

A reassessment of the Dibamidae, including the division of the genus *Dibamus* Duméril and Bibron, 1839 (Squamata:Sauria: Dibamidae).

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ABSTRACT

The legless lizards in the genus *Dibamus* Duméril and Bibron, 1839 of the family Dibamidae have been of considerable taxonomic interest in recent years. Greer (1985) did a review of the South-east Asian genus, then consisting of nine species. Currently as of 2012 there are 22 described species and it is certain this number will increase.

Molecular studies of component species by Brandley et. al. (2005) found that *Dibamus* were not skinks as previously believed. This result was adopted by Townsend et. al. (2011) and other similar studies, who have in turn found the origins of the related Mexican monotypic genus *Anelytropsis* Cope, 1885 to be rooted between two divisions of *Dibamus*. All were estimated to have diverged well over 60 million years before present.

Relying on these results, the taxonomy of the component genera is revised accordingly.

Taking a conservative position, *Dibamus* is split into four genera, with the new genera *Paulwoolfus* gen. nov., *Leswilliamsus* gen. nov. and *Dalegibbonsus* gen. nov. created and defined according to the Zoological Code. In turn three subfamilies within the Dibamidae are created and diagnosed to reflect their deep historical divergences. Two subfamilies each contain clades consisting two genera each formerly placed within *Dibamus*, while the third includes the monotypic genus *Anelytropsis*.

A new subgenus *Nindibamus* subgen. nov. is created for the divergent species *Dibamus dalaiensis* Neang et. al. 2011 within *Paulwoolfus* gen. nov.

Keywords: Taxonomic revision; Dibamidae; new subfamilies; Dibiminae; Amelytropsinae; Paulwoolfinae; new genera; subgenus; *Paulwoolfus*; *Dibamus*; *Leswilliamsus*; *Dalegibbonsus*; *Nindibamus*.

INTRODUCTION

The fossorial and burrowing legless lizards in the genus *Dibamus* Duméril and Bibron, 1839 of the family Dibamidae have been of considerable taxonomic interest in recent years. Greer (1985) did a review of the South-east Asian genus, then consisting of nine species. Currently as of 2012 there are 22 described species and it is certain this number will increase.

Molecular studies of component species by Brandley et. al. (2005) found that *Dibamus* were not skinks as previously believed.

This result was adopted by Townsend et. al. (2011) and other similar studies, who have in turn found the origins of the related Mexican monotypic genus *Anelytropsis* Cope, 1885 to be rooted between two divisions of *Dibamus*. That is, one section of *Dibamus* diverged from the other section and *Anelytropsis* at an earlier time.

All three lineages were estimated to have diverged well over 60 million years before present. The first split within *Dibamus* was nearly 80 years before present.

As a result of these findings, continued placement of obviously divergent species within the same genus is clearly not appropriate and this paper resolves the matter by summarizing a reviewing of all known species of *Dibamus* as presently defined.

The species are grouped into obvious groups of closely related taxa. These in turn are placed accordingly depending on timing of divergences as found by Townsend et. al. (2011).

Important recent publications in terms of *Dibamus* as defined to date, *Anelytropsis* and component species include, Angel (1935), Auffenberg (1980), Axtell (1958), Bauer, et. al. (1998), Bleeker (1860), Boulenger (1887a, 1887b, 1890, 1897), Brandley et. al. (2005), Bullock and Medway (1966), Campbell (1974), Cole and Gans (1997), Cope (1885), Darevsky (1992), Darevsky and Sang (1983), Das (1996, 1999, 2004), Das and Lim (2003, 2005, 2009), Das and Yaakob (2003), Diaz et. al. (2004), De Rooij (1922), Dixon and Lemos-Espinal (2010), Duméril and Bibron (1839), Dunn (1927), Ezaz et. al. (2009), Gasc (1968), Greer (1985, 1990), Grismer (2011), Hodkiss (1992), Honda et. al. (1997, 2001), Ineich (1999), Inger and Voris (1993), Iordansky (1985), Lazell 1996), Lazell and Lu (1990), Lim and Lim (1999), Liner (2007), Liu and Hu (1962), Manthey and Grossmann (1997), Mertens (1930), Miller (1996), Müller (1895), Neang et. al. (2011), Nguyen et. al. (2009), Peters (1864), Quijano et. al. (1993), Riepell (1984), Schlegel (1858), Soes (2007), Smith (1935), Smith (1921, 1935), Steindachner (1867), Stoliczka (1873), Tan (1993), Taylor (1915, 1962, 1963), Townsend et. al. (2004, 2011), Tweedie (1950), Underwood and Lee (2000), Venugopal (2010), Vidal et. al. (2008), Zaldivar-Riveron et. al. (2008) and Zhao and Adler (1993).

Relying on the phenotypic differences between these morphologically conservative lizards and a review of the literature, the taxonomy of the component genera is revised accordingly.

Taking a conservative position, *Dibamus* is now split into four genera, with the new genera *Paulwoolfus* gen. nov., *Leswilliamsus* gen. nov. and *Dalegibbonsus* gen. nov. created and defined according to the Zoological Code (Ride et. al. 1999). In turn three subfamilies within the Dibamidae are created and diagnosed to reflect their deep historical divergences. Two subfamilies each contain major clades, consisting two genera each formerly placed within *Dibamus*, while the third includes the monotypic genus *Anelytropsis*.

The subfamily Dibaminae includes the nominate genus containing 13 described species and *Leswilliamsus* gen. nov. containing the single species *Dibamus tiomanensis* Diaz, Leong, Grismer and Yaakob, 2004.

The subfamily *Paulwoolfinae* includes genera *Paulwoolfus* gen. nov. (6 species) and *Dalegibbonsus* gen. nov. (2 species).

The subfamily *Anelytropsinae* includes the monotypic genus *Anelytropsis*.

FAMILY DIBAMIDAE BOULENGER, 1884

Type species: *Dibamus novaeguineae* Duméril and Bibron, 1839.

Diagnosis: Small, thin, worm-like fossorial lizards. They are easily recognized by their unusually large head plates, with the rostral often covering more than half the head (alone being diagnostic for the family) and degenerate vestigial eyes. Rarely more than 15 cm snout-vent length.

All species are elongate, pencil-long animals with blunt noses, no obvious ear openings and scale covered eyes. There are no functional limbs, but there are tiny flaps near the cloaca and preanal pores.

SUBFAMILY ANELYTROPSINAE SUBFAM. NOV.

Type species: *Anelytropsis papillosus* Cope, 1885

Diagnosis: As for the family Dibimidae, but separated from all others in the family (the Asian taxa) by possessing an interorbital septum, columella cranii and a single premaxillary bone. Osteoderms are present.

These are small, thin, worm-like fossorial lizards. They are easily recognized by their unusually large head plates, with the rostral often covering more than half the head (alone being diagnostic for the family) and degenerate vestigial eyes. Rarely more than 15 cm snout-vent length.

All species are elongate, pencil-long animals with blunt noses, no obvious ear openings and scale covered eyes. There are no functional limbs, but there are tiny flaps near the cloaca and preanal pores. The tail is moderately long, with obtuse extremity. Scales are scincoid, with rounded edges, everywhere equal, including the preanal region. Color brownish flesh-color. The head is distinguishable from the body by its slightly greater width, and is slightly contracted at the position of the orbits, and continued as a distinct muzzle.

The body is cylindrical, and the tail is a little longer than one-fourth the total length. Twenty longitudinal series of scales.

The taxon (monotypic for the genus) is only known from eastern Mexico where it occurs in the States of Tamaulipas, Veracruz, San Luis Potosi, Queretaro and Hidalgo.

GENUS ANELYTROPSIS COPE, 1865

Type species: *Anelytropsis papillosus* Cope, 1885

Diagnosis: As above for the subfamily Anelytropsidae.

When first described by Cope in 1885, he was under the impression the taxon was a skink.

The following detail is taken from Cope's original description:

"Char. gen. Rostral plate capping muzzle, the nostril at the junction of its posterior border with the suture separating the loreal and first labial. No frontonasal nor supraorbital plates.

Three plates on top of head, which should probably be identified as anterior and posterior frontal and parietal. Eye scarcely visible through the single ocular plate. Scales equal, smooth. Vent not terminal. No limbs. No preanal pores. This genus only differs from *Feylinia* Gray (= *Anelytrops* Hallow), in the arrangement of the lateral plates of the muzzle. In that genus and *Typhlosaurus*, the only other genus of the family, the rostral plate is as in *Acontias*; i. e., divided longitudinally on each side by a fissure which extends from the nostril posteriorly. Whether the internal characters differ remains to be ascertained. I give the genus the name *Anelytropsis* in order to justify the family name Anelytropsids. This will produce no confusion, as the name *Anelytrops* was given by Hallowell to the genus which had previously been named *Feylinia*, and as a synonym disappears from view.

Limbless.

Char. Specif. Form slender. Tail moderately long, with obtuse extremity. Scales scincoid, with rounded edges, everywhere equal, including the preanal region. Color brownish flesh-color. The head is distinguishable from the body by its slightly greater width, and is slightly contracted at the position of the orbits, and continued as a distinct muzzle. The body is cylindrical, and the tail is a little longer than one-fourth the total length. Twenty longitudinal series of scales. The area represented by the rostral plate of *Acontias*, is invaded on each side by two labial plates, and a large loreal above them. Behind the second labial plate is a very small third, and above it is a large Ocular plate which extends upwards and forwards to a line with the superior border of the loreal. The pale spot which represents the eye is situated in the lower posterior corner. The fourth and last labial is a little larger than the second, and has a narrowly rounded posterior extremity. Above it is a small postocular, which is in contact with the posterior frontal. On the summit of the head there are three scuta. The anterior, or anterior frontal is the smallest. It forms a transverse band between the loreal and ocular of one side and those of the other. The succeeding plate, the postfrontal, is the largest. It is succeeded by the parietal, which is a transverse plate, concave in front and convex posteriorly, and which is separated from the postocular on each side by a single scale. Posterior to this scute, the scales of the body commence. There is a large symphyseal plate which is a triangle with its apex

posterior and truncate. It is bounded on each side by a very large inferior labial, which is also a triangle. This is followed on the labial margin by two very small labial plates. A small body scale succeeds the symphyseal, and this is connected with the small posterior labials by a narrow plate on each side. These are followed by the body scales. Six laterally imbricated scales bound the vent in front. Total length, M.170; length of tail, .045; of head, to line connecting rictorius, .0041. The rostral, loreal and anterior twolabial scuta are marked with minute papillie, which when removed leave punctiform impressions. They are not very closely placed."

SUBFAMILY DIBAMINAE SUBFAM. NOV.

Type species: *Dibamus novaeguineae* Duméril and Bibron, 1839.

Diagnosis: Anelytropsinae sub fam. nov. is separated from this subfamily by possessing an interorbital septum, columella cranii and a single premaxillary bone and having osteoderms are present. It is the only subfamily found outside Asia, being Mexican. The other two subfamilies are from South-east Asia. Dibaminae species are most easily separated from those within Paulwoolfinae by the relative length of the unregenerated tail. In Dibaminae this is between 15-20 per cent of the snout-vent, whereas in Paulwoolfinae it is usually 20-25 per cent in most species, except for the two species in the genus *Dalegibbonsus* gen. nov. where it's more than 40 per cent.

The relative unregenerated tail lengths also reflect in subcaudal counts that separate the two Asian subfamilies, for Dibaminae the usual number is under 50 in males and under 45 in females, versus above these numbers for Paulwoolfinae. While build of all species within the Dibaminae is similar, species within Paulwoolfinae are on average more slender than those in Dibaminae.

Dibaminae as defined herein, are known from the Andaman Islands west of the Thai/Malay Peninsula, across the Malay Peninsula, including the Thai section and most parts of Indonesia, including Irian Jaya and some of the Philippines.

Species formerly referred to *Dibamus*, with their distribution centred on Cambodia, Vietnam and China are now referred to the subfamily *Paulwoolfinae* subfam. nov., genera *Paulwoolfus* gen. nov. and *Dalegibbonsus* gen. nov..

At the present time and as far as is known from collected specimens, both subfamilies have mutually exclusive distributions.

GENUS *DIBAMUS* DUMÉRIL AND BIBRON, 1839

Type species: *Dibamus novaeguineae* Duméril and Bibron, 1839.

Diagnosis: The diagnosis for this genus is the same as for the subfamily (above), but with the following information that removes the other genus in the same subfamily: *Leswilliamsus* gen. nov. is separated from species in this genus (*Dibamus*) by having cycloid scales which are slightly notched posteriorly as an adult and flat cycloid light brown dorsal scales with cream borders as a juvenile. *Leswilliamsus* gen. nov. also differs from other *Dibamus* in having the following combination of characters: rostral sutures incomplete; nasal and labial sutures complete; scales bordering posterior edge of first infralabial 4; postocular 1; transverse scale rows just posterior to head 29, at midbody 25, proximally anterior to vent 21; subcaudals 45; snout blunt in lateral profile; presacral vertebrae 124; postsacral vertebrae 23.

Dibamus as defined herein, is known from the Andaman Islands west of the Thai/Malay Peninsula, across the Malay Peninsula, including the Thai section and most parts of Indonesia, including Irian Jaya and some of the Philippines.

Species formerly referred to *Dibamus*, with their distribution centred on Cambodia, Vietnam and China are now referred to the subfamily *Paulwoolfinae* subfam. nov., genera *Paulwoolfus* gen. nov. and *Dalegibbonsus* gen. nov..

Content of genus *Dibamus* Duméril and Bibron, 1839.

Dibamus novaeguineae Duméril and Bibron, 1839. (Type species)

Dibamus celebensis Schlegel, 1858.

Dibamus seramensis Greer, 1985.

Dibamus alfredi Taylor, 1962.

Dibamus ingeri Das and Lim, 2003.

Dibamus vorisi Das and Lim, 2003.

Dibamus dezwaani Das and Lim, 2005.

Dibamus leucurus (Bleeker, 1860).

Dibamus taylori Greer, 1985.

Dibamus booliati Das and Yaakob, 2003.

Dibamus somsaki Honda, Nabhitabhata, Ota and Hikida, 1997.

Dibamus tebal Das and Lim, 2009.

Dibamus nicobaricum (Steindachner, 1867).

GENUS *LESWILLIAMSUS* GEN. NOV.

Type species: *Dibamus tiomanensis* Diaz, Leong, Grismer and Yaakob, 2004

Diagnosis: This genus is monotypic for the taxon, *tiomanensis*. It differs from all other species within subfamilies Dibaminae and Paulwoolfinae subfam. nov. in having cycloid scales which are slightly notched posteriorly as an adult and flat cycloid light brown dorsal scales with cream borders as a juvenile. It also differs from other Dibaminae and Paulwoolfinae subfam. nov. in having the following combination of characters: rostral sutures incomplete; nasal and labial sutures complete; scales bordering posterior edge of first infralabial 4; postocular 1; transverse scale rows just posterior to head 29, at midbody 25, proximally anterior to vent 21; subcaudals 45; snout blunt in lateral profile; presacral vertebrae 124; postsacral vertebrae 23.

This monotypic genus and species is only known from the type locality, Kampung Paya, Pulau Tioman, Pahang, West Malaysia.

Etymology: Named in honor of now deceased herpetologist, Les Williams, formerly of Ballan, Victoria, Australia for many years of valuable work as an emergency snake catcher and for assisting Snakebusters, reptile education in numerous capacities.

Content of genus *Leswilliamsus* gen. nov.

Leswilliamsus tiomanensis Diaz, Leong, Grismer and Yaakob, 2004. (Monotypic for the type species).

SUBFAMILY PAULWOOLFINEAE SUBFAM. NOV.

Type species: *Dibamus montanus* Smith, 1921.

Diagnosis: Anelytropsinae sub fam. nov. is separated from this subfamily by possessing an interorbital septum, columella cranii and a single premaxillary bone and having osteoderms are present. It is the only subfamily found outside Asia, being Mexican. The other two subfamilies are from South-east Asia.

Dibaminae species are most easily separated from those within Paulwoolfinae by the relative length of the unregenerated tail. In Dibaminae this is between 15-20 per cent of the snout-vent, whereas in Paulwoolfinae it is usually 20-25 per cent in all species, except for the two species in the genus *Dalegibbonsus* gen. nov. where it's more than 40 per cent.

The relative unregenerated tail lengths also reflect in subcaudal counts that separate the two Asian subfamilies, for Dibaminae the usual number is under 50 in males and under 45 in females, versus above these numbers for Paulwoolfinae. While build of all species within the Dibaminae is similar, species within Paulwoolfinae are on average more slender than those in Dibaminae.

Paulwoolfinae subfam. nov. is known from the region encompassing Cambodia, Vietnam and southern China, but so far is not known from any part of the Thai/Malay Peninsula, Nicobar Islands or the islands of the Philippines, Malaysia or Indonesia. In other words, so far as is currently known, this

subfamily has a distribution mutually exclusive of the subfamily Dibaminae, which is known only from the Thai/Malay Peninsula, Nicobar Islands and the islands of the Philippines, Malaysia or Indonesia.

Etymology: As for the genus *Paulwoolfus* gen. nov. (below).

GENUS PAULWOOLFUS GEN. NOV.

Type species: *Dibamus montanus* Smith, 1921.

Diagnosis: *Paulwoolfus* gen. nov. is most readily separated from the other genus in the subfamily (*Dalegibbonsus* gen. nov.) by the absence of an ash-white tail end section diagnostic for *Dalegibbonsus* gen. nov..

Other characters diagnostic for the two described species in *Dalegibbonsus* gen. nov. (which separates these taxa from *Paulwoolfus* gen. nov.) are 1 postocular, 2 scales on the edge of the infralabial, 20-24 mid-body rows, variable subcaudal counts, 115-135 presacral vertebrae, maximum snout-vent of about 18 cm, unregenerated tail length is over 40 percent of snout-vent length versus under 25 per cent for species of *Paulwoolfus* gen. nov..

The diagnosis for *Paulwoolfus* gen. nov. is otherwise for the subfamily Paaulwoolfinae subfam. nov..

Paulwoolfus gen. nov. is known from the region encompassing Cambodia, Vietnam and southern China, but so far is not known from any part of the Thai/Malay Peninsula, Nicobar Islands or the islands of the Philippines, Malaysia or Indonesia.

Etymology: Named in honor of Paul Woolf of Walloon, near Brisbane, Queensland, Australia, foundation president of the Herpetological Society of Queensland (HSQJ), in recognition of his many contributions to Australian herpetology.

Content of genus *Paulwoolfus* gen. nov.

Paulwoolfus montanus (Smith, 1921).

Paulwoolfus deharvengi (Ineich, 1999).

Paulwoolfus dalaiensis (Neang, Holden, Eastoe, Seng, Ith and Grismer, 2011).

Paulwoolfus greeri (Darevsky).

Paulwoolfus kondaoensis (Honda, Ota, Hikida and Darevsky, 2001).

Paulwoolfus smithi (Greer, 1985).

SUBGENUS NINDIBAMUS SUBGEN. NOV.

Type species: *Dibamus dalaiensis* Neang, Holden, Eastoe, Seng, Ith and Grismer, 2011.

Diagnosis: This subgenus is monotypic for the species *N. dalaiensis*, known only from the southwestern Cardamom Mountains in Cambodia in a region that lays between the distribution of the two Asian subfamilies of Dibamidae.

Notwithstanding this fact, there remains no known sympatry between species within the two subfamilies.

This taxon is most easily separated from all Asian Dibamidae by possessing an enlarged, central, sublabial scale as opposed to relatively similar size of those scales in all other species.

N. dalaiensis is differentiated from all other Dibamids by having the following combination

of characters: maximum SVL of 127.6 mm; tail length 18-22% of SVL; labial and nasal sutures complete; rostral suture present but incomplete; rostral pad divided into two equal parts; a single postocular; three scales bordering the posterior edge of first infralabial; an enlarged, medial, sublabial scale; 20 midbody scale rows; 22 transverse scale rows just posterior to head; 20 transverse scale rows just anterior to vent; 185-209 ventral scales; 48-52 subcaudal scales; relative size of frontal to frontanasal 1.4; and relative size of interparietal to surrounding scales 1.5. These characters were scored across all known nominal species of the Asian Dibamidae (adapted from Neang et. al. 2011).

Etymology: Named in honor of Dara Nin, of Ringwood (Melbourne), Victoria, Australia for various contributions to reptile education with company Snakebusters, Australia's best reptiles. Here I note that Dara was born in New Zealand of native Cambodian parents, so it is fitting that he have a Cambodian subgenus named in recognition of his valuable work.

Content of subgenus *Nindibamus* subgen. nov.

Paulwoolfus (*Nindibamus*) *dalaiensis* (Neang, Holden, Eastoe, Seng, Ith and Grismer, 2011).

GENUS DALEGIBBONSUS GEN. NOV.

Type species: *Dibamus bourreti* Angel, 1935.

Diagnosis: Specimens from this genus are most readily separated from *Paulwoolfus* gen. nov. by the ash-white tail end section, not seen in any *Paulwoolfus* gen. nov. or for that matter not seen in any species within the other subfamilies of Dibamidae.

Other characters diagnostic for the two described species within this genus are, 1 postocular, 2 scales on the edge of the infralabial, 20-24 mid-body rows, variable subcaudal counts, 115-135 presacral vertebrae, maximum snout-vent of about 18 cm, unregenerated tail length is over 40 percent of snout-vent length versus under 25 per cent for species of *Paulwoolfus* gen. nov..

The two species are known only from the region of the North Vietnam/China border (*D. bourreti*), including an inshore island, (Katba, Haifong Province), and from Hei Ling Chau and Shek Kwu Chau Islands Hong Kong (*D. bogadeki*) (Darevsky 1992).

Etymology: Named in honor of Dale Gibbons of Maiden Gully, Bendigo, Victoria, Australia for his many contributions to herpetology in Australia.

Content of genus *Dalegibbonsus* gen. nov.

Dalegibbonsus bourreti (Angel, 1935) (Type species).

Dalegibbonsus bogadeki (Darevsky, 1992).

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