

Correspondence

Coloration and pattern of hatchlings
of six *Pelomedusa* speciesUWE FRITZ¹, TOMÁŠ MAZUCH², ALICE PETZOLD¹ & HYNEK PROKOP³¹Museum of Zoology, Senckenberg Dresden, A. B. Meyer Building, 01109 Dresden, Germany²Dříteč 65, 53305 Dříteč, Czech Republic³U Zámečku 459, 53003 Pardubice, Czech Republic

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It is well known that juveniles, and in particular hatchlings, of turtles are more intensely patterned and more colourful than adults, rendering them more distinctive than conspecific adults. For instance, hatchlings of many species of cooter and slider turtles (*Pseudemys* spp., *Trachemys* spp.) are easy to tell apart by their coloration and pattern alone, while adult individuals of distinct species are often quite similar (cf. the photos in ERNST et al. 2000, ERNST & LOVICH 2009). Likewise, coloration and pattern of hatchlings and juveniles of *Nilssonina* species are quite species-specific, in contrast to adults of these softshell turtles (cf. the figures in PRASCHAG et al. 2007, LIEBING et al. 2012). While the plastral pattern of hatchlings of *Emys trinacris* differs significantly from that of hatchlings of all subspecies of *E. orbicularis* (FRITZ et al. 2006), many adults of *E. orbicularis galloitalica* closely resemble *E. trinacris* (FRITZ et al. 2005, 2006). In the present correspondence, we compare coloration and pattern of hatchlings of six species of helmeted terrapins (*Pelomedusa* spp.).

Helmeted terrapins have a wide sub-Saharan distribution in Africa and the southwestern Arabian Peninsula (IVERSON 1992), with introduced populations in Madagascar (VARGAS-RAMÍREZ et al. 2010, WONG et al. 2010), and were thought by most authors to represent a single species for more than a century (BOULENGER 1880, 1889, WERMUTH & MERTENS 1961, 1977, IVERSON 1992, FRITZ & HAVAŠ 2007, VAN DIJK et al. 2014). However, this view was challenged by two independent studies that discovered many deeply divergent genetic lineages in *Pelomedusa* (VARGAS-RAMÍREZ et al. 2010, WONG et al. 2010). Their genetic divergences resemble or exceed those between species of *Pelusios* (FRITZ et al. 2011, PETZOLD et al. 2014), the genus most closely related to *Pelomedusa*. As a conse-

quence, a recent revision (PETZOLD et al. 2014) formally recognized no fewer than 10 distinct species and pointed out that four additional candidate species exist for which too little material was available to name them. Recently, a fifth candidate species was discovered (NAGY et al. 2014), so that the genus includes at least 15 species and candidate species. Some of these taxa are morphologically distinctive. Others are ‘cryptic species’ that can be identified only by genetic means (PETZOLD et al. 2014), unless additional diagnostic characters can be discovered. In this context, coloration and pattern of hatchlings may be promising characters.

Amongst the approximately 350 museum specimens studied by PETZOLD et al. (2014) were 81 hatchlings and small juveniles of *Pelomedusa*. These specimens, together with photos of live terrapins (see below), serve as the basis for the present paper. As the specific identify of many museum specimens could not be determined because they lacked molecular data, the descriptions below are based only on terrapins that could be assigned with certainty to a particular species and which are sufficiently preserved for morphological description (Appendix; see there also for straight carapace lengths).

The carapace of newly hatched helmeted terrapins measures approximately 22–35 mm (straight line) and is olive brown to dark horn-coloured. Sometimes the shell margin is patterned with yellow but, in general, hatchlings of all *Pelomedusa* species are quite similar in dorsal view. However, with respect to coloration and pattern of the ventral side of the shell, there are pronounced species-specific characters, which will be described below. Currently, data are available for only six species. Adults of some of these species are difficult to tell apart by morphology alone (PET-

ZOLD et al. 2014), in particular *Pelomedusa kobe*, *P. neu-manni*, and *P. subrufa* sensu stricto, and to a lesser extent also *P. somalica*. However, hatchlings of these species are quite distinctive in some characters.

Pelomedusa galeata (SCHOEPFF, 1792)

This species has a wide distribution in South Africa (PETZOLD et al. 2014), and is rather common in natural history museums. We studied six hatchlings from the holdings of natural history museums. In addition, a live hatchling

was photographed by UF near Elandsberg, Western Cape, South Africa, in mid-November 2011 (Figs 1a, b). In most of its range, *Pelomedusa galeata* is the only *Pelomedusa* species (PETZOLD et al. 2014). Thus, its identification is unambiguous in these regions.

Hatchlings of *P. galeata* are characterized by a dark marking that covers most of the plastron. The bridge is horn-coloured to yellow. Also the submarginal scutes are of this colour, with the seams between the submarginals being darker in some individuals. The light parts of the plastral coloration of the live hatchling from Elandsberg had a slight orange tinge (Fig. 1b).

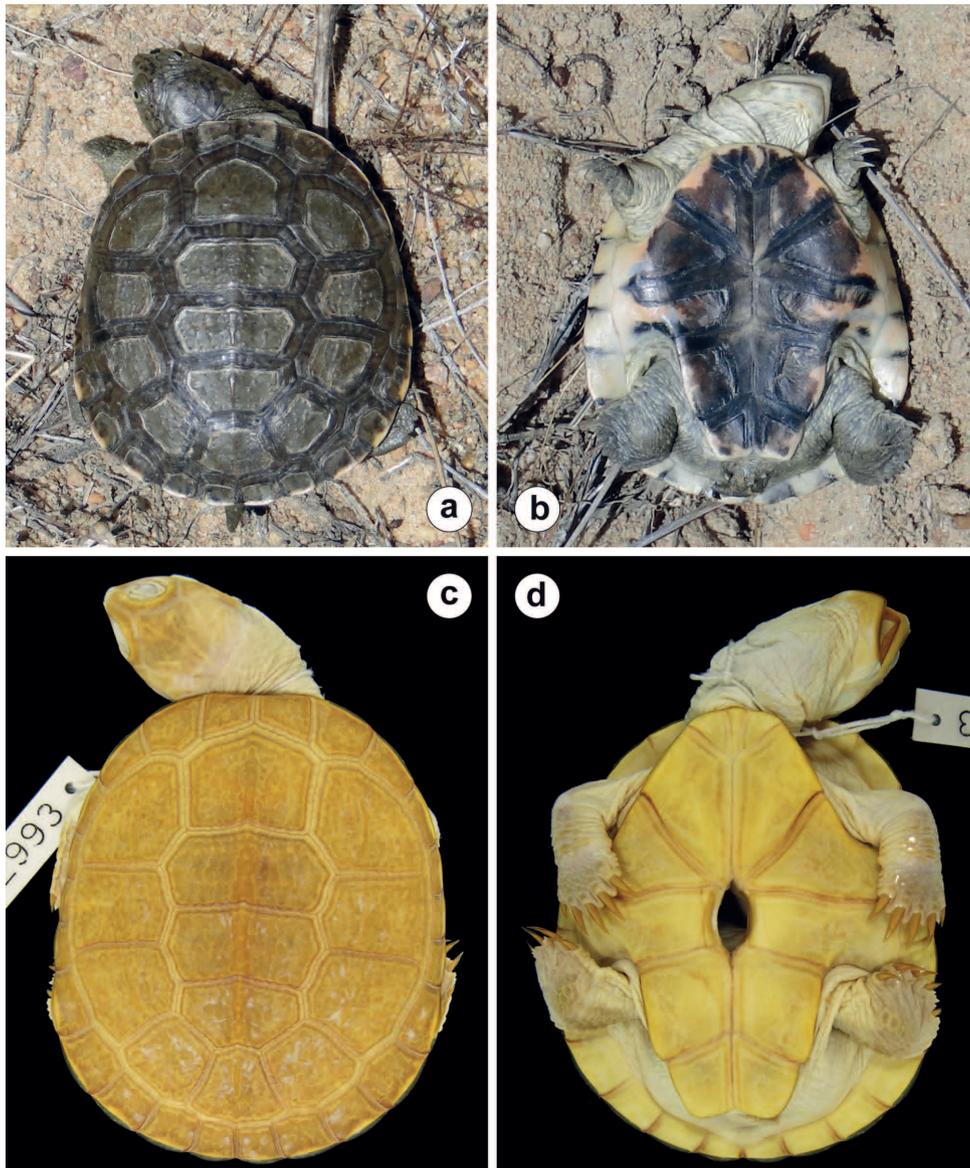


Figure 1. Hatchling of (a, b) *Pelomedusa galeata* (Elandsberg, Western Cape, South Africa) and (c, d) small juvenile of *P. gehafie* (MCZ R42993, paralectotype, eastern slope of coastal mountains, Eritrea). Note the light bridge and the light plastral edges in *P. galeata* and the absence of dark pigmentation in *P. gehafie*. Photos: U. FRITZ and Museum of Comparative Zoology, Cambridge, Massachusetts (© President and Fellows of Harvard College).

Pelomedusa gehafie (RÜPPELL, 1835)

This morphologically distinctive species is only known from a few museum specimens from Eritrea and perhaps Sudan (PETZOLD et al. 2014). We examined five hatchlings or small juveniles of *Pelomedusa gehafie*, including four paralectotypes. One paralectotype (MCZ R42993; Figs 1c, d) was unknown to FRITZ et al. (2014) and PETZOLD et al. (2014). All of these specimens are extremely light coloured. Even if it is considered that coloration and pattern of these terrapins, originating from 1834 (MCZ and SMF paralectotypes) and 1872 (NMW 24448), respectively, are faded, this cannot explain the complete lack of any dark pigmentation, which is why we conclude that hatchlings of *P. gehafie* are indeed without any dark plastral pattern.

Unlike adult *P. gehafie*, in which the triangular pectoral scutes are widely separated, the tips of the pectoral scutes of NMW 24448 meet at the plastral midline, and the tips of the pectorals of MCZ R42993 nearly touch the midline

(Fig. 1d). In the remaining hatchlings and small juveniles, the pectorals do not meet medially.

Pelomedusa kobe PETZOLD et al., 2014

This species is only known from Tanzania, where it occurs in close proximity to, or in sympatry with, *Pelomedusa neumanni* and *P. subrufa* sensu stricto in the Arusha region (PETZOLD et al. 2014). Therefore, many hatchlings in museum collections cannot be assigned to a certain species without genetic study. Amongst the genetically verified paratypes of *P. kobe* are three hatchlings and one small juvenile. These specimens have dark plastra and, in contrast to *P. galeata* and *P. subrufa* sensu stricto, also dark bridges (Fig. 2a). Thus, hatchlings of *P. kobe* resemble those of *P. neumanni* (see below). However, unlike *P. neumanni*, the edges of the plastron are yellow or horn-coloured, especially at the plastral forelobe. The seams between the sub-

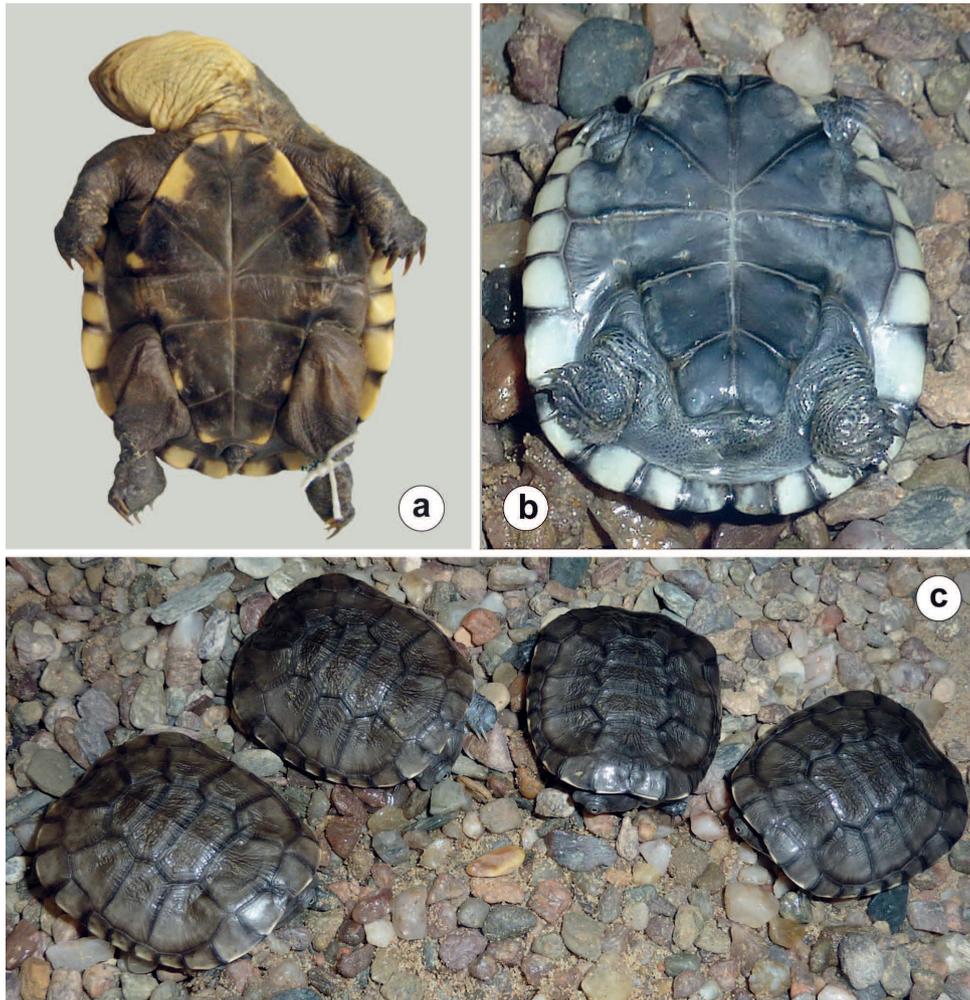


Figure 2. Hatchlings of (a) *Pelomedusa kobe* (ZSM 96/1960:3, paratype, Naberera, Tanzania), ventral aspect, and *P. neumanni* (captive-bred terrapins from parents from South Horr, Kenya), ventral aspect (b) and dorsal aspect (c). Note the dark bridge in both species and the completely dark plastron in *P. neumanni*. Photos: A. PETZOLD and H. PROKOP.

marginal scutes are bordered with dark lines. Moreover, hatchlings of *P. kobe* have conspicuous yellow carapacial rims (PETZOLD et al. 2014).

Pelomedusa neumanni PETZOLD et al., 2014

This East African species is known from Kenya and Tanzania, and occurs together with *Pelomedusa kobe* and *P. subrufa* sensu stricto in the Arusha region (PETZOLD et al. 2014). Like in *P. kobe*, the proper identification of hatchlings in museum collections is therefore not straightfor-

ward. However, one of us (HP) succeeded in 2011 in breeding helmeted terrapins collected near South Horr (Marsabit, Kenya). The adult terrapins of this breeding group were sequenced by VARGAS-RAMÍREZ et al. (2010) and represent *P. neumanni*. The four captive-bred juveniles of 2011 serve here for describing hatchling characteristics, together with two genetically verified museum specimens (paratypes of *P. neumanni*).

At first glance, hatchlings of *P. neumanni* (Figs 2b, c) are similar to those of *P. galeata*, *P. kobe*, and *P. subrufa* sensu stricto. Unlike these species, the entire plastron (including the bridge and plastral edges) is dark grey to black

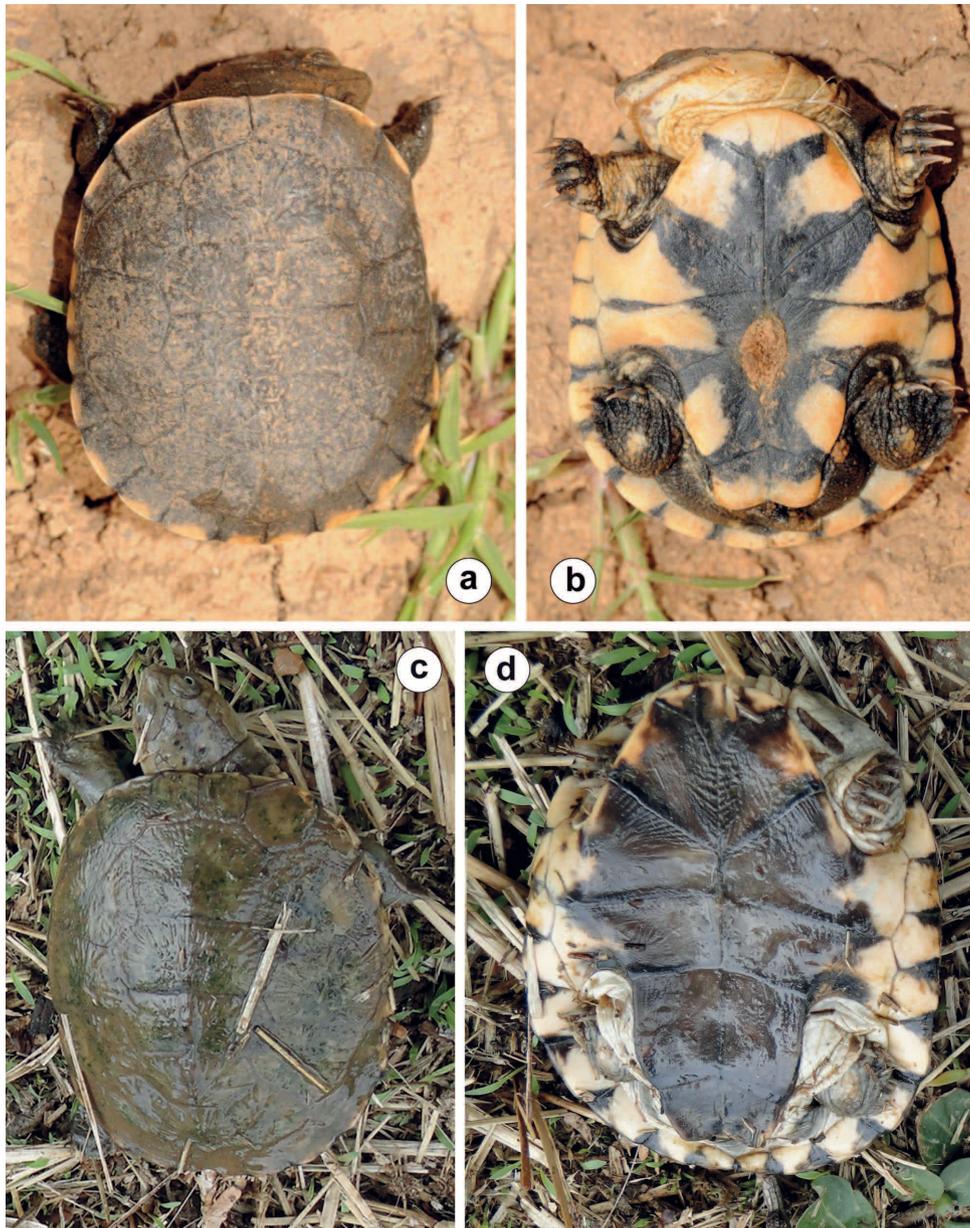


Figure 3. Hatchlings of (a, b) *Pelomedusa somalica* (NE Hargeysa, Somaliland) and (c, d) *P. subrufa* sensu stricto (Hohewarte, Namibia) in dorsal and ventral aspects. Note the light bridge in both species, the small black plastral marking in *P. somalica*, and the black triangles on the submarginals in *P. subrufa*. Photos: T. MAZUCH and U. FRITZ.

in *P. neumanni*, and only the submarginal scutes are pale horn-coloured, with darker seams. However, this coloration will soon fade and small juveniles may already exhibit a more or less dirty beige plastron.

Pelomedusa somalica PETZOLD et al., 2014

This species from Somalia is only known from a few museum specimens (PETZOLD et al. 2014), including a hatchling paratype (BMNH 1931.7.20.414). Besides *Pelomedusa somalica*, another undescribed *Pelomedusa* species is thought to occur in Somalia (PETZOLD et al. 2014). One of us (TM) photographed in November 2010 and July 2011 some live helmeted terrapins 30–60 km NE Hargeysa, Somaliland, which closely resemble the type series of *P. somalica*. Thus, we tentatively identify these individuals as *P. somalica*. Amongst them was, besides some adults, one hatchling (30 km NE Hargeysa; Figs 3a, b). It has a plastral pattern that is very similar to that of BMNH 1931.7.20.414, consisting of a dark central marking that spreads from the scute seams. However, unlike the museum specimen, the remaining plastron and submarginals are not only yellow, but have an orange tinge. The carapacial rim is light in colour, like in *P. kobe*. As is obvious, coloration and pattern of hatchling *P. somalica* are significantly different from those of other *Pelomedusa* species.

Pelomedusa subrufa (BONNATERRE, 1789) sensu stricto

This species is distributed from Namibia and southern Angola through Botswana and the southern Democratic Republic of the Congo to East Africa, and has also been introduced to Madagascar (PETZOLD et al. 2014). In many regions, *Pelomedusa subrufa* sensu stricto is the only *Pelomedusa* species, so that its identification is unambiguous in these areas. Hatchlings are quite common in natural history museums, and we studied 29 museum specimens. BILL BRANCH provided photos of another four specimens in the Port Elizabeth Museum. In addition, seven live hatchlings were photographed by UF in early December 2011 between Otjiwarongo and Okahandja and at Hohenwarte (approx. 40 km SE Windhoek), Namibia.

Most hatchlings of *P. subrufa* have mainly black plastra. Only the plastral margin is horn-coloured to yellow, as are the bridge and submarginal scutes. In some hatchlings, the seams between the submarginals are patterned with conspicuous black triangles (Figs 3c, d). There is little variation amongst hatchlings from different sites in southern Angola, Madagascar and Namibia, with one exception: ZFMK 47524 has only a small dark plastral marking, so that approximately half of the plastron is horn-coloured.

Based on coloration and pattern alone, hatchlings of *P. subrufa* are generally difficult to tell apart from *P. galeata*. However, these two species differ in head scalation and adult size. Moreover, many adult *P. galeata* are much darker than adult *P. subrufa* (PETZOLD et al. 2014).

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- Pelomedusa subrufa*: The Natural History Museum, London (BMNH 1877.7.5.7, Madagascar, 56.7 mm; BMNH 1907.6.29.52–54, Donguena, Angola, 56.5–59.0 mm; BMNH 1907.6.29.55, Namibe, Angola, 55.9 mm), Naturhistorisches Museum Wien (NMW 24446:4, Namibia, 40.0 mm; NMW 24461, Namibia, 53.0 mm), Port Elizabeth Museum (field numbers AM 8125:1–4, Rehoboth, Namibia, 43.5–55.6 mm), Senckenberg Museum, Frankfurt am Main (SMF 7954, Soalala, Madagascar, 46.3 mm; SMF 46248, Spitzkoppe, Erongo Mts, Namibia, 42.9 mm), Zoologisches Forschungsmuseum Alexander Koenig, Bonn (ZFMK 33064, Otjihaenamaparero Farm near Kalkfeld, Namibia, 26.5 mm; ZFMK 47524, Ombujomatemba near Waterberg, Namibia, 26.5 mm), Zoologisches Museum Berlin (ZMB 6142, Damaraland, Namibia, 25.7 mm; ZMB 10769, Walvis Bay, Namibia, 42.6 mm; ZMB 16660, Mahajanga, Madagascar, 56.2 mm; ZMB 17749, Grootfontein, Namibia, 25.6 mm; ZMB 24374, Narubis, Namibia, 29.4 mm; ZMB 36260, Mahajanga, Madagascar, 56.4 mm; ZMB 36506, Skamis, Namibia, 31.7 mm; ZMB 49609, Mahajanga, Madagascar, 58.3 mm; ZMB 49720, Mahajanga, Madagascar, 51.8 mm; ZMB 49726–49727, Walvis Bay, Namibia, 48.1 mm and 44.3 mm; ZMB 49728–49729, Skamis, Namibia, 32.3 mm and 30.7 mm; ZMB 49738–49742, Grootfontein, Namibia, 24.0–27.3 mm).

Appendix

Studied museum specimens and their straight carapacial lengths

Pelomedusa galeata: The Natural History Museum, London (BMNH 1841.1.15.57–58, Cape of Good Hope, South Africa, 56.5 mm and 51.2 mm), Senckenberg Museum, Frankfurt am Main (SMF 7951, South Africa, 44.1 mm), Staatliches Museum für Naturkunde, Stuttgart (SMNS 3961:1–3, Cape, South Africa, 23.9–30.0 mm).

Pelomedusa gehafie: Museum of Comparative Zoology, Cambridge, Massachusetts (MCZ R42993, eastern slope of coastal mountains, Eritrea, 60.0 mm), Naturhistorisches Museum Wien (NMW 24448, “Gebel Arary”, 56.0 mm), Senckenberg Museum, Frankfurt am Main (SMF 7960–7962, eastern slope of coastal mountains, Eritrea, 31.6–47.3 mm).

Pelomedusa kobe: Zoologische Staatssammlung München (ZSM 96/1960:3–5, Naberera, Manyara, Tanzania, 31.2–41.1 mm; ZSM 334/1978:2, Naberera, Manyara, Tanzania, 31.1 mm).