Siam Farm, 5/2527"), QSMI 343, QSMI 386 ("7/2527")

*Dendrelaphis subocularis*: QSMI 198-99 ("5/2527")

*Dryocalamus davisonii*: QSMI 183

*Dryocalamus subannulatus*: QSMI 182 (striped form)

*Elaphe flavolineata*: QSMI 106-07

*Elaphe guttata*\*: QSMI 109-10 ("Siam Farm, American species, 5/11/2527")

*Elaphe obsoleta*\*: QSMI 102 ("Northern part of Florida, 9/12/27"), QSMI 111-14 ("Siam Farm, American species, 5/11/2527")

*Elaphe radiata*: QSMI 103, QSMI 104 ("17/9/[25]41, age: 2 years"), QSMI 105 ("Siam Farm, 28/11/2527"), QSMI 108 ("caught at Moo Ban Kasetniwet, Chom Rom 6, near Moo Ban Muangthong, at 8.45 a.m."), QSMI 133-34, QSMI 316 (H, "Ela. rad. 3"), QSMI 610 (skin in alcohol), QSMI 615 (head and neck

only)

*Elaphe taeniura ridleyi*: QSMI 131 ("Phang-Nga [Prov.], 30/1/1990"; specimen quoted by Pauwels et al., 2000), QSMI 132

*Enhydris bocourti*: QSMI 211-14, QSMI 215 (head only), QSMI 216-17, QSMI 257 ("12/2526"), QSMI 265, QSMI 299 (H, "En. boc. 2"), QSMI 302 (H, "En. boc. 5"), QSMI 304 (H, "En. boc. 6"), QSMI 395 (H, "En. boc. 4"), QSMI 401 (H)

*Enhydris enhydris*: QSMI 219, QSMI 328-30 ("4/2527"), QSMI 402 (H)

*Enhydris jagorii*: QSMI 218, QSMI 220-22, QSMI 334 ("Siam Farm, 5-11/2527")

*Enhydris plumbea*: QSMI 248-54 ("2/2527"), QSMI 272

*Erpeton tentaculatum*: QSMI 54-66, QSMI 306 (H), QSMI 307 (H, "Er. ten. 2"), QSMI 308 (H, "Er. ten. 3"), QSMI 309 (H, "Er. ten. 4"), QSMI 310 (H, "Er. ten. 6"), QSMI 311 (H, "Er. ten. 7"), QSMI 312 (H, "Er. ten. 8"), QSMI 313 (H, "Er. ten. 9"), QSMI 335-342 ("3/2527"), QSMI 397 (H)

*Gonyosoma oxycephalum*: QSMI 135 ("13/8/2526"), QSMI 136-38, QSMI 423, QSMI 424 (head and anterior part of body)

*Homalopsis buccata*: QSMI 80-81, QSMI 82 ("2/2527"), QSMI 83-86, QSMI 89, QSMI 297 (H, "Ho. buc. 1"), QSMI 298 (H, "Ho. buc. 2"), QSMI 300 (H, "Ho. buc. 3"), QSMI 301 (H, "Ho. buc. 4"), QSMI 303 (H, "Ho. buc. 6"), QSMI 305 (H, "Ho. buc. 8"), QSMI 314, QSMI 393 (H, "Ho. buc. 5"), QSMI 609 (skin in alcohol)

*Lampropeltis getulus*\*: QSMI 391

*Lepturophis albofuscus*: QSMI 236

*Lycodon capucinus*: QSMI 181

*Lycodon effraenis*: QSMI 176 ("South Thailand, 20/10/1984"), QSMI 177 ("Krabi [Prov.], 20/8/2533")

*Lycodon laoensis*: QSMI 100 ("Thung Song, Nakhon Si Thammarat [Prov.], 6/9/2539"), QSMI 101 ("Krabi [Prov.], 20/8/1990"), QSMI 169-75 ("Siam Farm, 13/8/2526")

*Lycodon subcinctus*: QSMI 178 ("2/2527"), QSMI 179, QSMI 180 ("Siam

Farm, 17/4/[25]27"), QSMI 228

*Oligodon fasciolatus*: QSMI 223-24, QSMI 359, QSMI 381

*Oligodon sp.*: QSMI 385 (Krabi Prov.)

*Oligodon taeniatus*: QSMI 317

*Pareas macularius*: QSMI 229 & 234 ("Thung Song, Nakhon Si Thammarat [Prov.], 1995"), QSMI 235 ("South [Thailand], 20/4/1988") (See note below)

*Pareas malaccanus*: QSMI 380

*Pareas margaritophorus*: QSMI 226 ("Thung Song, Nakhon Si Thammarat [Prov.], 1995")

*Psammodynastes pulverulentus*: QSMI 140 ("Khao Soi Dao, Chanthaburi Prov., 23/12/2527")

*Psammophis condanarus*: QSMI 139 ("Siam Farm, 5/11/2527"), QSMI 366

*Ptyas carinatus*: QSMI 190-92, QSMI 193 ("15/6/40"), QSMI 194 ("Siam Farm, 24/12/2527"), QSMI 608 (skin in alcohol)

*Ptyas fuscus*: QSMI 184 ("2/10/40", specimen photographed in Cox et al., 1998: 55), QSMI 185

*Ptyas korros*: QSMI 162 (H, "Pty. kor. 1"), QSMI 163 (H, "Pty. kor. 2"), QSMI 164 (H, "Pty. kor. 3"), QSMI 165 (H, "Pty. kor. 5"), QSMI 166 (H, "Pty. kor. 6"), QSMI 167-168, QSMI 186-87, QSMI 321 ("Siam Farm, 27/4/2527"), QSMI 390 (H), QSMI 430

*Ptyas mucosus*: QSMI 188-89, QSMI 319 ("4/2527")

*Rhabdophis chrysargos*: QSMI 160 ("Krabi [Prov.], 25/7/1990"), QSMI 161

*Rhabdophis subminiatus*: QSMI 156-58 ("6/2527"), QSMI 159, QSMI 225 ("Thung Song, Nakhon Si Thammarat [Prov.], 1995")

*Sinonatrix trianguligera*: QSMI 95 ("Thung Song, Nakhon Si Thammarat [Prov.], 1996"), QSMI 96-97 ("Surat Thani [Prov.], 4/7/1990"), QSMI 98 ("Nakhon Si Thammarat Prov., 1995"), QSMI 99 ("7/2526")

*Xenochrophis flavipunctatus*: QSMI 90-94, QSMI 320, QSMI 322-27 ("Siam Farm, 6-12/2527"), QSMI 398-99 (H)

Comments on noteworthy specimens*Amphiesma khasiense* (Boulenger, 1890)

QSMI 273: female, snout-vent length 267 mm, tail length 122 mm, 0 preventrals + 143 ventrals, 97 divided subcaudals, anal divided, 9 supralabials on each side of which the 4<sup>th</sup> to the 6<sup>th</sup> contact the eye, 1 loreal and 1 preocular on each side, 3 postoculars on each side, 1 anterior temporal, 10 infralabials of which 5 touch the 1st pair of sublinguals on each side, dorsal scale rows reduction from 19 to 17 by fusion of dorsal rows 3 and 4 at the level of the 93rd ventral on the left and of the 94<sup>th</sup> on the right side, dorsals strongly keeled, at the exception of the first row, entirely smooth, eye very large, pupil round.

We identified this specimen as *A. khasiense* on the basis of its coloration, pattern and morphometric features. At first glance, this specimen might be identified as *A. inas* (Laidlaw, 1901), a species also present in Thailand, but not known north of the southern part of the peninsula. *Amphiesma khasiense* and *A. inas*, two obviously closely related species of small, montane natricines, are much similar in coloration, pattern and scalation. For example, the typical pattern of the posterior supralabials, dark brown with an irregularly rounded cream spot in their center, is present in both species. Main scalation data are nearly identical.

These species can be separated as follows: (1) *A. khasiense* is shorter and more slender than *A. inas*; (2) *A. inas* is usually reddish brown, with a dorsal pattern made, on each side, of distinct, separated yellowish spots on a faint rusty dorsolateral line, whereas *A. khasiense* is dark brown or dark greyish brown, with faint spots anteriorly, indistinct posteriorly, on visible dorsolateral lines (3) the dark brown colour of the tip of ventrals is confluent with the dorsal background colour on the whole length of the body in *A. khasiense*, whereas, in *A. inas*, this dark brown colour is usually separated from the dorsum colour along the first 30 ventrals, this separation producing a yellowish cream ventrolateral stripe on each side anteriorly; (4) dorsal scales of *A. khasiense* are very strongly keeled, except first row, whereas the dorsal scales are less strongly and more irregularly keeled in *A. inas*, but including the first dorsal scale row; (5) the whitish yellow nuchal stripe on each side of the neck is wide in *A. inas* and furthermore connects diffuse but wide white spots, whereas these stripes are narrow in *A. khasiense*, and most often reduced to a series of small, disjoint, more or less distinct spots; (6) internasals as wide as long in *A. khasiense*, but longer than wide (1.1 to 1.2 times) in *A. inas*; (7)

internasals are more distinctly narrowed anteriorly in *A. inas* than in *A. khasiense*, where they are broadly truncated; and (8) the frontal is about 2.2 to 2.5 times longer than prefrontals in *A. khasiense*, but much less than 2.0 in *A. inas*. There are other characters, which will be detailed in a revision of the group *A. modestum-khasiense* currently in preparation (David et al.).

In agreement with these distinctive features, based on the observations of types and several tens of specimens, the present specimen is unambiguously referred to *Amphiesma khasiense*, previously unknown from Thailand.

Five species of the genus *Amphiesma* were previously known from Thailand: *A. stolatum* (Linnaeus, 1758), *A. deschauenseei* (Taylor, 1934), closely related to *Amphiesma modestum* (Gunther, 1875) but which deserves a specific status (David et al., unpublished), *A. groundwateri* (Smith, 1921) and *A. inas* from the southern part of the Peninsula, and *A. bitaeniatum* (Wall, 1925), recently discovered in Chiang Mai Province (see David & Pauwels, 2000). The present addition of *A. khasiense* brings to Thailand another species belonging to the snake fauna typical of northern Indochinese mountain ranges.

*A. khasiense* has extensively been confused in the literature with *A. modestum* and *A. boulengeri* (Gressitt, 1937). Currently, it is definitely known from Northeastern India, Myanmar, southwestern China (Yunnan and Xizang provinces), Laos (Zhao & Adler, 1993: 226), and now northern Thailand. Although widely cited in the literature from northern Vietnam, we failed to examine any specimen, but its occurrence is more than likely in the north of this country. *Amphiesma inas* is currently restricted to West Malaysia and southern Peninsular Thailand. Although we did not examine it, the specimen, also from Phu Luang, Loei Province, identified as *A. inas* in Chan-ard et al. (1999: 153) does not belong to this species nor to *A. khasiense*.

*Pareas macularius* Theobald, 1868

QSMI 229: male, snout-vent length 353 mm, tail length 83 mm, 0 preventrals + 159 ventrals, 49 divided subcaudals, anal single, 7 supralabials on each side, 1 loreal and 1 preocular on each side, 1 postocular and 1 elongate subocular on each side, 2+3+3 temporals, 7 infralabials of which 4 touch the 1st pair of sublinguals on each side, 15 dorsal scale rows throughout body with no reduction, dorsals keeled except 4 first rows, pupil vertically elliptic. The meristic characters of our specimens as well as the general coloration fit perfectly with the description given notably by Cox (1991: 260) for the species, except for the coloration of the belly which is white maculated with

numerous brown spots ("dull white" in the description of Cox), and for the size, 436, 370 and 397 mm of total length in QSMI 229, QSMI 234 & 235, respectively (contra a maximal size of 375 mm given by Cox). However, Boulenger (1896: 445) describes *P. macularius* as having "lower parts brownish white, spotted with brown". The species was known in Thailand from the northern provinces of Chiang Mai and Loei (Cox, 1991: 260; Chan-ard et al., 1999: 178).

*Xenochrophis flavipunctatus* (Hallowell, 1860)

The dimensions and body scalation of the four largest females are as follows:

QSMI 90: snout-vent length 977 mm, tail length >257 mm, 2 preventrals + 134 ventrals (plus an additional half ventral on the left side just before anal), >55 divided subcaudals, anal divided;

QSMI 93: snout-vent length 982 mm, tail length >183 mm, 2 preventrals + 137 ventrals, >36 divided subcaudals, anal divided;

QSMI 94: snout-vent length 990 mm, tail length >174 mm, 2 preventrals + 135 ventrals, >32 divided subcaudals, anal divided;

QSMI 320: snout-vent length 923 mm, tail length 352 mm, 2 preventrals + 135 ventrals, 77 divided subcaudals, anal divided.

A maximal total length of 1200 mm for this species was cited by Cox (1991: 250) and Manthey & Grossmann (1997: 309). The total length of QSMI 320, of which the tail is complete, is 1275 mm. If we follow the same ratio of tail length, QSMI 94 would have a total length of 1368 mm.

We examined several hundreds of specimens from Thailand, Vietnam and the People's Republic of China. Detailed results will be published elsewhere, but on the basis of our observations, we concur with Taylor (1965) in regarding *Xenochrophis piscator* (Schneider, 1799) and *Xenochrophis flavipunctatus* as distinct species, the latter one being widely distributed in Southeastern Asia, whereas *X. piscator* seems to be absent east of a line ranging from western Yunnan (southwestern China) to western mountain ranges of Thailand. In our four record-sized females, the presence of the black oblique streaks on supralabials, of black stripes on the upper neck surface, as well as of the transversal black stripe on every ventral scale are typical of *X. flavipunctatus*.

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## Variation in *Drymobius chloroticus* from Central Western Veracruz, Mexico (Reptilia: Serpentes: Colubridae)

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*Drymobius chloroticus* has a wide although spotty range. In the state of Veracruz, the only known records at present are from median elevations in the region of Los Tuxtlas and at 7 mi W Xalapa, 900 and 1900m respectively (Pérez-Higareda and Smith, 1991). We here record another site of occurrence in the mountainous region of Orizaba, of central-western Veracruz.

The three specimens are UNAM-LT 4032 from Cerro Matlaquiahuatl, municipality of Ixhuatlán del Café, Veracruz, 1500m, adult male 1090mm in total length, Diego Almaraz collector, August 2000, in the Biological Station "Los Tuxtlas," UNAM: and H-FBUV 202 and 211 (herpetological collection of the Facultad de Biología, Universidad Veracruzana, campus Córdoba), immature specimens poorly preserved, Sergio Rojas Márques coll.

Data on these specimens are as follows: nasal divided; one loreal; 1-1 preoculars; 2-2 postoculars; 2-2 temporals; 9-9 supralabials, 5<sup>th</sup> and 6<sup>th</sup> contacting eye (in two specimens, not determinable in the other, except that the 4<sup>th</sup> is not involved); 10-0 infralabials; anal divided; 17-15-15 scale rows in two specimens, 17-17-15 in one; dorsal scales keeled except in the lower two rows; median keels prominently black in the adult, color not distinguishable in the two immatures; keeled scales with two apical pits; 157-171 ventrals; 115-119 subcaudals. All three specimens are uniform reddish brown dorsally, dark brown in preservative; the dorsal color invades the lateral one-fourth of the ventrals; venter pale yellow.

For comparison we have a single adult from Tepanca, municipality of San Andrés Tuxtla, southern Veracruz (0083-RRA), in the zoological collection of the Centro de Biología Marina in Alvarado, Veracruz, Ramón Tamírez collector. It has 17-17-15 dorsal scale rows, 159 ventrals and 114 subcaudals. In life its dorsal color was olive green, the venter yellow; in preservative the dorsal color has become gray, the venter white. The dorsal color extends onto the edges of the ventrals, and the keels on the dorsal scales are not black or otherwise distinctive in color.

The specimens from near Orizaba differ from typical *D. chloroticus* in four ways: (1) 5<sup>th</sup> and 6<sup>th</sup> supralabials entering orbit; (2) dorsal scale rows 17-

15-15 in two (17-17-15 in one); (3) median rows of dorsals distinctly black-keeled (in the adult; not determinable in the two juveniles); and (4) reddish brown dorsal color in life, dark brown in preservative (not determinable in the two juveniles).

*D. chloroticus* is recorded elsewhere (Wilson, 1971; Wilson and Meyer, 1985; the Tepanca specimen) with (1) 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> supralabials entering orbit, or 4<sup>th</sup>, 5<sup>th</sup> and 6<sup>th</sup>, or 4<sup>th</sup> and 5<sup>th</sup>, or 5<sup>th</sup>, 6<sup>th</sup> and 7<sup>th</sup>, but not 5<sup>th</sup> and 6<sup>th</sup>; (2) regularly with 17-17-15 dorsal scale rows; (3) dorsal keels very seldom black (one from Oaxaca), otherwise of the ground color; and (4) dorsum usually green, seldom brown (one each from Oaxaca and San Luis Potosí) or gray (one from Veracruz, probably green in life).

On the contrary, black keels are regularly present on *D. melanotropis*, whose range in Central America is south of that of *D. chloroticus*, and the scale rows are regularly 17-15-15. The southern species generally has fewer subcaudals (91-108 vs 107-125).

Thus there is a slight overlap in all character-states distinguishing the two species. However, geographic range is a valid taxonomic character (Schmidt, 1950). Thus the unusual variants from near Orizaba remain representative of *D. chloroticus*, coming from within its range and having the normal number of subcaudals as well as variations known elsewhere, although rare, in that species (the orbital supralabials are unique, but as great as the variation is already known to be, they are not likely to be of much significance).

### Acknowledgments

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Errata: The map below is to be inserted for page 4 in the March 2001 issue (Vol. 36, No. 1) of the "Bulletin of the Maryland Herpetological Society." The printer omitted the correct version.

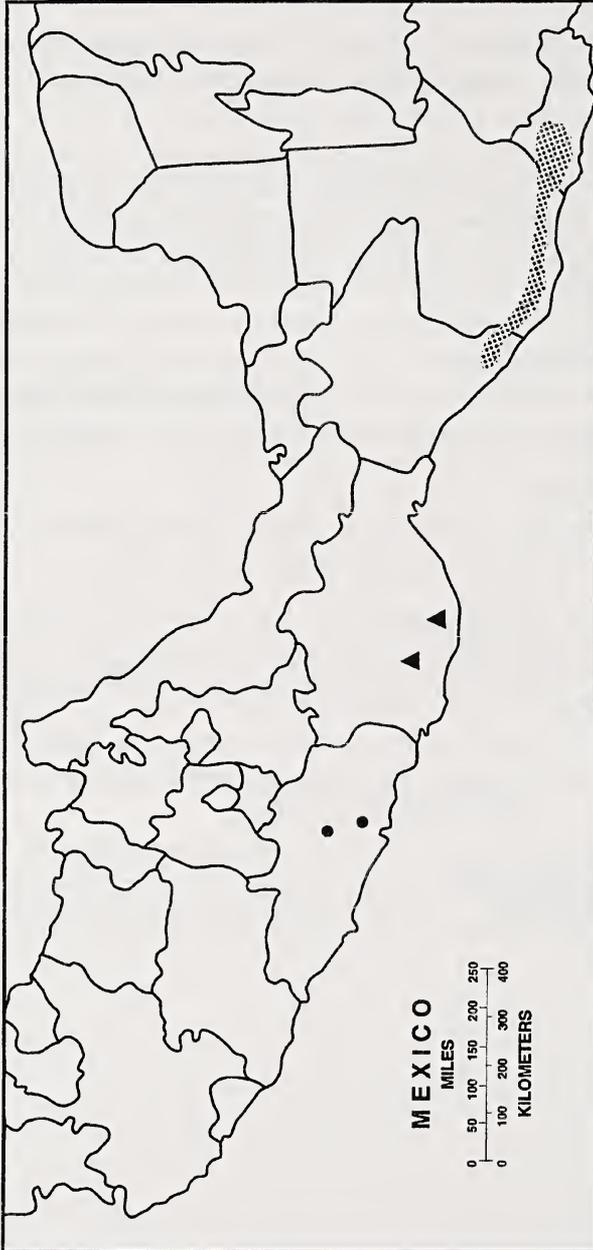
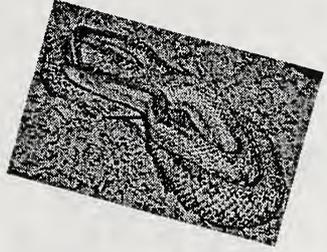


Fig. 1. Distribution of the members of the *Sceloporus acanthinus* superspecies. Two dots in the state of Guerrero, *S. stejnegeri*; two triangles in the state of Oaxaca, *S. tanneri*; shading in southeastern Chiapas, Guatemala and El Salvador, *S. acanthinus*. Base map courtesy Roger Conant.

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*News and Notes*

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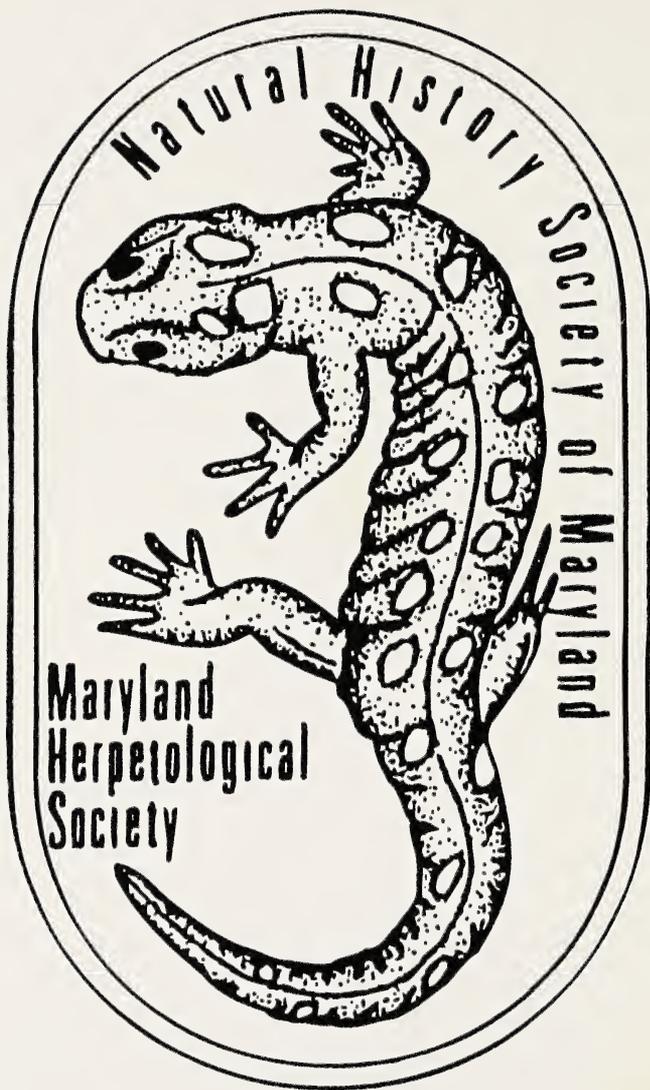
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## Interspecific Variation in Egg and Hatchling Size in Four Sympatric Chelonians: Influence of the Hydric Environment of Incubation

John K. Tucker<sup>1</sup>, Gary L. Paukstis<sup>2</sup>, and Frederic J. Janzen<sup>3</sup>

### Abstract

We examined interspecific variation in the physiological response of eggs, embryos, and hatchling turtles to substrates with differing water potentials in one terrestrial turtle (*Terrapene carolina*) and three aquatic turtles (*Chrysemys picta*, *Trachemys scripta*, and *Sternotherus odoratus*). Eggs of all four species incubated on a drier substrate (-850 kPa) gained less mass during incubation and had shorter incubation periods than eggs incubated on a wetter substrate (-150 kPa). The terrestrial species laid heavier eggs that produced heavier hatchlings than did the aquatic species. Hatchling terrestrial turtles were not consistently larger than hatchlings of aquatic turtles in two linear measures of size but were significantly heavier than hatchling aquatic turtles. These results support the hypothesis that hatchling *T. carolina* hatch with either increased energy stores or higher levels of hydration, both potentially important to species adapted to patchy terrestrial habitats versus species adapted to more uniform aquatic habitats.

Key words: Turtles, *Chrysemys picta*, *Sternotherus odoratus*, *Terrapene carolina*, *Trachemys scripta*, egg size, hatchling size.

### Introduction

Egg and hatchling sizes are important life history traits for all chelonians because they are thought to be primary correlates of lifetime fitness (Congdon and Gibbons, 1990). Consequently, the suggestion by Packard et al. (1958a) that the terrestrial turtle, *Terrapene ornata*, lays relatively large eggs is important. Packard et al. (1958a) suggested that such large eggs may represent an adaptation of this species to stressful hydric environments during incubation. Congdon and Gibbons (1990) discounted this explanation while proffering a modification of Wilbur and Morin's (1988) habitat productivity hypothesis. Congdon and Gibbons (1990) considered large egg size in terrestrial turtles to be an adaptation to the difficulty faced by post-emergence terrestrial turtle hatchlings in attaining a positive energy balance in patchy terrestrial habitats compared to aquatic turtle hatchlings that enter relatively

uniform aquatic environments. Central to their hypothesis is the untested assumption that larger eggs result in larger hatchlings with larger energy stores provided by the parent. Offspring with larger energy stores could move greater distances between habitat patches and experience higher survivorship (Congdon and Gibbons, 1990).

A number of review papers (Elgar and Heaphy, 1989; Ewert, 1979; Iverson 1992; Iverson et al., 1993; Van Buskirk and Crowder, 1994; Wilbur and Morin, 1988) have examined the association of various factors such as latitude, phylogeny, age at maturity, morphological constraints, and habitats with variation in morphology of chelonian eggs. On finding, consistent with those of Packard et al. (1958a) and Congdon and Gibbons (1990), is that terrestrial turtles tend to lay larger eggs relative to maternal size than aquatic turtles (Elgar and heaphy, 1989).

Moreover, many studies report profound effects on survivorship, fitness, and hatchling phenotype of chelonians by incubation environments (reviewed by Packard, 1991). With few exceptions, each of these physiological studies utilized a single aquatic species, thus making direct comparisons between species difficult (but see Tucker and Paukstis, 2000). Few investigators have experimented with eggs of terrestrial turtles (Costanzo et al., 1995 and Packard et al., 1985a for *Terrapene ornata*; Spotila et al., 1994 for *Gopherus agassizii*, Tucker and Paukstis, 2000 for *T. carolina*). Only one study compares interspecific physiological responses of turtle embryos to varying incubation conditions (Janzen et al., 1995) and one other compares interspecific physiological responses to dry substrates (Tucker and Paukstis, 2000).

Comparisons of egg and hatchling characteristics of terrestrial and aquatic turtles could be confounded by possible interspecific differences in physiological responses of embryos to varying incubation conditions. Consequently, testing the seemingly simple hypothesis that terrestrial turtles lay relatively larger eggs and produce relatively larger hatchlings than aquatic turtles is difficult.

Our study had three main objectives. First, we test the hypothesis that the eggs and hatchlings of a terrestrial turtle are larger relative to maternal size than eggs and hatchlings of three syntopic aquatic turtles. Simultaneous incubation of eggs allows us to test a second hypothesis: are hatchlings from eggs of a terrestrial turtle relatively larger than hatchlings from eggs of aquatic turtles once difference in initial egg size are removed? Finally, we determine

whether the hatchlings of these four species differ in mass after adjusting for differences in hatchling size and incubation environments.

## Materials and Methods

### **Egg Collection.**

Gravid aquatic turtles (*Chrysemys picta*, *Sternotherus odoratus*, and *Trachemys scripta*) were collected as they emerged to nest along the Illinois River in Jersey and Calhoun Counties, Illinois (see Tucker, 1997 for details). We collected the terrestrial turtle (*Terrapene carolina*) crossing roads in the same two counties in Illinois. The aquatic turtles were either moving to or were at nesting areas at the time of collection. Their eggs were, therefore, mature and ready to lay. The terrestrial turtle females were palpated to determine egg maturity status. These are important considerations because induction of oviposition could have affected egg size if induction was inappropriately timed. The 90.8% hatch rate that we achieved suggested that the eggs we used were appropriately gathered.

In all, we examined six clutches each for *Chrysemys picta* and *Sternotherus odoratus*, five clutches from *Terrapene carolina*, and eleven clutches from *Trachemys scripta*. For each female, we measured gravid body mass (to nearest 5 g) and estimated spent body mass using the method of Iverson and Smith, 1993. We also measured midline carapace length, midline plastron length, maximum carapace width, and maximum carapace height to the nearest mm for each female.

We induced oviposition with oxytocin (Ewert and Legler, 1978). Eggs were patted dry and uniquely numbered with carbon ink. Eggs were weighed to the nearest 0.01 g. Once the first egg pipped, we placed a bottomless waxed paper cup over each egg (Janzen, 1993). We recorded pip date and defined incubation period as pip date minus initial date (Gutzke et al., 1984). We then measured hatchling mass (to 0.01 g) and hatchling carapace length and width (both to 0.1 mm). Females and surviving hatchlings were released at the original collecting locations.

### **Experimental Procedures.**

We prepared four Rubbermaid brand plastic boxes (20.6 x 33.8 x 8.8 cm) by adding a mixture of 1.11 g water / g coarse vermiculite (wet substrate: - 150 kPa) to two of the boxes and a mixture of 0.18 g water / g coarse ver-

miculite (dry substrate: -850 kPa) (Morris et al., 1983) to two other boxes. Water potentials in natural nests usually are relatively wet (Ratterman and Ackerman, 1989). However, some nests become much drier and at times may drop well below the -850 kPa water potential that we used (Packard et al., 1985b).

Maximum clutch size for any species was 13 eggs. We assigned the eggs from each clutch to a box by egg number. Thus, eggs numbered 1, 5, 9, and 13 were assigned to box 1 (dry substrate). Eggs numbered 2, 6, and 10 were assigned to box 2 (wet substrate). Eggs numbered 3, 7, and 11 were assigned to box 3 (dry substrate). Eggs numbered 4, 8, and 12 were assigned to box 4 (wet substrate). Eggs were assigned by this method until all eggs of the clutch had been placed in one of the four boxes.

All eggs were reweighed three times during incubation. Hydration in each box was maintained by first determining the mass of the box, eggs, and substrates at day 0, the date of oviposition. We added sufficient water at each remeasurement to bring each box back to original mass after subtracting water taken up by the eggs in the box and any losses to the atmosphere. Boxes were rehydrated by adding water onto the substrate in the boxes as evenly as possible without allowing water to contact the eggs directly. All boxes had an aluminum foil covering between the box and lid to retard moisture loss.

During incubation, all boxes were kept at the same vertical height in the incubation room. Boxes were horizontally rotated once weekly to reduce the effects of undetected temperature gradients. We allowed incubation temperature to fluctuate and recorded it daily with minimum-maximum thermometers. Estimated mean incubation temperature was 26.4°C with a range of 16.2 to 36.0°C using the method of Godfrey and Mrosovsky (1994). This range of temperatures is commonly experienced by developing eggs in natural nests (e.g., Packard et al., 1985b; Cagle et al., 1993). We used ANCOVA for interspecific comparisons of egg and hatchling mass. The turtles used in this experiment varied greatly in shape. Consequently, selection of an appropriate measure of maternal size to use as a covariate must be carefully made. Jackson (1988) suggested that maternal mass, which is an indirect measure of maternal volume, was preferable as a covariate compared to more traditional linear measures of size such as plastron length or carapace length. This might particularly be the case where comparisons of other measurements of mass are being made (Jackson, 1988). Stepwise multiple regression can also be used to select an appropriate covariate from the available measures of maternal

size. We selected spent body mass, gravid body mass, midline plastron length, midline carapace length, maximum carapace width, and maximum carapace height as potential independent variables in a stepwise multiple regression for mean egg mass per clutch and mean hatchling mass per clutch with the detail option selected. This option yields  $R^2$ ,  $F$ , and  $P$  values for each independent variable. Maximum carapace height was the variable that entered step 1 of the regression first for both mean egg mass per clutch ( $R^2 = 0.76$ ,  $F_{1,26} = 84.38$ ,  $P < 0.0001$ ) and mean hatchling mass per clutch ( $R^2 = 0.68$ ,  $F_{1,26} = 55.95$ ,  $P < 0.0001$ ). We therefore used maximum carapace height as the covariate for ANCOVA. Slopes for egg mass and hatchling mass vs. maternal carapace height did not differ significantly ( $P > 0.07$ ).

We used repeated measures ANCOVA to analyze the response of egg mass during incubation to experimental treatments. A series of preliminary ANCOVAs was used to assess the influence of random variation in initial egg mass (= covariate) for other measured variables. We reverted to analysis of variance (ANCOVA) for total change in egg mass and incubation period where the covariate proved not to be a significant source of variation. ANCOVA was retained for hatchling mass and linear measures of the hatchling size because the covariate was a significant source of variation. ANCOVA was retained for hatchling mass and linear measures of the hatchling size because the covariate was a significant source of variation. Our analytical approach followed the method used by Packard and Packard (1993).

We used type III sum of squares to compute mean squares. Mean squares were then used to gauge the relative contribution to variance for each effect in the particular model (Packard and Packard, 1993). For the interspecific variation model, species, substrate moisture box, and their interactions were main effects. Clutch nested in species was a random effect. We subsequently used the sequential Bonferroni method to determine table-wide  $P$  values sufficient to exclude overall type I errors at the 0.05 level for all pair-wise comparisons of means or least squares means (= LSM) for each analysis (Rice, 1989).

## Results

*Trachemys scripta* tended to lay the largest eggs, particularly when compared to those of *Chrysemys picta* and *Sternotherus odoratus* (Table 1). However, once adjusted for differences in maternal size, the eggs of *Terrapene carolina* were relatively heavy and were significantly heavier than those of *C. picta* and *S. odoratus* (Table 2;  $P < 0.03$  for pairwise comparisons). However,

Table 1. Means (standard errors) and ranges for females and clutches from four species of turtles collected in west-central Illinois.

	<i>Terrapene carolina</i>	<i>Trachemyd scripta</i>	<i>Chrysemys picta</i>	<i>Sternotherus odoratus</i>
Gravid body mass (g)	595 (24.2) 525-650	1745 (104.3) 1125-2150	565 (35.2) 475-675	235 (10.5) 200-275
Spent body mass (g)	550 (49.8) 480-600	1620 (313.9) 1070-1975	510 (79.7) 430-620	210 (23.8) 180-245
Carapace length (mm)	128 (1.9) 122-132	218 (4.48) 189-240	152 (2.71) 143-160	104 (1.65) 101-112
Plastron length (mm)	134 (3.5) 124-145	207 (4.59) 178-230	143 (2.03) 136-150	81 (2.17) 74-90
Carapace width (mm)	99 (4.4) 95-104	154 (10.1) 138-172	106 (6.6) 98-113	72 (3.3) 69-76
Carapace height (mm)	66 (5.0) 61-72	87 (9.7) 72-104	53 (3.2) 48-57	44 (2.1) 41-46
Clutch size (eggs)	5.0 (.55) 4-7	11.5 (1.22) 6-18	7.8 (0.40) 7-9	6.0 (0.37) 5-7
Egg mass (g)	9.73 (0.46) 8.29-10.86	10.60 (0.45) 8.55-12.94	6.95 (0.38) 5.56-8.04	4.04 (0.15) 3.62-4.54
Egg length (mm)	35.3 (1.44) 32.6-40.4	35.2 (0.57) 32.9-39.2	32.8 (0.85) 30.6-36.2	26.6 (0.51) 24.1-27.5
Ed width (mm)	21.3 (0.29) 20.7-22.2	22.3 (0.35) 20.4-24.1	18.4 (0.37) 17.0-19.5	15.6 (0.29) 14.7-16.4
Sample size (clutches)	5	11	6	6

they were not significantly heavier than those of *T. scripta* ( $P = 0.3260$ ). The eggs of *S. odoratus* were relatively small compared to those of *T. scripta* ( $P = 0.04$ ) and *C. picta* ( $P = 0.03$ ). In contrast, egg mass adjusted for maternal size for the latter two species did not differ statistically ( $P > 0.46$ ).

The hatchlings of *Terrapene carolina* were also relatively heavy (Table 2) and were significantly heavier ( $P < 0.01$ ) than hatchlings of the other three species (Table 2). In contrast, hatchlings of the three aquatic species did not differ significantly from each other in mass or carapace length ( $P > 0.14$ ).

In general, eggs of all four species gained more mass on the wetter substrate as compared to those on drier substrate. Variance for between – and within – subject effects was dominated by covariate and/or substrate moisture effects (Table 3). Other effects explained little of the variance (Table 3).

Sources of variation for total change in egg mass, a measure of net water exchange, were similar to the response of egg mass during incubation

Table 2. Sources of variance in egg mass and hatchling mass of four species of turtles from west-central Illinois.

<u>Source</u>	<u>df</u>	<u>Egg mass (g)</u>			<u>Hatchling mass (g)</u>		
		<u>Mean</u>	<u>Mean</u>	<u>P</u>	<u>Mean</u>	<u>Mean</u>	<u>P</u>
		<u>Square</u>	<u>F</u>		<u>Square</u>	<u>F</u>	
Species	3	21.63	18.23	0.0001	18.13	26.64	0.0001
Maternal carapace height	1	4.41	3.71	0.0665	4.07	5.99	0.0225
Error	23	1.19			0.68		
LSM (SE):							
<i>Terrapene carolina</i>		9.82	(0.46)		7.80	(0.35)	
<i>Trachemys scripta</i>		8.95	(0.70)		6.06	(0.53)	
<i>Chrysemys picta</i>		8.06	(0.60)		5.97	(0.45)	
<i>Sternotherus odoratus</i>		5.89	(0.82)		4.39	(0.63)	

LSM= least squares mean; SE = standard error. Note: LSM's in this analysis may be outside the normal range of egg sizes for these species as a result of ANCOVA which adjusted egg size in relation to female sizes. Regardless, the relative size differential among species is demonstrated by the LSM's.

Table 3. Results of repeated measure ANCOVA for eggs of four species of turtles incubated on two differing substrate water potentials.

<u>Source</u>	<u>df</u>	<u>Between -subject effects</u>		
		<u>Mean Square</u>	<u>F</u>	<u>P</u>
Species	3	0.81	4.25	0.0069
Substrate moisture	1	17.61	92.45	0.0001
Species X substrate moisture	3	1.11	5.82	0.0010
Box	1	0.01	0.03	0.8728
Box X species	3	0.09	0.48	0.6996
Box X substrate moisture	1	0.00	0.00	0.9977
Box X species X substrate moisture	3	0.12	0.54	0.6582
Clutch nested in species	24	0.89	4.68	0.0001
Covariate: Initial egg mass	1	43.32	227.44	0.0001
Error	117	0.19		
Time	2	0.12	2.36	0.0964
Time X species	6	0.42	7.93	0.0001
Time X substrate moisture	2	6.78	129.37	0.0001
Time X species X substrate moisture	6	0.47	8.96	0.0001
Time X box	2	0.00	0.03	0.9712
Time X box X species	6	0.02	0.43	0.8586
Time X box X substrate moisture	2	0.00	0.01	0.9879
Time X box X species X substrate moisture	6	0.03	0.56	0.7654
Time X covariate: Initial egg mass	2	0.07	1.36	0.2584
Time X clutch nested in species	48	0.49	9.26	0.0001
Error	282	0.05		

(Table 4). Substrate moisture affected variance nearly four times as much as did species identity (Table 4). Eggs on the wetter substrate gained relatively more mass than did eggs on the drier substrate (Table 5). Species varied in water relations, however, with the eggs of *Sternotherus odoratus* differing little between substrate moisture regimes. The eggs of *S. odoratus* lost mass during incubation regardless of substrate water potential (Table 5). In contrast, the eggs of the other species lost mass (*Chrysemys picta*) or gained mass (*Terrapene carolina* and *Trachemys scripta*) on the drier substrate and eggs of these three

Table 4. Results from ANOVA for eggs of four species of turtles incubated on two different substrate moistures.

<u>Source</u>	<u>Initial egg mass</u>			<u>Change in egg mass</u>			<u>Incubation period</u>			
	<u>df</u>	<u>Mean square</u>	<u>F</u>	<u>P</u>	<u>Mean square</u>	<u>F</u>	<u>P</u>	<u>Mean square</u>	<u>F</u>	<u>P</u>
Species	3	292.93	2236.90	0.0001	7.66	42.94	0.0001	1304.98	959.64	0.0001
Substrate moisture	1	0.00	0.00	0.9672	26.22	147.01	0.0001	27.11	19.94	0.0001
Species X substrate moisture	3	0.01	0.09	0.9642	1.76	9.89	0.0001	2.93	2.15	0.0973
Box	1	0.00	0.02	0.8751	0.01	0.04	0.8398	2.20	1.61	0.2064
Box X species	3	0.03	0.19	0.9021	0.10	0.57	0.6361	0.58	0.43	0.7320
Box X substrate moisture	1	0.04	0.30	0.5856	0.00	0.01	0.9047	0.60	0.44	0.5078
Box X species X substrate moisture	3	0.07	0.55	0.6472	0.06	0.36	0.7811	0.14	0.10	0.9578
Clutch nested in species	24	7.12	54.36	0.0001	1.37	7.69	0.0001	16.19	11.90	0.0001
Error	118	0.13			0.18			1.36		

Table 5. Comparison of least squares means and means for variables measured from four species of turtles collected in west-central Illinois. Standard errors in parentheses.

Substrate moisture	Dry				Wet			
	<i>Terrapene carolina</i>	<i>Trachemys scripta</i>	<i>Chrysemys picta</i>	<i>Sternotherus odoratus</i>	<i>Terrapene carolina</i>	<i>Trachemys scripta</i>	<i>Chrysemys picta</i>	<i>Sternotherus odoratus</i>
Actual means:								
Initial egg mass (g)	9.58 (0.28)	10.64 (0.25)	6.99 (0.19)	4.05 (0.09)	9.64 (0.36)	10.81 (0.26)	7.02 (0.19)	4.13 (0.09)
Change in egg mass (g)	0.16 (0.23)	0.17 (0.13)	-0.39 (0.20)	-0.20 (0.07)	1.45 (0.21)	1.23 (0.08)	0.67 (0.100)	-0.03 (0.01)
Incubation period (days)	64.1 (0.45)	71.9 (0.27)	64.0 (0.27)	79.1 (1.00)	65.3 (0.29)	72.7 (0.21)	65.4 (0.32)	79.4 (0.80)
Hatchling mass (g)	7.36 (0.27)	7.46 (0.20)	5.02 (0.17)	2.74 (0.09)	7.91 (0.30)	7.67 (0.22)	5.08 (0.16)	2.88 (0.06)
Carapace length (mm)	29.4 (0.40)	30.0 (0.41)	26.5 (0.34)	22.8 (0.36)	29.6 (0.44)	30.1 90.32)	26.7 (0.36)	23.3 (0.18)
Least squares means:								
hatchling mass (g)	6.68 90.15)	6.07 (0.21)	5.80 (0.15)	5.31 (0.38)	7.20 (0.17)	6.22 (0.21)	5.88 90.15)	5.37 (0.39)
Carapace length (mm)	28.3 (0.52)	27.9 (0.69)	27.7 (0.49)	26.7 (1.30)	28.6 (0.56)	27.8 (0.71)	27.9 (0.49)	27.0 (1.30)
Carapace width (mm)	26.1 (0.40)	26.5 (0.53)	24.6 (0.37)	19.4 (0.98)	26.4 (0.54)	27.0 (0.54)	24.7 (0.54)	19.6 (0.99)
Eggs pipped	13	32	20	14	9	33	21	16
Failed to pip	1	2	3	2	2	3	2	1

Table 6. Results from ANCOVA for hatchlings of four species of turtles from eggs incubated on two different substrate moisture levels.

<u>Source</u>	<u>Initial egg mass</u>			<u>Change in egg mass</u>			<u>Incubation period</u>			
	<u>df</u>	<u>Mean square</u>	<u>F</u>	<u>P</u>	<u>Mean square</u>	<u>F</u>	<u>P</u>	<u>Mean square</u>	<u>F</u>	<u>P</u>
Species	3	24.48	38.32	0.0001	4.11	3.09	0.0298	34.58	45.03	0.0001
Substrate moisture	1	1.29	11.03	0.0012	0.96	0.72	0.3979	2.61	3.40	0.0678
Species X substrate moisture	3	0.27	2.29	0.0823	0.34	0.26	0.8575	0.35	0.46	0.7129
Box	1	0.01	0.06	0.8008	0.10	0.08	0.7800	1.02	1.33	0.2507
Box X species	3	0.03	0.28	0.8398	0.25	0.19	0.9058	0.57	0.74	0.5280
Box X substrate moisture	1	0.02	0.20	0.6527	0.05	0.04	0.8502	1.50	1.95	0.1652
Box X species X substrate moisture	3	0.09	0.80	0.4936	1.02	0.77	0.5151	0.67	0.87	0.4605
Clutch nested in species	1	5.59	47.81	0.0001	12.80	9.62	0.0024	9.24	12.03	0.0007
Error	116	0.12			1.33			0.77		

Table 7. Type III mean squares from ANCOVA for hatchling mass adjusted for differences in hatchling carapace length of four species of turtles from west-central Illinois.

<u>Source</u>	<u>df</u>	<u>Between -subject effects</u>		
		<u>Mean Square</u>	<u>F</u>	<u>P</u>
Species	3	9.68	29.58	0.0001
Substrate moisture	1	0.62	1.90	0.1706
Species X substrate moisture	3	0.42	1.29	0.2814
Hatchling carapace length	1	79.30	242.48	0.0001
Error	152	0.33		

species added mass on the wetter substrate (Table 5).

Actual hatchling size varied among the four species (Table 6). Variance attributable to species was particularly pronounced in comparisons of hatchling carapace with (Table 6). The variation was largely due to *Chrysemys picta* and *Sternotherus odoratus* hatchlings. Both species had relatively narrower carapaces than did hatchling *Terrapene carolina* or *Trachemys scripta*. Carapace width LSM for *S. odoratus*, regardless of substrate moisture, was less than that of any of the other turtles ( $P < 0.0001$  in all pairwise comparisons).

Despite the extensive interspecific variation in measures of carapace width, carapace length LSM for these four species (regardless of substrate water potential) did not differ significantly in any pairwise comparison ( $P > 0.12$ ). Thus, hatchlings of all four species had equivalent carapace lengths once adjusted for difference in initial egg mass. Consequently, hatchlings of the terrestrial turtle, *Terrapene carolina*, were not consistently larger than hatchlings of aquatic turtles in two linear measures of size once differences in initial egg mass were removed by ANCOVA. Nonetheless, hatchling *T. carolina* were significantly heavier ( $P < 0.0001$ ) than hatchlings of all three aquatic species once differences in initial egg mass were removed with ANCOVA. Remarkably, hatchling *T. carolina* from eggs incubated on the drier substrate weighed relatively more than hatchlings of the aquatic species that were incubated on the wetter substrate.

The hypothesis that terrestrial turtle hatchlings of a given carapace length were relatively heavier than aquatic turtle hatchlings of similar carapace length was supported by ANCOVA (Table 7). Only species and hatchling

carapace length contributed significantly to variance in this model (Table 7). Overall, hatchling mass LSM of *Terrapene carolina* ( $6.89 \text{ g} \pm 0.09 \text{ g}$ ,  $P = 0.0459$ ), *Chrysemys picta* ( $5.55 \text{ g} \pm 0.10 \text{ g}$ ,  $P < 0.0001$ ), and *Sternotherus odoratus* ( $4.80 \text{ g} \pm 0.17 \text{ g}$ ,  $P < 0.0001$ ).

### Discussion

Because our study is based on collections from a single year from a restricted geographic area, our results are not confounded by possible annual or latitudinal variation (Iverson, 1992, Iverson et al., 1993). The simultaneous incubation of eggs of four species allows us to evaluate the degree of interspecific differences in physiological response of embryos. Moreover, we can compare hatchling size not confounded by interspecific differences in physiological responses due to varying substrate moisture levels. Thus, our experimental study simultaneously tests three hypotheses: 1) terrestrial turtles lay relatively large eggs that produce relatively large hatchlings in comparison to maternal size, 2) relatively large hatchlings emerge from eggs of terrestrial turtles, and 3) hatchling terrestrial turtles are relatively heavy after accounting for linear measures of hatchling size.

Our study generally supports the first hypothesis that eggs and hatchlings of the terrestrial species are relatively heavier than those of the aquatic species. The prediction that egg mass and possibly hatchling mass should be larger in terrestrial species than aquatic species is supported. Thus, our study supports (and extends to hatchlings) results reported by Packard et al. (1985a) and Elgar and hepahy. (1989).

The concordance between our study and the conclusions of Congdon and Gibbons (1990) is important. Consistent with the second hypothesis, eggs of the terrestrial species do produce relatively heavier hatchlings than do the eggs of the aquatic species. However, terrestrial hatchlings are not necessarily longer or wider than hatchlings of aquatic turtles.

More importantly we found support for the third hypothesis. Terrestrial turtle hatchlings of a given carapace length are heavier than hatchlings of three aquatic species of the same carapace length. Thus, terrestrial turtle hatchlings differ from aquatic turtle hatchlings in either energy stores (residual yolk, mass), tissue mass, or hydration. The terrestrial turtle hatchlings apparently hatched with more of the initial egg mass and water gain during incubation converted to tissue mass, residual yolk mass, or water content than did the aquatic turtle hatchlings. Without sacrificing eggs and hatchlings,

we cannot determine whether the differences are due to extra tissue, more residual yolk, or increased hydration levels in the terrestrial hatchlings. Regardless of whether the difference is due to increased energy stores or increased hydration, either would likely be important in allowing hatchlings to reach a suitable habitat patch (Congdon and Gibbons, 1990), but would have little meaning if hatchlings dehydrated during the search.

Our study does not negate the hypothesis that larger egg size in terrestrial turtles is also an important adaptation to incubation environments normally encountered by eggs of terrestrial turtles, as originally advanced by Packard et al. (1985a). Their hypothesis was rejected out of hand by Congdon and Gibbons (1990) because aquatic turtles also nest in terrestrial environments. However, the premise of Packard et al. (1985a) was based on the untested assumption that eggs of terrestrial turtles are more often laid in more xeric sites than usual for the eggs of aquatic turtles. In such sites, increased egg size may be an advantage (Gutzke et al., 1987; Packard et al., 1989; Packard, 1991; Spotila et al., 1994). We observed no interspecific differences in embryonic survival in our study but we also selected relatively moderate water potentials that would be unlikely to induce mortality (Packard et al., 1985b). Consequently, simultaneous incubation of eggs of aquatic and terrestrial turtles at much more stressful water potentials would be necessary to test the hypothesis of Packard et al. (1985a).

Despite the general agreement of our experimental results with hypotheses made from statistical comparisons of eggs and adults of many turtle species (e. g., Elgar and heaphy, 1989; Iverson, 1992), our study has certain limitations. First, we were unable to examine a large number of clutches simultaneously due to limited availability of all species excepting *Trachemys scripta*. Limited sample size makes comparison of egg mass hatchling mass relative to maternal size less reliable than the comparisons relative to egg size. We note, however, that no previous interspecific studies of turtle eggs consider data from female parents. Moreover, the variance due to substrate moisture has to be submerged in the comparison among females.

Interspecific comparisons are also complicated by morphological differences among species and selection of an appropriate covariate (Tucker et al., 1998). Possibly comparisons should be made on some volumetric basis as suggested earlier by Jackson (1988). Measurement of hatchling volume directly or indirectly is complicated by developmental changes that the hatchling undergoes. All of these hatchlings leave the egg with a yolk sack that eventu-

ally will be internalized. When exactly should volume (or carapace height) be determined for such hatchlings? This is an important question and has never been addressed in other experimental studies. Volume can also be estimated for hatchlings and females by application of formulae for volume. However, mass comparisons are also essentially volumetric estimates and can be more accurately determined than volume estimates using formulae. Thus, examination of hatchling mass and egg mass are appropriate measure of hatchling size.

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## The Unken Reflex in the Eft (*Notophthalmus viridescens*): Warning for Predators, or Escape Maneuver?

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### Introduction

The red-spotted newt, *Notophthalmus viridescens*, is a small salamander ranging east of Mississippi River in North America. This animal has a unique life cycle in that eggs hatch into larvae that grow to a bout 3 cm then emerge from the water as aposematically colored red efts. They live a terrestrial existence for 6 months to 5 years then return to the water as aquatic adults. All life stages produce tetrodotoxin, a potent poison (Brodie 1982) from their skin. Brodie (1973) noted unken in efts, and induced anti-predator postures in several species by pricking salamanders with a straight pin. He did not specify which species he pin-pricked. Cochran and Redmer (1992) observed unken in efts upon striking them with an object or "moderately harassing efts". Both Brodie (1973) and Brandon, et al. (1979 b) proposed that unken reflex is used to communicate eft's toxicity to predators, allowing the eft to escape predation without injury.

Endler (1986) divided predation into five different stages: detection, identification, approach, subjugation, and consumption. Efts communicating distastefulness and toxicity to predators during the identification phase avoid the energetic costs of escape or battle (Feder and Arnold 1982) and death. This would be highly adaptive to the eft. Predators that can identify such communications avoid metabolic costs of processing toxins (Smith and White 1955, Anderson 1963), lost opportunity (Stephens and Krebs 1986), and potentially death (Webster 1960, Mosher, et al. 1964, Fuhrman 1967, Licht and Low 1968, Brodie 1968, Brodie 1982).

Toxin metabolism is a significant cost to a predator. Epinephrines (Licht and Lowe 1968) and antibodies (Kuby 1997) required for detoxification are a significant cost to produce. Epinephrines can also damage the body tissues when large quantities are produced in response to toxins. Additionally the toxins themselves damage cells and tissues which must be replaced and repaired.

Lost opportunity (Stephens and Krebs 1986) is another substantial cost to the predator feeding on efts. Since the snake has a limited stomach vol-

ume, feeding on an eft may preclude it from eating a more nutritious food later. Also if unken increases handling time, then the snake will lose searching time for additional prey.

Death is also a possibility. Mosher, et al. (1964), Fuhrman (1967), Licht and Low (1968), Brodie (1968), and Brodie (1982) each discussed the toxicity of tetrodotoxin. They each relay that this is one of the most potent poisons known. Every year people die from feeding upon blowfish that produce tetrodotoxin (Fuhrman 1967).

In order for unken reflex to be a warning display it must: 1) relay eft toxicity accurately, 2) be utilized prior to the predators "subjugation" stage, and 3) result in avoidance of predation. The evidence suggests the primary role of unken is not as a warning but rather a specialized anti-predator behavior for defense against snakes.

I used the comparative method via a literature survey to examine the role of unken in relaying palatability and edibility of efts to various predators, the temporal utilization of this maneuver by efts, its recognition by predators, and the success rate of its utilization. I also offer an alternative hypothesis of its function.

If unken is a warning behavior it must be performed prior to the predator's subjugation phase. As avoidance of subjugation (attack) is what the unken is for. If it occurs any time after subjugation, then it cannot function in this manner.

If unken is a warning behavior, the eft's toxins should impart harmful effects on animals that eat them. Displaying unken attracts the attention of the predator. Non-toxic eft's should be quickly removed from the population by predation pressure. In order for unken to be successful, the predator must not eat prey performing it. If they do, then it is a counter productive strategy.

## Results

The results of eft-predator encounters based on 16 studies are summarized in Table 1. Although the two species of birds appear not to eat efts, raccoons, and many species of reptiles (6), amphibians (2), invertebrates (2), and fishes (2) are able to eat this noxious species without any apparent harm. Based both on laboratory and field observations, the primary predators of efts are species of *Thamnophis*.

Brandon (1979 a, b) examined the response of chickens to efts. Of the 32 events, no chickens ate efts. Killdeer rejected 5 of 5 efts offered as food (Hurlbert 1970). Although an unlikely predator, a red-tailed hawk was offered 5 efts, none of which were eaten (Hurlbert 1970). It is possible that other bird species will eat efts, especially herons which are known for eating amphibians.

Cochran and Redmer (1992) and Hurlbert (1970) offered efts to raccoons. The 1992 study subjects showed no interest in efts as food, while the 1970 study found raccoons learned to roll the efts in their hands to remove the toxic skin, then eat the prey.

Turtles were offered efts by Hurlbert (1970) and McCallum (1994). Hurlbert found that snapping turtles (*Chelydra serpentina*) ate 5 of 7 efts offered without harm. He also found that painted turtles (*Chrysemys picta*) fed on 7 of 10 efts. Painted turtles rolled the efts onto their back and fed on the ventral surface. McCallum (1994) found that painted turtles fed on efts initially, but refused to feed on efts or any other salamanders after 8 weekly, repeated feedings.

Snake acceptance of efts was examined by Brodie (1968), Carpenter (1952), Hurlbert (1970), McCallum (1994), Uhler, et al. (1936), and Wetzel (pers. comm.). Brodie (1968) force fed efts to a copperhead (*Ankistrodon contortrix*), although the animal accepted the eft, the snake later died. A timber rattlesnake was also force fed efts, and died. The western ribbon snake (*Thamnophis proximus*), varied in response to eft feeding. When force fed, two ribbon snakes died. Another ribbon snake voluntarily fed upon an eft without ill effects. Four of six stomachs from field-caught eastern ribbon snakes (*Thamnophis sauritus*) contained newly metamorphosed efts (Carpenter 1952). Carpenter (1952) alleged that "some" Garter snakes (*Thamnophis sirtalis*) fed on efts without ill effects, but gave no quantitative data. Hurlbert (1970) found that garter snakes experienced no noticeable ill effects from force feeding efts, but only voluntarily accepted 3 of 51 efts as food. McCallum observed 18 of 27 efts were accepted as food by garter snakes. Eastern hognose snakes (*Heterodon platyrhinos*) ate 5 of 8 efts readily in captivity (McCallum 1994, Wetzel pers. comm.). Initially, McCallum (1994) observed some refusal of efts, but all ate efts after the first trial. Wetzel (pers. comm.) reported eastern hognose snakes were fed efts as a staple for years but no quantitative data was provided.

Cooper (1942), Hurlbert (1970), Brandon (pers. comm), Webster (1960), and Webster and Little (1942) observed predation on adult newts in the field.

Cooper (1942) found newts in 3 of 133 stomach samples of *Salvelinus fontinalis*. All three specimens were in good health and appeared unaffected by the prey. Webster found a dead

*S. fontinalis* X *trutta* with an adult newt in its stomach. He hypothesized that the fish died from consuming the newt. He then force fed three *S. fontinalis* newts and two died, while the third showed no ill effects. Webster and Little (1942) fed efts to hatchery raised *Salmo trutta*. The fish ate a "few" efts without ill effects.

Brodie (1973) described several anti-predator postures by salamanders, including the unken reflex in efts. He induced many species to display postures by sticking them with a needle, but did not specify which species were induced this way. Cochran and Redmer (1992) observed 52 efts, none of which performed unken when attacked by raccoons (*Procyon lotor*). They did report that 4 of 12 efts displayed unken upon being struck on the back by the junior investigator. Brandon, et al. (1979) observed six instances of unken as an initial response to harassment (they did not specify what harassment was), 15 of 19 unken after "moderate" harassment, and three efts that did not perform the behavior. Of six efts seized by chickens, four showed unken and one did not posture. In all cases of unken, the eft was pecked by chickens beforehand. McCallum observed unken in 21 of 43 attacks on efts by garter snakes (*Thamnophis sirtalis*) while 18 of 27 efts were eaten by the snakes. The differences in number of attacks and number of efts results from multiple attacks on a single eft. McCallum (1994) noted efts only performed unken in the snake's mouth. Garter snakes eating efts performing unken ingested them significantly slower (Table 2) than non-unken performing efts (Mann-Whitney,  $U=19$ ,  $p<0.05$ ). Furthermore, 4 of 7 control salamanders escaped from the snake's mouth after he lifted the snake from the substrate by the tail. Only 3 of 43 salamanders escaped when not lifted off the substrate.

### Discussion

For unken to be an effective communication mechanism to predators, it must result circumvent attacks during the "identification" stage of predation. In the studies outlined above this is not the case. In fact, none of the major studies offer evidence suggesting unken is performed at any time but during consumption. Brodie (1973) used a pin prick to induce some salamanders to posture. He did not discern between species or individuals receiving pin pricks and those that did not. A pin prick may be interpreted as a predator bite by the eft. If he did prick efts, then they were not giving a pre-

attack warning, but rather utilizing unken behavior would be a post-attack response.

Cochran and Redmer (1992) did not observe unken prior to 52 raccoon attacks. Since the raccoons manipulated the efts to remove the skin, they could not observe unken if it were performed. They did observe unken in efts after striking them on the back. They give no indication how hard the eft was struck, or what instruments were used to strike them. Such information is vital for interpreting this data. Such a stimulus may be interpreted as jaws clamping on the eft. This, combined with a lack of unken's observed prior to attack further supports unken not being a warning behavior.

Brandon, et al. (1979) did not observe unken prior to harassment by himself or chickens. He did not define what "harassment" was. Depending upon how hard he had to harass the animals, this also may be interpreted by the eft as a predator attack. Efts performed unken after chickens pecked them. Because efts are not larger than 5 cm a light peck by a chicken would be a major predation attack.

McCallum did not observe unken prior to a snake attack among 43 events. He did observe 21 instances of a behavior in snake's mouths that appeared to be unken. When efts were in the snakes mouth, unken appeared to position the primary of poison glands aggregations in the pectoral dorsum, occipital cranium, and pelvic dorsum along the snakes maxillary dentition. Considering these investigator observations, unken could be an adaptation to expedite the release of noxious skin secretions. This behavior would explain the immediate rejection after grabbing efts by several snake species (McCallum 1994). *Thamnophis sirtalis* is not highly susceptible to these secretions (Brodie and Brodie 1990, 1991) so it is inclined to utilize efts as food. Brodie and Brodie (1990, 1991) found newts were a major component of wild garter snake diets in the pacific northwest. So the skin secretions that were effective against other snakes did not work against this species.

Besides positioning the poison glands for optimal stimulation, McCallum (1994) also observed garter snakes swallowed efts in unken much slower than non-performing efts. This suggests unken may have a dual role in eft anti-predator behavior. Besides facilitating toxin release, it also appears to function like tail wrapping in other salamander species. Tail wrapping significantly increases the swallowing time of snakes as observed with unken. The increased swallowing time would preoccupy the snake, making it more susceptible to predators. If a predator attacked a snake grasping a salamander,

the snake may drop the salamander in its efforts to escape. McCallum (1994) anecdotally observed snakes release salamanders in 4 of 7 times when gently picked up by the tail. Only 3 of 77 trials resulted in salamander escape when snakes were not picked up.

An additional cost of eft induced lengthened snake swallowing time was observed by Feder and Arnold (1982). Snakes accumulate lactic acid levels 260% above resting levels while eating a tail wrapping salamander, but they calculated these costs to represent less than 1% of the energy available in the prey. As swallowing time increased, the metabolic costs to the predator increased. If a snake were under a log (where all of these prey would be common) with other debris surrounding it, there would be less opportunity to writhe its body to manipulate and swallow the salamander. This might substantially increase the swallowing time and the metabolic costs incurred by the snake (Arnold 1982). The increase in snake swallowing time induced by the eft's unken may be an even more effective strategy.

The net energy value of efts compared to other salamanders is probably much less than for other salamanders. In addition to the costs of increased handling time through unken reflex, the toxic nature of this species would require additional investment in adrenal enlargement (Smith and White 1955) and IgG production for immuno-neutralization of these defenses. Further investment in immune memory in case of future exposure could dramatically reduce net energy returns to the snake. The influence of these costs on garter snake resistance to tetrodotoxin (the primary toxic component of eft secretions) is apparent through geographic analysis (Brodie and Brodie 1991). Garter snakes sympatric with *Taricha torosa* (a related salamander secreting tetrodotoxin) are resistant to the toxin, and readily feed on this salamander. Garter snakes allopatric to all tetrodotoxin producing salamanders have zero tolerance for the poison and can die from its ingestion. Obviously a substantial investment is made by garter snakes to exploit efts or the resistance to tetrodotoxin would not be so geographically defined (Brodie and Brodie 1999, Licht and Lowe 1968).

Schoener (1971) concludes that the expense in time and energy for feeding includes that of searching, pursuit, handling, and eating prey. While efts do not increase investments in pursuit or searching, they are considerably increasing snake investment in the other two aspects of feeding. They also confer lost opportunity costs in terms of capturing other prey on snakes. Because snakes are spending added time feeding on efts in unken, they lose the

opportunity to feed on other organisms that may become available that are easier and less expensive to eat (Schoener 1971).

Because no efts escaped during undisturbed attacks, and predation events themselves tend to be rare this alone cannot completely explain the evolutionary significance of unken in efts. An possible factor favoring eft unken to increase snake swallowing time is kin selection. Newly metamorphic efts migrate from their larval home ponds in large numbers in the summer. *Thamnophis sp.* are known to capitalize on these prey at this time (Carpenter 1952). If efts increase the time in the snakes grasp, they functionally decrease the opportunity for that snake to feed on any siblings that will be leaving the pond at nearly the same time, and likely nearby. This would increase the reproductive success of the attacked eft through the reproductive productivity of its surviving siblings (Pfennig 1990, Pfennig, et al. 1993).

These studies suggest unken reflex in efts is not a pre-attack strategy, but rather a post-attack maneuver for expediting toxin release and increasing snake swallowing time. Because the maxillary dentition is in direct contact with the main aggregations of poison glands on the efts dorsum while in unken the stimulus of biting readily stimulates toxin release (McCallum 1994). The toxins appear to be an effective deterrent against many predators while the increase in swallowing time may bestow fitness rewards on the prey through kin selection, or the small probability that the snake will come under attack during this interaction allowing the eft to escape. Investigation of the unken reflex in efts has been neglected as most researchers assume it is a predator warning signal. The evidence suggests that efts are eaten by many predators and they do not normally perform unken until after attacked. Because unken is not performed prior to attack, it cannot convey eft toxicity accurately or otherwise to the predator. Furthermore, unken is not utilized in the identification phase of predation, but rather the subjugation and consumption phases, so its warning nature becomes even more doubtful. Based on these observations I conclude that unken reflex in efts is probably a post-attack strategy with multiple evolutionary forces driving its expression, none of which involve warning the predator of this prey's distastefulness.

Table 1. The results of eft ñ predator encounters from laboratory and field observations. Field observations are noted with a superscript "L" for laboratory and "F" for field. Efts were designated as accepted if they were eaten. If predator ignored or released eft the trial was designated as rejected. Although many predators avoid efts, it appears they can and will eat them. Results: healthy = no ill effects, juvenile = young raccoon, ? = unknown.

<u>Study</u>	<u>Predator</u>	<u>Predation Outcome</u>		<u>Results</u>
		<u>(# eaten</u>	<u>#r ejected)</u>	
Brandon 1979 a	chickens	0	27	
Brandon 1979 b	chickens	0	5	
Brandon, pers. comm.	<i>Esox masquinongy</i> <sup>F</sup>	1	?	healthy
Brodie 1968	<i>Rana catesbeiana</i> <sup>L</sup>	1	2	healthy
	<i>Rana clamitans</i> <sup>L(force fed)</sup>	0	2	healthy
	<i>Ankistrodon</i>			
	<i>contortrix</i> <sup>L(force fed)</sup>	1	0	died
	<i>Eumeces fasciatus</i> <sup>L(force fed)</sup>	1	0	died
	<i>Diadophis</i>			
	<i>punctatus</i> <sup>L(force fed)</sup>	2	0	2 died
	<i>Crotalus horridus</i> <sup>L(force fed)</sup>	1	0	died
	<i>Thamnophis</i>			
	<i>proximus</i> <sup>L(force fed)</sup>	2	0	2 died
	<i>T. proximus</i> <sup>L</sup>	1	0	healthy
Brown, pers. comm.	<i>Rana catesbeiana</i> <sup>L</sup>	1	0	death
Carpenter 1952	<i>Thamnophis sirtalis</i> <sup>F,L</sup>	"some" unknown		healthy
	<i>T. sauritus</i> <sup>F</sup>	in 4 of 6 stomachs		healthy
Cochran & Redmer 1992	<i>Procyon lotor</i> <sup>L</sup>	0	52	healthy
Cooper 1942	<i>Salvelinus fontinalis</i> <sup>F</sup>	3 in 133 stomachs		healthy
Formanowicz, et al. 1982	<i>Dytiscus &amp; crayfish</i> <sup>L</sup>	149	69	healthy
Hurlbert 1970	<i>Lepomis gibbosus</i> <sup>L</sup>	2	>2	healthy

Figure 1 continued

	<i>Rana catesbeiana</i> <sup>L</sup>	5/week for 6 months		
	<i>Bufo americanus</i> <sup>L</sup>	8	2	healthy
	<i>Chelydra serpentina</i> <sup>L</sup>	5	2	healthy
	<i>Chrysemys picta</i> <sup>L</sup>	7	3	healthy
	<i>Thamnophis sirtalis</i> <sup>L</sup>	3 forcefed	0	healthy
	<i>T. sirtalis</i> <sup>L</sup>	3	51	healthy
	<i>Nerodia sipedon</i> <sup>L</sup>	0	1	healthy
	<i>Charadrius vociferus</i> <sup>L</sup>	0	5	healthy
	<i>Buteo jamaicensis</i> <sup>L</sup>	0	5	healthy
	<i>Procyon lotor</i> <sup>L</sup>	0	10	juvenile
	<i>P. lotor</i> <sup>L(adults)</sup>	10	0	healthy
McCallum 1994	<i>Ambystoma tigrinum</i> <sup>L</sup>	0	6	healthy
	<i>Chrysemys picta</i> <sup>L</sup>	12	28	healthy
	<i>Diadophis punctatus</i> <sup>L</sup>	0	2	healthy
	<i>Nerodia sipedon</i> <sup>L</sup>	0	6	healthy
	<i>H. platyrhinos</i> <sup>L</sup>	5	3	healthy
	<i>T. sirtalis</i> <sup>L</sup>	18	9	healthy
Shure, et al. 1989	unidentified predator <sup>F</sup>	58	?	?
Uhler, et al. 1936	<i>Heterodon platyrhinos</i> <sup>F</sup>	2	?	healthy
Webster 1960	<i>Salvelinus fontinalis x trutta</i> <sup>F</sup>	1	?	dead
	<i>S. fontinalis</i> <sup>L(force fed)</sup>	?	?	2 died, 1 lived
Webster & Little 1942	<i>Salmo trutta</i> <sup>F</sup>	few	?	healthy
Wetzel, pers. comm.	<i>H. platyrhinos</i> <sup>L</sup>	100 +	none	healthy

Table 2. Time for snakes to swallow efts. The affect of anatomical location of attach (Anova  $f=2.50$ ,  $df=4$ ,  $p<0.04$ ), unken (Anova  $f=10.17$ ,  $df=1$ ,  $p<0.002$ ) and the interaction between these (Anova  $f=4.03$ ,  $df=4$ ,  $p<0.004$ ) were found to significantly increase swallowing times of snakes.

<u>Attack location</u>	<u>Unken</u>	<u>Mean Swallowing Time (min)</u>	<u>Standard Deviation</u>
Head	no	0.62	0.424
	yes	1.81	0.777
Pectoral Girdle	no	1.12	1.79
	yes	2.90	2.21
Midbody	no	1.83	1.72
	yes	2.39	2.87
Pelvic Girdle	no	1.67	3.11
	yes	7.58	9.68
Tail	no	1.06	0.338
	yes	0.45	0.00

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## The Identity of *Sceloporus clarkii uriquensis* Tanner and Robison (Reptilia: Sauria)

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### Abstract

Because the area of intergradation between *Sceloporus c. clarkii* and *S. c. boulengeri* was thought to be in southern Sonora, *S. c. uriquensis* of southwestern Chihuahua was distinguished when described from *S. c. boulengeri*, the southern subspecies. That discrimination is well founded, but in reality *S. c. uriquensis* represents the southernmost population known of *S. c. clarkii*, from which it cannot be distinguished taxonomically.

Populations regarded as intergrades between *Sceloporus c. clarkii* Baird and Girard, the northern subspecies, and *S. c. boulengeri* Stejneger, the southern subspecies of *S. clarkii*, were reported from southern Sonora by Bogert and Oliver (1945) and Langebartel and Smith (1954), and were so accepted by Hardy and McDiarmid (1969). Therefore when the species was discovered in Chihuahua by Tanner and Robison (1959) at Urique, somewhat south as well as east of the apparent area of intergradation, as well as south of the known range of *S. c. clarkii*, their concern was differentiation of the three specimens there named *S. c. uriquensis* from *S. c. boulengeri*, which was known from nearby Sinaloa.

Not all authorities accepted that discrimination; Hardy and McDiarmid (1969) were the most influential in that context. But Tanner (1987) redefended the validity of *S. c. uriquensis* on the basis of 17 additional specimens from several other localities in the vicinity of the type locality.

One of us (JLE) collected eleven more specimens 14-17 July 2000, which we have studied for any light they might throw on the validity of separation of *S. c. uriquensis* and *S. c. boulengeri*. They are all from the vicinity of Batopilas (27° 1' 34.1"N, 107° 45' 44.5" W), 435m, close to the other localities of occurrence of the subspecies: JLE 5904, Arroyo de Dolores; JLE 5906, road to Satevo; JLE 5942, 5950-7, Arroyo El Camuchil. All are adults or subadults, and are in the herpetological collection of the Laboratorio de Ecología, UBIPRO.

Hardy and McDiarmid (1969) regarded *S. c. uriquensis* as inseparable from *S. c. boulengeri* on the basis of examination of 140 specimens of the latter from Sinaloa, and three topotypes of the former. They showed that the differ-

ences pointed out in the original description (Tanner and Robison, 1959, all involving head scales) were invalid. Tanner (1987) utilized 17 specimens in reiterating the validity of *S. c. uriquensis*, but on different bases, abandoning the former scale characters. He differentiated *S. c. uriquensis* from *S. c. boulengeri* by having (1) "a green head cap" in males (2) fewer dorsals, (3) fewer femoral pores, and (4) dorsolateral light lines faint or absent.

Our present series also lacks any clear evidence of the dorsolateral light lines, in life appearing rather uniform dark gray and sharply contrasting with 11 specimens of *S. c. boulengeri* in the UCM from Sinaloa.

The green head cap in adult males is locally variable, however, the specimens from Batopilas lacking them, whereas those from Dolores had them. It seems not to be constant in occurrence, hence is invalid as a taxonomic character.

The dorsal scale count likewise exhibits too much overlap to be diagnostically significant: in *S. c. uriquensis*, 27-33 (M=29.3, N=28), in *S. c. boulengeri* (fide Hardy and McDiarmid, 1969, 28-37 (M=32.7, N=88). The difference is nevertheless statistically significant ( $t=17.03$ ,  $df=114$ ,  $p<0.01$ ), even in comparison of *S. c. uriquensis* with the nearby Sinaloa specimens from Vaca and El Fuerte ( $t=17.02$ ,  $df=70$ ,  $p<0.01$ ).

A strong and diagnostic difference in number of femoral pores exists, although Tanner compared his separate femoral counts with Hardy and McDiarmid's (1969) total femoral pore counts, hence concluding that *S. c. uriquensis* has fewer femoral pores than *S. c. boulengeri*. Actually, comparing total counts alone, the femoral pores are more numerous in the former than the latter: in *S. c. uriquensis*, 21-27 (M=23.9, N=28), 86% 23 or more; in *S. c. boulengeri* 13-27 (M=18.6, N=140), 6% (estimated from the Hardy and McDiarmid graphs, 1969) 23 or more. The difference is strongly significant ( $t=16.75$ ,  $df=114$ ,  $p<0.001$ ), even in comparison of *S. c. uriquensis* with the nearby Sinaloa specimens from Vaca and El Fuerte ( $t=13.54$ ,  $df=68$ ,  $p<0.01$ ).

*S. c. boulengeri* is also distinguished by reduction distally of the femoral pores in females (Smith, 1939; Bogert and Oliver, 1945), to the point where they are difficult to discern; they are not reduced in the Batopilas specimens.

Thus we regard three characters as diagnostically significant in distinguishing Chihuahua material from *S. c. boulengeri*: (1) most importantly, the more numerous femoral pores; (2) the absence of a light dorsolateral zone;

and (3) the more or less uniform size of the femoral pores throughout the length of the series in females. In addition there is a statistically significant difference in dorsal scale count. The taxonomic distinction is thus confirmed.

The validity of *S. c. uriquensis* depends, however, not only upon its distinctness from *S. c. boulengeri* but also from *S. c. clarkii*. Pertinent data for the latter subspecies (from Smith, 1939) include (1) unilateral femoral pore counts (total counts not available) 10-18 ( $M=12.3$ ,  $N=370$ ), 91% >12; (2) no dorsolateral light zones; (3) no distal reduction in size of femoral pores in females; and (4) dorsal scales 28-36 ( $M=31.8$ ,  $N=105$ ).

In *S. c. uriquensis*, (1) unilateral femoral pore counts are 10-14 ( $M=12.6$ ,  $N=56$ ), 21% >12; (2) no dorsolateral light zones; (3) no distal reduction in size of femoral pores in females; and (4) dorsal scales 27-33 ( $M=29.3$ ,  $N=28$ ).

These data make it apparent that *S. c. uriquensis* is indistinguishable taxonomically from *S. c. clarkii*. The features that distinguish the former from *S. c. boulengeri* are essentially the same as those that distinguish the latter from *S. c. clarkii*. There are no or insignificant differences. We therefore conclude that *S. c. uriquensis* is a junior synonym of *S. c. clarkii*.

The distributional pattern between the ranges of *S. c. clarkii* and *S. c. boulengeri* in their contact zone is unclear, and requires further study. We have not seen any of the so-called intergrades during the course of this study. There is no reason at present to think that the Chihuahua population is isolated from other populations of *S. c. clarkii*.

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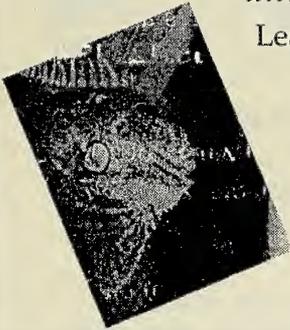
*News and Notes*

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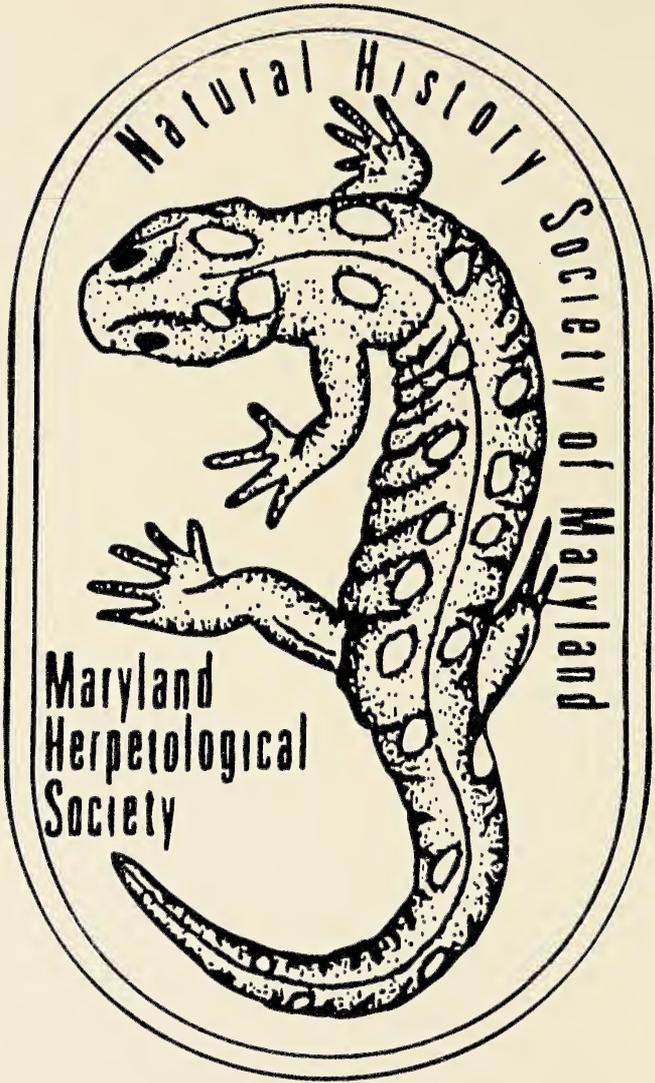
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*Natural History Society of Maryland, Inc.*  
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DEPARTMENT OF HERPETOLOGY

THE NATURAL HISTORY SOCIETY OF MARYLAND, INC.



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# BULLETIN OF THE

# mdhs

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Volume 37 Number 4

December 2001

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Department of Herpetology, Natural History Society of Maryland, Inc.

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## The Subspecies of *Sceloporus merriami* (Reptilia: Lacertilia) in Chihuahua and Durango, Mexico

Julio A. Lemos-Espinal, Hobart M. Smith, David L. Auth and David Chiszar

### Abstract

The subspecies of *Sceloporus merriami* known from Chihuahua are reviewed, adding *S. m. annulatus*, new to the state. *S. m. ballingeri* subsp. nov. is described from Durango.

---

Knowledge of *Sceloporus merriami* Stejneger in eastern Chihuahua and Durango, Mexico, has accumulated slowly, due to paucity of field work. Smith et al. (1963) first recorded the species (as *S. m. merriami*) from the lower Río Conchos, Chihuahua, but those specimens remained enigmatic in Olson's revision of the species (1973). He later (1979) regarded them (and others from the same area) as *S. m. longipunctatus*. The same subspecies was spotted on his map in extreme southeastern Chihuahua, but the collection housing that material was not noted and hence it was not studied. Webb (1982) reported the species from extreme northeastern Durango, without allocation to subspecies.

So matters remained until Lemos-Espinal et al. (2000) reported on a large sample of *S. m. longipunctatus* from near Manuel Benavides, Chihuahua, about 100 km SE of the Río Conchos locality. At the same time the Río Conchos material reported by Smith et al. (1963) was described as a distinct subspecies, *S. m. williamsi* (the spelling *S. merriarni williamsi* was a lapsus calami).

In the summer of 2000 JLE collected three large samples of *S. merriami* from three localities in Mexico. The Río Conchos and Durango samples were greatly augmented, and an equally large sample was taken in the vicinity of Sierra El Virulento, ~70km SSW of the Manuel Benavides localities, where *S. m. longipunctatus* occurs. These samples confirm (1) the validity of *S. m. williamsi*, (2) the occurrence of another subspecies of *S. merriami* (*S. m. annulatus*) in Chihuahua at the Sierra El Virulento localities, and (3) that the Durango populations, ~250 km S El Virulento in the vicinity of Tlahualilo, constitute a subspecies as yet undescribed. These three samples are discussed in the following, arranged north to south.

It is possible that still another subspecies, *S. m. australis*, occurs in Durango south of the Tlahualilo area, because it is known from fairly near the border, 58 mi NE San Pedro de los Colonias, in Coahuila (R. E. Olson, pers. coll.).

*Sceloporus merriami williamsi* Lemos-Espinal, Chiszar and Smith

Data are available for 50 specimens (26 males, 23 females): 33.4 mi W. Ojinaga, 19 May 1974, R. E. Olson and J. Scudday (REO [R. E. Olson, private collection] 4095-9); El Fortín (UIMNH 52377-80); El Álamo (UIMNH 52381-4); Cañon El Pegis (29°32'3.7"N, 104°47'38.8"W), 20 June 2000 (UBIPRO) [Unidad de Biotecnología y Prototipos, UNAM, México] 5473-89; Cañon de Barrera, Ejido El Álamo (29°32'36.4"N, 104°52'23.0"W), 21 June 2000, (UBIPRO 5510-24). All of the UIMNH specimens are types of *S. m. williamsi* (Smith et al., 1963) taken ~30 August 1962 by K. L. Williams, E. O. Moll, F. Vuilleumier and J. E. Williams.

These series consistently exhibit the diagnostic character-states of the subspecies. The most important is the high number of dorsals — higher than in any other subspecies of *S. merriami* except *S. m. merriami*, which has equally high numbers. The range is 58-67 (M=61.4, N=49, 94% over 59). In the other subspecies known from Chihuahua and Durango, 0-2% have 60 or more.

*Sceloporus m. williamsi* is also similar to *S. m. merriami* in 61% having the labiomental series of scales reaching the first infralabial; 93% occurs in *S. m. merriami*, less than 10% in all other races of the species.

*S. m. merriami* is distinguishable from *S. m. williamsi* in range (occurring eastward from the east side of the Big Bend in Texas [Olson, 1979]), and coloration. The former has weak gular bars not reaching the lips (vs strong, reaching lips), and no or faint evidence of subcaudal rings (vs pale blue ones, complete and continuous with the brown dorsal caudal rings).

In all 26 males of *S. m. williamsi* the abdominal semeions are separate medially.

The smallest specimen (30.5mm SVL) inexplicably was taken 19 May; in mid-June the smallest was 37mm SVL, and in late August the smallest was 40mm SVL.

The dorsal pattern consistently includes a paravertebral series of small, rounded dark spots, as in all other subspecies except *S. m. annulatus* and *S. m.*

*longipunctatus*.

*Sceloporus merriami longipunctatus* Olson

No specimens of this subspecies were taken by JLE in 2000, but variation in 98 taken near Manuel Benavides in 1999 was reported by Lemos-Espinal et al. (2000). Its chief distinguishing characteristic is the comma-shaped paravertebral dark spots. It also lacks the high dorsal scale counts of *S. m. merriami* and *S. m. williamsi*, the latter being the closest of Mexican populations.

Seventeen specimens were 19-31.5mm SVL, taken in late August and early September.

*Sceloporus merriami annulatus* Smith

Fifty-four specimens (30 males, 24 females), the first known from Mexico, were taken by JLE in 2000, all in the vicinity of Ranchos El Virulento de Adentro and El Virulento de Afuera: Sierra El Virulento (28°45'50.5"N, 104°19'12.8"W), 1775m, 17 June (UBIPRO 5385-97); cañones de Sierra El Virulento (28°47'45.1"N, 104°19'1.9"W), 1602m, 19 June (UBIPRO 5417-23); and an unnamed mountain N Sierra El Virulento, 19 June (UBIPRO 5434-67).

The most distinctive feature of this subspecies is the usually full medial contact of the abdominal semeions. In the 30 males, the semeions are in contact in 28, fully in 24, narrowly in one, and moderately in three. The separation is very narrow (<2 scales) in one, 2 scales in the other; these are the smallest of this sample, at 42-43mm SVL, suggesting that fusion advances ontogenetically. All full grown males have full fusion.

The subspecies is distinctive from all others also in color and pattern; the general tone is dark both above and below. The caudal bands are typically broad, prominent and brown both dorsally and ventrally, sharply in contrast with the light color of the intervening spaces. The gular bars are relatively few and exceptionally broad and extensive. The dorsal pattern is also unique: the paravertebral dark spots are large and rectangular, somewhat bar-like.

*Sceloporus m. annulatus* also averages somewhat larger than any of the subspecies here reported. The maximum SVL is 55mm, and 29 of 54 (54%) exceed 49mm SVL, vs 53mm, 10 in 98 (10%) respectively in *S. m. longipunctatus*,

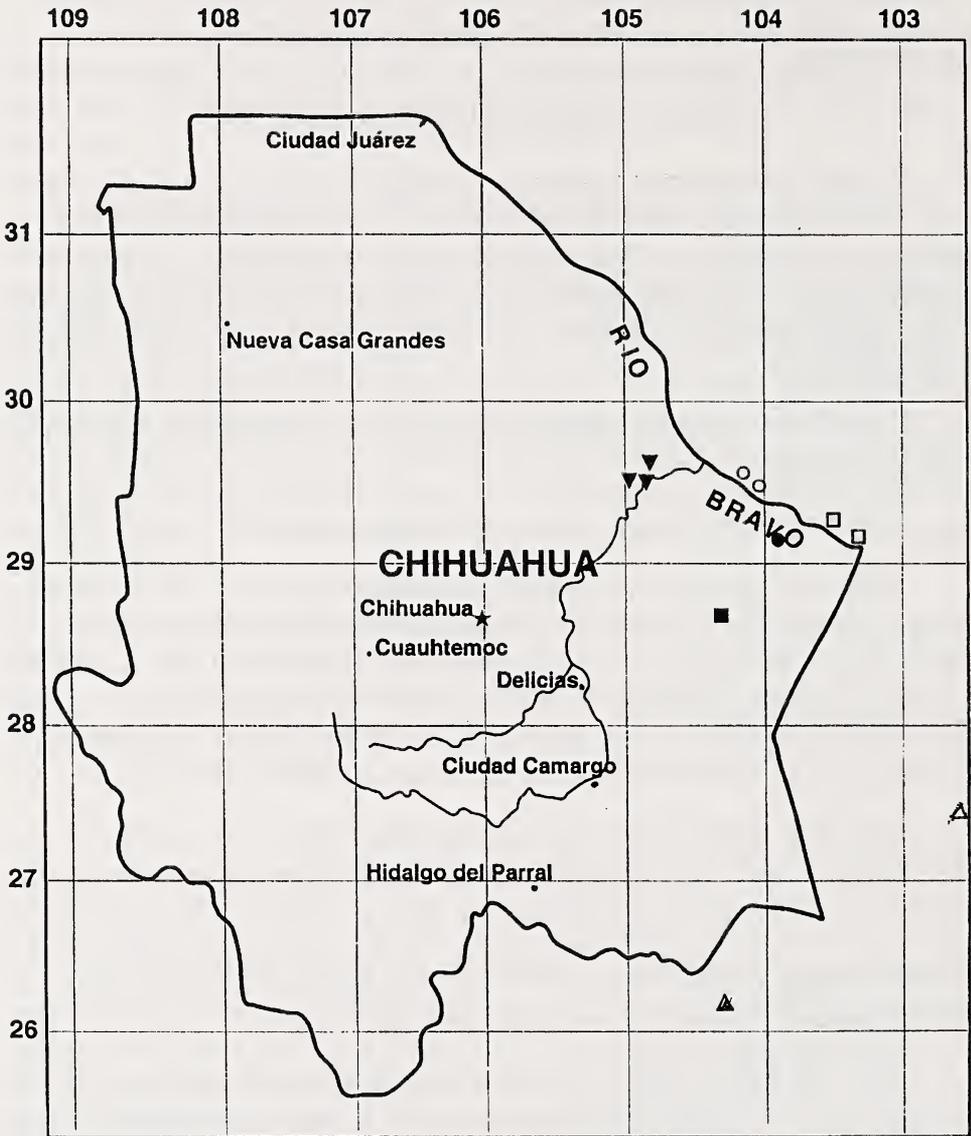


Fig. 1. Distribution of *Sceloporus merriami* in Chihuahua and adjacent areas. Inverted triangles, *S. m. williamsi*; solid circle, *S. m. longipunctatus*, and hollow circles, nearest localities of record of the same in Texas; solid square, *S. m. annulatus*, and hollow squares, nearest localities of record of the same in Texas (between the latter two, intergrades occur fide Olson, 1979); hollow triangle, nearest locality of record to Chihuahua of *S. m. australis*; upright solid triangle, *S. m. ballingeri*.

49mm, 0 in 50 (0%) in *S. m. williamsi*, and 50mm, 4 in 59 (7%) in the series from Durango.

*Sceloporus merriami ballingeri* subsp. nov. Lemos-Espinal and Smith

Holotype.

UBIPRO 5094, an adult male 49mm SVL, tail 58mm, La Campana, Sierra La Campana, mpio Tlahualilo, Durango (26°7'39.1"N, 103°41'00.0"W), 9 June 2000, Julio A. Lemos-Espinal.

Paratypes.

Sixty-eight: UBIPRO 5033-57, 5062-93, 5094-6, all topotypes and data as for the holotype; UTEP 4276-9, 7 km N La Campana, 30 June 1973, R. G. Webb and R. W. Axtell; UTEP 6052-6, 2.5 km NNE La Campana, 26 June 1980, R. G. Webb and R. W. Axtell.

Diagnosis and Definition.

A member of the *S. merriami* complex, having granular lateral scales, a rudimentary gular fold, and dorsal scales separated by granular scales where the dorsals overlap. Distinguished from *S. m. merriami* and *S. m. williamsi* most conspicuously by fewer dorsal scales (94% vs 1% less than 59); from *S. m. annulatus* by separation of the abdominal semeions and small, rounded paravertebral dark spots (vs usually fused abdominal semeions and large, rectangular paravertebral dark spots); from *S. m. australis* by its more numerous dorsals (99% vs 15% over 48); and from *S. m. longipunctatus* by its rounded rather than comma-shaped paravertebral dark spots, and more distinct caudal bands in males.

Description of holotype.

Dorsals 59; labiomenal series separated from 1st infralabials and anterior chinshields; 7 rows of enlarged scales across rump; a row of enlarged scales posterior to interparietal. Paravertebral dark spots rectangular; gular bars 6 on each side, all dark blue or black, separated medially throughout, 1-3 scales broad (longitudinally); caudal rings complete, sharply defined, dark ventrally as well as dorsally; groin not black; diffuse dark spots anterior to femoral pores; chest almost entirely white, although a string of chromatophores between the black streaks anterior to arm insertions.

---

### Variation.

Dorsals 47-60 (M=54.9, N=69, 99% 49 or more and less than 60); labio-mental scale series reaching anterior infralabial in 8 of 138 (6%); SVL 38-50mm (N=68, 4 at 50mm); rump rows and row of enlarged postinterparietal scales as in holotype. Although the tail is relatively fragile in the whole species, the breakage is especially high in the samples available of *S. m. ballingeri*; 46 have the tail incomplete or regenerated, only 22 (including just 4 females) a complete tail (in seven of those the tail is broken but complete).

Paravertebral dark spots usually small and round, occasionally weakly extended laterally; abdominal semeions separated medially in all but one with a short contact the length of six scales (in a specimen 46mm SVL); gular bars numerous in all, but variable, distinctly darker in larger males than in smaller males and females, often darker and/or fused posteromedially in males; caudal rings typically complete and sharply defined in males, incomplete and weak in females; diffuse pigmentation in the preanal and prefemoral pore areas, and as streaks on the chest in some large males.

*Comments.* *Sceloporus m. ballingeri* is most similar to *S. m. longipunctatus*, but it resembles *S. m. annulatus* also, the nearest subspecies, in the complete, dark tail bands, and a weak extension laterally in some specimens of the paravertebral dark spots. These extensions look like weak remnants (or precursors) of the large rectangular spots of *S. m. annulatus* rather than the attenuated extensions occurring in *S. m. longipunctatus*.

*Sceloporus m. merriami*, *S. m. annulatus* and *S. m. australis* each have nearly categorical, objective distinctions from other subspecies of *S. merriami*. The remaining subspecies differ from each other almost entirely in pattern. The western populations appear to be relictual because of their wide isolation from other populations of the species or even the same subspecies. In Texas, on the contrary, the distribution of the species seems to be more nearly continuous. Relationships, however, remain to be clarified.

*Etymology.* The name *S. m. ballenteri* is a patronym honoring Dr. Royce E. Ballinger of the University of Nebraska – professionally, for his contributions to herpetology over many years, and personally, especially for his guidance of JLE through his doctoral years, and for continued collaboration.

---

Acknowledgments.

JLE is indebted for grants awarded to him by the Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, under project CONABIO-U003 and X004. We are all much indebted for the loan of material from 5 collections: REO (Dr. R. E. Olson), SRSU (Dr. James Mueller), UIMNH (Dr. Chris Phillips, John Petzing), UCM (Dr. Alan DeQueiroz, Rosanne Humphrey) and UTEP (Dr. Robert G. Webb). We thank Deborah Aguilar for finalizing the map.

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**A New Subspecies of Cantil (*Agkistrodon bilineatus*)  
from Central Veracruz, Mexico  
(Reptilia: Serpentes)**

*Hobart M. Smith and David Chiszar*

Abstract.

*Agkistrodon bilineatus lemosespinali* is described from near Palma Sola, Veracruz.

---

Gloyd and Conant (1990: 60) made it evident that a large hiatus exists in the known distribution of *Agkistrodon bilineatus* (Günther) on the Atlantic drainage of Mexico between northeastern San Luis Potosí and the Yucatán peninsula. Indeed, the only other known occurrences of the species on Atlantic slopes are in Chiapas and Guatemala. There they are known but a short distance from Pacific slopes (Gloyd and Conant, 1990: 72).

However, Blair et al. (1997) reported a single specimen of *A. bilineatus* from central coastal Veracruz near Palma Sola. Upon further study we conclude that a hitherto unrecognized subspecies is represented, which we here name

*Agkistrodon bilineatus lemosespinali* subsp. nov.

Holotype.

West Texas A. and M. University Natural History Museum herpetological collection 1385, an adult male taken "north of Palma Sola," Veracruz, Mexico, by J. D. Lanham (field no. H-247b), 29 December 1970.

Diagnosis and Definition.

A member of the *Agkistrodon bilineatus* complex as defined by Gloyd and Conant (1990). It differs from all other subspecies in several ways, if constant (uncertain in a sample of one): (1) the presence of 8 symmetrical scales in the prefrontal/internasal area, instead of 4; (2) a snout (measured from anterior edge of the frontal through rostral) longer (*vs.* shorter) than frontal; (3) virtually all black above and below, with no vestiges of juvenile cross bands, either as alternating light and dark bands, or as regular transverse rows of white flecks; and (4) a tail/total length ratio of 15.3 (*vs.* a minimum of 17).

From *A. b. russeolus* and *A. b. howardgloydi*, *A. b. lemosespinali* differs also in the continuity at tip of snout of supraocular and supralabial light lines (*vs.* interrupted).

From *A. b. taylori* (now *A. taylori fide* Parkinson et al. (2000)), *A. b. lemosespinali* differs also in having fewer subcaudals (45-56 *vs.* 61), and broader, continuous light lines on head, both dorsally and ventrally, with the supralabial lines reaching lip, not dark-bordered ventrally (*vs.* supralabial light lines dark-bordered ventrally, ventral light lines on head narrow, discontinuous).

### Description of holotype.

Dorsal head scales as shown in Fig. 1; lateral and ventral head scales in general as described in Gloyd and Conant (1990) for the species as a whole; preoculars 2-2, lower divided on one side; 4-4 postoculars/suboculars; supralabials 8-9; infralabials 11-11; scale rows 25-23-19; ventral 138; subcaudals 61, with the basal 30 entire, followed by 2 divided, then 2 entire, and finally 27 divided (52% entire); the tail ends with a down-turned terminal spine, assuring that the tail is complete. Total length 834mm, tail 128mm; tail/total length ratio 15.3.

Both hemipenes are everted, and have the structure described by Gloyd and Conant (1990) for the species.

Supraocular and labial light stripes united at tip of snout with each other and with a vertical light bar on rostral; lateral and ventral surfaces of head marked essentially as illustrated for *A. b. bilineatus* in Gloyd and Conant (1990: 88, 91, 91).

Head and body black above and below, with light marks on head as described above, and small light flecks scattered on sides of body, including the ends of ventrals. There are very few on the tail, which lacks a light tip. There is no evidence of alternating lighter and darker crossbands on body, although the lateral light flecks are arranged in discontinuous vertical rows in some areas, but mostly scattered irregularly along the lower sides of the body, more numerous anteriorly than posteriorly.

### Remarks.

The Diagnosis and Definition provides basic contrasts with other subspecies. *A. b. lemosespinali* is more like *A. b. bilineatus* than any other subspe-



Fig. 1. Dorsal view of the head of holotype of *A. b. lemosespinali*, showing the relatively elongate snout that accommodates the unusually large number of scales in the prefrontal/internasal area.

cies, differing categorically in tail/total length ratio, snout length and head scale arrangement; a possible difference exists in the magnitude of melanism in *A. b. lemosespinali*. The difference in snout scales is suspect, because Gloyd and Conant (1990: 66) observed that there is "occasional subdivision of the internasals and prefrontals." However, the scales in that area of *A. b. lemosespinali* are so symmetrical in shape that they do not appear anomalous. Furthermore, the snout is longer than is typical in *A. b. bilineatus* (see Fig. 4 in Gloyd and Conant, 1990: 66), perhaps as an accommodation to the extra, prefronto-internasal scales.

The type locality of *A. b. lemosespinali*, on the Atlantic coast, is far removed from the essentially Pacific slope distribution of *A. b. bilineatus* (Fig. 2). That isolation suggest a greater possibility of significance of the peculiarities of the holotype than would otherwise be the case. Confirmation of those peculiarities is much to be desired.

The area around Palma Sola is now highly agricultural, and adjacent to it is a functioning nuclear power plant regarded by many local residents and environmentalists in general as having contaminated the surrounding area with radioactivity (Lemos-Espinal, pers. comm.). If *A. b. lemosespinali* ever occurred in that area, it is likely now to be extinct, or it likely would have been found long ago.

We suggest, on the contrary, that *A. b. lemosespinali* occurs in the eastern ridge of the Trans-Mexican Neovolcanic Belt, where the mountains come virtually to the Gulf of Mexico at Punta del Morro (Mulcahy and Mendelson III, 1999). That ridge is some 10km north of Palma Sola, which is consistent with the data on the holotype. That ridge does not appear to have been collected extensively, but it is an ecologically distinct barrier separating the lowlands to the north and south sufficiently to lead to taxonomic differentiation of related populations occurring on both sides. Pérez-Higareda and Navarro-L. (1980) cited six examples of the range of conspecific subspecies and of numerous species of reptiles that are delimited by the barrier. Also, Mulcahy and Mendelson III (1999) found the ranges of *Bufo nebulifer* and *B. valliceps* separated at that ridge.

During the same period of zoogeographic change, or earlier, ancestral *A. bilineatus* could have taken refuge within the confines of the barrier itself, differentiating as *A. b. lemosespinali*, as the rest of the population withdrew or become extinct. It is there that the taxon should be sought.

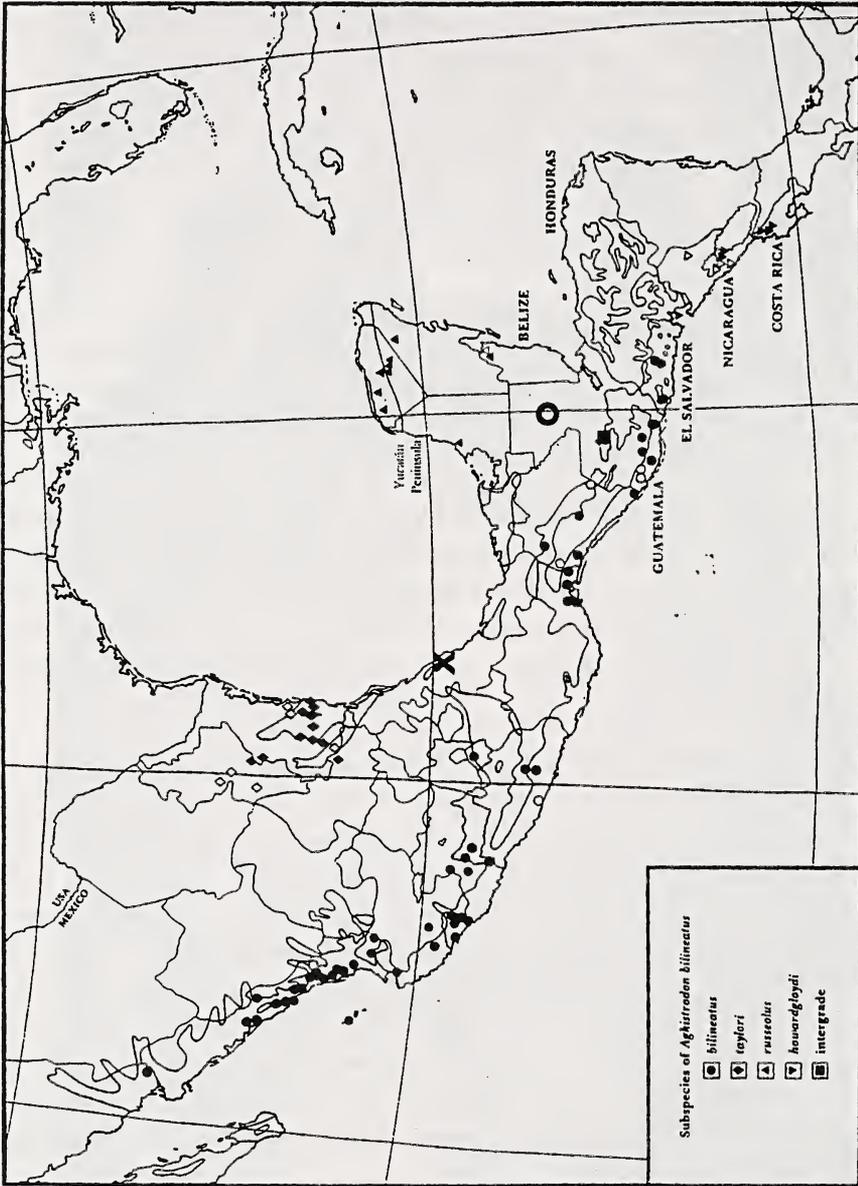


Fig. 2. Distribution of the members of the *Agkistrodon bilineatus* complex, adapted from Gloyd and Conant (1990:60), courtesy of SSAR through the kindly intervention of the editor, Dr. Kraig Adler. The "x" represents the type locality of *A. b. lemosespinali*, and the large circle represents a recent major range extension of *A. b. russcolus* (Campbell, 1998).

A remote possibility cannot be eliminated, of course, that the specimen actually came from within the range of *A. b. bilineatus* and had escaped from or was released by a private collector or unwitting transport. In such case its deviations from normal would have to be considered as taxonomically insignificant variations, whatever their magnitude.

The reliability of the locality data is secure. The collector was with a group of students and faculty members on their formerly annual Christmas Natural History of the Vertebrates field trip from West Texas A. and M. University. Field notes verify authenticity of locality, but do not give exact distance. The Christmas field trips were never conducted within the known range of *A. b. bilineatus*.

### Etymology.

The patronym *A. b. lemosespinali* honors Prof. Dr. Julio Alberto Lemos-Espinal, a scholar and field man par excellence, with whom we have shared many hours in both the field and laboratory.

### Acknowledgments.

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## Taxonomic Status of *Sceloporus becki*, the Island Fence Lizard From the Channel Islands, Santa Barbara Co., California

Van Denburgh (1905) described *Sceloporus becki* (holotype, a male, California Acad. of Science 44537), collected 26 March, 1903, by R. H. Beck from the westernmost Channel Island, San Miguel Island. The other Channel Islands are Santa Rosa and Santa Cruz. All are emergent peaks of the Santa Monica Mts. off the coast of Santa Barbara County, California. Among the five specimens collected by Beck, dorsal counts ranged from 43-48. The throat (gular) coloration was unique, with the entire ventral gular semeion being dark black from shoulder to shoulder, with thin lines radiating diagonally forward to the chin edge. A unique headscale feature was the contact of some of the supraocular scales with the large interparietal scale. Contact of these scales does not normally occur on any of the mainland subspecies of *Scoloporus occidentalis* (Van Denburgh, 1905: 9-10).

The holotype has just one supraocular contacting the interparietal. Gustav Eisen collected eight more lizards (Santa Rosa Island), only two had this headscale feature. Joseph Grinnell collected five lizards (Santa Cruz Island), and three of the five had this headscale feature. Van Denburgh (1905) felt this was taxonomically important, and named the Santa Rosa and Santa Cruz specimens intergrades (*S. biseriatus becki*).

The largest (snout-vent) length taxon in this group at that time was *S. biseriatus* (now *S. occidentalis biseriatus*) and had a range including the Great Basin, the Tehachapi Mts. in Kern Co., California, including the Santa Monica Mts. in Los Angeles Co. west of the desert southward into the Sierra San Pedro Mts. of Baja California. Unfortunately the San Francisco fire of 1906 destroyed all of the San Miguel specimens, except for the holotype, which was saved by Van Denburgh. He (personal comm. from Dr. Joseph Slevin) gathered all of the type specimens he could carry and fled the building when fire threatened it. San Miguel Island is now a federal preserve, and collecting is rigidly prohibited.

*S. o. bocourti* occupies the mainland on the Coast Range from San Francisco to Santa Barbara County. *S. o. biseriatus* occupies only the San Joaquin Valley and Sierra Nevada below about 4,000 ft., southeast of Fresno County (Bell, 1954a, 1954b, and Bell and Price, 1996). This latter subspecies has a definitely higher scale count, which distinguishes it taxonomically from *S. o*

*longipies*, which occurs in the great Basin, and coastal California from Los Angeles southward into the Sierra San Pedro Mts. of Baja California, Mexico.

Presently the variable headscale feature is considered less important taxonomically than the gular semeion coloration. With no intervening intergrade specimens on the mainland, *Sceloporus becki* should be regarded as a species rather than a subspecies of *S. occidentalis*. Wiens and Reeder (1997: 40) state "*S. occidentalis becki* certainly is allopatric on the Channel Islands, and diagnosable (Stebbins, 1985) and should possibly be recognized as distinct species." Comparisons of scalation of *S. becki* and that of adjacent mainland subspecies of *S. occidentalis* are given in Tables 1 and 2 (Bell, 1954a).

**Table 1. Scalation of *Sceloporus becki***

Scale Count	Mean $\pm$ S. E.	Standard Deviation	Range	Number Counted
1. dorsal count	47.25 $\pm$ .18	1.68	43-52	87
2. ventral count	82.79 $\pm$ .38	3.47	75-90	84
3. scales around body	50.72 $\pm$ .21	1.91	47-57	82
4. femoral pores	16.64 $\pm$ .08	1.10	14-20	171
5. scales between femoral pores	11.59 $\pm$ .17	1.61	9-17	87
6. no. 4th toe lamellae	24.94 $\pm$ .14	1.73	19-29	148

Sixty specimens of *S. becki* examined were from Santa Cruz Island (51, no specific locality); Scorpion Harbor (1); Smuggler's Cover (1); Pelican Bay (1); 1 m. S. Prisoner's Harbor (2); Friar's Harbor (1); and Johnson's Harbor near Gull Rock (2); Twenty-seven were examined from Santa Rosa Island from Santa Rosa Island (23, no locality), 2 mi. NW Becher's Bay (1); near Becher's Bay (2); and Water Canyon (1). Only the holotype was available from San Miguel Island when these data were taken and compiled (Bell, 1954a).

The groups in Tables 1 and 2 have high scale counts of *S. occidentalis* subspecies, including *S. becki*. It appears that the smaller the ranges of most subspecies of *S. occidentalis*, the higher the scale counts on average.

**Table 2. Scalation of *S. o. biseriatus* and *S. o. longipes* X *biseriatus* (intergrades)**

Scale Count	<i>o. biseriatus</i> San Joaquin Valley and lower Sierra Nevada	<i>o. longipes</i> X <i>biseriatus</i> Tehachapi Mts.
1. dorsal count	48.47 ± .17	45.14 ± .25
2. ventral count	91.75 ± .34	85.10 ± .10
3. scales around body	54.36 ± .29	51.09 ± .39
4. femoral pores	17.21 ± .11	13.47 ± .18
5. scales between femoral pores	14.60 ± .15	13.47 ± .18
6. no. 4th toe	25.53 ± .09	25.62 — .13

A new species of sporozoan coccidian, *Schellackia occidentalis* was described from hosts *S. becki*, *S. o. biseriatus* (presently *S. o. longipes*), and *Uta stansburiana hesperis* from Santa Cruz Island (Bonorris and Ball, 1955).

*S. becki* has been listed as a subspecies of *S. occidentalis* by Stejneger and Barbour, 1917: 55; idem. 1923: 57; idem. 1933; idem. 1939: 68 idem. 1943: 79; Van Denburg and Slevin, 1914: 135-6 (*S. biseriatus becki* on Santa Rosa and Santa Cruz islands). Other references as subspecies include Cochran and Goin, 1970: 197; Collins et al., 1982: 2363; Ditmars, 1946: 54; Frank and Ramus, 1955: 172; Grinnell and Camp, 1917: 162; Jennings, 1983; Pickwell, 1947: 184; Schmidt, 1953: 128; Smith, 1946: 239; Smith et al., 1992: 137; and Stebbins, 1954: 316. Smith, 1939: 29 listed it as a species.

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## Extra Hind-limb in a Smallmouth Salamander (*Ambystoma texanum*) from Central Illinois

Isolated amphibian malformations have been reported for centuries (Bishop and Hamilton 1947, Van Valen 1974). However, amphibian malformations are believed to have recently increased beyond the historical rate (Ouellet et al. 1997, Hoppe 2000). In August 1995, a hotspot of amphibian malformation was discovered by schoolchildren near Henderson, MN. This discovery sparked a flurry of debate surrounding the possible causes regarding the observed increase in abnormalities (Helgen et al. 1998). Since this time, malformed amphibians have been reported from numerous other sites and many types of deformities have been documented, such as missing eyes, digits, and appendages, extra digits, extra appendages (polymely) and malformed jaws (Northern Prairie Wildlife Research Center 2001).

Several hypotheses have been generated, but three are currently debated in the literature. Pollution in the watersheds, such as retinoids (Bryant and Gardiner 1992) or retinoid mimics (i.e., methoprene, Harmon et al. 1995) are believed to lead to the current amphibian malformations. Retinoids have been shown to interact with steroid hormone-like receptors and are known teratogens (Bryant and Gardiner 1992). The pollution hypothesis appears to be the most parsimonious explanation (Lannoo 2000), but the roles that other xenobiotic pollutants and any possible synergistic effects that toxicants may play in eliciting amphibian malformations require further investigation (Burkhart et al. 2000). Ultraviolet radiation (UV-B) has also been hypothesized as a possible cause for the observed malformations because it has been found to induce abnormalities in amphibian larvae in both lab (Butler and Blum 1963) and field (Blaustein et al. 1997) studies. A third hypothesis, the parasite hypothesis, has also been implicated in causing malformations. Sessions and Ruth (1990) suggested that a parasitic flatworm (*Manodistomum* sp.) known to use amphibians as a second intermediate host and snakes as a definitive host was responsible. These parasites encyst as metacercariae in the developing limb buds of frogs and salamander larvae and may cause mechanical or chemical disruption to the developing tissue leading to abnormalities, including duplicated limbs and digits. Johnson et al. (1999, 2001a, 2001b) have lent support to this hypothesis by linking the trematode *Ribeiroia ondatrae* to a broad range of experimentally induced abnormalities in *Hyla regilla* and *Bufo boreas* tadpoles following exposure to *R. ondatrae* cercariae. However, it is relevant to note that Sutherland (2001) has found high levels of *R. ondatrae* in-

fections in several, but not all, amphibians from malformation hotspots in Minnesota.

On March 10, 2001, I visited a small woodland pond in McLean County at Moraine View State Park (NW 1/4, SE 1/4, SW 1/4, Sec. 34, T23N, R4E) in central Illinois to search for early signs of amphibian activity. After observing many *Ambystoma texanum* egg masses, I began turning logs to search for adults. After a few minutes of searching, I found an adult male in good physical condition with an extra left hind-leg (Plate 1). The extra leg originates at the knee and appears fully formed (all five digits), but is slightly smaller. After speaking with Dr. Mike Lannoo of Indiana University regarding the specimen, he recommended I send it to Dr. Dan Sutherland at the University of Wisconsin-La Crosse to inspect for *Ribeiroia* sp. cysts. Upon inspection, no *Ribeiroia* sp. were found (only the intestinal dwelling protozoan *Tritrichomonas* sp.). I then sent the specimen to Dr. Lannoo for radiographic analysis (Figure 3). I returned to the site on subsequent nights to survey for more malformed salamanders and found twelve adults, none of which were outwardly abnormal. To the best of my knowledge, this is the first report of a smallmouth salamander (*Ambystoma texanum*) with a duplicated limb in Illinois (Table 1). I have deposited the specimen at the Illinois Natural History Survey in Champaign, Illinois (INHS 17770).

Plate 1. Smallmouth salamander (*Ambystoma texanum*) with an extra hind-limb from McLean County, Illinois. Fig. 1. dorsal view. Fig. 2. ventral view. Fig. 3. radiograph. (Photographs courtesy of D. Sutherland, radiograph courtesy of M. Lannoo.)

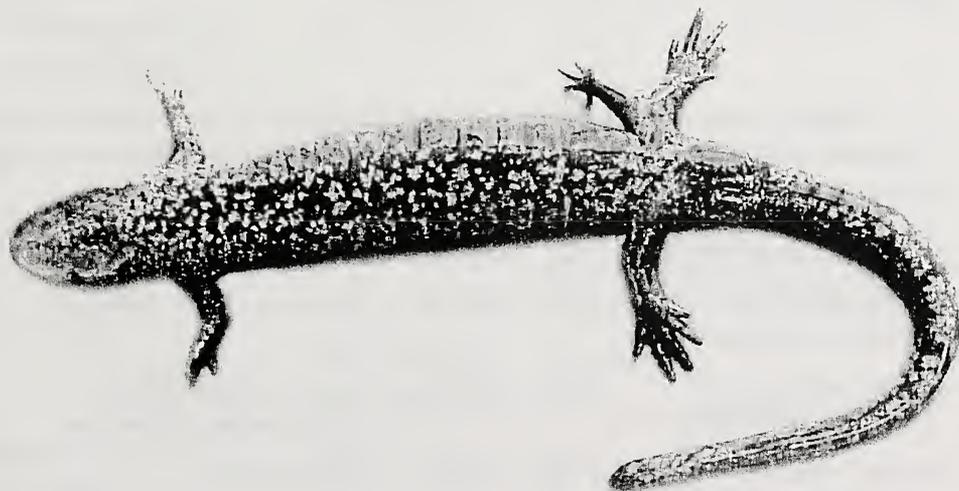
In conclusion, this specimen most likely represents an anomaly of undetermined cause since it did not contain *Ribeiroia* sp. cysts and since no water or UV-B analyses were conducted at the site. The specimen is not likely from a malformation hotspot since no other abnormal specimens were found (N=12). Because this specimen was found as an adult in good physical condition, one could question how much of an impediment this malformation was to the individual. Gray (2000) found two malformed cricket frogs (*Acris crepitans*) that had survived through the winter and suggested that certain abnormalities may not be as detrimental as generally assumed. However, it is important to note that there may be differential effects that a certain malformation may have between species or between taxa.

For example, comparing the potential effect of polymely in an anuran and a salamander with relation to predation reveals an intriguing scenario.

Figure 1



Figure 2



Due to the saltatorial (jumping) locomotion of anurans, an extra appendage may cause an individual to flip over when jumping (revealing their light colored venter) and/or hinder escape behavior. This will obviously attract the attention of a predator more often and may result in increased anuran mortality. In salamanders, however, their mode of locomotion is more conservative and they would not likely face this type of increased predation and therefore may live to an adult stage. It is important to note that this is purely speculative, but may at least partially explain why the specimen described in this paper was found in such good condition and as an adult. Further research would need to be conducted to be able to support such a hypothesis.

Figure 3



I thank Dr. Lauren Brown for guidance and reviewing the manuscript, Dr. Dan Sutherland for evaluation of the specimen and for critically reviewing the manuscript, Dr. Michael Lannoo for advice and the radiograph, and I thank my wife for her constant encouragement.

Table 1. Amphibian malformations from Illinois as reported by the Northern Prairie Wildlife Research Center North American Reporting Center for Amphibian Malformations (2001).

<u>Common / Scientific Name</u>	<u>Year</u>	<u>County</u>	<u>Malformation Type</u>
Smallmouth salamander <i>Ambystoma texanum</i>	1999	Madison	Right front hand missing
Spotted salamander <i>Ambystoma maculatum</i>	1992	Vermilion	Second tail growing at 90 degree angle from base
Fowler's toad <i>Bufo woodhousii fowleri</i>	1996	St. Clair	Extra forelimb

<u>Common / Scientific Name</u>	<u>Year</u>	<u>County</u>	<u>Malformation Type</u>
American toad <i>Bufo americanus</i>	1998	Lake	Abnormal forelimb
	1999	Lee	Abnormal pigmentation
Cricket frog <i>Acris crepitans</i>	1969	McLean	Missing hind limb, missing fore digit, partial hind and forelimb, extra forelimb
		Union	Missing fore digit, abnormal mandible
	1970	McLean	Missing forelimb, abnormal hind limb, partial hind and forelimb, extra forelimb
	1971	McLean	Missing hind and forelimb, partial hind limb
	1987	Fayette	Extra forelimb
Gray treefrog <i>Hyla chrysoscelis</i>	1997	Clinton	Missing eye
<i>Hyla versicolor</i>	1999	Lee	Syndactyly of digits on right forelimb, abnormal hind limbs, missing hind digits
Green frog <i>Rana clamitans</i>	1982	Cook	Extra forelimb
Southern leopard frog <i>Rana sphenoccephala</i>	1997	Calhoun	Shortened and clubbed hind digits
	1997	Madison	Missing eye, split/ partial/ missing hind limb, partial fore limb
	1997	Washington	Extra body (headless, with fused hind limbs) fused anteriorly to main body
	1999	Madison	Retained tail
	1999	Williamson	Left front limb missing
Bullfrog <i>Rana catesbeiana</i>	1998	St. Clair	Right eye missing

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## Year 2000 Amphibians Taken in Chihuahua, México

### Abstract.

The eight anuran species collected by Julio A. Lemos-Espinal in Chihuahua during the summer of 2000 include a species new to the state, *Rana forreri*. We also propose that *Spea multiplicata stagnalis* is a full species, and that the west slope *Bufo punctatus*, as now accepted, belongs to a species not yet defined, separate from east slope populations of *Bufo punctatus*.

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The 109 anurans collected by JLE in 2000 in Chihuahua and Durango represent eight species. In the following summary, all localities are in Chihuahua unless otherwise indicated. Catalog numbers refer to the collection of the Unidad de Biotecnología y Prototipos (UBIPRO), UNAM, Mexico).

*Bufo cognatus* Say. One adult: 6084, Ejido San Dionisio, mpio Tlahualilo, Durango (26°12'94.1"N, 103°41'47.2"W), 1111m, 2 August.

The locality represented lies well within the range depicted by Krupa (1990).

*Bufo debilis insidiosus* Girard. Eight: 5544-51, Sierra El Morrión, mpio Aldama (29°4'45"N, 105°35'3.7"W), 1352m, 24 June.

The four females vary 39-54mm SVL, matching the maximum length recorded (Conant and Collins, 1998); the next largest in this series is 44mm SVL. Males vary 35-39mm SVL.

Frost (2000) stated that in *B. debilis* "The nominal subspecies are unlikely to be more than arbitrarily defined sections of clines and therefore indefensible." However, Sanders and Smith (1951) noted a categorical difference in presence (*B. b. debilis*) or absence (*B. d. insidiosus*) of a subloreal ridge. That observation has not been refuted.

The subloreal ridge is absent in all of the present specimens, which also possess the other diagnostic features of the subspecies as summarized by Sanders and Smith (1951): well developed thenar tubercle (vs weak), cranial crests weak or absent (vs small), and dorsal spots tending to be fused, forming a somewhat reticulate pattern (vs mostly dots).

At this locality in Chihuahua, even though close to the range of *B. d.*

*debilis*, there is no evidence of intergradation of the two subspecies, despite their narrow separation. Range overlap is possible although unlikely. The subloreal ridge has not been sufficiently widely studied at the present time to alter the assumed status of the taxa.

*Bufo punctatus* Baird and Girard. Three: 5905, Arroyo de Dolores, Batopilas (27°1'34.1"N, 107°45'44.5"W), 435m, 13 July; 6350-1, La Perla (28°18'21.4"N, 104°33'7.3"W), 1610m, 8 September.

We also tentatively refer 30 stub-tailed transformlings to this species: 6131-6160, Llanos Tres Castillos (29°23'3.0"N, 105°39'7"W), 1282m, 20 July. They are ~11-12mm SVL, unicolor gray brown above, white below, with no evidence of cranial crests or parotoid glands, no pronounced metatarsal tubercle, and with very small, scattered incipient warts.

Frost (2000) stated that "We suggest that this binominal may represent a composite of geographically variant species." The present series supports that suggestion, inasmuch as the Pacific coastal specimen from low altitude near Batopilas differs sharply from the eastern slope specimens in having a fine middorsal white line (most readily visible under magnification) extending from snout to near anus. The line does not occur in the La Perla specimens, and a middorsal light line is categorically stated not to occur in the species by Conant and Collins (1998). Furthermore, none of the dorsal warts are light-tipped in the Batopilas specimen, contrary to the La Perla specimens and the literature (e.g. Stebbins, 1985; Korcy, 1999). In western Chihuahua Tanner (1989) stated that the species occurs "usually between 5000 to 7000 ft," although he listed a specimen from low-altitude at Cerocahui.

We therefore suggest that two species of the *Bufo punctatus* complex occur in Chihuahua. The identity of the western, lowland population, if taxonomically distinct, remains to be determined.

*Hyla arenicolor* Cope. Two: 5858, Valle de los Pinos, 9 km S Creel (27°41'43.5"N, 107°35'8.1"W), 2386m, 10 July; 5875, Rancho El Ojito (27°41'21.8"N, 107°42'31.5"W), 2422m, 11 July. The localities lie well within the known range of the species (Duellman, 2001).

*Hyla wrightorum* Taylor. Fifteen: 5830-3, 5859-67, Valle de los Pinos, 9 km S Creel (27°41'43.5"N, 107°35'8.1"W), 2386m, July 10; 5876-7, Rancho El Ojito (27°41'21.8"N, 107°42'35.1"W), 2422m, 11 July.

These localities fall well within the known range limits of the species as depicted by Duellman (2001: 983), who reversed his conclusion of 1970 that *H. wrightorum* is a jr. synonym of *H. eximia*; its range is separated by about 500 km from the nearest records of *H. eximia*, in central Durango.

*H. wrightorum* is readily distinguished from the sympatric *Hyla arenicolor* by the skin — smooth in the former, tuberculate in the latter.

*Rana forreri* Boulenger. One, a juvenile 33mm SVL: 5923, Arroyo El Camuchil, nr Batopilas (27°1'34.1"N, 107°45'44.5"W), 435m, 17 July. The dorso-lateral folds are complete, and in that respect it differs from *R. magnaocularis*, the only other lowland species of the *R. pipiens* complex in that area (Frost and Bagnara, 1976; Hillis, 1988).

The species has been recorded from no nearer Chihuahua than north-eastern Sinaloa and southeastern Sonora (Frost and Bagnara, 1976).

*Scaphiopus couchii* Baird. Forty-seven: 5552, Sierra El Morrión, mpio Aldama (29°4'45.0"N, 105°35'3.7"W) 1352m, 24 June; 6085-6130, Ejido San Dionisio, mpio Tlahualilo, Durango (26°12'9.1"N, 103°41'47.2"W), 1111m, 2 August. Both localities are well within the known range of the species (Wasserman, 1970).

Three are adults (5552, 6085-6), the first the largest (64mm SVL), the others 53mm SVL. The remainder are recently transformed, 15-28mm SVL.

*Spea multiplicata* (Cope). One: 5868, Valle de los Pinos, 9 km S Creel (27°41'43.5"N, 107°35'8.1"W), 2386m, 10 July. This very warty specimen conforms with the morphology and known distribution of the species (Tanner, 1989). The specimen is immature, 47mm SVL.

Wiens and Titus (1991) showed on electrophoretic grounds that *S. hammondii* and *S. multiplicata* are separate species.

*Spea stagnalis* (Cope). One specimen, without number, was taken during a night rainstorm on the highway between El Pastor and Coyame, 17 June. It is a large male, 69mm SVL, with the smooth skin and speckled pattern illustrated by Tanner (1989: 58, fig. 13B) and diagnostic of the taxon.

Upon confirmation of allospecificity of *S. hammondii* and *S. multiplicata* (Wiens and Titus, 1991), Frost (2000) allocated the taxon formerly designated *S. h. stagnalis* (which Wiens and Titus did not examine) as a subspecies of *S.*

*multiplicata*.

Tanner (1989) illustrated one example each of "*S. h multiplicata*" and "*S. h. stagnalis*" from 11 mi NW Yepómera and 3.8 mi SE Yeplómera, respectively, Chihuahua. He commented that the former locality is at 7000ft in pine forest, the latter at 6200ft in grassland, 15mi apart. As distinct as these taxa are, without evidence of intermediacy at such close approximation as reported, we propose that they constitute separate species.

Acknowledgments.

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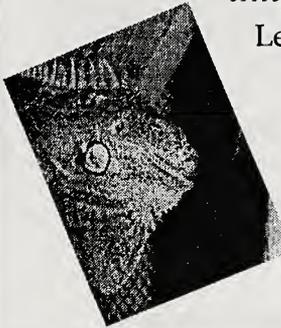


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*News and Notes*

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