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The Amphisbaenian Carpus: How Primitive Is It?

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The three species of *Bipes* are the only known amphisbaenians to retain the forelimbs. As currently interpreted, the forelimb shows a primitive character state unique for squamates: the presence of a distal (or lateral) centrale in the carpus (Renous-Lecuru, 1973; Gans, 1978). However, as we now report, this "centrale" is actually a misidentified pisiform. Furthermore, as the carpus of *Bipes* lacks the intermedium, it is not primitive, but slightly derived relative to the probable primitive squamate condition.

The error arises from the mislabelling of the carpal elements in the useful study of Castaneda and Alvarez (1968). In their only labelled figure of the carpus (Fig. 5, dorsal and ventral views) they unfortunately reversed the digital sequence from their figures 2 and 8. They refer to a "central distal" bone (here considered the pisiform) and an "intermedium" (here considered the medial and only centrale). In her review of the carpus of living lepidosaurs, Renous-Lecuru (1973, also 1974 and Gans, 1978) accepted these identifications (though she did note as unusual the apparent absence of a pisiform) and emphasized the "central distal" as a unique primitive character state for squamates.

Zangerl (1945) had correctly identified and illustrated the bones in the carpus of *B. biporus*, noting that the pattern shown was equivalent to that of the digits of lizards. As Zangerl observed and we have confirmed in all three species, the carpus of *Bipes* consists of the radiale, ulnare, pisiform, a single centrale and five distal carpals. This complement differs from the primitive squamate condition in the absence of the intermedium and hence is slightly derived and not primitive.

Specimens examined (cleared and stained material indicated by an asterisk; all other material, dried skeletons): *Bipes biporus*: C. Gans 3052, 5458*; CAS 150527*; MCZ 31523-4 (part); MVZ 97568*, 98926, 111505-6, 116542 and 175852; *B. canaliculatus*: CAS 144793*, 150523*; MVZ 175855-6; and *B. tridactylus*: CAS 150525-6, 150529*.

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Small Clutch Size in a Tropical Whiptail Lizard (*Cnemidophorus arubensis*)

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Models of lizard populations frequently contribute to studies on vertebrate life history phenomena (Tinkle et al., 1970; Pianka and Parker, 1975). The genus *Cnemidophorus* (whiptail lizards) has proven particularly interesting because of variation in reproductive characteristics related to geographic distribution (McCoy and Hoddenbach, 1966; Pianka, 1970), body size (Schall, 1978, 1981), and the evolution of parthenogenesis (Cole and Townsend, 1977; Schall, 1978, 1981; Congdon et al., 1978). Observed patterns in a taxon's reproductive biology become more intriguing when exceptions to the patterns are discovered. In general, larger whiptails produce larger clutches of eggs; this pattern holds both within and among species. I report here that the tropical whiptail lizard (*Cnemidophorus arubensis*) from Aruba is-

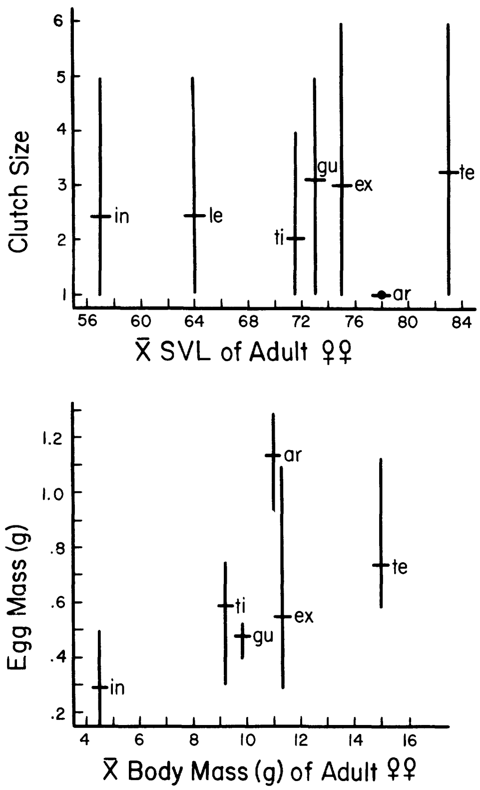

FIG. 1A. (Above). Body size (snout-vent length in mm) and clutch size for *C. arubensis* and six other *Cnemidophorus* species. Data for these six species from Schall (1978) and León and Cova (1973). Means indicated by horizontal bar and ranges by vertical line. Species indicated by first two letters of specific name: *C. arubensis*, *C. lemniscatus*, *C. exsanguis*, *C. tesselatus*, *C. inornatus*, and *C. tigris*. FIG. 1B. (Below). Mass of a single shelled oviducal egg and mean body mass of adult female whiptail lizards of six species, *C. arubensis* and five of the six other species shown in Fig. 1A. Means indicated by horizontal bar and ranges by vertical line.

land, Netherlands Antilles, apparently produces an exceptionally small clutch for its body size, only one egg, and the single egg is exceptionally large.

I have dissected 146 adult female *C. arubensis* collected during three periods: September 1971 to January 1972, October 1979, and October 1980. Of these, 26 contained yolked ovarian follicles and 12 had oviducal shelled eggs. To determine reproductive activity I used presence of yolked follicles, oviducal eggs, or greatly enlarged oviduct(s). The number of reproductive lizards were: September, 3 of 5; October, 24 of 85; November, 0 of 9; December, 10 of 38; January, 1 of 9. Thus, female reproductive activity seems to take place throughout the five month interval.

Of 38 females with yolked follicles or oviducal eggs, 37 had only one yolked follicle or shelled egg and one had 2 small (5 mm) yolked follicles. Fig. 1A compares clutch size and body size measures for *C. arubensis* and six other whiptail species, five previously reported on from western Texas (Schall, 1978), and a tropical species, *C. lemniscatus* (León and Cova, 1973). If *C. arubensis* fit the general reproductive pattern, it would produce an average of about 3.2 eggs, with a range of 1–6.

I was able to measure 9 and weigh 4 intact oviducal shelled eggs from *C. arubensis*. Compared to other *Cnemidophorus*, this species produces exceptionally heavy eggs (Fig. 1B). The shape of these eggs was similar to those of other *Cnemidophorus*, but larger. Length measurements are given here for those who wish to compare *C. arubensis* with other species. The largest Aruban whiptail egg measured was 26 mm long ($\bar{x} = 21$ mm), whereas the largest from *C. tesselatus* was 20 mm long, and the largest from *C. exsanguis* was 18 mm. Size of the ovum at ovulation for *C. arubensis* is only slightly larger than for similarly sized *Cnemidophorus* (largest observed yolked follicles are: *C. arubensis* ~12 mm; *C. exsanguis* ~11 mm; *C. tesselatus* ~11 mm).

It is likely that *C. arubensis* is reproductively active through most of the year as other tropical whiptails (genera *Cnemidophorus* and *Ameiva*) seem to be (León and Cova, 1973; Smith, 1968). Perhaps the Aruban whiptail produces larger clutches during months that were not sampled. However, Aruba experiences pronounced wet and dry seasons; I sampled during the wet season which extends from September to January. As the Aruban whiptail is primarily a herbivore (Schall, 1973), food should be most abundant during the wet season and the largest clutches produced then.

The reproductive output of *C. arubensis* seems at variance with the overall trend in lizard reproductive patterns of increasing clutch size with increasing body size (Tinkle et al., 1970). Another obvious exception to this pattern is the genus *Anolis*; anoline lizards also produce a single egg per clutch (Fitch, 1970). Andrews and Rand (1974) proposed three selective forces that may have led to a single egg clutch in *Anolis*. First, *Anolis* are primarily arboreal and possess adhesive toe pads which are functional only for relatively light weight lizards, unburdened by a large heavy clutch. (This may also explain the small clutch size of geckos as well.) Second, strong predation pressure on tropical lizards may lead to an "r-selected" life history pattern. Third, unpredictable short-term fluctuations in precipitation would favor an opportunistic strategy in which at least one egg can be rapidly produced during favorable periods.

In contrast to *Anolis*, the Aruban whiptail is a large, active, terrestrial species. Predation pressure does not appear to be appreciably greater on

Aruban lizards, compared to temperate species (unpublished tail break data). Other tropical whiptails produce clutch sizes comparable to those of temperate *Cnemidophorus* (Fig. 1A; León and Cova, 1973; Smith, 1968), although rainfall fluctuations may be more important for a herbivorous species such as *C. arubensis*.

Perhaps the small clutch size is in part a result of this species' herbivorous diet. If *C. arubensis* has not evolved adaptations for efficiently extracting nutrients from its plant diet it may be able to produce only one egg at a time. Also, the large egg may constrain the number of eggs produced in each clutch. The very large eggs will probably yield relatively large hatchlings. Tinkle et al. (1970) argue that strong intraspecific competition in lizards would lead to large egg size. I have suggested that there is strong adult-juvenile competition in this species (Schall, 1974), so larger hatchlings may have a competitive advantage resulting in selective pressure on females to produce large eggs.

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Leiocephalus nebraskensis nom. nov. pro. *L. septentrionalis* Wellstead, 1982, a Junior Homonym

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Wellstead (1982) applied the name *Leiocephalus septentrionalis* to a new species of Miocene fossil lizard from the Valentine Formation of Nebraska. However, he overlooked the work of Garrido (1975) in which a new extant subspecies of the genus is named *L. stictigaster septentrionalis*. Wellstead's usage of the epithet 'septentrionalis' creates a junior primary homonym and must be rejected (see e.g., Blackwelder, 1967:433–434). I propose the new specific epithet *nebraskensis* be applied to the fossil species which Wellstead described. The name of this fossil lizard becomes *Leiocephalus nebraskensis*. I thank Gregory Pregill for bringing this problem to my attention.

On a related matter, figures 1f and 1g in Wellstead (1982) depict *Liolaemus elongatus*, MCZ 14926, not *Liolaemus platei* as labelled.

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