

A new species of *Paroedura* Günther from northern Madagascar

(Reptilia, Squamata, Gekkonidae)

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Paroedura lohatsara, spec. nov. is described from Montagne des Français, a deciduous dry forest on a karstic underground in the far north of Madagascar. The new gecko species is relatively large (up to 80.6 mm snout-vent length and 156.1 mm total length) and has blackish markings on the head which can form a vermiculated pattern. It is further characterized by having the nostril excluded from contact with the rostral scale, distinctly enlarged and spinous tubercles on the dorsal surface, and specific colouration of juveniles and adults. The relationships of the new species are obscure: Based on the nostril position, *P. lohatsara* belongs to the phenetic *Paroedura picta* species group which was hitherto considered as largely restricted to southern Madagascar. Other morphological and chromatic characters indicate a closer relationship of *P. lohatsara* with the syntopic *P. stumpffi* which is a member of the *P. sanctijohannis* species group. Two further species of *Paroedura*, *P. stumpffi* and *P. korstophila*, are recorded from Montagne des Français for the first time.

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Introduction

The genus *Paroedura* Günther, 1879 comprises nocturnal geckos which are endemic to Madagascar and the Comoro islands (Guibé 1956, Dixon & Kroll 1974), although fossil remains are also known from the Aldabra Atoll (Arnold 1976). The genus was recently reviewed by Nussbaum & Raxworthy (2000). According to these authors, *Paroedura* currently contains 14 species and can be divided into two phenetic species groups. The *sanctijohannis* group is defined by having the nostril in contact with the rostral scale whereas the *picta* group is defined by having the nostril excluded from contact with the rostral scale. The *picta* group was hitherto considered as restricted to the dry southern and western Madagascar, whereas species of the *sanctijohannis* group generally occur in less dry regions.

In this paper we describe a new species of *Paroedura* from northern Madagascar which belongs to the *picta* group according to the nostril position, but also shares similarities with a species of the *P. sanctijohannis* group.

Material and methods

Specimens were anesthetized by injection with chlorobutanol, fixed with 96% ethanol and stored in 70% ethanol. To make comparisons easier, the terminology and abbreviations of characters largely follow Nussbaum & Raxworthy (2000). Abbreviations used: UADBA = Université d'Antananarivo, Département de Biologie Animale; ZFMK = Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn; ZSM = Zoologische Staatssammlung, München. SVL = snout-vent length; TL = tail length; HL = head length; HW = head width, at widest point; SL = snout length, anterior edge of eye to tip of snout; ED = horizontal eye diameter; EO = ear opening diameter; AGL = axilla-groin length; Forelimb = forelimb length, from axilla to tip of longest finger; Hindlimb = hindlimb length, from groin to tip of longest toe; Supralab = number of supralabial scales; Infralab = number of infralabial scales; Sdlm = number of subdigital lamellae on digits I-V of manus; Sdhp = number of subdigital lamellae on digits I-V of pes. Counts are listed left-right. All measurements were done with a caliper to the nearest 0.1 mm by the same person (FG). Material of 11 of the 14 *Paroedura* species (all except *P. mangoka*, *P. vahiny* and *P. homalorhina*) from the ZSM and ZFMK collections was available for comparison.

Paroedura lohatsara, spec. nov.

Figs 1-3

Types. **Holotype:** ZSM 985/2001, adult male, collected 14-21 March 2000 at Montagne des Français (between 12°19'17"S, 49°20'13"E, 174 m altitude and 12°19'34"S, 49°20'09"E, 334 m altitude), northern Madagascar, by F. Glaw, K. Schmidt & M. Vences. Captured as adult and kept for more than one year in captivity before preserved. **Paratypes:** ZSM 529/2000 (adult male), ZSM 807/2001 (adult female, captured as adult and kept for about one year in captivity before preserved), ZSM 530/2000 (juvenile), and three further uncatalogued adult specimens (one male and two females which are still kept alive in the vivarium), all collected 14-21 March 2000 at the same locality by the same collectors as the holotype. ZSM 986/2001, just hatched juvenile, and ZSM 987/2001, 7-14 days old juvenile, both captive bred, being offspring of the holotype and of one of the two uncatalogued female paratypes.

Diagnosis. *Paroedura lohatsara*, spec. nov. is a relatively large-sized species (maximum SVL 80.6 mm, maximum total length 156.1 mm) with prominent dorsal tubercles which are arranged into distinct longitudinal rows. It differs from the species of the *sanctijohannis* group (*P. gracilis*, *P. homalorhina*, *P. karstophila*, *P. oviceps*, *P. masobe*, *P. sanctijohannis*, *P. stumpffi*, *P. tanjaka* and *P. vazimba*) in having the nostril excluded from contact with the rostral scale by interposition of a large prenasal scale. *P. lohatsara* shares the nostril position with the species of the *picta* group (*P. mangoka*, *P. bastardi*, *P. picta*, *P. vahiny* and *P. androyensis*), but differs from *P. androyensis* and *P. vahiny* in much larger size (80.6 compared to 47 mm maximum SVL); from *P. mangoka* and *P. picta* by distinctly larger dorsal tubercles which are arranged into obvious longitudinal rows. It differs from *P. bastardi* (including the recently described subspecies *P. b. ibityensis*, see Rösler & Krüger 1998) by mainly tetrahedral dorsal tubercles (mainly trihedral in *P. bastardi*), a relatively longer and thinner tail, and the shape of the postmental scales (distinctly longer than wide in *P. lohatsara* versus regular hexagonal in *P. bastardi*). Furthermore, *P. lohatsara* differs from all other *Paroedura* species by its distinct adult colouration and from *P. bastardi*, *P. mangoka*, *P. picta*, and *P. stumpffi* by juvenile colouration (the juvenile colourations of the other species are still undescribed).

Description of the holotype

Measurements and counts in tab. 1. Well preserved, with complete original tail. Hemipenis extruded, head wider than neck, about as wide as body. Snout angled downward to tip, slight depression between prominent canthal ridges. Ear opening is a vertical slit. Tail longer than snout-vent length, nearly round in cross section, with sharply pointed tip; ventral pygal section with pair of postcloacal sacs. Digits moderately expanded at tips. Rostral scale rectangular, wider than tall, as wide as mental. Nostril in contact with large prenasal anteriorly, and four further scales, but not with first supralabial. First supralabial largest, labials smooth. Snout and interorbital scales juxtaposed, some raised, scales in front of orbits tuberculate, as are larger lateral occipital scales. Dorsolateral neck and body scales very heterogeneous with about 12 distinct longitudinal rows at midbody of enlarged, spiny, mainly tetrahedral tubercles; enlarged tubercles separated mostly by small flat scales and smaller tubercles. Dorsal scales of forelimbs flat or tuberculate and weakly imbricate. Dorsal scales of hindlimbs large and



Fig. 1. *Paroedura lohatsara*, spec. nov. Male holotype (ZSM 985/2001).

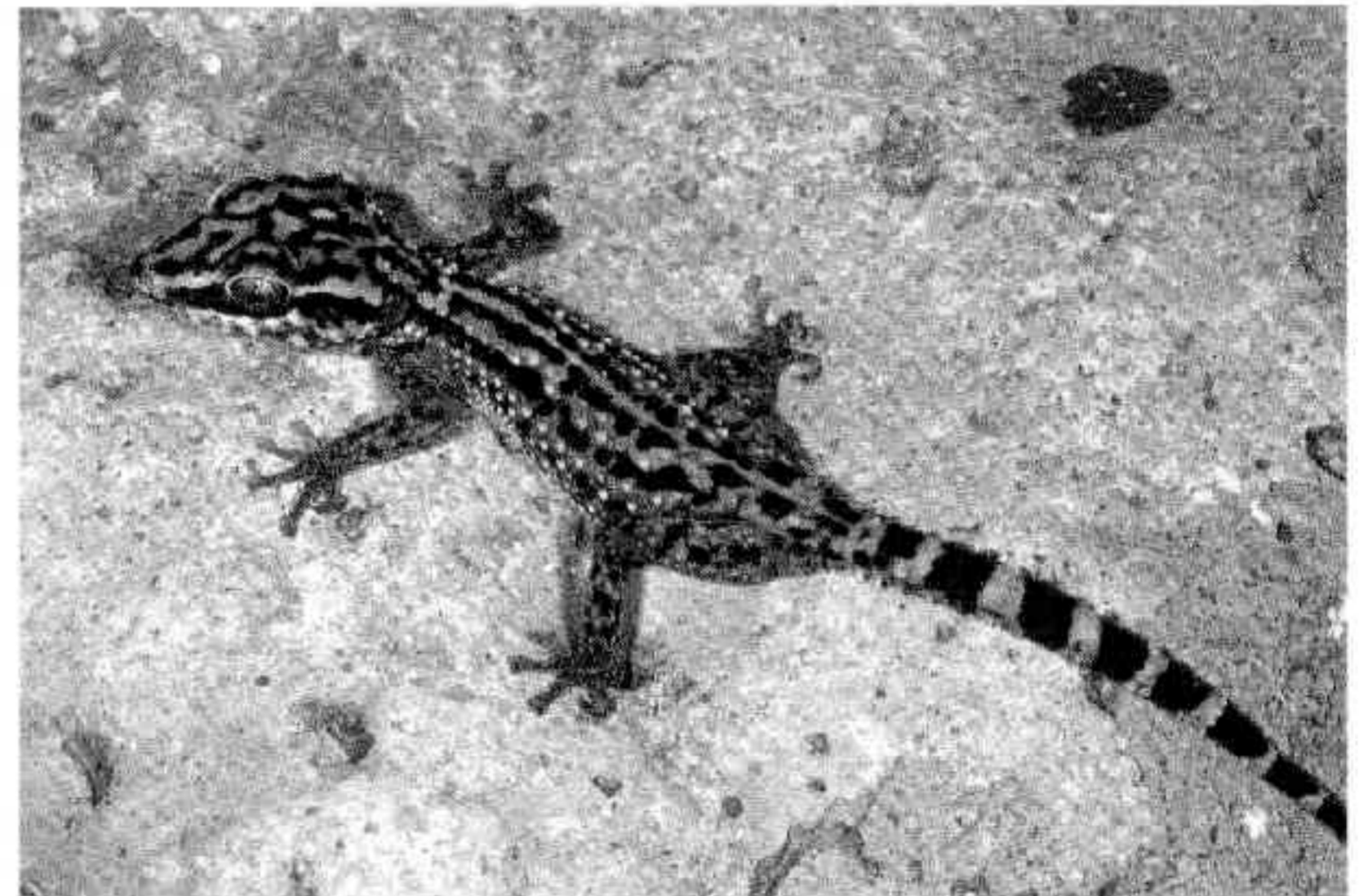


Fig. 2. *Paroedura lohatsara*, spec. nov. Female paratype (uncatalogued).

strongly tuberculate, much smaller above kneejoint. Ventral scales of forelimbs and hindlimbs slightly smaller than surrounding ventral scales of the body. Dorsal pygal scales like dorsal body scales; lateroventral pygals tuberculate but less spinous. First 19 postpygal tail segments each with transverse row of spiny tubercles dorsolaterally; first four rows with 10-12 tubercles, gradually decreasing to the last rows with about four tubercles; posterior tail with flat scales. Mental triangular, bordered posteriorly by a pair of elongate, irregular hexagonal postmentals. Postmentals contact mental, first infralabial, one enlarged lateral gular, one smaller posterolateral gular, and one slightly larger central gular. First three infralabials significantly larger than others. Gulars small, granular. Ventrals of chest and abdomen flat, posterior abdominals largest. Proximal subdigitals in rows of 2-3, distally to narrow leaf-like rows of scales followed by enlarged row supporting terminal pads. Pair of squarish, terminal pads, each pad about 1 mm across. Claws curving downwards between terminal pads of digits.

Colour after one day in alcohol virtually identical to that in life (Fig 1). Head dorsally beige with more or less symmetrical blackish markings. A black band from the second supralabial to anterior eye and from posterior eye to a point above the ear opening. A beige mid-dorsal stripe (of 2 mm diameter at midbody) runs from the neck to the pygal portion of tail. Neck and dorsum beige with blackish spots which are arranged into four irregular longitudinal rows; two rows border the mid-dorsal stripe, the other two rows run more dorsolaterally to the pygal portion of the tail. Additional black spots are present on the flanks. Many of the enlarged tubercles on the flanks are whitish. Dorsal surface of forelimbs and hindlimbs beige with dark brown markings. Postpygal tail dorsally with about nine whitish and nine black alternating transverse bands which are partly not well delimited in the proximal portion of the tail. Throat, chest, venter, pygal tail portion and ventral parts of forelimbs and hindlimbs whitish; ventral side of tail light brownish. Tongue dark grey at its distal tip. A yellow ring around the eye. Iris silvery-golden with small veins in life, not recognizable when preserved since pupil was much enlarged after preservation.

Tab. 1. Morphometric and meristic variation among the holotype and two adult paratypes of *Paroedura lohatsara*. Measurements in mm.

| Collection number | ZSM 985/2001 | ZSM 529/2000 | ZSM 807/2001 |
|-------------------|--------------|--------------|--------------|
| Status | holotype | paratype | paratype |
| Sex | male | male | female |
| Maturity | mature | mature | mature |
| SVL | 70.6 | 69.0 | 72.8 |
| TL | 75.8 | 45.8* | 65.0 |
| HL | 25.1 | 24.0 | 25.6 |
| HW | 17.5 | 16.3 | 17.0 |
| SL | 9.7 | 9.3 | 9.6 |
| ED | 5.7 | 5.4 | 5.5 |
| HO | 2.7×0.5 | 2.2×0.5 | 3.1×0.8 |
| AGL | 30.4 | 30.1 | 33.0 |
| Forelimb | 23.7 | 25.0 | 25.9 |
| Hindlimb | 36.3 | 34.4 | 32.0 |
| Supralab | 12-11 | 10-10 | 13-12 |
| Infralab | 11-12 | 9-9 | 11-11 |
| Sdlm I | 8-8 | 10 | 9-9 |
| Sdlm II | 10-9 | 9 | 10-11 |
| Sdlm III | 11-10 | 12 | 11-11 |
| Sdlm IV | 12-12 | 11 | 11-11 |
| Sdlm V | 10-10 | 11 | 10-10 |
| Sdlp I | 8-9 | 8-9 | 9-9 |
| Sdlp II | 10-11 | 9-9 | 10-11 |
| Sdlp III | 12-13 | 12-13 | 11-12 |
| Sdlp IV | 14-14 | 13-13 | 13-13 |
| Sdlp V | 13-14 | 14-12 | 12-11 |

* tail regenerated

Variation. Morphometric and meristic variation of two paratypes (ZSM 529/2000 and ZSM 807/2001) are summarized in table 1. ZSM 529/2000 is an adult male with extruded hemipenes; the right forelimb was removed for future DNA studies. The regenerated tail has no spinous tubercles and is irregularly marbled with brown and white. The general colouration is similar to the holotype whereas that of the female ZSM 807/2001 is more contrasting; the largely symmetrical blackish markings on the head form a vermiculated pattern and the black spots on the dorsum are less clearly arranged into longitudinal rows. A distinct white band bordered by a thin blackish band on each side runs from the anterior dorsum to the anterior insertion of arm. The original and complete tail has 11 alternating dark and 10 light bands and is distinctly thinner than in the holotype. The whitish scales on the flanks are very prominent. The three living paratypes (all with original tail) largely agree with the preserved types. Their size (measured 12 July 2001 in life) was 73.9 mm SVL + 82.2 mm TL (male), 80.6 mm SVL + 72.5 mm TL (female, Fig. 2), and 79.7 mm SVL + 57.1 mm TL (female, last tail tip missing). TL is shorter than SVL in the three females, but longer than SVL in the two males with original tail. The SVL of the three adult males (69.0-73.9 mm SVL) is slightly shorter than in the three females (72.8-80.6 mm), but total length appears similar in both sexes. All type specimens and all further captive-bred specimens agree in having distinct dark markings on the head. The juvenile paratypes (ZSM 530/2000, 32.4 mm SVL + 31.3 mm TL; ZSM 986/2001, 32.0 mm SVL + 26.8 mm TL; ZSM 987/2001, 31.2 mm SVL + 29.8 mm TL) have a distinct juvenile colouration which was also typical for the other juveniles which we reared in captivity (Fig. 3): Four distinct whitish transverse bands on the dark brown back and flanks. Laterally, the most anterior band is distinctly narrower than the two following bands and ends pointed slightly anterior of the insertion of the forelimbs. The two bands between forelimbs and hindlimbs are not pointed laterally and have the same width on the entire flanks as on the back. The posteriormost band, positioned between the hindlimbs, is restricted to the back. There is no light mid-dorsal line. The upper surface of the tail is banded with beige and brown in the preserved specimens, but bright orange with dark crossbands in life. Dark symmetrical markings on the head are already well recognizable. The head is relatively broad and short, especially in comparison with similar sized juveniles of *P. stumpffi* and *P. bastardi*. About three months after hatching the juvenile colouration gradually converts into the adult colouration. Subadults still have more or less distinct transversal bands on the back whereas in older adults these bands are poorly or not recognizable. A light mid-dorsal stripe is present in subadults and adults.

Distribution and conservation. *Paroedura lohatsara* is only known from the Montagne des Français in the far north of Madagascar. Numerous animal and plant species appear to be endemic to this karstic massif, among them a still undescribed snake species of the genus *Heteraliodon* (pers. obs.). It is therefore likely that *Paroedura lohatsara* is a further endemic species of the Montagne des Français massif. In this case the new species may be considered as vulnerable due to its small range although its habitat is apparently not immediately threatened by destruction. Regarding the numerous endemics in Montagne des Français this area should be protected as nature reserve.

Habitat and habits. In nature, the new species was only observed at night in dry forest on a karstic underground, several days after heavy rains. The geckos were mainly climbing on rocks and branches up to two metres above the ground. In captivity, juveniles and adults were able to feed on relatively large insects. Nussbaum & Raxworthy (2000) described a prominent vertical or anteriorly curved tail display in disturbed *Paroedura maingoka* which they interpreted as defensive behaviour. A similar behaviour was sometimes observed by us in disturbed captive-bred subadult *P. lohatsara* and *P. stumpffi*, e.g. when the specimens were faced with torchlight at night. However, it was also observed in undisturbed *P. lohatsara* in the vivarium, indicating that it may also serve for intraspecific communication. A detailed analysis of this and other behavioural traits in *Paroedura picta* was provided by Brillet (1986, 1993).

Sympatric species. Two other species of *Paroedura* were found in sympatry with *P. lohatsara*. Both are hereby recorded for the first time at Montagne des Français: *P. karstophila* (ZSM 531/2000 and 532/2000) was found in close syntopy with *P. lohatsara* in the limestone massif whereas *Paroedura stumpffi* (ZSM 635/2000) was only encountered on the slope between the massif and the sea, outside the karstic underground.

