

A new species of *Hemidactylus* from Lake Turkana, Northern Kenya (Squamata: Gekkonidae)

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Abstract. A new species of the genus *Hemidactylus* is described on the basis of two specimens (an adult male and an adult female) collected in 2005 in rocky and sandy habitat of the semiarid climatic region on the eastern shore of Lake Turkana (Kenya). It is a medium-sized *Hemidactylus* (SVL from 40 to 50 mm) distinguished from all other species by a unique combination of characters. The back is covered by large, trihedral, strongly keeled tubercles, intermixed with a few small, irregular shaped granules, forming 14 quite regular transverse rows from axilla to groin; nostrils contact the rostral, first supralabial, 1 enlarged internasal and 2-3 postnasals; the dorsal half of the rostral scale is divided longitudinally; there are 6 lamellae under the first toe and 10 under the 4th toe; male with 8 precloacal pores; female without pores. The dorsal colour pattern is very distinctive, consisting of four transverse bands, bordered with dark margins. The types are housed in the Herpetological Collections of the Museo di Storia Naturale of the University of Pavia and in the National Museums of Kenya (Nairobi).

Riassunto. Una nuova specie di *Hemidactylus* dal Lago Turkana, Kenya settentrionale (Squamata: Gekkonidae). Si descrive una nuova specie del genere *Hemidactylus* sulla base di due esemplari (un maschio e una femmina adulti) raccolti nel 2005 sulla sponda orientale del Lago Turkana (Kenya) in ambienti caratterizzati da affioramenti rocciosi e sabbiosi nella fascia climatica semi-arida. Si tratta di un *Hemidactylus* di taglia media (lunghezza apice del muso-cloaca da 40 a 50 mm), che si distingue dalle altre specie del genere grazie ad una combinazione di caratteri. L'ornamentazione dorsale è caratteristica e consiste in quattro bande trasversali con margini scuri. Sul dorso sono presenti grossi tubercoli triedri fortemente carenati, che formano 14 file trasversali dall'inguine alla base degli arti anteriori, inframezzati da granuli di forma irregolare; le narici sono in contatto con la squama rostrale, con la prima sopralabiale, con una grande internasale e con 2-3 postnasali; la squama rostrale è divisa longitudinalmente per metà della sua lunghezza nella parte superiore; sono presenti 6 lamelle sotto il pri-

mo dito del piede e dieci sotto il quarto. Il maschio mostra 8 pori preloacali mentre la femmina ne è priva. Il materiale tipico è depositato presso il Museo di Storia Naturale dell'Università degli Studi di Pavia e il National Museums of Kenya di Nairobi.

Keywords. *Hemidactylus*, Kenya, Lake Turkana, new species.

INTRODUCTION

Hemidactylus is one of most specious genera of the family Gekkonidae, that has its main centre of speciation in East Africa: Somalia, Kenya, Ethiopia, and Eritrea host more than 40 species of *Hemidactylus*, most of which are endemic (cf. Parker, 1942; Loveridge, 1947; Lanza, 1983; Spawls et al., 2002; Brogard, 2005; Largen and Spawls, 2006).

The two specimens described in the present paper, belonging to an unknown species, were collected during the scientific surveys carried out within the Project "Conservation of Biodiversity and Community Development of east Lake Turkana" promoted by Pavia University for Italian Cooperation and with the support of the National Museums of Kenya and Kenya Wildlife Service.

MATERIALS AND METHODS

We conducted four herpetological field surveys, from 2004 to 2005 (total search effort 53 days of searching with a medium of three observer), throughout all eastern Lake Turkana, Marsabit District, Northern Kenya, from the Ethiopian border to South Horr, and from the lake shores eastwards to North Horr, about 37°E.

Although rather varied, the Turkana region is typically characterized by scattered low shrub temporary vegetation, and acacia trees emerging from lava barelands, interspersed with dense vegetation of *Commiphora-Acacia mellifera* shrub bush, it belongs to the Sahel-Somalic dominion of the saharo-sahelian region (Schnell, 1976). The only areas where the density of fauna seems higher are the dry river beds (lagga) that are narrowly bordered by denser vegetation of shrub and trees and thick undercover. A bimodal and unpredictable distribution of rains (from 200 to 300 mm/year) characterize these semi desert regions (Schnell, 1976).

The collected specimens are deposited in the Herpetological Collections of the National Museums of Kenya in Nairobi, and the Museo di Storia Naturale of the University of Pavia, Italy.

The new species was compared to all the other *Hemidactylus* species with similar characteristics and especially to the East African ones. We checked the collections of several museums (see Appendix 1), the original descriptions, and taxonomic reviews (see References).

RESULTS

Hemidactylus barbierii Sindaco, Razzetti and Ziliani, sp. nov.
(Figs 1-5)

Type material

Holotype — Adult male MSNPV-CR849, Kenya, Marsabit district, lagga Daudi (3°53'08"N – 36°19'02"E), about 17 km South of Koobi Fora not far from the eastern lake Turkana shore, U. Ziliani, E. Razzetti, R. Sindaco, C. Carugati leg., 7.VII.2005.

Paratype — Adult female NMK-L/3054, Kenya, Marsabit district, "petrified forest" (3°40'23"N – 36°19'43"E) about 10 km inland of the eastern lake shore at Allya Bay, U. Ziliani, E. Razzetti, R. Sindaco, C. Carugati leg., 6.VII.2005.

Derivatio nominis — In memory of our friend Francesco Barbieri (1944-2001), Professor of Zoology at the University of Pavia, herpetologist and a keen naturalist, one of the founders of the "Turkana project" (Galeotti, 2002).

Diagnosis

A medium sized *Hemidactylus* (male SVL = 40 mm, female SVL = 50 mm), with a very distinctive dorsal banded pattern. Back covered by large, trihedral, strongly keeled



Fig. 1. Dorsal view of *Hemidactylus barbierii* sp. n. Right: male (holotype, MSNPV-CR849); left: female (paratype, NMK-L/3054).



Fig. 2. Ventral view of *Hemidactylus barbierii* sp. n. Right: male (holotype, MSNPV-CR849); left: female (paratype, NMK-L/3054).

tubercles intermixed with a few small, irregular shaped granules, forming 14 quite regular transverse rows from axilla to groin (counted along a paravertebral line); nostril in contact with the rostral, first supralabial, 1 enlarged internasal (post-rostral) and 2-3 postnasals; rostral scale divided longitudinally for half of its length in the superior part; 6 lamellae under the first toe and 10 under the 4th toe; sole without enlarged scales; male with 8 pre-cloacal pores; female without pores.

Description of the holotype

Head rather depressed (ratio of head length to the mandibular angle and head depth = 2.3), length 1.4 times its width; snout subacuminate, concave between the nares and the eyes, swollen in front of the eyes, 1.3 times as long (to the anterior margin of the eye) as the distance between the posterior margin of the eye and the anterior margin of the ear-opening; ear opening elliptical, its major axis subvertical and slightly more than 1/4 of the exposed eye. Major diameter of the exposed eye about 1/5 the head length (to the mandibular angle); pupil a vertical slit with lobed margins.

Rostral subquadrangular, nearly twice wide as high, divided longitudinally for half of its length in the superior part; nostril in contact with the rostral, first supralabial, 1 enlarged internasal (post-rostral) and 3 postnasals; the uppermost nasal very large and in contact with its fellow; 9/10 (right/left) upper (7/7 before the centre of the eye) and 6/6 lower labials; mental large, subtriangular, approximately as long as the anterior chin-shields; anterior chin-shields broadly in contact along the median line and with the first lower labial roughly in contact with the second pair of lower labials. A second pair of chin shields slightly smaller than the first pair (maximum length about 0.74 of the first pair of postmentals), touching the second pair of sublabials and 2 rows of paralabials.

Snout covered by roundish, juxtaposed, flat or slightly convex scales (keeled on the preocular swelling); these scales vary in size, being smaller centrally, larger peripherally; the largest snout scales are those of the loreal region and preorbital swelling as well as the two behind the supranasals. Posteriorly the scales grade into small, juxtaposed granules (about 20 in the interorbital region, in the narrower line between the eyes) mixed on the vertex, nape and temporal region with conical or subtrihedral strongly keeled tubercles

clearly larger than the nostril and separated by 1-3 granules. Trunk covered dorsally by large, subtrihedral, strongly keeled tubercles, arranged in 14 relatively regular longitudinal rows (6 between the hindlimbs), 14 in a straight paravertebral line between axilla and groin separated by small, subimbricate, smooth, heterogeneous scales. Ventral scales large, flat, smooth, and imbricate, about 28 in a transverse row at mid-belly, 43 between axilla and femoral pores along a line on the middle of the belly,



Fig. 3. Gular region of the holotype (right) and paratype (left) of *Hemidactylus barbierii* sp. n.

5+2/3 in an eye diameter in the middle of the belly, counted longitudinally. Head covered ventrally by juxtaposed or subimbricate granules (about 18 in an eye diameter in the middle of the throat, counted longitudinally). Trunk rather depressed; 8 (4/4) preloacal pores forming an obtusely angulated, uninterrupted series. Antero-dorsal side of forearm, dorsal side of tibia and postero-dorsal side of thigh with large keeled tubercles, those of the forearm smaller than the other ones. Digits free, moderately dilated, slightly webbed at the base with free undilated terminal portion clearly projecting beyond the dilated part (that of fourth toe with 8 scales along the dorsal edge); lamellae beneath the toes from first to fifth (undivided+divided+entire apical): 6 (2+3+1), right 9 (2+6+1) / left 8 (1+6+1), right 9 (1+7+1) / 9 (2+6+1), 10 (3+6+1), right 9 (3+5+1) / 8 left (2+5+1); beneath the fingers: 6 (2+3+1), 7 (1+5+1), 7 (1+5+1), 8 (2+5+1), 6 (2+4+1).

Adpressed hind limb reaches the elbow of adpressed forelimb. Testes well developed. Tail lost.

Measurements. Snout-vent = 40 mm; tail lost; head length (to the mandibular angle) = 12.2 mm; head width = 8.5 mm, head depth = 5.4 mm; major (horizontal) diameter of the exposed eye = 2.9 mm; axilla to groin = 16.5 mm; forelimb = 12.5 mm; hind limb = 16.0 mm.

Colouration. A very distinctive dorsal colour pattern of four complex transverse bands (one on the neck and three between anterior and posterior limbs), each with very dark anterior and posterior margins and less dark inner area; a curved dark line, resembling these margins, bordering the rear of the head continued forwards through the eye to the nostril, *canthus rostralis* more or less distinctly lighter than the upper parts of the snout; limbs almost patternless.

Life colouration during daytime: see Fig. 4. Apparently no change of color was observed between night and daytime.

In alcohol the ground colour of back is light roseate-greyish, a little bit darker inside the transverse bands; these bands are delimited by dark brown, irregular and discontinuous margins one-tubercle wide. Under parts are off-white.

Description of the paratype

Head very similar to that of the holotype, although larger and stouter, a little less depressed (head length / head depth = 1.9), and shorter (length / width = 1.2). 2 (instead of 3) postnasals. Enlarged upper labials 7/7 (6/6 before the centre of the eye), enlarged infralabials 6/6. Arrangement of the mental scale and chin shields as in the holotype. Scales on the upper surface of the head similar to the holotype, those on the upper part of snouth larger than in the male. Trunk covered dorsally by tubercles as in the male, but arranged in 16 longitudinal rows (6 between the hindlimbs), 14 between axilla and groin.

Large ventral scales, flat, smooth, and imbricate, about 32-33 in a transverse row at mid-belly, 49 between axilla and the preloacal scales along a line on the middle of the belly, 7 counted longitudinally in an eye diameter in the middle of the belly; about 18 scales in an eye diameter in the middle of the throat. Preloacal pores absent. Tip of adpressed hind limb reaches the elbow of adpressed forelimb.

Measurements. Snout-vent = 49.5 mm; tail lost; head length (to the mandibular angle) = 13.6 mm; head width = 11.2 mm; head depth = 7.2 mm; major (horizontal) diameter of the exposed eye = 3.3 mm; axilla to groin = 22 mm; forelimb = 16.0 mm; hind limb = 20.0 mm.

Subdigital lamellae (first to fifth toes): 6 (1+3+2), 8 (1+6+1), 9 (1+6+2), 10 (1+6+3), 8 (1+5+2). Lamellae beneath the fingers: 6 (2+3+1), 7 (1+5+1), 7 (1+5+1), 8 (2+5+1), 7 (1+5+1).

Colouration. As in the holotype, but more heavily patterned, with dorsal bands better defined; a continuous dark line joins the temporal dark lines across the nape; upper parts of the snout with a “Λ” shaped dark arrow bordered, on the *canthus rostralis*, by a narrow dark stripe. Life colouration: see Fig. 5.

Habitat

Both specimens were collected while active on the ground after sunset. The male was found on the sandy ground of a dry *lagga* (seasonal stream) with riverine vegetation (Fig. 6). The female was collected on rocky ground with scattered vegetation (Fig. 7).

Other reptiles found in the same area where the male was collected were: *Stenodactylus sthenodactylus*, *Hemidactylus ruspolii*, *Agama rueppelli*, *Agama agama lionotus*, *Psammophis* sp.; among amphibians only *Bufo lughensis* and *Tomopterna* cf. *cryptotis* were found. Syntopic reptiles in the paratype collecting locality were: *Hemidactylus* cf. *angulatus*, *H. isolepis* and *Agama agama lionotus*.

Comparison with other species

Hemidactylus barbierii is closely related to some species of the “Arid clade” of *Hemidactylus* sensu Carranza and Arnold (2006). It belongs to the *Hemidactylus* species characterized by the presence of preloacal pores (lacking femoral pores) in males, and enlarged tubercles on the dorsum.

The species, which is most similar to *H. barbierii*, is the very rare *H. bavazzanoi* Lanza, 1978 (occurring in S Somalia and NE Kenya), having a similar arrangement of dorsal enlarged tubercles.

The main differences are the extremely distinctive pattern, and the sequence of mental scales (in particular the second pair of post-mentals not entering the 3rd infralabials in *H. barbierii*) and the number of subdigital lamellae beneath the fourth toe (10 in *H. barbierii* instead of 6-9 in *H. bavazzanoi*).

The recently described *H. foudaii* Baha El Din 2003 (Baha El Din 2003, 2006) from SE Egypt has a rather similar colour pattern, but without nuchal band; the main differences are the much smaller ventral scales (40-44 across midbelly in *H. foudaii* instead of 28-33) and smaller dorsal tubercles (20 across the back and intermixed with medium-sized granular scales, vs. 14-16 in contact among them in *H. barbierii*).

Also *H. citernii* Boulenger, 1912 from NW Somalia and N Juba province, has large trihedral, strongly keeled tubercles on the back narrowly separated by fine granules; this



Fig. 4. Life colouration of the holotype of *Hemidactylus barbierii* sp. n.



Fig. 5. Life colouration of the paratype of *Hemidactylus barbierii* sp. n.



Fig. 6. Habitat of *Hemidactylus barbierii* sp. n. lagga Daudi, Marsabit district (3°53'08"N – 36°19'02"E), 7.VII.2005.

taxon differs by the short free distal joints of the digits, the small ventral scales, juxtaposed or subimbricate (strongly imbricate in *H. barbierii*), and different pattern of the back and limbs.

Hemidactylus fossatii Scortecci 1928, a doubtful taxon from Eritrea, differs by having enlarged dorsal tubercles perfectly smooth.

H. puccionii Calabresi, 1927, from central and SE Somalia, considered as a synonym of "*H. turcicus*" s.l. by Parker (1942), has the first supralabial excluded from nostril, postmentals separated on median line and the second pair of postmentals smaller; the enlarged dorsal tubercles are only feebly keeled (see also Scortecci 1931).

All the following species differ from *H. barbierii* by having the dorsal enlarged tubercles smaller and more widely separated by small granular scales; moreover, most of the individuals of these species, apart from *H. sinaitus* Boulenger, 1885, have the supranasals (internasals) separated by one or more granules.

H. arnoldi Lanza, 1978 (NW Somalia) has an enlarged tubercle on the sole of foot, more rows of dorsal tubercles (27 from axilla to groin), higher number (7-10) of lamellae beneath the first toe, and a different colour pattern.

H. barodanus Boulenger, 1901 (Ethiopia and N Somalia) is larger (SVL up to 72-78 mm); enlarged tubercles may be large and triedral in some specimens, whereas in other



Fig. 7. Habitat of *Hemidactylus barbierii* sp. n. petrified forest, eastern lake Turkana, Marsabit district, Kenya (3°40'23"N – 36°19'43"E), 6.VII.2005.

are less than half this size and only feebly keeled (Parker, 1942); the internasals are separated by a single granule; the tail is strongly depressed.

H. granchii Lanza, 1978 (central and SE Somalia) has the first upper labial widely separated by the nostril, and an inconspicuous colour pattern.

H. jubensis Boulenger, 1895, is a poorly known species and could be a senior synonym of *H. barodanus*. The back of this species is covered by round or oval feebly keeled tubercles (instead of strongly keeled tubercles).

H. macropholis Boulenger, 1896 (Ethiopia, Somalia, N Kenya) has a completely different arrangement of chin-shield, larger size (SVL up to more than 80 mm in both sexes), and a different colour pattern; according to Lanza (1978: tab. 4) in most of specimens the first chin-shields does not enter the first and the second infralabials (62%) and most of specimens (77%) have separated supranasals (internasals), moreover it has an higher number of lamellae beneath the first toe (7-10 instead of six).

H. robustus Heyden, 1827 (incl. *H. parkeri* Loveridge, 1936) (Egypt to Somalia and extreme NE Kenya), usually has separated supranasals (76% of individuals), and a different colour pattern.

H. sinaitus Boulenger, 1885 (from Sudan to N Somalia, and Arabia) has smaller and more widely separated dorsal tubercles, lower number of precloacal pores, and a different colour pattern.

H. taylori Parker, 1932 (NE Somalia) has supranasals separated and a different colour pattern.

H. turcicus (Linnaeus, 1758) (widespread in the Arabian Peninsula and the Middle East, and along the Mediterranean Sea shores, south to northern Sudan, and probably replaced further south by *H. robustus*) has supranasals separated in the 90% of specimens, smaller and more widely separated dorsal tubercles, and a different colour pattern.

H. yerburii pauciporosus Lanza, 1978 from N Somalia (the nominate subspecies occurs in Arabia) has a different pattern; the ventral scales are smaller, and the supranasals (internasals) are separated in the 78% of specimens.

DISCUSSION

The Horn of Africa is the main speciation centre for the genus *Hemidactylus* with more than 40 species widespread mostly in Somalia and adjoining Kenya, Eritrea and Ethiopia. The arid eastern shores of Lake Turkana are the western distributional limit for many Somali taxa sensu La Greca (1990), and the genus *Hemidactylus* forms the richest reptile genus of this area with six species, the ground dwelling *H. barbierii*, *H. isolepis* and *H. macropholis*, the rock or building climbers *H. cf. angulatus* and *H. ruspolii*, and the tree climbers *H. platycephalus* and *H. ruspolii*.

Until recently, the herpetofauna of the eastern Lake Turkana (west of 37°E), excluding Mount Kulal, included 27 reptiles species (Spawls et al., 2002), a figure now increased to 35 (+30%) by the additional information gathered during the herpetological surveys carried for our “Turkana Project” (Ziliani et al. 2006), and by further unpublished data collected by Czech herpetologists. Thus the discovery of this new species was not entirely unexpected. The results of these surveys have contributed to enhance the knowledge of the biodiversity of Northeastern Africa. Further efforts should be made to enable further investigation aimed to identify the exact distribution of this new species and its occurrence in such remote areas

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Appendix 1 — Materials examined for comparison.

Abbreviations: MZUF = Museo Zoologico dell'Università di Firenze; MCC = Museo Civico di Storia Naturale di Carmagnola; MZUT = Museo Zoologico dell'Università di Torino (now in the Museo Regionale di Scienze Naturali, Torino); MSNPV = Museo di Storia Naturale dell'Università di Pavia; NMK = National Museums of Kenya (Nairobi).

- H. bavazzanoi*. MZUF 21886 (holotypus).
- H. cf. angulatus*. MCC R0570, MCC R1035, MSNPV CR647-648, MSNPV CR633-636, MZUT-R2662, MZUT-R3119, MZUT-R2393, NMK L/2115/1-4, L/1284/1-2, L/1612, L/1878/1-2, L/1879/1-4, L/2132/1-2, L/2282.
- H. flaviviridis*. MZUT-R2660, MZUT-R2699.
- H. frenatus*. MZUT-R1695, MZUT-R2663, MZUT-R2669, MZUT-R2676, MZUT-R2692, MZUT-R3071, MZUT-R3288.
- H. granchii*. MZUF 21189 (holotypus), MZUF 21114-18 (paratypi).
- H. mabouia*. MCC R803, MCC R805, MCC R902, MCC R0903(1-2), MZUT-R2689.
- H. macropholis*. MCC R1224(1-2); NMK L/2587/1-4.
- H. parkeri*. MZUF (many specimens).
- H. platycephalus*. MCC R1225, MSNPV CR648.
- H. ruspolii*. MSNPV CR680-681, MSNPV CR654, MSNPV CR639, MSNPV CR670, MSNPV CR846.
- H. sinaitus*. MZUT-R2657.
- H. turcicus*. Many specimens in MCC, MZUF, MZUT.
- H. yerburii pauciporosus*. MZUF 6245 (holotypus) + many additional specimens.
- H. yerburii yerburii*. MCC R814.