

A new species of the *Zonosaurus rufipes*-complex (Reptilia : Squamata : Gerrhosauridae), from Northern Madagascar

by Mathias LANG & Wolfgang BÖHME

Abstract

The taxonomic status of *Zonosaurus rufipes* and var. *subunicolor* are reviewed. In addition, a new species of *Zonosaurus* closely related to *rufipes* is described from northern Madagascar. Phylogenetic affinities of this new species are discussed. This study also represents the first report of mite pockets in Gerrhosauridae.

Key-words : Gerrhosauridae ; *Zonosaurus brygooi* sp. nov.; phylogenetic affinities.

Résumé

Le statut taxonomique de *Zonosaurus rufipes* et var. *subunicolor* est examiné. Une nouvelle espèce, qui est proche de *Z. rufipes* est décrit qui se trouve sur les îles de Nosy Bé et Nosy Boraha et à Sakana. La position systématique de cette nouvelle espèce est discutée. Cette étude rapporte aussi pour la première fois sur des poches d'acariens dans la famille Gerrhosauridae.

Mots-clés : Gerrhosauridae ; *Zonosaurus brygooi* sp. nov.; implications phylogénétiques.

Introduction

The island of Nosy Bé (293 km²) has been a well-known and favorite collecting area since the late 19th century (BOETTGER, 1880, 1881a, 1881b). Nevertheless, only recently three new saurian species have been discovered occurring on this small island belonging respectively to *Brookesia* (RAMANANTSOA, 1979), *Phelsuma* (MEIER, 1988) and *Uroplatus* (BÖHME, in prep.). It is furthermore surprising that on this island no less than six species of *Zonosaurus* occur: *aeneus*, *boettgeri*, *laticaudatus*, *madagascariensis*, *rufipes* (see BRYGOO, 1985 ; MEIER 1989) and the new species described below.

BOETTGER (1881a) described the seemingly endemic *Zonosaurus rufipes* with diagnostic throat stripes, and var. *subunicolor* without throat pigmentation. Taxonomic confusion followed the original type description and we therefore wish to reiterate some of the problems and clarify the situation.

Taxonomic account

MERTENS (1967) designated SMF 40743 (6128, 1a of

BOETTGER's Catalogue), a female specimen as lectotype of *Zonosaurus rufipes*. This specimen, however, by no means matches BOETTGER's original type description as far as measurements are concerned. First of all the lectotype has a SVL of 85 mm (total length 205 mm) in contrast to the described SVL of 55 mm with a total length of 162 mm (see also BRYGOO, 1985). Rather SMF 40747 of BOETTGER's (1881a) original syntype series better fits the measurements given in the type description. The latter specimen also resembles the illustration by BOETTGER (reproduced in ANGEL, 1942). The designated lectotype has very faint lateral throat stripes, the medial ones entirely absent in contrast to the well-defined 6 throat stripes so characteristic of *rufipes*. MERTENS' (1967) lectotype designation is maintained, bearing in mind that the lectotype is considerably larger than the dimensions given in the original type description.

In a recent review of *Zonosaurus*, BRYGOO (1985) supported the validity of *rufipes*, rejecting earlier statements by MOCQUARD (1909: 25), who considered *rufipes* identical to *aeneus*. ANGEL (1942: 95) on the other hand, doubted the validity of *aeneus*, but presented a list of characters separating *rufipes* from both *aeneus* and *madagascariensis*. Here we accept BRYGOO's (1985) views, because he clearly demonstrated that *aeneus*, *rufipes* and *madagascariensis* constitute valid species.

The taxonomic history of *Zonosaurus rufipes* var. *subunicolor* is rather complex. BOETTGER (1881a) based the description of his var. *subunicolor* on two specimens. The specimen for which accurate measurements are given (SMF 41051; lectotype) as well as the paralectotype (SMF 41052) are clearly *Zonosaurus rufipes* based on morphometric characters (Table 1). Both have only very faint lateral throat stripes, hence the name *subunicolor*.

BOETTGER (1913) indicated that the color pattern of *subunicolor* may be the juvenile pattern of *rufipes*. MERTENS (1967) rejected this notion and after designation of lectotypes for these two taxa (see above) placed

Table 1: Summary of meristic values differentiating *Zonosaurus* on Nosy Bé. For more detail on values of *Zonosaurus rufipes* and *Z. brygooi* see Table 2 and 3 respectively. A slash mark (/) distinguishes between left and right sides whereas a hash mark (#) indicates a range.

TAXON	FEM.POR.	SO	IP	SVL(TOT)	MIDBOD	CH-CL	4 TOE
<i>aeneus</i>							
BRYGOO (1985)	12-19(15)	3	AB	86(236?)	19-23(20)	42-58(51)	16-22(19)
<i>boettgeri</i>							
NMW 23348	16/17	4	PR	113	14	48	22
holotype							
<i>madagascariensis</i>							
BRYGOO (1985)	15-23(19)	4	AB	160	18-24(22)	52-60(57)	20-24(22)
<i>laticaudatus</i>							
BRYGOO (1985)	17-28(23)	4	AB	142(434)	22-26(24)	45-50(48)	22-27(24)
<i>rufipes</i>							
TABLE 2	9-14(11)	3	PR	31-85	23-28(25)	44-51(47)	20-23(21)
<i>brygooi</i>							
TABLE 3	16-19(17)	3	AB	51-76	20-23(21)	43-48(45)	17-19(18)

(Abbreviations used in Table 1-4 & Fig. 1): Fem. Por. = number of femoral pores on thighs; SO = the number of supralabial scales anterior to the large supraocular scale that forms part of the labial margin (not including rostral); IP = interparietal scale (AB = absent; PR = present); SVL = snout vent length, TOT = total length (expressed in mm); ? = tail incomplete or missing; MIDBOD = number of scales at midbody excluding the ventral scales; Ch-C1 = number of scales between chin and cloaca (including mental scale); 4 toe = number of subdigital scales below 4th toe.

var. *subunicolor* as a synonym of *rufipes*. Finally, BRYGOO, 1985:34) categorically states that from a taxonomic standpoint *subunicolor* can not be distinguished from *rufipes* and is therefore considered to be a junior synonym thereof.

After examination of new material from Nosy Bé in addition to the type material of *Zonosaurus rufipes* and *subunicolor*, it is evident that the description of a new species of *Zonosaurus* is warranted.

Zonosaurus brygooi sp. nov.

Diagnosis. - *Zonosaurus brygooi* differs from other species of *Zonosaurus* by the absence of an interparietal scale, relatively large dorsal scales (20-23), few scales between chin and cloaca (43-48), a relatively high number of femoral pores (16-19) and few subdigital lamellae below the 4th toe (17-19) (Fig. 1-4; Table 1). *Zonosaurus brygooi* distinguishes itself from *Z. rufipes* by the consistent lack of throat striping, interparietal scale and 3 characteristics of lepidosis that do not overlap (Fig. 1-4; Table 1). *Zonosaurus rufipes* and *brygooi* can furthermore be distinguished from the remaining *Zonosaurus* (except *quadrilineatus* and *trilineatus*) by having an entirely dark pigmented tongue.

Table 2: Meristic values of *Zonosaurus rufipes*. For abbreviations see Table 1.

TAXON	FEM.POR.	SO	IP	SVL(TOT)	MIDBOD	CH-CL	4 TOE
AMNH 24769	11/12	3	PR	35 (??)	24	46	21
BM 86.2.25.8	**	11/12	3	AB 75 (???)	25	48	21
BM 86.2.25.9	**	11/11	3	AB 51 (???)	24	48	21
BM 87.12.5.13		11/11	3	PR 37 (??)	25	49	20
BM 95.10.29.12		11/11	3	AB 66 (??)	24	45	20
CAS 156896		10/11	3	PR 31 (90)	25	47	21
CAS 156897		14/14	3	PR 38 (???)	27	48	21
NMW 12243		12/12	3	PR 55 (135)	24	50	22
NMW 12245.1		12/12	2	PR ?? (???)	26	46	22
NMW 12245.2		11/11	3	PR 52 (???)	26	46	22
NMW 12246.1		13/11	3	PR 81 (???)	24	??	22
NMW 12246.2		12/11	3	PR 40 (???)	25	48	21
NMW 12247.1		11/11	3	AB 69 (197)	25	47	21
NMW 12247.2		9/9	3	AB 69 (195)	26	??	21
NMW 20097.1		10/11	3	AB 80 (204)	25	48	21
NMW 20097.2		13/14	3	PR 73 (207)	25	51	23
NMW 23350.1	**	11/10	3	PR 34 (???)	25	48	22
NMW 23350.2	**	11/11	3	PR 51 (126)	25	48	22
SMF 40743	*	13/13	3	AB 85 (???)	25	??	22
SMF 40744	**	11/10	3	PR 81 (???)	27	48	21
SMF 40745	**	11/11	3	PR 44 (99)	25	45	22
SMF 40746	**	11/10	3	PR 37 (???)	24	48	21
SMF 40747	**	9/9	3	PR 55 (??)	23	46	21
SMF 40748	**	10/10	3	PR 42 (??)	24	44	20
SMF 41051	#	10/10	3	PR 45 (142)	??	46	22
SMF 41052	###	11/11	3	PR 38 (??)	25	45	20
ZFMK 21270		11/12	3/4	PR 45 (101)	28	50	22
ZFMK 46796		10/11	3	PR 36 (106)	24	??	22
ZFMK 46797		11/10	3	PR 34 (???)	25	47	22
ZFMK 47295		11/11	3	PR 36 (102)	25	49	22
ZFMK 48239		13/12	3	PR 36 (100)	27	49	22
ZMB 10097	**	14/14	3	PR 63 (109)	??	47	21
ZMB 10097	**	11/12	3	PR 48 (76)	25	47	21
RANGE:	9-14			31-85	23-28	44-51	20-23
MEAN:	11.3				25.1	47.4	21.5

* = lectotype *Zonosaurus rufipes*

** = paralectotype *Zonosaurus rufipes*

= lectotype *Z. rufipes* var. *subunicolor*

= paralectotype *Z. rufipes* var. *subunicolor*

Table 3: Meristic values of *Zonosaurus brygooi*. For abbreviations see Table 1.

TAXON	FEM.POR.	SO	IP	SVL(TOT)	MIDBOD	CH-CL	4 TOE
ZFMK 46789	*	19/19	3	AB 76 (???)	22	44	18
ZFMK 46790	**	17/17	3	AB 63 (???)	21	43	19
ZFMK 46792	**	16/16	3	AB 51 (145)	23	45	17
ZFMK 46793	**	19/17	3	AB 55 (???)	??	??	18
ZFMK 46794	**	17/16	3	AB 45 (129)	21	46	18
ZFMK 46795	**	16/16	3	AB 49 (124)	20	48	18
ZFMK 48165	**	16/16	3	AB 74 (???)	22	45	18
IRSNB 2.534	**	17/17	3	AB 74 (???)	22	45	18
ZMB 19018	**	16/17	3	AB 69 (161)	21	45	17
SMF 41053	**	17/17	3	AB 68 (???)	21	47	19
RANGE:	16-19			51-76	20-23	43-48	17-19
MEAN:	16.9				21.4	45.3	18

* = holotype

** = paratype

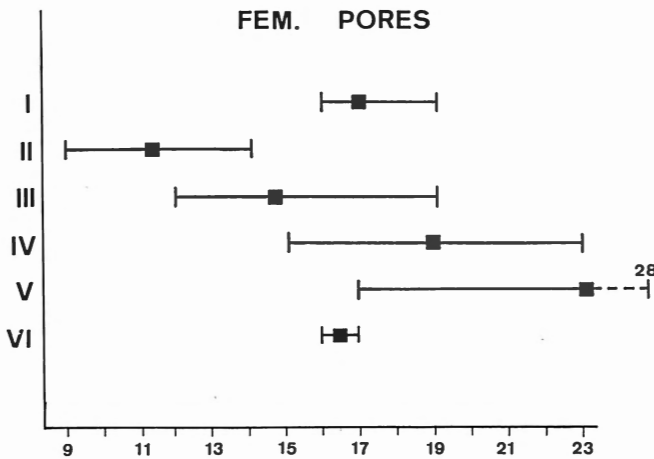


Fig. 1.: Diagram illustrating differences in the number of femoral pores between the 6 species of *Zonosaurus* occurring on Nosy Bé. I) brygooi; II) rufipes; III) aeneus; IV) madagascariensis; V) laticaudatus and VI) boettgeri. (Values derived from Table 1).

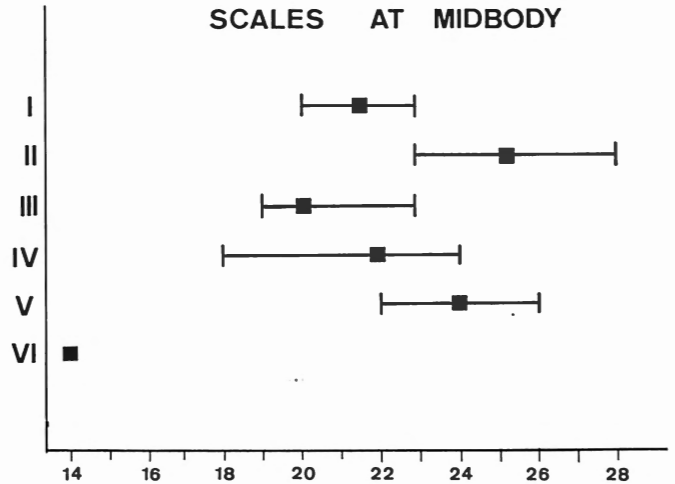


Fig. 2.: Diagram illustrating differences in the number of scales at midbody between the 6 species of *Zonosaurus* occurring on Nosy Bé. I) brygooi; II) rufipes; III) aeneus; IV) madagascariensis; V) laticaudatus and VI) boettgeri. (Values derived from Table 1).

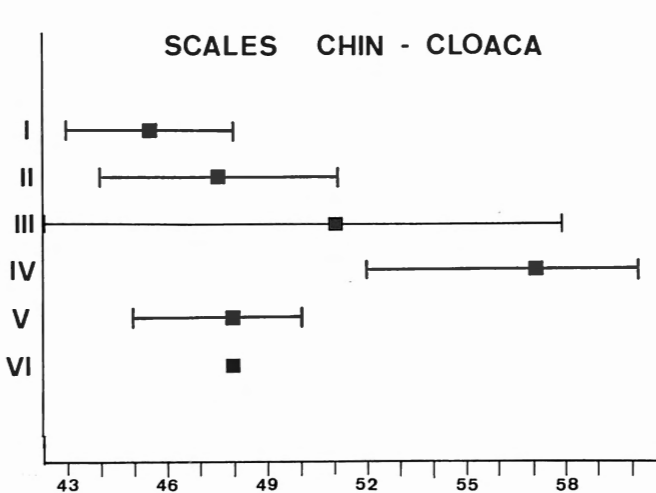


Fig. 3.: Diagram illustrating differences in the number of scales between the chin and the cloaca of the 6 species of *Zonosaurus* occurring on Nosy Bé. I) brygooi; II) rufipes; III) aeneus; IV) madagascariensis; V) laticaudatus and VI) boettgeri. (Values derived from Table 1).

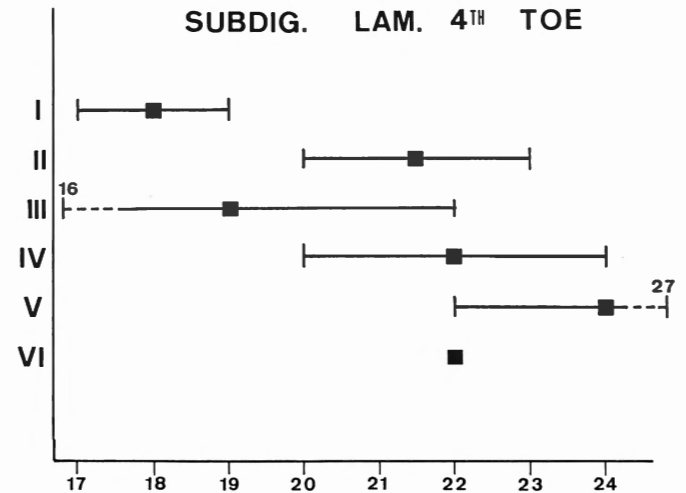


Fig. 4.: Diagram illustrating differences in the number of subdigital lamellae below the 4th toe in the 6 species of *Zonosaurus* occurring on Nosy Bé. I) brygooi; II) rufipes; III) aeneus; IV) madagascariensis; V) laticaudatus and VI) boettgeri. (Values derived from Table 1).

Zonosaurus aeneus, *brygooi* and *rufipes* have 3 supralabial scales anterior to the subocular that forms part of the upper labial margin, whereas the remaining *Zonosaurus* all have 4 supralabials anterior to the subocular. In addition, these three species all have 2-3 mite pockets located in the antehumeral fold in addition to postaxillary and postfemoral mite pockets. This condition is not found in any other species of *Zonosaurus*. The mite pockets contained larvae of *Ophionyssus natricis* (Laelaptidae). For differentiation from the remaining *Zonosaurus* see BRYGOO (1985).

Holotype. - ZFMK 46789, a male from Loucoubé, Nosy-Bé, Madagascar; coll. R. Seipp, IV 1987.

Description of holotype. - (Fig. 5-6). Nasal scales not in median contact; separated by large frontonasal scale. Prefrontals separated by frontal-frontonasal contact. Two large parietal scales; no frontoparietals. Interparietal scales absent. Four supraocular scales. Four supraciliary scales. Two loreals. A total of 6 scales between rostral and tympanum with 3 scales anterior to the subocular, the 4th scale being the subocular. A total of 5 temporal scales. Lower eyelid contains about 13 scales forming a translucent window. Temporal and parietal scales with slight carinations (Fig. 5). Lateral and dorsal body scales have slight carinations. The number of midbody scales, scales between chin and cloaca, subdigital scales below the 4th toe as well as

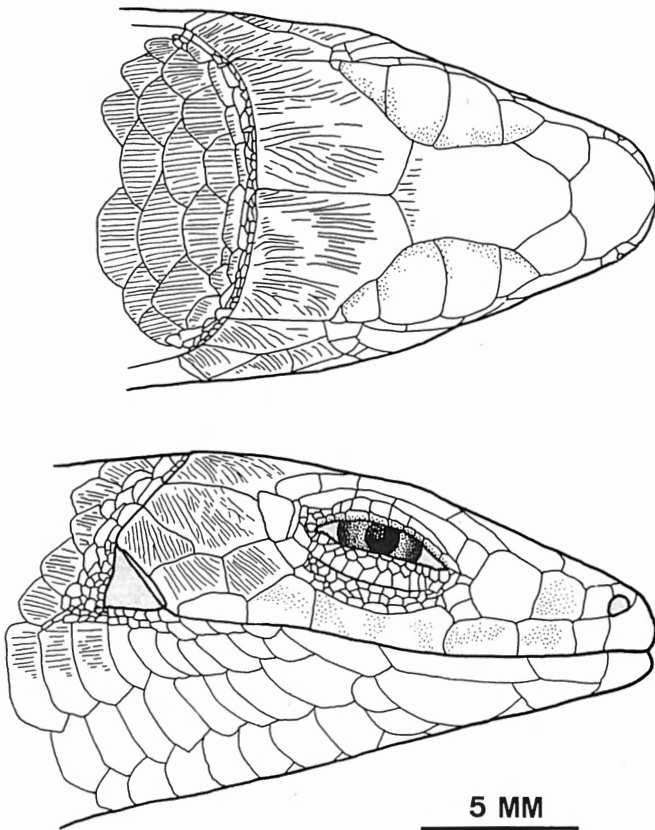


Fig. 5.: Upper and lateral views of the head of the holotype (ZFMK 46789) of *Zonosaurus brygooi* sp. nov.

the number of femoral pores are listed in Table 3. At midbody the ventrals are arranged in 8 longitudinal rows. The tail is abruptly constricted just posterior to the sacral region, whereafter it is vertically compressed (Fig. 6). The scales on the distal aspect of the tail are smooth.

Head : 11 mm; Trunk: 65 mm; Snout-vent length: 76 mm; head width at tympanum: 11 mm; anterior limb: 23 mm; posterior limb: 41 mm; incomplete tail: 66 mm. The holotype is a well-preserved male specimen with non-faded colors and a snout-vent length of 76 mm. The head is a metallic medium brown with some iridescence. A few dark pigmented areas are situated along the lateral aspect of the supraoculars and below the eye. The supralabials are only slightly pigmented. The throat and chest areas are a light blue, which grades to a light red in the abdominal area, cloacal region and interior thighs. The palmar surface is also reddish (as is the case in *Zonosaurus rufipes*). The ventral aspect of the tail is light blue.

The lateral aspect of the body, the dorsum and the dorsal aspect of the tail are a darker shiny brown. The flanks are separated from the dorsum by 2 interrupted longitudinal lines that start just posterior to the parietal region. These lines consist of bluish-white and deep brown rectangles 1 scale wide and 2 scales long. These longitudinal lines are interrupted by scales (usually 1) having the dorsal medium brown coloration. The

lighter bluish-white flecks of the longitudinal lines are lateral to the darker flecks. The longitudinal lines stop short of the sacral region. Also on the flanks are up to 13 light blue spots. A few of these spots are located on the dorsal aspect of the anterior limbs.

Darker pigmented areas are found in the dorsum, and in the neck region, where up to 6 spots form a short interrupted line. These spots also continue into the tail region.

Paratypes. - ZFMK 46790; 46792-46795 same data as holotype; IRSNB 2.543 same data as holotype; ZFMK 48165 Madagascar, Nosy Boraha (= Ile Ste. Marie), coll. F.W. Henkel & R. Seipp, IV 1988; ZMB 19018, Madagascar, Sakana, coll. Voeltzkow, no date; SMF 41053 Nosy Bé, Madagascar, coll. A. Stumpff, 1881. The latter specimen was listed as *Zonosaurus aeneus* by BRYGOO (1985: 44).

Variation. - Paratypes for the most part follow the description of the holotype. For variation of lepidosis see Table 3. No considerable color variations of paratypes with respect to the holotype were observed. MEIER (1989: Fig. 8 a, b) presents color photographs of the underside of both *Z. brygooi* and *Z. rufipes*, showing the striking color and pattern differences between the two species. ZFMK 46790 is remarkable in that it has the head of a swallowed juvenile protruding from its mouth. This animal was terrarium kept and it is therefore not known if cannibalism is a natural behavior of this species.

Distribution and Habitat. - *Zonosaurus brygooi* occurs on the island of Nosy Bé and Nosy Boraha and at Sakana (Eastern Forest). The latter locality is problematic and has not been found on any map or in any gazetteer (BRYGOO and BOUR, pers. comm.). We suspect that it is located on the north eastern coast of Madagascar, coinciding with the travel routes of VOELTZKOW. Sakana was cited by BRYGOO (1985) as being erroneous for *Zonosaurus rufipes*. Indeed the specimen from that site is *Z. brygooi*. This new species occurs in regions of primarily damp wet rainforests (MEIER, 1989 ; listed as *Zonosaurus rufipes*).

As can be deduced from the geographical distribution of *Zonosaurus*, some species show a disjunct distributional pattern between the forest relicts of Nosy Bé and the forested areas of northeastern Madagascar, including the island of Nosy Boraha (= Ile Ste. Marie). Species exhibiting this pattern include *aeneus*, *boettgeri* and *brygooi*. *Zonosaurus rufipes* is also a forest inhabitant and has been found at Imerina (Eastern Madagascar). *Zonosaurus laticaudatus* and *madagascariensis*, which are adapted to more open habitats show a more continuous distribution throughout the main island of Madagascar (BRYGOO, 1985: 26 & 56). The niche segregation and resource partitioning of these six species of *Zonosaurus* on the small island of

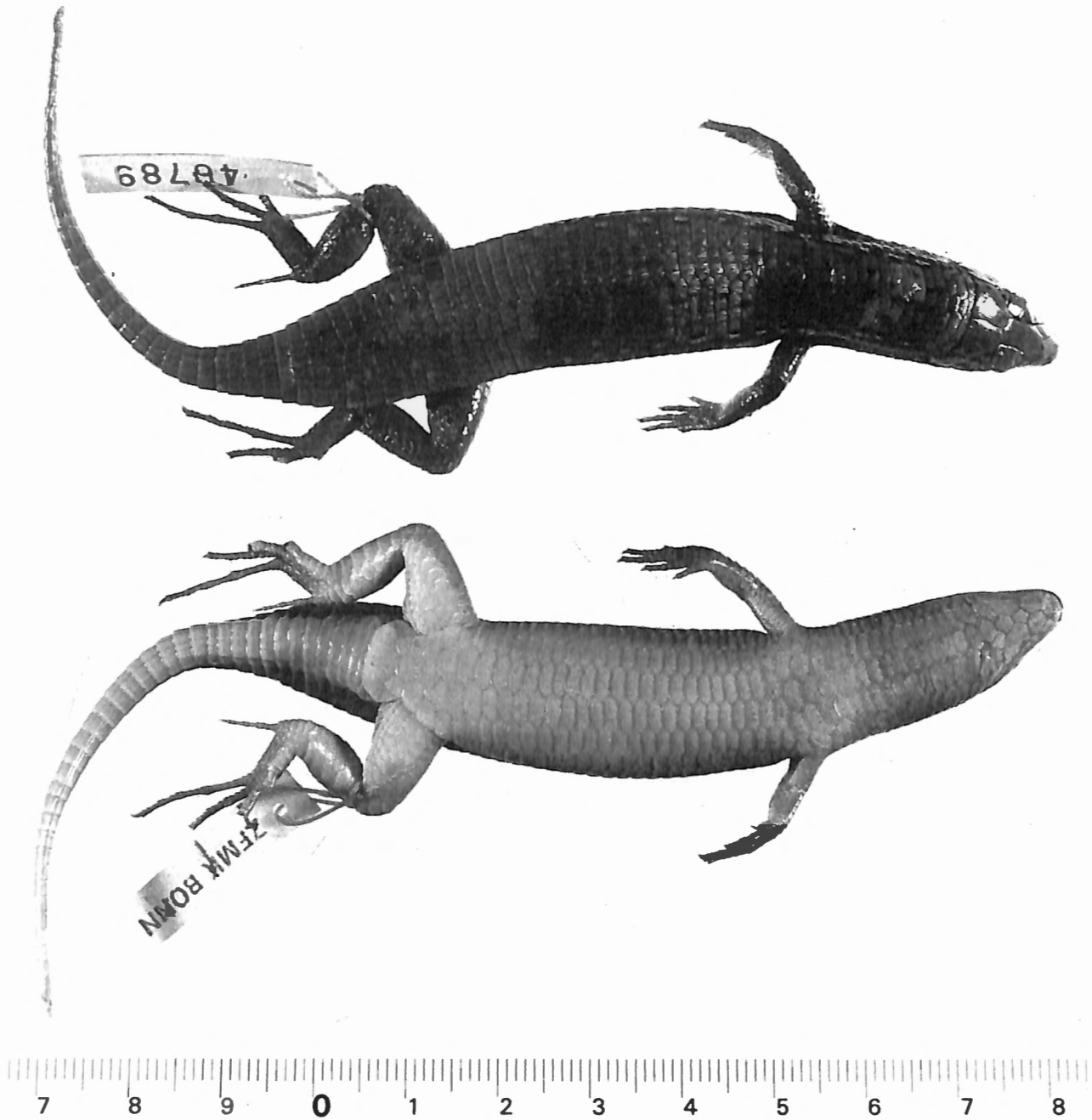


Fig. 6.: Dorsal and ventral views of the holotype of *Zonosaurus brygooi*.

Nosy Bé would constitute a most interesting ecological project.

Phylogenetic affinities. - *Zonosaurus brygooi* is more closely related to *Z. rufipes* than to any other species of *Zonosaurus*. This is based on the presence of an entirely pigmented tongue (convergent with *Z. trilineatus* and *Z. quadrilineatus*) and the possession of reddish feet, which is not found in any other species of *Zonosaurus*. The entire genus is at present being analyzed within a phylogenetic framework (LANG, in prep.). Preliminary

phylogenetic results indicate that *aeneus* + (*rufipes* + *brygooi*) form a phylogenetic unit that is based on the presence of 2-3 well-defined mite pockets within the antehumeral fold and in having 3 supralabial scales anterior to the subocular scale that is part of the labial margin.

Etymology. - This new species is named in honour of Professeur E. R. BRYGOO who has contributed so much to the knowledge of the lizard fauna of Madagascar, in particular of the genus *Zonosaurus*.

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Specimens examined

For museum acronyms see LEVITON et al. (1985).

Zonosaurus brygooi:

Holotype: ZFMK 46789, Nosy Bé, Loucoubé

Paratypes: ZFMK 46790, 46792-95, Nosy Bé, Loucoubé; SMF 41053 Nosy Bé, IRSNB 2.534 Nosy Bé, Loucoubé; ZFMK 48165, Nosy Boraha (= Ile Ste. Marie); ZMB 19018, Sakana.

Zonosaurus rufipes: AMNH 24769 Nosy Bé; BM 86.2.25.8-9 Nosy Bé (paralectotypes); BM 87.12.5.13 Nosy Bé; BM 95.10.29.12, Imerina, Madagascar. CAS 156896-156897 Nosy Be, Lokobe Forest; MCZ 17633 Nosy Bé (paralectotype); NMW 12243,

12245.1-2, 12246.1-2, 12247.1-2, 20097.1-2, 23350.1-2 (paralectotypes) Nosy Bé; SMF 40743 (lectotype), 40744-40748 (paralectotypes), 41051 (lectotype of var. *subunicolor*), 41052 (paralectotype) Nosy Bé; ZFMK 21270 no data; ZFMK 46796-46797, 47295, 48239 Nosy Bé, Loucoubé; ZMB 10097 (2 spec.) (paralectotypes) Nosy Bé.

Zonosaurus boettgeri: NMW 23348, Nosy Bé, 1891.

Zonosaurus aeneus: ZFMK 14365, 21272, Nosy Bé (Madagascar).

Remaining *Zonosaurus* examined are from the collections of ZFMK (Bonn), IRSNB (Brussels), SNMS (Stuttgart), SMF (Frankfurt) and ZMB (E. Berlin).