

Original article

## A further new species of limbless skink, genus *Paracontias*, from eastern Madagascar

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**Abstract.**—We describe a new species of the genus *Paracontias* from a rain forest in the northern Central East of Madagascar based on a single specimen. *Paracontias kankana* sp. nov. is unique among all known species of *Paracontias* by exhibiting large loreals meeting each other in midline dorsally, separating the rostral from the frontonasal scale. All other known *Paracontias* species have the rostral in broad contact with the frontonasal. In the new species, the nasal scale is in contact with the first suprabial, a character shared with *P. brocchii*, *P. milloti*, *P. rothschildi* and an unnamed species, but distinguishing it from other known congeners. The type locality is a forest fragment heavily threatened by slash-and-burn agriculture, but the species may well be present in some nearby protected areas and probably also occurs at Marojejy.

**Key words.**—Squamata, Scincidae, *Paracontias*, new species, Madagascar.

The fossorial skinks of the genus *Paracontias* belong to a rich endemic radiation of scincid lizards from Madagascar, the Comoros, and Glorioso Island that currently comprises 52 described and numerous undescribed species (Glaw & Vences 2007; Crottini *et al.* 2009). Various lineages in this radiation contain species with partly or completely reduced limbs, and molecular data are just beginning to provide reliable data on their phylogenetic relationships (Whiting *et al.* 2004; Schmitz *et al.* 2005; Crottini *et al.* 2009). Within this radiation, *Paracontias* are one monophyletic group of completely limbless taxa, related to the more generalised (and limb-bearing) *Madascincus*. The genus *Paracontias* is currently composed of 10 species, including *P. minimus* that recently was transferred from

*Cryptoscincus* to *Paracontias* (Crottini *et al.* 2009; Köhler *et al.* in press). *Paracontias* are almost exclusively distributed in the northern parts of Madagascar, with only one record of one species (*P. holomelas*) from the southern edge of the Northern Central East region (according to Boumans *et al.* 2007). New species of *Paracontias* were recently described by Andreone & Greer (2002) and by a work in progress (Köhler *et al.* in press). In several cases, these descriptions were based on single specimens only, indicating how little is known about these secretive fossorial species. In this paper we describe an additional species of *Paracontias*, again based on a single specimen that we recently collected in a disturbed and unprotected patch of rainforest in the northern Central East of Madagascar.

## MATERIAL AND METHODS

Geographic coordinates were obtained using a GPS receiver. The specimen was killed by injection of chlorobutanol, fixed in 90% ethanol and preserved in 70% ethanol; a tissue sample from the left flank at the anterior body was preserved in pure ethanol for DNA analyses. Scale counts were performed using a Leica MZ6 stereomicroscope at 40x magnification. Schematic drawings of the head were made using the same binocular with a Wild drawing tube attachment. All measurements and counts of the new species were taken by the same person (NK). Measurements were taken with a digital caliper to the nearest 0.1 mm. Notes on colour in life were taken from digital images. Osteological characters were assessed from radiographs produced with Faxitron X-ray LX-60 and the software Faxitron SR v1.5. Sex was determined by dissection and direct observations of gonads. Methods as well as structure and terminology in the description of the new species largely follow Andreone & Greer (2002). Unless otherwise mentioned, comparative data are based on our examination of museum specimens listed by Köhler *et al.* (in press). Abbreviations used: MNHN (Museum National d'Histoire Naturelle, Paris), ZMB (Museum für Naturkunde, Berlin), ZSM (Zoologische Staatssammlung München), DRV (David R. Vieites field numbers). Snout-vent length is abbreviated SVL.

## RESULTS

### *Paracontias kankana* sp. nov.

(Figs. 1-2)

*Holotype*.—ZSM 1810/2008 (field number DRV 05711), adult female, from Mahaso forest (pitfall camp), 17.29769° S, 48.70199° E, 1032 m a.s.l., near Ambatodisakoana village, central eastern Madagascar, collected on 13

February 2008, by D. R. Vieites, M. Vences, P. Bora, C. Patton and J. Patton.

*Diagnosis*.—A member of the genus *Paracontias* as revealed from sequence analyses of mitochondrial and nuclear genes (Crottini *et al.* 2009) and the absence of supranasals. *Paracontias kankana* differs from all other *Paracontias* species by the presence of large loreals extending and meeting each other in midline dorsally, separating the rostral from the frontonasal scale. All other known *Paracontias* species have the rostral in broad contact with the frontonasal.

*Paracontias kankana* and *P. tsararano* share similar size and colour, the same number of supralabials and infralabials, a bell-shaped frontal, and 21 scale rows around midbody. However, *P. tsararano* differs from the new species by the lack of a visible eyespot in the interparietal scale and the nostril and surrounding nasal scale fully embedded within the rostral scale and connected to the first supralabial only by a narrow suture (Andreone & Greer 2002), whereas in the new species the nasal scale borders the first supralabial.

A similar number of scale rows around midbody is present in *Paracontias hildebrandti* (20), *P. hafa* (20) and *P. manify* (22). *P. hildebrandti* mainly differs from the new species by an hourglass-shaped frontal, a lower number of infralabials (3 vs. 4), and a nostril lying deeply within the rostral scale, not in contact with first supralabial. *P. hafa* mainly differs from the new species by an hourglass-shaped frontal and a nostril deeply within the rostral scale. *P. manify* mainly differs from the new species by absence of a parietal eyespot and the position of the nostril (Andreone & Greer 2002). *Paracontias kankana* has fewer scale rows around midbody than *P. holomelas* (30) and *P. brocchii* (26). Moreover, *P. holomelas* exhibits a lower number of supralabials (3 vs. 5). *Paracontias kankana* has more scale rows

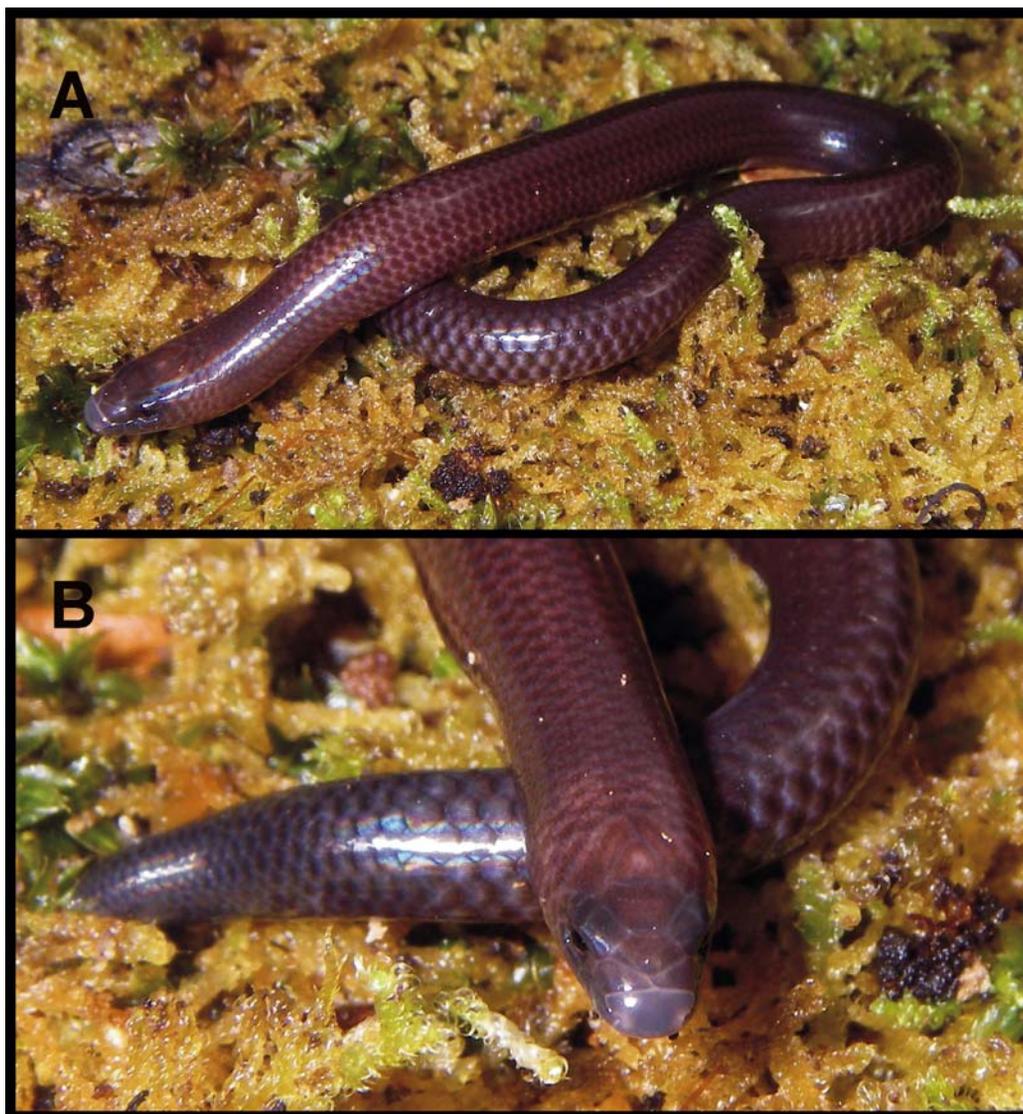


Figure 1. Female holotype of *Paracontias kankana* sp. nov. (ZSM 1810/2008) in life: (A) dorsolateral view, (B) frontal view of head and anterior body.

around midbody than *Paracontias rothschildi* (16), *P. milloti* (18), *P. minimus* (18) and *Paracontias* sp. (16), a species currently in description by Köhler *et al.* (in press). Moreover, *P. minimus* lacks an eye opening, a nasal scale and has a nostril deeply embedded within the rostral scale. *P. rothschildi* has a beige longitudinal middorsal stripe, lacking in

*P. kankana* and its rostral scale is distinctly larger and shaped differently in lateral view (Mocquard 1905; Angel 1942; Brygoo 1980; Köhler *et al.* in press). Comparative morphological characters are also presented in Table 1.

*Paracontias kankana* differs from the only known limbless species of *Amphiglossus*, *A.*

Table 1. Comparative morphological characters of known species of *Paracontias*. Unless otherwise indicated, data are based on our examination of specimens; (1) data taken from Brygoo (1980) and/or (2) Andreone and Greer (2002).

Species	presacral vertebrae	position of nostril	frontal scale	scale rows around mid-body	ventral scales	maximum SVL [mm]
<i>P. kankana</i>	59	in contact with 1st supralabial	bell-shaped	21	105	59
<i>P. brocchii</i> <sup>1,2</sup>	63-64	in contact with 1st supralabial	bell-shaped	26	125-130	97
<i>P. hafa</i> <sup>2</sup>	53	entirely within rostral	hourglass-shaped	20	102	69
<i>P. hildebrandti</i>	54-57	entirely within rostral	hourglass-shaped	20	92-100	50
<i>P. holomelas</i> <sup>1,2</sup>	57-58	entirely within rostral	hourglass-shaped	30	124-142	158
<i>P. manify</i> <sup>2</sup>	59	entirely within rostral	bell-shaped	22	125	67
<i>P. milloti</i> <sup>1</sup>	47	in contact with 1st supralabial	hourglass-shaped	18	78	42
<i>P. minimus</i>	59-60	entirely within rostral	bell-shaped	18	102-112	75
<i>P. rothschildi</i>	50-51	in contact with 1st supralabial	bell-shaped	16	89-104	55
<i>P. tsararano</i> <sup>2</sup>	57	entirely within rostral	bell-shaped	21	114	66
<i>Paracontias</i> sp. (in description)	46	in contact with 1st supralabial and loreal	hourglass-shaped	16	71	34

*stylus*, by a bell-shaped frontal (hourglass-shaped), lower number of supralabials (5 vs. 6), and a lower number of supraciliaries (4 vs. 6). Furthermore, *A. stylus* exhibits knob-like structures at the former position of limbs (Andreone & Greer 2002), lacking in *P. kankana*.

Morphologically, the new species differs from all species of *Pseudoacontias* by smaller body size (minimum SVL in *Pseudoacontias* is 181 mm) and a lower number of scale rows around midbody (25-34 scale rows in *Pseudoacontias*). *P. kankana* differs from limbless species of *Voeltzkowia* (*V. lineata*, *V. mira*, *V. rubrocaudata*) mainly by a more rounded snout in lateral view (vs. pointed), presence of an eye opening, colouration and head scalation (Brygoo 1981; Glaw & Vences 1994).

*Description of holotype*.—Adult female. In general appearance, a thin dark brown skink of small size (SVL 58.5 mm, total length 81.6 mm), with both pairs of limbs completely absent and no external indication of their former position. Snout rounded in dorsal view, bluntly rounded in lateral view; rostral projecting anteriorly, slightly thickened; frontonasal wider than long, separated from rostral by loreals; frontal bell-shaped; supraoculars three, first two contacting frontal, second and third in contact with parietal; frontoparietals absent; interparietal well separated from supraoculars; parietal eyespot just anterior of centre of interparietal; parietals meet behind interparietal; two pairs of nuchals.

Nasal relatively large, rostradorsally open, larger than nostril and located at the middle of

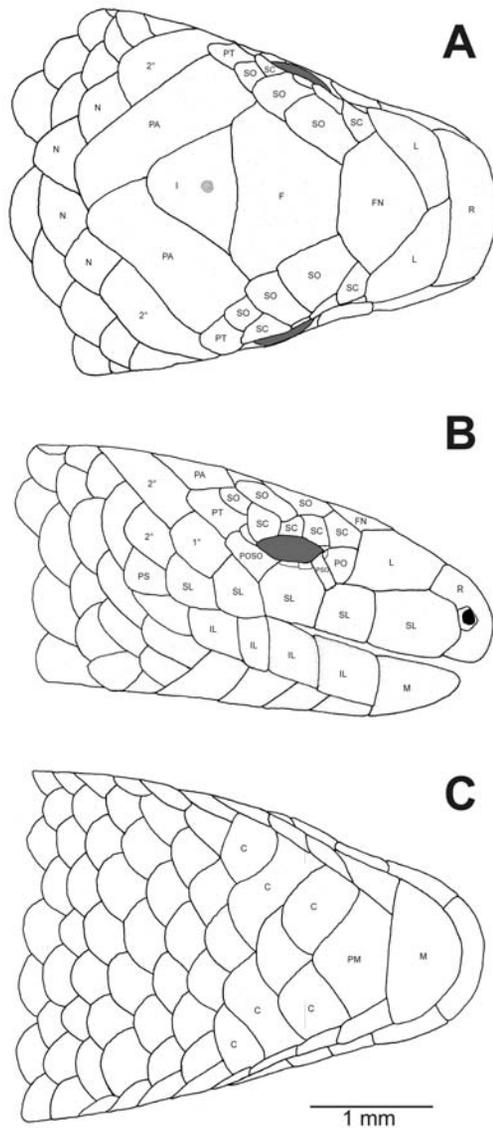


Figure 2. Schematic drawings of the head of the preserved female holotype of *Paracontias kankana* sp. nov. (ZSM 1810/2008): (A) dorsal view, (B) lateral view, (C) ventral view. Abbreviations for nomenclature of scales are those used by Andreone & Greer (2002).

posterior edge of rostral, in contact with first supralabial; nostril almost completely surrounded by nasal and rostradorsally by rostral; postnasal absent; supranasals absent; loreals large, extending and meeting dorsomedially, thus separating rostral from frontonasal scale; preocular single; presubocular single; supraciliaries four, first contacting frontonasal and loreal, and bordered by minute scale in anterodorsal corner of upper eyelid, ultimate superciliary large and projecting medially into supraocular series (thereby reducing third supraocular in size); one pretemporal, contacting parietal; postsubocular single, contacting third and fourth supralabial; postocular small, wedged between last superciliary and pretemporal, rostradorsally to postsubocular; lower eyelid not evident; primary temporal single, secondary temporals two, lower bordering last supralabial and postsupralabial; supralabials five, first one slightly thickened; suboculars two; postsupralabial single; external ear opening absent, with no external indication of its former position.

Mental wider than long; postmental single, contacting one infralabial on each side; infralabials four; three pairs of large chin scales; members of anterior pair not in contact, members of second pair large, barely in contact, and members of third pair separated by three scale rows; chin scales flush with infralabials, i.e. genials do not encroach between chin scales and infralabials.

Body scales cycloid, smooth with glossy finish; head scales including rostral scattered with numerous minute pits; longitudinal scale rows at mid-body 21; ventral scales 105; inner precloacals overlap outer; scales in mid-ventral caudal row of similar size to scales in adjacent rows. Tail length 22.6 mm, 9.0 mm of it regenerated. Lateral scales on tail slightly larger than midbody scales.

On radiograph, hyoid elements detectable;

teeth well-developed, short, crowns of teeth bluntly rounded; pectoral girdle not detectable; rudiment of humerus absent; sternum barely visible; mesosternum cannot be resolved on radiograph; pelvic girdle's two halves separated on midline, each consisting of tri-partite element representing ilium, ischium and pubis; no evidence of femur on radiograph; presacral vertebrae 59, first free rib on fourth presacral; two sacral vertebrae; twelve caudal vertebrae remaining, rest of tail regenerated; transverse processes of caudal vertebrae project anterolaterally at an angle of app. 55-65°.

In preservative, ground colouration dark brown; head dark brown dorsally, rostral, first supralabial and mental scales with slightly paler colour; parietal eyespot visible as beige spot; throat light brown; ventrally a narrow lighter band at posterior edge of head; dorsal body scales brown with dark brown colour at their outer edges; numerous minute irregular beige flecks and spots present within scales;

flanks slightly paler than dorsal scales; ventral side paler than flanks; precloacal scales almost transparent; colouration of tail generally identical to that of body, regenerated part of tail darker.

In life, colouration differs only slightly from that in preservative. General ground colour of dorsum dark brown with a violet tint; each scale with darker area at its outer edges. Tail scales appear lighter. Rostral scale pale grey. Parietal eyespot light brown. Eyes black.

*Distribution, habitat and habits.*—The single known specimen of *Paracontias kankana* was captured in a pit fall trap with drift fences in a heavily disturbed, unprotected forest fragment, locally called Mahasoa forest (Fig. 3), next to Ambatodisakoana village, located east of the northeastern edge of the Alaotra Lake. However, comparisons of a fragment of the 16S gene of the holotype of *P. kankana* with 16S sequences of other species of *Paracontias*



Figure 3. View of the surroundings of the fragmented Mahasoa forest, the type locality of *Paracontias kankana* sp. nov.

revealed that it is identical to a sequence available in GenBank (AY391157) with its voucher identified as *P. holomelas* from Marojejy (Köhler *et al.* in press). According to the great morphological differences between the new species and *P. holomelas*, it is apparent that the mentioned sequence from Marojejy most probably corresponds to a misidentified specimen of *P. kanakana*. No further specimens are known.

*Etymology.*—The specific name is derived from the Malagasy word "kanakana" meaning worm, and refers to the worm-like body shape. The name is used as an invariable noun in apposition to the generic name.

## DISCUSSION

*Paracontias kankana* has previously been included in the multi-gene phylogeny of Crottini *et al.* (2009) as *Paracontias* sp. aff. *tsararano*, and occupied the most basal position in *Paracontias* relative to the other included species, *P. minimus*, *P. brocchii*, *P. manify*, *P. hildebrandti*, *P. rothschildi* and *Paracontias* sp. This is relevant because the genus *Paracontias* is largely restricted to forests in northern Madagascar, and besides distribution records of *P. holomelas* from the central East of the island (Günther 1877, Brygoo 1980) which were considered at least partly doubtful (Boumans *et al.* 2007), the type locality of *P. kankana* is the southernmost record of a *Paracontias*. Furthermore, *P. kankana* is unique among *Paracontias* in having large loreals meeting each other dorsally in midline, thus separating the rostral from the frontonasal scale (possibly, in *P. kankana* the loreal is fused to a former supranasal scale, but more likely in *Paracontias* supranasals were fused with the rostral as an adaptation to borrowing habits).

A basal phylogenetic position of this geograph-

ically and morphologically disparate species could therefore be relevant in attempts to assess the biogeographic centre of origin of a *Paracontias* radiation. However, no molecular data are so far available for several *Paracontias* species which might be closely related to *P. kankana* (e.g. *P. holomelas*, *P. milloti*). Moreover, the head scalation evident in *P. kankana* may also put into question the generic placement of *Amphiglossus stylus*, the only known limbless species of *Amphiglossus* (no molecular data available). As typical for *Amphiglossus*, in *A. stylus* rostral and frontonasal scales are separated by supranasals, which however might be homologous with loreals in *P. kankana*.

As discussed by Köhler *et al.* (in press), morphology in the genus *Paracontias* is of rather limited value to elucidate phylogenetic relationships, and former phenetic grouping within the genus (e.g. Greer 1970; Brygoo 1980) has to be rejected in view of phylogenetic approaches. We here refrain from any more detailed statement concerning the relationships of the new species, unless inclusion of additional samples of other species (such as *A. stylus*, *P. holomelas*, *P. milloti*, *P. tsararano*) allow testing the phylogenetic position of *P. kankana* revealed by the preliminary analyses (Crottini *et al.* 2009; Köhler *et al.* in press).

The type locality of Mahasoa is a small and anthropogenically threatened forest fragment in a largely deforested, unprotected area. During our visit we observed ongoing timber extraction of large trees in this forest, and slash-and-burn agriculture fields approaching at a fast pace. It is likely that the natural habitat at this site, and thus the population of *P. kankana*, will completely disappear in the near future. However, it is possible that this secretive species is present also at nearby protected areas such as Zahamena, Marotondrano or Ambatovaky. Its putative occurrence at

Marojejy (see Distribution) furthermore argues for a much wider range of the species. Considering the extremely fragmentary data, we propose an IUCN red list status of "Data Deficient".

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