A New Species of Giant Sengi or Elephant-Shrew (Genus *Rhynchocyon*) Highlights the Exceptional Biodiversity of the Udzungwa Mountains of Tanzania

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A new species of giant sengi or elephant-shrew (genus *Rhynchocyon*) highlights the exceptional biodiversity of the Udzungwa Mountains of Tanzania

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- Eastern Arc Mountains; Udzungwa Mountains; Tanzania.

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Abstract
A new species of sengi, or elephant-shrew, is described. It was discovered in the northern Udzungwa Mountains of Tanzania in 2005. Sengis (Order Macroscelidea, super-cohort Afrotheria) include four genera and 15 species of mammals that are endemic to Africa. This discovery is a significant contribution to the systematics of this small order. Based on 49 camera trap images, 40 sightings and five voucher specimens, the new sengi is diurnal and distinguished from the other three species of *Rhynchocyon* by a grizzled grey face, pale yellow to cream chest and chin, orange-rufous sides, maroon back and jet-black lower rump and thighs. The body weight of the new species is about 700 g, which is 25–50% greater than any other giant sengi. The new *Rhynchocyon* is only known from two populations that cover about 300 km² of montane forest. It has an estimated density of 50–80 individuals km⁻². This discovery has important implications for the conservation of the high biodiversity that is found in the forests of the Eastern Arc Mountains.

Introduction
Sengis, or elephant-shrews, include 15 species of c. 30–500 g mammals that form a well-defined order, the Macroscelidea (Corbet & Hanks, 1968; Simons, Holroyd & Bown, 1991; Schlitter, 2005). They are restricted to Africa and belong to the recently recognized super-cohort Afrotheria, which includes elephants, sea cows, hyraxes, the aardvark, golden moles, tenrecs and sengis (Springer *et al.*, 1997; Stanhope *et al.*, 1998; Douady *et al.*, 2003). According to the definitive taxonomic revision by Corbet & Hanks (1968), the single extant family Macroscelididae is divided into two subfamilies: the Rhynchocyoninae, with the single genus *Rhynchocyon*, and the Macroscelinae, with three genera. *Rhynchocyon* includes three species that were described between 1847 and 1881 (Corbet & Hanks, 1968). They are known as ‘giant sengis’ because they are the largest members of the Macroscelidea.

The taxonomy of extant *Rhynchocyon* is based nearly exclusively on distinct colour patterns of the pelage and the allopatric distributions of the different forms, with virtually no use of cranial features (Corbet & Hanks, 1968; Kingdon, 1974). The historical absence of skull metrics in the taxonomy of this genus is related to the similarity of the crania among the different forms, which is not surprising because giant sengis are considered ‘living fossils,’ showing little skeletal divergence from Miocene ancestors (Novacek, 1984; Butler, 1987; Holroyd & Mussell, 2005). Although Corbet & Hanks (1968) distinguished three species, Kingdon (1974) considered the genus monospecific due to colour patterns that he interpreted as hybridization between two of the three species.

We describe a new species of *Rhynchocyon* that is endemic to the Udzungwa Mountains of south-central Tanzania. These mountains are part of the Eastern Arc Mountains, which are a series of ancient and isolated mountain blocks stretching from southern Kenya to south-central Tanzania. Portions of the Eastern Arc Mountains are believed to have supported moist forest for c. 30 million years (Wasser & Lovett, 1993). The age, stability, isolation and fragmented
nature of these forests have combined to produce high levels of biological diversity and endemism (Burgess, Fjeldså & Botterweg, 1998; Myers et al., 2000; Dinesen et al., 2001). The Udzungwa Mountains have the largest area of moist forest and support the highest mammalian diversity in the Eastern Arc Mountains and adjoining Southern Highlanders (Kingdon & Howell, 1993; Burgess et al., 2007). In recent years, a number of undescribed vertebrates have been found in the Udzungwa Mountains, including a new genus and species of bird, the Udzungwa partridge Xenoperdix udzungwensis (Dinesen et al., 1994); the Phillips’ Congo shrew Congosorex philipporum (Stanley, Rogers & Hutterer, 2005); a new genus and species of monkey, the kipunji Rungwecebus kipunji (Jones et al., 2005; Davenport et al., 2006); and several amphibians (Clarke, 1988; Menegon, Salvidio & Loader, 2004) and reptiles (Salvidio et al., 2004; Bauer & Menegon, 2006; see also Burgess et al., 2007 for a complete list).

In 2005, several camera-trap images of what appeared to be an undescribed giant sengi were obtained from the Ndundulu Forest, northern Udzungwa Mountains (Rovero & Rathbun, 2006). In 2006, we organized an expedition to collect voucher specimens. Here, we describe these as a new species of Rhynchocyon.

Materials and methods

Specimens were collected during a 2-week expedition into the Ndundulu forest (Fig. 1) in March 2006. We deployed several trapping methods that have proven successful for giant sengis, including live traps (Tomahawk Trap Company, Tomahawk, WI, USA; model 102, 13 × 13 × 40.5 cm) and white nylon gill nets that were dyed black (21D/18 twine, 7.62-cm stretch mesh, 20-mesh deep, 45.7 m long). The live traps and net mesh proved to be too small for the unexpectedly large sengis. In addition, the nets were not deep enough and were too mesh visible when the black dye leached out with the frequent rain. However, R. R. M. captured four Rhynchocyon with traditional nylon-twine snares set on presumed sengi trails. We also collected and preserved in formalin a partially eaten carcass, assumed to be abandoned by a raptor, found next to a foothpath in the forest. Captured animals were photographed, measured, weighed, euthanised if alive and prepared as standard museum study skins and skulls. The remaining postcranial material from three of the four captured specimens was preserved in formalin. The specimens are deposited at the California Academy of Science (CAS), University of Dar es Salaam (UDSM), National History Museum (BMNH, formerly British Museum of Natural History), Field Museum of Natural History (FMNH) and Museo Tridentino di Scienze Naturali (MTSN). The study skins were compared with a diverse collection of Rhynchocyon specimens by G. B. R., including 57 Rhynchocyon cirnei Peters 1847 (chequered sengi), 15 Rhynchocyon petersi Bocage 1880 (black and rufous sengi) and four Rhynchocyon chrysopygus Günther 1881 (golden-rumped sengi). These specimens represented all valid subspecies described by Corbet & Hanks (1968) except for Rhynchocyon cirnei cirnei Peters 1847 (Supplementary Material Appendix S1).

Data on distribution, activity patterns and abundance were derived from camera-trapping and visual sightings. Camera-traps (Vision Scouting cameras, Non Typical Inc., Park Falls, WI, USA) were set to take pictures 24 h a day with a 1-min delay between exposures. The date and time of each photograph were automatically imprinted on the film (ASA 200, colour, Kodak, Rochester, NY, USA) when exposed. Four cameras were deployed in pristine sub-montane and montane moist forest (sensu Lovett, 1993) in the Vikongwa River Valley of the Ndundulu forest within a 1 km radius of 7°48.203’S, 36°30.255’E at 1360–1440 m above sea level (a.s.l.) between September 2005 and March 2006. Camera-trap days were calculated as the total number of 24-h periods each camera was operating (i.e. from deployment until the film was full or the cameras were retrieved) and camera-trap rate was calculated as the ratio of sengi images to trap-days multiplied by 100. The total camera-trap days at these sites was 168, with a mean of 24 per camera. Twenty cameras were deployed at two sites in Mwanihana forest: site 1 was centred on 7°45.11’S, 36°51.974’E (altitude 900–1700 m a.s.l.) and site 2 was centred on 7°50.448’S, 36°56.912’E (altitude 900–1100 m a.s.l.). Sampling occurred during June–July 2006, totalling 557 camera-trap days with a mean of 29 trap-days per camera.

In addition to our giant sengi sightings (n = 40), which were obtained opportunistically during c. 150 man-days of survey work, we used two sightings obtained by Thomas Butynski and Quentin Luke (Rovero & Rathbun, 2006). We calculated a visual encounter rate for the new sengi using 10 of the overall 40 sightings, which we obtained during an intensive 7-day survey in Ndundulu-Luhomero forest in March 2006 between 1350 and 1800 m a.s.l. [11 km² of forest area surveyed (Jones, 2006)]. Three teams of two observers slowly walked non-overlapping routes of least resistance through a different area of the forest each day, and recorded all giant sengis encountered between 6:50 and 18:00 h. Surveying was paused between 12:30 and 14:30 h, and whenever it was raining, yielding a survey effort of 132.5 h. All records were geo-referenced using portable global positioning system receivers (Garmin Ltd, Romsey, Hampshire, UK).

Description of the new species

Rhynchocyon udzungwensis Rathbun & Rover sp. nov.

Holotype
CAS 28043, adult female prepared as skin, skull, post-cranial carcass in formalin and tissue samples in alcohol. Collected on 18 March 2006 (Figs 1 and 2).

Paratypes
UDSM 467, entire adult male in formalin and tissue samples in alcohol, collected on 12 March 2006 at 7°47.665’S,
36°29.513'E, which is 2.5 km north-west of the type locality; BMNH 2007.7, adult male skin, skull, post-cranial carcass in formalin and tissue samples in alcohol, collected on 18 March 2006 at the type locality; FMNH 194127, adult female skin, skull, post-cranial carcass in formalin and tissue samples in alcohol, collected on 20 March 2006 at 7°48.214'S, 36°30.354'E, which is 0.1 km north of the type locality; MTSN 6000, adult male skin, skull and tissue samples in alcohol, collected on 23 March 2006 at 7°48.214'S, 36°30.354'E, which is 0.1 km north of the type locality (Fig. 2).

Type locality
Vikongwa River Valley, Ndundulu Forest, West Kilombero Scarp Forest Reserve, Udzungwa Mountains, Iringa Region, Tanzania [7°48.269'S, 36°30.355'E (Arc 1960 datum)], at 1350 m a.s.l. This location is c. 15 km south-east of Udekwa Village, Iringa Region, Tanzania.

Etymology
The specific epithet is derived from the Udzungwa Mountains in Tanzania, where this species is endemic. We recommend the common name grey-faced sengi or grey-faced elephant-shrew, which maintains the tradition of naming each giant sengi for its most defining colour pattern.

Diagnosis
The mean weight of *R. udzungwensis* is 710 g, which is 25–50% greater than other giant sengis. The mean total body length is 564 mm, which exceeds that of other giant sengis by 10–20%. The upper tooth row is also remarkably longer than other giant sengis (Table 1). *Rhynchocyon udzungwensis* differs in coloration and pattern (colours as used in Corbet & Hanks, 1968) from all other *Rhynchocyon* by its grizzled grey forehead and face, jet-black fur restricted to the lower rump and thighs and slightly grizzled yellow-rufous pelage extending from behind the ears to the shoulders, where it becomes orange-rufous (with no grizzling) on the sides and indistinctly separated from a wide maroon (= dark rufous) stripe down the back (Fig. 2).

Description
The pelage is sparse, glossy, stiff and colourful – similar to other *Rhynchocyon* species and in contrast to the shorter,
the shoulders is grizzled yellow-rufous and becomes orange-
down onto the rear legs. The fur behind the ears and on
jet-black fur on the lower rump extends to the upper thighs
the same length as the pelage on the surrounding areas. The

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rufous on the sides and lacks grizzling, forming an indistinct
boundary with the maroon dorsal stripe. The grizzled
appearance of the shoulders is due to black tips on the hair,
which become slightly shorter on the sides. The orange-
rufous sides integrate over about 2 cm with the jet-black fur
on the leading edge of the thighs. The belly and inner thighs
have very sparse pale rufous fur about the same length as on
the sides, but starting at about the base of the sternum and
onto the chest the fur becomes denser and pale yellow,
becoming pale cream on the chin. The inner forelegs are a
mixture of short pale yellow fur that extends from the chest
and orange-rufous fur that extends from the shoulders. The
feet are black with sparse and short rufous fur on the
dorsum. The tail skin is slightly bi-coloured, nearly black
dorsally and dark brown ventrally, with a sub-terminal
white band 4–6 cm long. The short and very sparse tail hairs
are the same colour as the skin. The pinnae are essentially
naked and dark brown to nearly black.

Figure 2 Photographs of *Rhynchocyon udzungwensis* sp. nov.: above, captive live animal (holotype, CAS 28043, photo F. R.); below, four specimens (three paratypes and holotype) prepared as study skins. From top to bottom: BMNH 2007.7, FMNH 194127, MTSN 6000, CAS 28043 (photo D. Lin, CAS). BMNH, British Museum of Natural History; CAS, California Academy of Science; FMNH, Field Museum of Natural History; MTSN, Museo Tridentino di Scienze Naturali.

denser, fluffier and greyish or brownish fur of the Macro-
scelidinae. The first 2 cm of the exceptionally long nose are
essentially naked and black. The hair on the sides and top of
the face back to the base of the ears has black bases and
cream to pale white tips, giving a grizzled grey appearance.
A maroon nuchal crest 2–2.5 cm high, about 1 cm higher
than the ear crowns, starts between the ears and extends
back about 3 cm. The maroon colour of the crest encroaches
about 1 cm into the grey pelage of the forehead and forms an
indistinct stripe that widens along the back from behind the
ears to the rump, where it narrows and integrates with the
jet-black fur over about 3 cm to a point about 3 cm above
the tail insertion. The lower rump is jet black. In certain
lights and from certain angles, two parallel slightly darker
lines are barely visible within the maroon dorsal stripe, each
with up to four very faint pale spots near the leading edge of
the black rump. This vestigial chequering is similar to that of
*R. petersi* and *R. chrysopygus*. The black rump hair is about
the same length as the pelage on the surrounding areas. The
jet-black fur on the lower rump extends to the upper thighs
and down onto the rear legs. The fur behind the ears and on
the shoulders is grizzled yellow-rufous and becomes orange-

Distribution

All records of *R. udzungwensis* are from the Ndundulu–Lu-
homero forest and the Mwanihana forest to the east (Fig. 1).
These two forest blocks are separated by about 20 km of
grazing and woodland that is unlikely to be suitable
habitat for *R. udzungwensis* (Corbet & Hanks, 1968).

*Rhynchocyon udzungwensis* occurs in closed canopy forest
from 1350 to 2300 m a.s.l. in Ndundulu–Luhomero (esti-
imated range 200 km²) and from 1000 to 1700 m a.s.l. in
Mwanihana forest (estimated range 100 km²). At site 1 in
the Mwanihana forest (see ‘Methods’), we only camera-
trapped *R. udzungwensis*, whereas at site 2, which is about
10 km south, we only recorded *Rhynchocyon cirnei reichardi*
Reichenow 1886.

Variation

There is little colour variation in the five specimens from
Ndudulu, except for the length of the sub-terminal white
zone on the tail (73, 94, 52, 50 and 58 mm). The weight, body
measurements and length of the upper tooth row of the
specimens are remarkably consistent, but there appears to
be sexual dimorphism in canine length (Table 1). The
vestigial chequers on the back vary from hardly visible on
the Ndudulu specimens to more defined on some indivi-
duals camera-trapped at Mwanihana.

Comparison

The differences in pelage pattern between *R. udzungwensis*
and *R. chrysopygus* and most forms of *R. cirnei* are clear and
unambiguous. A bright yellow rump patch (with slightly
longer hair) is found only on *R. chrysopygus*, while distinct
chequers (a series of six dark and light stripes and spots on
the back) are only found on *R. cirnei*. Although there are
some similarities in the coloration of *R. udzungwensis*, *R.
petersi* and the dark coastal form of *Rhynchocyon cirnei*
macrurus Günther 1881, the defining characteristics can be
summarized as follows: the feet, tail and pinnae of *R.*
udzungwensis are mostly black compared with orange-rufous in R. petersi and the face is grizzled grey in R. udzungwensis and orange-rufous in R. petersi; the jet-black rump of R. udzungwensis is restricted to the lower rump and thighs while in R. petersi it extends up to the back of the shoulders. The fur on the chest of R. udzungwensis is pale yellow, whereas it is orange-rufous in R. petersi. The dark forms of R. c. macrurus and R. udzungwensis are more difficult to distinguish. Rhynchocyon c. macrurus has a grizzled yellow forehead that extends below the eyes, whereas in R. udzungwensis the forehead is grizzled grey and extends below the eyes and to the pinnae. In R. c. macrurus, the outer surface of the pinnae is orange-brown, the chin and chest are orange-rufous and the rump and thighs are maroon, whereas in R. udzungwensis the pinnae are dark brown to black, the chin and chest are pale cream and pale yellow and the rump and thighs are jet black. We found no evidence of a dermal shield on the rump of R. udzungwensis, as occurs in R. chrysopygus (Rathbun, 1978), and there was no evidence of a dermal shield in any of the other forms of Rhynchocyon examined by G. B. R. at the BMNH.

Ecology, behaviour and reproductive biology

We found R. udzungwensis in different forest types, but always within moist, sub-montane and montane evergreen to upper montane closed-canopy forest, including bamboo thickets. The canopy of sub-montane and montane forest was typically 25–50 m high, while that of the upper montane forest was 10–25 m. The forest floor vegetation varied from relatively open areas covered in leaf litter to more densely covered with clumps of grasses, herbs and tree seedlings. Rhynchocyon udzungwensis constructs nests similar to congeneric species (Rathbun, 1979). We examined five nests: each had an oval cup excavated in the soil lined with layered leaves and loose leaves piled on top to form an indistinct dome surrounded by thick leaf litter on the forest floor. Four of the five nests were each situated at the base of a tree (tree-base diameters c. 20 cm for two sites, and 10 cm for other two). Camera-trapping data indicate that R. udzungwensis is strictly diurnal. The 10 images from Ndundulu were obtained between 06:29 and 15:16 h, and the 39 images from Mwanihana were obtained between 06:50 and 17:21 h. We

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### Table 1 Comparative biometrics for Rhynchocyon taxa

<table>
<thead>
<tr>
<th>Taxon</th>
<th>W</th>
<th>HB</th>
<th>T</th>
<th>TL</th>
<th>HF</th>
<th>E</th>
<th>UTR</th>
<th>CF</th>
<th>CM</th>
</tr>
</thead>
<tbody>
<tr>
<td>R. udzungwensis</td>
<td>710.8</td>
<td>310.0</td>
<td>254.0</td>
<td>564.0</td>
<td>82.0</td>
<td>34.6</td>
<td>31.4</td>
<td>6.2</td>
<td>6.9</td>
</tr>
<tr>
<td>R. chrysopygus</td>
<td>534.8</td>
<td>277.9</td>
<td>240.5</td>
<td>518.4</td>
<td>74.0</td>
<td>33.5</td>
<td>27.5</td>
<td>4.6</td>
<td>6.6</td>
</tr>
<tr>
<td>R. petersi</td>
<td>N/D</td>
<td>275.4</td>
<td>233.5</td>
<td>508.9</td>
<td>71.2</td>
<td>29.1</td>
<td>27.6</td>
<td>N/D</td>
<td>4.4</td>
</tr>
<tr>
<td>R. cimae stuhlmanni</td>
<td>N/D</td>
<td>272.7</td>
<td>243.5</td>
<td>515.1</td>
<td>85.7</td>
<td>31.0</td>
<td>27.7</td>
<td>N/D</td>
<td>N/D</td>
</tr>
<tr>
<td>R. cimae macrurus (c)</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>26.5</td>
<td>4.3</td>
<td>N/D</td>
<td>N/D</td>
</tr>
<tr>
<td>R. cimae macrurus (m)</td>
<td>N/D</td>
<td>254.7</td>
<td>230.8</td>
<td>485.4</td>
<td>71.4</td>
<td>28.1</td>
<td>27.6</td>
<td>N/D</td>
<td>N/D</td>
</tr>
<tr>
<td>R. cimae reichardi</td>
<td>N/D</td>
<td>352.0</td>
<td>242.0</td>
<td>458.8</td>
<td>81.9</td>
<td>29.3</td>
<td>25.7</td>
<td>N/D</td>
<td>N/D</td>
</tr>
</tbody>
</table>

Data are mean (sample size), so (when the sample size is greater than four) and range. W, weight; HB, head and body; T, tail; TL, total length; HF, hind foot *sin unguis* (without nail); E, ear; UTR, upper tooth row; CF, canine length females; CM, canine length males; N/D, no data. UTR excludes rudimentary incisor, which is sometimes absent. All measurements are in mm, except weight (g).

Data source:
- aG. B. R. (unpubl. field data).
- bRathbun (1978).
- cG. B. R. (data from BMNH specimens).
- dAllen (1922).
- ePresumably measured *con unguis* (with nail); *con unguis* data for R. udzungwensis: 91.4 mm (n=5), ± 1.2 mm, 89–96 mm.
obtained a total of 37 daylight sightings in Ndundulu–Luhomero and three in Mwanihana forest. During intensive primate surveys at Ndundulu (Jones, 2006), we obtained 10 sightings, yielding an encounter rate of 0.08 animals h\(^{-1}\). The mean camera-trapping rate was 7.4 (\(n = 10\) photographs) in Ndundulu and 11.1 (\(n = 39\)) in Mwanihana.

One of the females captured (MTSN 6000) was pregnant with one foetus in each horn of the uterus (33 mm crown–rump lengths). Single and twin births are common in \(R.\ cirnei\) and \(R.\ petersi\), but only single births are known for \(R.\ chrysopygus\) (Rathbun, 1979).

**Discussion**

Corbet & Hanks (1968) defined the three species of *Rhynchocyon* based on their geographic distribution and pelage coloration, but they used no skull features. Based on their keys and descriptions, *R. udzungwensis* is clearly deserving of species status. The authors, however, made note of a peculiar cline of *R. macrurus* specimens in south-eastern Tanzania that grade from a dark coastal form with indistinct chequers to a highly chequered form inland. Kingdon (1974) viewed that grade from a dark coastal form with indistinct chequers to a highly chequered form inland. Kingdon (1974) viewed evidence like this as supporting his description of *Rhynchocyon* as being monotypic (*R. cirnei*), with distinct chequers being more common in forms inhabiting open woodlands and darker coloration being more common in forests and areas of high humidity. Kingdon (1974) also viewed the chequered pattern on the back, visible in many *Rhynchocyon*, as further proof of the monospecific nature of *Rhynchocyon*. However, Kingdon (1974) did recognize *R. chrysopygus* and *R. petersi* as likely incipient species. The distinct chequering found on the back of most *R. cirnei*, and the vestigial chequers of *R. chrysopygus*, *R. petersi* and *R. udzungwensis*, suggest that this colour pattern is ancestral and therefore not helpful in distinguishing species of *Rhynchocyon*. Unfortunately, there are few published cranimetric data for *Rhynchocyon* for comparison with the new species.

The large size of *R. udzungwensis* suggests that this dark form is different from *R. petersi* and the coastal form of *R. c. macrurus*. This larger size may be due to climatic factors such as a lower temperature and therefore discordant with Bergmann’s rule, although, as indicated by a recent review (Millien et al., 2006), the factors contributing to a larger body size are complex and might be correlated with a number of ecological factors. Moreover, other forms such as *Rhynchocyon cirnei hendersoni* Thomas 1902 and *Rhynchocyon cirnei shirensis* Corbet & Hanks (1968) occur at similar altitudes as *R. udzungwensis*, but they are not reported to be unusually large (Corbet & Hanks, 1968). We believe that the large size of *R. udzungwensis* is of considerable taxonomic significance.

*Rhynchocyon udzungwensis* appears to be restricted to submontane and montane forest in the Ndundulu–Luhomero and Mwanihana forests. Based on our results, and camera-trapping and surveys conducted before this study at elevations ranging from 300 to 1000 m a.s.l., the highly chequered *R. c. reichardi* occurs between 450 and 870 m a.s.l. (Fig. 1; F. Rovero, unpubl. data), whereas *R. udzungwensis* occurs above 1000 m a.s.l. In Mwanihana forest, there appears to be a spatial gap of about 10 km between the known localities of these two species, where no giant sengis have yet been recorded, despite camera-trapping and visual surveys. Thus, the difference in size and the observed lack of any hybrids support the idea that this new *Rhynchocylon* is a different species, which is also consistent with the number of other endemics in the same area.

An estimate of the abundance of *R. udzungwensis* can be made using population density data for other *Rhynchocyon*. Based on home-range sizes (Rathbun, 1979; FitzGibbon, 1997) and surveys of nest densities (FitzGibbon & Rathbun, 1994), *R. chrysopygus* attains densities of up to 150 individuals km\(^{-2}\) in protected habitats (FitzGibbon, 1994), but there are no data relating these densities to visual encounter rates. In Tanzania, *R. petersi* nest surveys indicate densities of up to 80 individuals km\(^{-2}\), which are also more typical of *R. chrysopygus*, but in the South Pare Mountains (northern Eastern Arc Mountains of Tanzania) an estimated density of 19 individuals km\(^{-2}\) was determined (Coster & Ribble, 2005), with a visual encounter rate of 0.001 animals per survey hour (S. Coster, pers. comm.). Our encounter rate for *R. udzungwensis* of 0.08 per survey hour, therefore, suggests a relatively high density, even though differences in visibility between sites might also affect this comparison. Assuming a density range of 50–80 individuals km\(^{-2}\), which is within the mid-range for other giant sengis, the total population estimate for *R. udzungwensis* is 15 000–24 000 in the 300 km\(^2\) of forested habitat. This is similar to the estimated population of 20 000 individuals (FitzGibbon, 1994) for the Endangered *R. chrysopygus* (IUCN, 2007).

The newly described *R. udzungwensis* adds to at least 25 new vertebrate species from the Eastern Arc Mountains and Tanzanian Southern Highlands in the last decade, five of which are mammals (Burgess et al., 2007). In the Udzungwa Mountains alone, the number of strictly endemic mammals is now five, and 13 out of the 17 Eastern Arc endemic or near-endemic mammals (Burgess et al., 2007) are found in this area. The discovery of *R. udzungwensis* is yet further evidence of the global importance of the Eastern Arc and Southern Highlands for conservation of endemic vertebrates in general and mammals specifically (Myers et al., 2000; Burgess et al., 2007).}

All current records of *R. udzungwensis* occur either within the Udzungwa Mountains National Park or within the West Kilombero Scarp Forest Reserve, which are fully protected areas designated for biodiversity and ecosystem protection. Anthropogenic disturbance, such as forest fragmentation and destruction, and subsistence hunting, are documented threats to giant sengis (FitzGibbon, Mogaka & Fanshawe, 1995; Rathbun & Kyalo, 2000; IUCN, 2007). During our surveys, we did not encounter signs of human disturbance, such as hunting or tree cutting. However, as the human population around the Eastern Arc Mountains continues to expand and move closer to protected areas (Schipper & Burgess, 2004), threats to the very localized *R. udzungwensis* are likely to increase.
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Supplementary material

The following supplementary material is available for this article:

Appendix S1. Material examined by G.B.R. Specimen acronyms are BMNH (Natural History Museum), CAS (California Academy of Sciences), RMCA (Royal Museum of Central Africa). Taxa of Rhynchocyon follow Corbet & Hanks (1968). Collection locations are transcribed from specimen labels.

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