AFROTHERIAN CONSERVATION

Newsletter of the IUCN/SSC Afrotheria Specialist Group

IUCN The World Conservation Union

Species Survival Commission

Number 5 **December 2007**

Afrotherian Conservation is published once a year by the IUCN Species Survival Commission Afrotheria Specialist Group to promote the exchange of news and information on the conservation of, and applied research into, golden moles, sengis, hyraxes, tenrecs and the aardvark

Editors: PJ Stephenson and Stephanie Mansourian

Message from the Chair

Galen Rathbun
Chair, IUCN/SSC Afrotheria Specialist Group

Newsworthy occurrences involving the smaller afrotheres are often few, at least compared with the charismatic elephants and sea cows, but since our last newsletter a couple of important events have occurred. First, the number of species of Afrotheria increased when Steve Goodman and his colleagues described a new shrew tenrec (*Microgale jobihely*) from Madagascar (see abstracts on page 9). Similarly, it appears that a new form of giant sengi (*Rhynchocyon*) from a remote and pristine forest in the Eastern Arc Mountains of Tanzania may have been found (Rovero and Rathbun 2006, see bibliography). Word on the grapevine says that we may also expect additional new species of sengis to be described in the near future…..stay tuned. Given that there are relatively few extant afrotheres, these discoveries result in a significant increase in the diversity of this radiation.

The second noteworthy event is the increased interest in two afrotheres, which has resulted from some recent high profile publicity. A popular article on the tenrecs of Madagascar was written by our Tenrec Section Co-ordinator PJ Stephenson (2007), which has resulted in the BBC in the UK becoming interested in featuring streaked tenrecs (*Hemicentetes*) in their upcoming television series "LIFE". Similarly, the golden-rumped sengi (*R. chrysopygus*) was singled out for special attention by the Zoological Society of London's EDGE programme- http://www.edgeofexistence.org/home.asp. This publicity has resulted in several film producers focusing on this species, including the BBC. More importantly, the attention has resulted in potential support for a badly needed status and conservation survey for *R. chrysopygus* in coastal forests in northern Kenya (see news item on page 8). Both the tenrec and sengi efforts are good examples of the positive results that publicity can achieve.

Andrew Taylor, who has served so ably as the Aardvark Section Co-ordinator since we formed our group, now has a postdoctoral position in Wyoming, USA. Because of his new position, Andrew has switched rolls with Tom Lehmann, who is now Aardvark Section Co-ordinator. Andrew, however, will continue to provide us with valued expertise. Andrew, thank you for your past guidance - and welcome Tom!

We continue to fine-tune our website (http://www.calacademy.org/research/bmammals/afrotheria/ASG.html). Gary Bronner assembled material for the golden moles section and several of our specialist group members interested in the aardvark are working on an update of that section. I continue to update the sengi material, and PJ Stephenson is assembling material on tenrecs. We also implemented some improvements suggested by our members, including a new home page menu link to conservation issues, assembled by Rob Asher. Contact Rob to contribute material to these pages.

Thanks, again, for all your time and effort in continuing to keep the lesser-known afrotheres in the spotlight.

G.B. Rathbun
Cambria, California. 1 December 2007

INSIDE THIS ISSUE

Species Profile:
Streaked tenrecs, *Hemicentetes*

P.J. Stephenson
WWF International, Avenue du Mont Blanc, CH-1196 Gland, Switzerland.
pjstephenson@wwfint.org

The incredible adaptive radiation of the Tenrecidae on Madagascar is well demonstrated by streaked tenrecs of

the genus *Hemicentetes*. The two species in this genus, the lowland streaked tenrec (*H. semispinosus*) and the highland streaked tenrec (*H. nigriceps*), exhibit the relatively ancestral characteristics of an ancient lineage of mammals, while at the same time showing many highly adapted behavioural and morphological characteristics (see Eisenberg and Gould 1970, Olson and Goodman 2003).

Both species of *Hemicentetes* are recognized by their streaked appearance (Eisenberg and Gould 1970, Garbutt 1999). The upperparts of *H. semispinosus* are characterized by well-developed spines with yellow to orange longitudinal stripes. The dorsum of *H. nigriceps* has less developed, dull white to pale yellow spines that form broad lateral stripes. The crown and head are black and lack the yellow stripe that runs from nose to crown in *H. semispinosus*. The underfur in *H. nigriceps* is more developed, giving it a "woolly" appearance. The striped patterning of *Hemicentetes* provides a degree of crypsis when foraging. Immature common tenrecs (*Tenrec ecaudatus*) have similar striped patterning on their upper body, probably for the same reason, though this common adaptation may also reflect a close ancestry between these two genera (Eisenberg and Gould 1970, Nicoll 1983).

Hemicentetes semispinosus is the slightly larger species, with a head-body length of 130-190 mm and a mass of 90-220 g, compared to *H. nigriceps,* at 120-160 mm and 70-160 g (Stephenson 1991, Garbutt 1999). Body mass for both species varies seasonally, with a peak around March - April (Stephenson and Racey 1994). Both lack tails and have pronounced, pointed snouts. Quills in both species are barbed and detachable and are particularly prominent around the crown or nuchal crest. When agitated, streaked tenrecs raise the spines on the nuchal crest and, if further provoked, they resort to a head-butting action to embed spines in the aggressor. Besides camouflage and defence, streaked tenrecs use spines for intraspecific communication. The stridulating organ on the dorsum is able to vibrate quills together to create ultrasonic sounds that are detected by other individuals up to four metres away (Gould 1965, Wever and Herman 1968).

A lowland streaked tenrec, *Hemicentetes semispinosus.*

Streaked tenrecs occur in primary and secondary forest and are often seen on agricultural land and in gardens (Eisenberg and Gould 1970). The species are usually allopatric (occurring in different geographical areas) as *H. nigriceps* is largely confined to the central highlands and *H. semispinosus* is found in lower lying rain forest (see Goodman *et al.* 2000 for review). Even where their ranges overlap, such as on the mountains that skirt the eastern edge of the central highlands and the eastern escarpment, they generally occur at widely differing elevations. *H. nigriceps* occurs in montane and sclerao-phyllous forests and above the forest line, whereas *H. semispinosus* occurs in lowland forest and clearings near the forest edge. However, the two species were found living in sympatry at 1550 m in Mahatsinjo Forest, dispelling any lingering notion that they were the same species (Goodman *et al.* 2000).

Hemicentetes excavate burrows, which may be up to 150 cm in length and about 15 cm below the surface of the ground, containing a single nest chamber (Eisenberg and Gould 1970). Leaves may be used to plug the entrance hole. Although *H. semispinosus* is often recorded foraging in daylight hours*, H. nigriceps* is strictly nocturnal, with peak activity occurring three to four hours after darkness. Both species forage among leaf litter on the forest floor. They have reduced dentition, reflecting their specialized diet of earthworms and other soft-bodied invertebrates (Gould and Eisenberg 1966, Eisenberg and Gould 1970). Carnivores such as *Cryptoprocta ferox, Fossa fossana,* and *Galidia elegans*, as well as large snakes, prey upon them.

Both species of *Hemicentetes* exhibit a reduction in activity during the austral winter (Gould and Eisenberg 1966), apparently brought about by endogenous rhythms (or an "inner clock") entrained by ambient temperature or photoperiod or both (Stephenson and Racey 1994). *H. semispinosus* is a facultative hibernator (Stephenson and Racey 1994) and, if favourable climatic conditions prevail, it is able to remain active and can breed all year round. The ability of this species to avoid torpor may increase reproductive output and provide a competitive advantage. *H. nigriceps* is an obligate hibernator which enters a more profound torpor and aestivates from around May to October (Stephenson and Racey 1994). Throughout the austral winter body temperature in both species is maintained at less than 2^0C above ambient, and resting metabolic rate (RMR) is reduced by up to 75%. Both species have levels of RMR lower than expected for mammals of their size but similar to other tenrecs. During reproduction, females experience elevated RMR and an associated improvement in homeothermy (Stephenson and Racey 1994).

Hemicentetes is the most precocious tenrec. After a gestation length of 55-63 days (relatively long for a small mammal but typical of a tenrec), the neonates mature more rapidly than any other species in the family (Eisenberg and Gould 1970, Eisenberg 1975, Stephenson 1991, Stephenson *et al.* 1994). Neonates open their eyes at 7-12 days and are weaned within 3 weeks. *H. semispinosus* is sexually mature at 35-40 days, whereas other spiny tenrecs do not mate until they are at least six months old. Litter size *in H. nigriceps* is 2-4 with a mean of 2.8, whereas *H. semsipino*sus has 2-11 neonates per litter with a mean of 6.6. Neonate weight in both species is just over eight grams at birth (Stephenson *et al.* 1994). Longevity in the wild is unknown but *H. nigriceps* has lived for more than three years in captivity (Stephenson *et al.* 1994).

H. semispinosus lives in multi-generation groups with one of the most complex social systems known in an afrotherian. Because of the speed of maturation and

relatively large litter size, a family group may comprise more than 20 individuals from three related generations. They forage together, maintaining contact between individuals and subgroups through use of the stridulating organ. Little is known of the social organization of *H. nigriceps*. This reflects the fact that, although research published largely in the 1970s and 1990s improved our understanding of streaked tenrecs, much remains to be discovered about the behaviour, social organization and microhabitat use of these fascinating and unique animals.

The ability of streaked tenrecs to adapt to anthropogenic environments means they are not threatened. In addition, both species are found in a number of protected areas within their ranges (Nicoll and Langrand 1989).

References

Eisenberg, J.F. 1975. Tenrecs and solenodons in captivity. *International Zoo Yearbook,* 15:6-12.

Eisenberg, J.F. and Gould, E. 1970. The tenrecs: a study in mammalian behavior and evolution. *Smithsonian Contributions to Zoology,* 27:1-127.

Garbutt, N. 1999. *Mammals of Madagascar.* Yale University Press, New Haven and London, US and UK.

Goodman, S.M., Rakotondravony, D., Soarimalala, V., Duchemin, J.B. and Duplantier, J.-M. 2000. Syntopic occurrence of *Hemicentetes semispinosus* and *H. nigriceps* (Lipotyphla: Tenrecidae) on the central highlands of Madagascar. *Mammalia,* 64:113-116.

Gould, E. 1965. Evidence for echolocation in the Tenrecidae of Madagascar. *Proceedings of the American Philosophical Society,* 109:352-360.

Gould, E. and Eisenberg, J.F. 1966. Notes on the biology of the Tenrecidae. *Journal of Mammalogy*, 47:660-686.

Nicoll, M.E. 1983. Mechanisms and consequences of large litter production *in Tenrec ecaudatus* (Insectivora: Tenrecidae*). Annales du Musée Royale de l'Afrique Centrale, Sciences Zoologiques,* 237:219-226.

Nicoll, M.E. and Langrand, O. 1989. *Madagascar: Revue de la Conservation et des Aires Protégées.* WWF, Gland, Switzerland.

Olson, L.E. and Goodman, S.M. 2003. Phylogeny and biogeography of tenrecs. Pp. 1235–1242 in Goodman, S.M. and Benstead, J.P. (eds.), *The Natural History of Madagascar.* The University of Chicago Press, Chicago and London, US and UK.

Stephenson, P.J. 1991. Reproductive energetics of the Tenrecidae (Mammalia: Insectivora). Ph.D. thesis, University of Aberdeen, Aberdeen, UK.

Stephenson, P.J. and Racey, P.A. 1994. Seasonal variation in resting metabolic rate and body temperature of streaked tenrecs, *Hemicentetes nigriceps* and *H. semispinosus* (Insectivora: Tenrecidae). *Journal of Zoology, London,* 232:285-294.

Stephenson, P.J., Racey, P.A. and Rakotondraparany, F. 1994. Maintenance and reproduction of tenrecs (Tenrecidae) at Parc Tsimbazaza, Madagascar. *International Zoo Yearbook,* 33:194-201.

Wever, E.G. and Herman, P.N. 1968. Stridulation and hearing in the tenrec*, Hemicentetes semispinosus. Journal of Auditory Research,* 8:39-42.

This article was adapted from: Stephenson, P.J. 2003. *Hemicentetes,* Streaked Tenrecs. Pp 1281-1283 in Goodman, S.M. and Benstead, J.P. (eds.), *The Natural History of Madagascar.* University of Chicago Press, Chicago and London, US and UK.

Article:

Longevity and fecundity in sengis (Macroscelidea)

Gea Olbricht
Dept. General Zoology, University Duisburg-Essen, Universitätsstr.5, 45141 Essen, Germany
gealex@online.de

Introduction

Longevity records of mammals have elicited interest for many years. Most data rely on information from captive animals. Summarized information was published by Schmidt (1880), Jones (1968, 1982, 1993) and Weigl (1993, 2005). Information on the lifespans of free-ranging animals is hard to collect. In addition, wild animals face life-threatening situations with predators, intraspecific competition, disease and sometimes suboptimal diet, so the achievement of maximum life-span is unlikely.

Referring to unusual reproductive performances and ages achieved by captive small mammals, Egoscue *et al.* (1970) argued that, although maximum-recorded longevities establish species potentials and measure the suitability of the conditions under which the animal is kept, in practice such data has limited field application. In contrast, Holmes and Austad (1994) take into account that maximum-recorded longevities for captive animals are a generally-accepted index of maximum potential lifespan. Manville (1957) states that understanding the variability in lifespan among vertebrates may be useful to various field workers studying wild animals. Snyder and Moore (1968) emphasize the potential value of longevity data to scientists concerned with the problems of ageing.

Longevity in sengis

Lifespans for several sengi species are presented in Table 1. As expected, recorded longevity in wild specimens is shorter than in captive ones. Information on wild individuals is scarce. For some species no data are available. For captive animals, average recorded lifespan has increased over time due to improvements in meeting dietary requirements (Snyder and Moore 1968).

Rathbun (1979a) expected wild *Rhynchocyon chrysopygus* to live four to five years; yet some years later a captive specimen was found to have reached the age of almost 11 years (Weigl 2005) This was the longest lifespan for a macroscelid ever recorded; the second longest was *E. intufi* with nine years and *Macroscelides proboscideus* and *E. rufescens* with about eight years.

The contrast between the wild lifespan record in *E. rufescens* of 1.5 years (Rathbun 1979b) and the captive record of 8 years (Weigl 2005) further highlights the difficulty in extrapolating data to determine factors such as lifetime reproductive potential.

Table 1. Longevity records for several species of sengis. The data for captive animals was minimum age, and some animals were wild born. y=years, m=months (all captive records by Weigl, 2005).

Species	Longevity	
	In the wild	**In captivity**
Rhynchocyon chrysopygus	4 or 5y (Rathbun 1979a)	>11y
R. petersi		4y 6m
Petrodromus tetradactylus		6y 7m
Macroscelides proboscideus		8y 8m
Elephantulus edwardii		5y 8m
E. brachyrhynchus		4y 2m
E. intufi		9y 3m
E. rozeti	>2 y (Séguignes, 1989)	7y 2m
E. rufescens	>1y 7m (Rathbun, 1979b)	7y 11m
E. rupestris		4y 2m
E. myurus jamesoni	normally 1y 1 m, exceptionally 1y 7m (van der Horst, 1946)	

Fecundity in sengis

Increasing age may lead to a decline in breeding performance and survival. This correlation is subject to further investigation in *Macroscelides proboscideus* (Olbricht *diss. in prep)* but examples given here help to offer further insight.

A captive born male round-eared sengi at Wuppertal Zoo, Germany, had 23 litters with 44 offspring to date, all but two with the same mate. This male had his first litter born when he was aged six months and three days. Only the two first litters were single births, all others were twin litters. Most recently his last litter of surviving twins was born when he was six years and three months. Almost all of his breeding life, except for the two first litters, he has been with the same mate and was never separated from her or his newborn young. This pair, which is still alive, produced a total of 21 twin litters to date. The female was eight months old at the time of the first litter, and her most recent one was at the age of four years and nine months. In exceptional cases both sexes achieve sexual maturity earlier (Olbricht *et al.* 2006). Another captive born female at Wuppertal Zoo had 22 litters with 40 young during her lifespan of almost six years. Among those, were 16 twin pairs, 5 singletons and the unusual birth of triplets. All single births and three of the twin litters occurred after she had reached the age of three and a half and all these young, except one, died right after birth. This example suggests reduced fecundity with older age, as suggested by Harvey and Zammuto (1985). Nevertheless, reproduction was possible until the end of the female's life, with the last litter occurring three months before her death.

The relatively long breeding history demonstrated in these cases contrasts with van der Horst (1946) and McKerrow (1954) who expected female *Elephantulus myurus jamesoni* to die of old age after their third pregnancy.

Life history

Two determining factors for the fecundity of individuals are lifespan and inter-litter intervals (Promislow and Harvey 1990). In fact, continuous breeding with short inter-birth intervals following post-partum oestrous (e.g. van der Horst 1944, Kingdon 1990), and a long lifespan (see Table 1) reveal the high reproductive potential of sengis.

Sengis have a number of behavioural and ecological traits that may represent adaptations to improved survivorship, such as predator avoidance by young (Sauer 1972) and by adults (Rathbun 1979b), risk-sensitive foraging (Lawes and Perrin 1995), defending a territory (Ribble and Perrin 2005) and varied diet (Bernard *et al.* 1996).

The "K-selected" traits of sengis require an effective quality breeding performance over a long life time. This is in line with Harvey and Zammuto (1985) and Promislow and Harvey (1990) who support an evolutionary link between low mortality rates, delayed reproduction and long lifespans.

Jones (1982) suggested that an increase in lifespan is a direct consequence of an increase in body size. The long-term survival of sengis, despite their small body size, does not support this finding and ancestral sengis were not likely to be much smaller than extant species (Evans 1942, Patterson 1965, Simons *et al.* 1991).

Conclusions

Information on captive sengis allows us to draw some assumptions on potential lifespans as well as potential fecundity of particular species. This knowledge may have relevance in determining the capacity of species to recover from population declines, which is especially important for the threatened sengis listed under the IUCN categories "vulnerable" and "endangered" (Nicoll and Rathbun 1990, Boitani *et al.* 1999).

References

Bernard, R.T., Kerley, G.H.I., Doubell, T. and Davison, A. 1996. Reproduction in the round-eared elephant-shrew (*Macroscelides proboscideus*) in the southern Karoo, South Africa. *Journal of Zoology, London,* 240: 233-243.

Boitani, L., Corsi, F., De Biase, A., D´Inzillo Carranza, I., Ravagli, M., Reggiani, G., Sinibaldi, I. and Trapanese, P. 1999. A databank for the conservation and management of the African mammals. Istituto di Ecologia Applicata, Roma, Italy: A1092-A 1152.

Egoscue, H.J., Bittmann, J.G. and Pterovich, J.A. 1970. Some fecundity and longevity records for captive small mammals. *Journal of Mammalogy,* 51 (3): 622-623.

Evans, F.G. 1942. The osteology and relationships of the elephant-shrews (Macroscelididae). *Bulletin of the American Museum of Natural History,* LXXX(IV):85-125.

Harvey, P.H. and Zammuto, R.M. 1985. Patterns of mortality and age at first reproduction in natural populations of mammals. *Nature,* 315:319-320.

Holmes, D.J. and Austad, S.N. 1994. Fly now, die later: Life-history correlates of gliding and flying in mammals. *Journal of Mammalogy,* 75(1):224-226.

Jones, M.L. 1968. Longevity of primates in captivity. *International Zoo Yearbook,* 8:183-192.

Jones, M.L. 1982. Longevity of Captive Mammals. *Zoologischer Garten N.F.,* 52(2):113-128.

Jones, M.L. 1993. Longevity of ungulates in captivity. *International Zoo Yearbook,* 32:159-169.

Kingdon, J. 1990. *Island Africa.* Collins, London, UK.

Lawes, M.L. and Perrin, M.R. 1995. Risk-sensitive foraging behaviour of the round-eared elephant-shrew (*Macroscelides proboscisdeus*). *Behavioural Ecology and Sociobiology,* 37: 31-37.

Manville, R.H. 1957. Longevity of captive mammals. *Journal of Mammalogy,* 38(2): 279-280.

Mc Kerrow, M. 1954. The lactation cycle of *Elephantulus myurus jamesoni* (Chubb). *Philosophical Transactions of the Royal Society of London, series B, Biological Sciences,* 238(6539): 62-98.

Neal, B.R. 1982. Reproductive ecology of the rufous elephant-shrew, *Elephantulus rufescens* (Macroscelididae), in Kenya. *Zeitschrift für Säugetierkunde,* 47: 65-71.

Neal, B.R. 1995. The ecology and reproduction of the short-snouted elephant-shrew, *Elephantulus brachyrhynchus*, in Zimbabwe with a review of the reproductive ecology of the genus Elephantulus. *Mammal Review*, 51-60.

Nicoll, M.E. and Rathbun, G.B. 1991. African Insectivora and Elephant-shrews, An Action Plan for their Conservation. Published by The IUCN, Gland, Switzerland.

Olbricht, G. Kern, C. and Vakhrusheva, G. 2006. Einige Aspekte der Fortpflanzungsbiologie von Kurzohr-Rüsselspringern (*Macroscelides proboscideus* A. Smith, 18299 in Zoologischen Gärten unter besonderer Berücksichtigung von Drillingswürfen. *Zoologischer Garten N.F.* 75 (5-6):304-316.

Patterson, B. 1965. The fossil elephant-shrews (Family Macroscelididae). *Bulletin of the Museum of Comparative Zoology,* 133(6)297-336.

Promislow, D.E. and Harvey, P.H. 1990. Living fast and dying young: a comparative analysis of life-history variation among mammals. *Journal of Zoology, London,* 75(1): 224-226.

Rathbun, G.B. 1979a. *Rhynchocyon chrysopygus Mammalian. Species,* 117: 1-4.

Rathbun, G.B. 1979b. The social structure and ecology of elephant-shrews *Advances in ethology: Supplement to the Journal of Comparative Ethology/Fortschritte Verhaltensforschung, Beihefte zur Zeitschrift für Tierpsychologie* 20.

Ribble, D.O. and Perrin, M.R. 2005. Social organization of the eastern rock elephant-shrew (*Elephantulus myurus*): the evidence for mate guarding. *Belgian Journal of Zoology,* 135 (Supplement): 167-173.

Sauer, E.G.F. 1972. Setzdistanz und Mutterfamilie bei der Kurzohrigen Elefantenspitzmaus. *Mitteilungen der Baseler Afrika Bibliographien,* 4-6:114-134.

Schmidt, M. 1880. On the duration of life of the animals in the Zoological Garden at Frankfurt on the Main. *Proceedings of the Zoological Society of London,* XXI: 299-319.

Séguignes, M. 1989. Contributions à l´étude de la reproduction d`*Elephantulus rozeti* (Insectivora, Macroscelididae). *Mammalia,* 53(3):377-386.

Simons, E.L., Holroyd, P.A. Bown, T.M. 1991. Early tertiary elephant-shrews from Egypt and the origin of the Macroscelidea. *Proceedings of the National Academy of Science,* 88: 9734-9737.

Snyder, R.L. and Moore, S.C. 1968. Longevity of captive mammals in Philadelphia Zoo. *International Zoo Yearbook*, 8:175-183.

Van der Horst, C.J. 1944. Remarks on the systematics of *Elephantulus. Journal of Mammalogy,* 25(1):77-82.

Van der Horst, C.J. 1946. Some remarks on the biology of reproduction in the female of *Elephantulus*, the holy animal of Set. *Transactions of the Royal Society of South Africa,* 31:181-194.

Weigl, R. 1993. Höchstalter von Säugern im Zoo Frankfurt. *Annual report of the Zoological Garden Frankfurt/Main,* 134:24-29.

Weigl, R. 2005. Longevity of mammals in captivity; from the living collections of the world. *Kleine Senckenberg-Reihe Frankfurt,* 48: 198-199.

Article:

Vicariance and the endemic Cape rock sengi (*Elephantulus edwardii*): are these two linked?

H.A. Smit[1], T.J. Robinson[1] and B. Jansen van Vuuren[1, 2]

[1] Evolutionary Genomics Group, Department of Botany and Zoology, Stellenbosch University, Private Bag X1, Matieland 7602, South Africa

hanneline@sun.ac.za

[2]DST-NRF Centre of Excellence for Invasion Biology, Department of Botany and Zoology, Stellenbosch University, Private Bag X1, Matieland 7602, South Africa

African sengis (Order Macroscelidea) are confined in their distribution to sub-Saharan Africa with the exception of a single species present in North Africa. Within Southern Africa, nine species are recognized representative of three of the four described genera. The Cape rock sengi (*Elephantulus edwardii*) is the only strictly South African endemic sengi. The distribution of this afrotherian has recently been updated (Skinner and Chimimba 2005) and data now suggest that *E. edwardii* is continuously distributed (rather than two disjunct groups) from Namaqualand in the Western Cape Province to Port Elizabeth in the Eastern Cape Province, a distribution that spans several recognized biomes in South Africa (Succulent Karoo, Nama Karoo, and Fynbos; Low and Rebelo 1996; Mucina and Rutherford 2006).

The Cape rock sengi is monogamous, territorial and is confined to a habitat of rocky outcrops (Skinner and Chimimba 2005). Intuitively one would expect that these life history characteristics would play an important role in shaping the spatial distribution of genetic variation, and that this variation would be structured across the landscape. Our aim here is to describe the phylogeographic population structure of the Cape rock sengi and to correlate this pattern to the processes and vicariant events that might have caused it. For this we included 106 sengi specimens sampled from 26 localities throughout the species distribution. The value of museum and other archived specimens (including type specimens) has been largely underestimated in many molecular studies, especially where species have a low abundance and / or are listed by the IUCN as worthy of special conservation attention, a situation typified by the

Cape rock sengi (IUCN Red List 2004: concern; IUCN Red List 2006: least concern). Of the 106 specimens included in our study, 64 are housed in South African museums. In addition, we also included the type specimens of all the previously described, but currently synonymized species and subspecies.

© Arnaud Gregoire

A Cape rock sengi (*Elephantulus edwardii*) in the Cederberg, South Africa.

Some sengi species are phenotypically very similar, rendering field identification problematic. As such, we verified the field identification of all specimens included in this study using genetic distinctiveness as an indicator of species differences. For this, we included representative specimens of the three Southern African sengi species with overlapping ranges in the Western Cape (*E. edwardii*, *E. rupestris* and *M. proboscideus*) and, based on their genetic profiles, demonstrated that these are indeed distinct species. Within the Cape rock sengi, a spatial analysis of molecular variation provided unequivocal evidence of three (geographically and genetically) distinct lineages namely a Karoo, northern Namaqua and central Fynbos clade. The most distinct lineage was the Karoo lineage, representing the localities of Williston {30.2S 20.8E} and Beaufort-West {32.4S 22.6E}. Based on our genetic data, this lineage does not correspond to any of the previously described species / subspecies (*E. karoensis* Roberts 1938 and *E. capensis* Roberts 1924) and is new to science. This is supported by our analysis of several phenotypic characters including tuft length on the tail, the ventral and dorsal pelage and flank colour as well as the colour and shape of the eye ring (a scientific paper is currently in preparation describing this lineage as a new species).

Importantly, our results reveal the morphological misidentification of the *E. karoensis* type specimen which was grouped with *E. rupestris*, highlighting the problems of field identification among sengi species. The apparent misidentification of the *E. karoensis* type was subsequently confirmed by an examination of morphological and dental characters which suggest that Roberts' (1938) original classification was misled by the specimen's subadult pelage.

The northern Namaqua clade occurs along the Atlantic seaboard close to the South African - Namibian border with the central Fynbos clade distributed throughout the Cape Floristic Province. The geographic barrier between these two distinct clades appears to be the Knersvlakte region {30.5S 18.6E}. Importantly, this geographic delimitation corresponds closely to patterns reported for other rock-dwelling vertebrate species, the rock rabbit (*Pronolagus rupestris*; Matthee and Robinson 1996), and the rock agama (*Agama atra*; Matthee and Flemming 2002), indicating a shared biogeographic history for rock-dwelling taxa along the west coast of South Africa. Two independent methods of molecular dating indicate that these two evolutionary lineages separated ~1.7 million years ago (MYA). We speculate that various topographical and climatic events might have either singly, or in concert, repeatedly enforced the population fragmentation across the Knersvlakte. For example, at roughly two MYA (Linder 2003) a series of Pleistocene marine transgressions inundated the western coastal plains with rises in sea-levels of between 45-50m, 75-90m and 27m (Hendey 1970a, b). Secondly, changes in river-flow patterns could also have served as isolating mechanisms. Thirdly, Deacon and Lancaster (1988) argued that climatic changes during the past three million years were particularly harsh on the western side of the continent resulting in temperature fluctuations and associated wet-dry cycles. Lastly, recent Kalahari sand-flows occurred from the north to the south which would have acted as a physical barrier separating populations (Deacon and Lancaster 1988).

Finally, four evolutionary lineages were identified within the central Fynbos clade found within the relative safety of the Cape Fold Mountains (CFM) at the southern tip of Africa. We argue that the geographic occurrence of these four lineages broadly resembles the climatic differences and vegetation types related to the position of these mountain ranges. The high degree of diversity and endemism of the renowned Cape Floristic Province are credited to environmental fluctuations from the Pliocene and Pleistocene epochs (Midgley *et al.* 2001; Linder 2003) coinciding with the separation times (0.7 - 0.24 MYA) between the four evolutionary lineages.

For a full description of this work, see Smit, H.A., Robinson, T.J. and Jansen van Vuuren, B. 2007. Coalescence methods reveal the impact of vicariance on the spatial genetic structure of *Elephantulus edwardii* (Afrotheria, Macroscelidea). *Molecular Ecology,* 16: 2680-2692.

References

Deacon, J. and Lancaster, N. 1988. *Late Quaternary Paleoenvironments of Southern Africa.* Clarendon Press, Oxford, UK.

Hendey, Q.B. 1970a. A review of the Geology and Palaeontology of the Plio/Pleistocene Deposits at Langebaanweg, Cape Province. *Annals of the South African Museum*, 56:75–117.

Hendey, Q.B. 1970b. The Age of the Fossiliferous Deposits at Langebaanweg, Cape Province. *Annals of the South African Museum*, 56:119–131.

Linder, H.P. 2003. The radiation of the Cape Flora, southern Africa. *Biological Revolutions*, 78:597-638.

Low, A.B. and Rebelo, A.G. 1996. *Vegetation of South Africa, Lesotho and Swaziland.* DEAT, Pretoria, South Africa.

Matthee, C.A. and Robinson, T.J. 1996. Mitochondrial DNA differentiation among geographical populations of *Pronolagus rupestris*, Smith's red rock rabbit (Mammalia: Lagomorpha). *Heredity*, 76:514-523.

Matthee, C.A. and Flemming, A.F. 2002. Population fragmentation in the southern rock agama, *Agama atra*: more evidence for vicariance in Southern Africa. *Molecular Ecology*, 11:465-471.

Midgley, G.F., Hannah, L., Roberts, R., MacDonald, D.J. and Allsopp, J. 2001. Have Pleistocene climatic cycles influenced species richness patterns in the greater Cape Mediterranean Region? *Journal of Mediterranean Ecology*, 2:137-144.

Mucina, L. and Rutherford, M.C. (eds). 2006. *The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19.* South African National Biodiversity Institute, Pretoria, South Africa.

Roberts, A. 1924. *Elephantulus capensis. Annals of the Transvaal Museum,* 10: 62.

Roberts, A. 1938. *Elephantulus karoensis. Annals of the Transvaal Museum*, 19: 234.

Skinner, J.D. and Chimimba, C.T. 2005. *The Mammals of the Southern African Subregion.* Third edition. Cambridge University Press. Cambridge. UK.

Article:

A brief graphical history of sengis in captivity

Galen B. Rathbun[1] and Laurie Bingaman Lackey[2]
[1] Department of Mammalogy and Ornithology, California Academy of Sciences (San Francisco), c/o PO Box 202, Cambria, CA 93428, USA
grathbun@calacademy.org
[2] Laurie Bingaman Lackey, International Species Information System (ISIS), 2600 Eagan Woods Drive, Suite 50, Eagan, MN 55121-1170 USA

The International Species Information System (ISIS) is a database that was established in 1973. It currently includes records of nearly two million animals submitted by 700 member institutions in 72 countries (mostly zoos, but some universities). Out of the 15 species of sengi currently recognized, only nine are represented in the database and only two are currently in captivity. In Figure 1 we present data from three commonly held species.

Although there had been scattered early successes in breeding sengis in captivity, the first widespread success was with the rufous sengi (*Elephantulus rufescens*). Indeed, numerous popular and scientific papers were produced based on the founding 14 animals at the National Zoological Park in Washington, D.C. and their subsequent multiple generations in zoos across North America. However, after about 15 years this species completely disappeared from captivity. We believe that this "boom and bust" cycle was due to the initial novelty of captive sengis eventually being lost and the lack of any institution taking the lead in developing and maintaining a genealogical history of the captives ("studbook").

The round-eared sengi (*Macroscelides proboscideus*) has been successfully kept in captivity well before ISIS began compiling data, but not until relatively recently has the population of captives shown a boom – mostly in Europe. Similar to the rufous sengi, the large number of captives has resulted in a bloom of publications on this species. However, given the large number of institutions keeping this species, but the comparatively small total number in captivity, and the lack of a studbook, we wonder if a bust is on the horizon.

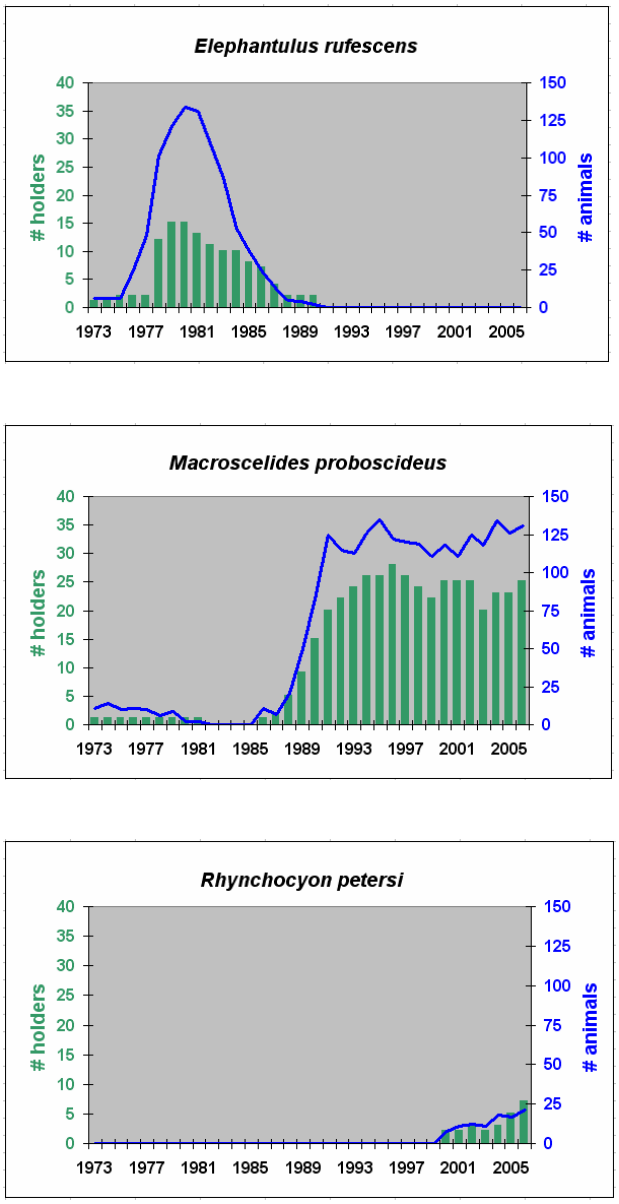

Figure 1: ISIS data on three species of sengi held in captivity.

The giant sengis (genus *Rhynchocyon* with three species) are large, strictly diurnal, and very appealing animals – arguably one of the more charismatic small mammals in the world (yes, we are biased). They all are threatened or near-threatened on the IUCN Red List. Most attempts at maintaining them in captivity have failed. The Frankfurt Zoo, however, was the first to succeed by keeping golden-rumped sengis (*R. chrysopygus*) for many years - but they never bred. Alan Root, the well-known African cinematographer, kept chequered sengis (*R. cirnei*), which were featured in a National Geographic Society film "*Heart of Africa – Forest Primeval*".

© Heidi Hellmuth

A black and rufous sengi (*Rhynchocyon petersi*) female with infant in Philadelphia Zoo.

The greatest success, however, has been with the black-and-rufous sengi (*R. petersi*), which is now held by several zoological parks in North America. As reported in *Afrotherian Conservation* issue 3, the Philadelphia Zoo has been particularly successful in breeding this species. The captive population is still small and it is probably too soon to predict whether this species will go through the boom and bust cycle. Because it is an excellent display animal, and a studbook has been established, perhaps there is hope that these animals will persist in captivity and continue to be a showcase for sengis.

We view captive breeding of great importance for three main reasons. First, the husbandry skills developed may prove to be critical in preventing extinctions. Secondly, displaying captives has immense educational potential, especially for raising awareness of rare and threatened species. Thirdly, maintaining captives often produces invaluable scientific knowledge, including insights that are difficult to gather from free-living animals. We hope that the boom and bust cycle can be avoided, especially with unusual, rare, and threatened species, which includes a large proportion of the afrotheria.

Afrotheria News

Survey of the golden-rumped sengi planned north of the Tana in Kenya

E.M. Mwangi
University of Nairobi; School of Biological Sciences, P.O. Box 30197 00100 Nairobi, Kenya
emmwangi@uonbi.ac.ke

A new study aimed at establishing the status of the golden-rumped sengi (*Rhynchocyon chrysopygus)* is being developed by the University of Nairobi's conservation biology programme. It is intended to cover the forests north of the Tana River along the Kenyan coast.

According to available records, the historical distribution of the sengi extended all along the eastern African coastal forests, stretching from northern Mozambique to southern Somalia. This was once a continuous swathe of forest, or closely interconnected forest patches.

Throughout recent history, human encroachment has seriously impacted on sengi habitat as a result of uncontrolled logging, clearing for cultivation and urbanisation. Rapid human population growth has also led to sengis being extensively hunted for meat. They are also exposed to severe predation pressure, including by feral dogs. Consequently the species has suffered a drastic reduction in both numbers and distribution. Currently, it is only known to occur in small isolated coastal forests north of Mombasa. It is only in the Arabuko Sokoke Forest (ASF) and five smaller patches around it that its status is reasonably well known from recent studies. There is ample reason, however, to believe that the sengi occurs in the forests north of the Tana River where habitats are still relatively intact and human impact is low.

In the new survey, which is expected to commence with a hands-on training for field researchers within the ASF, we hope to update out present knowledge of the species' conservation needs in ASF, and establish authoritatively the presence of sengis in the forests further north, including the Boni and other forests between the delta and Kiunga.

Site visits, live-trapping, and interviews with local residents will be used to determine the presence of sengis and the conservation status of forest habitats found to be occupied by sengis. The survey methodology will follow that developed by earlier researchers, with appropriate modifications to suit local conditions. Survey efforts will be directed towards establishing the relative densities and other attributes of the species' ecology in different habitats.

Golden-rumped sengis create leaf nests on the forest floor and previous studies have shown that the abundance of leaf nests is related to sengi density. It is proposed to carry out transects in different habitats to compare nest abundance and therefore, sengi abundance in different habitats. It is hoped that information on the distribution of these habitats from aerial or satellite photographs will then help to establish an approximate estimate of the current distribution of the sengi.

An assessment of the distribution and relative abundance of the golden-rumped sengi in suitable habitats in areas north of the Tana River would have considerable bearing on its conservation status. The findings of this survey will also be critical in further underscoring the importance of the ASF as a biodiversity hotspot, home to six endangered bird species, two of which are endemic, and to three rare mammals.

A graduate student from the University of Nairobi is developing a proposal for this survey. The survey is expected to commence in October 2007 and end before the next major rains in March-April 2008. The results will go towards the student's MSc thesis and is expected to be published in scientific journals.

The golden-rumped sengi has been selected as one of the focal species for the Zoological Society of London's recently launched EDGE (Evolutionarily Distinct and Globally Endangered) programme. EDGE species have few close relatives and therefore represent a disproportionate amount of unique evolutionary history. Many of them are on the verge of extinction and yet are receiving little or no conservation attention. It is hoped that the University of Nairobi student will be selected as an EDGE fellow, and thereby receive funding and support from this programme. However, we will need to raise further funding to enable the survey to be completed. Any suggestions for funding sources would therefore be gratefully received.

Afrotheria Noticeboard

New aardvark website

A new website has been launched that focuses entirely on one of the Afrotheria – the aardvark.

Visit www.aardvarkafrica.org and you will discover a lot about this fascinating creature. The site has a factsheet and pages explaining the importance of the aardvark to the environment and to other species, details of its biology and its conservation needs. There is also a photo gallery.

For more information contact Stefan Cilliers (*stefancilliers@absamail.co.za*)

Abstracts

This section presents abstracts from recent papers on the Afrotheria.

Reproductive biology of the short-eared sengi

Olbricht, G., Kern, C. and Vakhrusheva, G. 2006. Einige Aspekte der Fortpflanzungsbiologie von Kurzohr-Russelspringern (*Macroscelides proboscideus* A. Smith, 1829) in Zoologischen Garten unter besonderer Berucksichtigung von Drillingswurfen. *Der Zoologische Garten*, 75:304-316.

This paper covers some aspects of the reproductive biology of the short-eared sengi(*Macroscelides proboscideus* A. Smith, 1829) in captivity, with special consideration to triplet litters

Short-eared sengis occur in some dry regions of Namibia, Botswana and South Africa. In the wild as well as in captivity they breed throughout the year but are particularly free ranging. Short-eared sengis show seasonal trends. Litters with one or two cubs are well documented but the birth of triplets has never been mentioned. In this study 570 litters from different zoos were analyzed. The results show that 29% were born single, 70% as twins and 0.9% as triplets. Females can reach sexual maturity at the age of four months, while males reach sexual maturity at 2.8 months. Out of 774 individuals born, 44% were males, 41% females and 15% of unknown sex.

A new species of shrew tenrec

Goodman, S.M., Raxworthy, C.J., Maminirina, C.P. and Olson, L.E. 2006. A new species of shrew tenrec (*Microgale jobihely*) from northern Madagascar. *Journal of Zoology, London*, 270: 384–398.

A new species of shrew tenrec in the genus Microgale is described from a series of 12 specimens taken on the south-western slopes of the Tsaratanana Massif in northern Madagascar and is named *Microgale jobihely*. This new species is distinguished from other named members of this endemic genus by a variety of mensural and discrete morphological characters. Phylogenetic analysis of the mitochondrial ND2 gene supports its recognition as a distinct species and suggests a sister relationship with the much more widespread *Microgale cowani*. *Microgale jobihely* appears to be the only member of this genus that is a very localized endemic, and a biogeographic scenario is presented to explain this observation. It is currently known from a small area of forest, outside of the protected areas system, that faces considerable anthropogenic pressure.

Bibliography

Some Recent Publications on the Afrotheria

Golden moles

Bronner G.N. and Bennett N. 2005. Order Afrosoricida. Pp 1-21 in Skinner J. and Chimimba C. (eds.), *Mammals of the southern African subregion. 3rd edition.* Cambridge University Press.

Bronner G.N. and Jenkins P.D. 2005. Order Afrosoricida. Pp 71-81 in Wilson D. E. and Reeder D.M (eds.), *Mammal species of the World: a taxonomic and geographic reference (3rd Edition).* John Hopkins Press.

Gilbert C., O'Brien P., Bronner G.N., Yang F, Hassanin A., Ferguson-Smith M.A. and Lewis E.R., Narins P.M., Jarvis J.U.M., Bronner G.N.and Mason M.J. 2006. Preliminary evidence for the use of microseismic cues for navigation by the Namib golden mole. *Journal of the Acoustical Society of America.* 119:1260-1268.

Mason M.J., Lucas S.J., Wise E.R., Stein R.S. and Duer M.J. 2006. Ossicular density in golden moles (Chrysochloridae). *Journal Of Comparative Physiology A-Neuroethology Sensory Neural And Behavioral Physiology* 192 (12): 1349-1357.

Rathbun, G. B. and C. D. Rathbun. 2006. Habitat use by radio-tagged Namib Desert golden moles (*Eremitalpa granti namibensis).* Journal of African Ecology 45:196-201.

Robinson T.J. 2007. Chromosome painting and molecular dating indicate a low rate of chromosomal evolution in golden moles (Mammalia, Chrysochloridae). *Chromosome Research* 14:793–803

Scantlebury M., Oosthuizen M.K., Speakman J.R. Jackson C.R. and Bennett N.C. 2005. Seasonal energetics of the Hottentot golden mole at 1500 m altitude. *Physiology and Behavior* 84: 739–745

Willi, U. B., Bronner, G. N. and Narins P. M. 2005. Ossicular differentiation of airborne and seismic stimuli in the Cape golden mole (*Chrysochloris asiatica*). *Journal of Comparative Physiology A: Sensory, Neural, and Behavioral Physiology* 192(3): 267-277.

Willi, U. B., Bronner, G. N. and Narins P. M. 2005. Middle ear dynamics in response to seismic stimuli in

the Cape golden mole (Chrysochloris asiatica). *Journal of Experimental Biology* 209: 302-313

Sengis

Baker, A.J., McCafferty, K. and Hellmuth, H. 2005. Black-and-rufous sengi (*Rhynchocyon petersi*) at the Philadelphia Zoo. *Afrotherian Conservation - Newsletter of the IUCN/SCC Afrotheria Specialist Group,* 3: 6-7.

Conniff, R. 2005. Shrewd configuration. *Smithsonian Magazine*, 36:26-28.

Cordeiro, N.J., Seddon, N., Capper, D.R., Ekstrom, J.M. M., Howell, K.M., Isherwood, I.S. and Msuya, C.A. M. 2005. Notes on the ecology and status of some forest mammals in four Eastern Arc Mountains, Tanzania. *Journal of East African Natural History*, 94:175-189.

Coster, S. and Ribble, D.O. 2005. Density and cover preferences of Black-and-rufous elephant-shrews (*Rhynchocyon petersi*) in Chome Forest Reserve, Tanzania. *Belgian Journal of Zoology*, 135 (Supplement): 175-177.

Cox, P. G. 2006. Character evolution in the orbital region of the Afrotheria. *Journal of Zoology, London*, 269:514-526.

Dengler-Crish, C.M., Crish, S.D., O'Riain, M.J. and Catania, K.C. 2006. Organization of the somatosensory cortex in elephant shrews (*E. edwardii*). *The Anatomical Record Part A*, 288A:859-866.

Friedmann, Y. and Daly, B. 2004. *Red data book of the mammals of South Africa: A conservation assessment.* Conservation Breeding Specialist Group (IUCN-SSC), Endangered Wildlife Trust, Parkview, South Africa.

Hellmuth, H. 2005. The taping of the shrews. *Communique - American Zoo and Aquarium Association*, 2005:25-26.

Hoffmann, A. and Zeller, U. 2005. Influence of variations in land use intensity on species diversity and abundance of small mammals in the Nama Karoo, Namibia. *Belgian Journal of Zoology*, 135 (Supplement): 91-96.

Holroyd, P.A. and Mussell, J.C. 2005. Macroscelidea and Tubulidentata. Pp. 71-83 in Rose, K.D. and Archibald, J.D. (eds.), *The Rise of Placental Mammals.* The Johns Hopkins University Press, Baltimore, US.

Ihlau, J., Kachel, F. and Zeller, U. 2006. Graphical description of the ventral side of a sengi's (*Macroscelides proboscideus*) skull. *Afrotherian Conservation - Newsletter of the IUCN/SCC Afrotheria Specialist Group*, 4:11-12.

Keller, C. 2005. Do small mammals affect plant diversity? Field studies in Namaqualand, South Africa, a biodiversity-hotspot. Pp. 66 in *Department of Behavioural Biology*, University of Munster, Munster, Germany.

Kilonzo, B., Mhina, J., Sabuni, C. and Mgode, G. 2005. The role of rodents and small carnivores in plague endemicity in Tanzania. *Belgian Journal of Zoology*, 135 (Supplement):119-125.

McNab, B.K. 2006. The evolution of energetics in eutherian "insectivorans": an alternate approach. *Acta Theriologica*, 51:113-128.

Mess, A. and Carter, A.M. 2006. Evolutionary transformations of fetal membrane characters in Eutheria with special reference to Afrotheria. *Journal of Experimental Zoology*, 306B:140-163.

Modry, D., Jirku, M. and Hurkova, L. 2005. A new coccidean parasite (Apicomplexa:Eimeriidae) from the rufous elephant shrew, *Elephantulus rufescens*. *African Zoology*, 40:327-329.

Moutou, F. and Besnard, V. 2006. Observations of black-and-rufous sengis (*Rhynchocyon petersi*) in Diani Forest, Kenya. *Afrotherian Conservation - Newsletter of the IUCN/SCC Afrotheria Specialist Group*, 4:13-14.

Mukinzi, I., Katuala, P.G.B., Kennis, J., Gambalemoke, M., Kadange, N., Dudu, A.M., Colyn, M. and Hutterer, R. 2005. Preliminary data on the biodiversity of rodents and insectivores (Mammalia) in the periphery of Kisangani (D.R. Congo). *Belgian Journal of Zoology*, 135 (Supplement):133-140.

Mzilikazi, N. and Lovegrove, B.G. 2006. Noradrenalin induces thermogenesis in a phylogenetically ancient eutherian mammal, the rock elephant shrew, *Elephantulus myurus*. *Journal of Comparative Physiology B*, 176:75-84.

Nishihara, H., Satta, Y., Nikaido, M., Thewissen, J.G.M., Stanhope, M.J. and Okada, N. 2005. A retroposon analysis of afrotherian phylogeny. *Molecular Biology and Evolution*, 22:1823-1833.

Oguge, N., Hutterer, R., Odhiambo, R. and Verheyen, W. 2004. Diversity and structure of shrew communities in montane forests of southeast Kenya. *Mammalian Biology*, 69:289-301.

Olbricht, G., Kern, C. and Vakhrusheva, G. 2006. Einige Aspekte der Fortpflanzungsbiologie von Kurzohr-Russelspringern (*Macroscelides proboscideus* A. Smith, 1829) in Zoologischen Garten unter besonderer Berucksichtigung von Drillingswurfen. *Der Zoologische Garten*, 75:304-316.

Pratt, S. 2005. Mammals not out of Africa. *Geotimes*, 50: 12-13.

Rathbun, G.B., (subeditor). 2005. Order Macroscelidea. Pp. 22-34 in Skinner, J.D. and Chimimba, C.T. (eds.), *The Mammals of the Southern African Subregion, 3rd edition.* Cambridge University Press, Cape Town, South Africa.

Rathbun, G.B. and Kingdon, J. 2006. The etymology of "SENGI". *Afrotherian Conservation - Newsletter of the IUCN-SCC Afrotheria Specialist Group*, 4:14-15.

Rathbun, G.B. and Rathbun, C.D. 2005. Does the Cape sengi (*Elephantulus edwardii*) occur in Namibia? *Afrotherian Conservation - Newsletter of the IUCN/SCC Afrotheria Specialist Group*, 3:5-6.

Rathbun, G.B. and Rathbun, C.D. 2006. Social structure of the bushveld sengi (*Elephantulus intufi*) in Namibia and the evolution of monogamy in the Macroscelidea. *Journal of Zoology, London*, 269:391-399.

Ribble, D.O. and Perrin, M.R. 2005. Social organization of the eastern rock elephant-shrew (*Elephantulus myurus*): the evidence for mate guarding. *Belgian Journal of Zoology*, 135 (Supplement):167-173.

Rovero, F. and Rathbun, G.B. 2006. A potentially new giant sengi (elephant-shrew) from the Udzungwa Mountains, Tanzania. *Journal of East African Natural History*, 95:111-115.

Schlitter, D.A. 2005. Order Macroscelidea. Pp. 82-85 in Wilson, D. E. and Reeder, D.M. (eds.), *Mammal Species of the World, 3rd edition.* Johns Hopkins University Press, Maryland, US.

Schneider, G. and Marais, C. 2004. *Passage Through Time - The Fossils of Namibia.* Gamsberg Macmillan, Windheok, Namibia.

Smit, H.A., Robinson, T.J. and Jansen van Vuuren, B. 2007. Coalescence methods reveal the impact of vicariance on the spatial genetic structure of

Elephantulus edwardii (Afrotheria, Macroscelidea). *Molecular Ecology,* 16: 2680-2692.
Wegner, G., Howell, K.M., Burgess, N., Fanning, N. and Rubio, P. 2005. *Mtwara Reconnaissance Project.* Frontier-Tanzania, The Society for Environmental Exploration, London, UK.
Wiedon, A. and Schradin, C. 2005. Elephant shrews in Goegap. *Four-striped Mouse Times*, 3:25-26.
Yarnell, R.W. and Scott, D.M. 2006. Notes on the ecology of the short-snouted sengi (*Elephantulus brachyrhynchus*) at a game ranch in North-west Province, South Africa. *Afrotherian Conservation - Newsletter of the IUCN-SSC Afrotheria Specialist Group*, 4:2-4.
Zack, P.S., Penkrot, T.A., Bloch, J.I. and Rose, K.D. 2005. Affinities of 'hyopsodontids' to elephant shrews and a Holarctic origin of Afrotheria. *Nature*, 434:497-501.

Tenrecs

Asher, R.J. and Hofreiter, M. 2006. Tenrec phylogeny and the noninvasive extraction of nuclear DNA. *Systematic Biology,* 55(2):181-194.
Goodman, S.M., Raxworthy, C.J., Maminirina, C.P. and Olson, L.E. 2006. A new species of shrew tenrec (*Microgale jobihely*) from northern Madagascar. *Journal of Zoology, London*, 270: 384–398.
Poux, C.O., Madsen, E. Marquard, D.R., Vieites, W.W. de Jong and Vences, M. 2005. Asynchronous colonization of Madagascar by the four endemic clades of Primates, Tenrecs, Carnivores, and Rodents as inferred from nuclear genes. *Systematic Biology,* 54(5):719–730.
Salton, J. and Szalay, F.S. 2004. The tarsal complex of Afro-Malagasy Tenrecoidea: A search for phylogenetically meaningful characters. *J. Mamm. Evol.*, 11:73–104.
Stephenson, P.J. 2007. Mammals from another time: tenrecs in Madagascar. *Africa Geographic,* March 2007, 15(2):34-41.

Afrotheria (general)

Asher, R. 2006. The fossil record of endemic African mammals (Afrotheria). *Journal of Vertebrate Paleontology* 26(3): 38A-38A Suppl.
Kellogg M.E., Burkett S., Dennis T.R., Stone G., Gray B.A., McGuire P.M., Zori R.T. and Stanyon R. 2007. Chromosome painting in the manatee supports Afrotheria and Paenungulata. *BMC Evolutionary Biology* 7: Art. No. 6
Nishihara H., Satta Y., Nikaido M., Thewissen J.G.M., Stanhope,M.J. and Okada N. 2005. A Retroposon Analysis of Afrotherian Phylogeny. *Molecular Biology and Evolution* 22(9):1823–1833.
Pardini A.T., O'Brien,P.C.M., Fu B., Bonde R.K., Elder, F.F.B., Ferguson-Smith M.A., Yang F. and Robinson T.J. 2007. Chromosome painting among Proboscidea, Hyracoidea and Sirenia: Support for Paenungulata (Afrotheria, Mammalia) but not Tethytheria. *Proceedings of the Royal Society B-Biological Sciences*, 274 (1615): 1333-1340
Redi C.A., Garagna S., Zuccotti M. and Capanna E. 2007. Genome size: A novel genomic signature in support of Afrotheria. *Journal of Molecular Evolution* 64(4): 484-487.
Seiffert E.R. 2007. A new estimate of afrotherian phylogeny based on simultaneous analysis of genomic, morphological, and fossil evidence. *BMC Evolutionary Biology*. 7: 224.

IUCN/SSC Afrotheria Specialist Group
Membership (as of 1 November 2007)

CHAIR: Dr. Galen B. Rathbun
EDITOR, *Afrotherian Conservation*: Dr. Peter J. Stephenson
WEBMASTER: Dr. Erik Seiffert

Name	Address	Email, Voice, and Fax	Specialities	
			Taxa and Region	Disciplines
SECTION CO-ORDINATORS				
Dr. Gary Bronner **Golden-mole Section**	Department of Zoology, University of Cape Town, Private Bag, Rondebosch, Western Cape Province 7701, South Africa	gbronner@botzoo.uct.ac.za Voice: +27 21 6503301 Fax: +27 21 6503301	Chrysochloridae Southern Africa	Systematics and taxonomy, population biology, community ecology, conservation biology
Dr. Hendrik Hoeck **Hyrax Section**	Sonnenbergstr. 3, CH-8280 Kreuzlingen, Switzerland	hoeck@pingnet.ch Voice: +41 71 6882162 Fax: +41 71 6882169	Hyracoidea Tanzania, Kenya	Conservation biology, behavioural ecology, population biology, ecosystem biology
Dr. Thomas Lehmann **Aardvark Section**	Museum fur Naturkunde, Humboldt Universitat zu Berlin, Forschngsabteilung, Invalidenstrasse 43, 10115 Berlin, Germany	thomas.lehmann@MUSEUM.HU-Berlin.de Voice: +49 30 2093 8942 Fax: +49 30 2093 8565	Tubulidentata Africa	Palaeontology, morpho-anatomy, systematics, phylogeny
Dr. Galen Rathbun **Chair and Sengi Section**	California Academy of Sciences (San Francisco), c/o PO Box 202, Cambria, California 93428, USA	GRathbun@CalAcademy.org Voice: +1 805 927-3059 Fax: +1 805 927-3059	Macroscelidea East Africa, Southern Africa, North Africa	Behavioral ecology, population biology, conservation biology

Dr. Peter J. (PJ) Stephenson **Tenrec Section and Newsletter Editor**	WWF International, Avenue du Mont Blanc, CH-1196 Gland, Switzerland	PJStephenson@wwfint.org Voice: +41 22 364 9327 Fax: +41 22 364 4238	Tenrecidae Madagascar	Conservation, ecology, reproductive biology, energetics
MEMBERS				
Prof. Dr. Benjamin Dudu Akaibe	Laboratoire d'Ecologie et de Gestion des Ressources Animales (LEGERA), Democratic Republic of Congo	duduakaibe@yahoo.fr Voice: +243 998539647 Fax: +873 762014332	Macroscelidea DRC	Systematics, ecology, conservation
Dr. Robert Asher	Museum of Zoology, Cambridge University, Downing Street, Cambridge CB2 3EJ, UK	rja58@cam.ac.uk Voice: +44 1223 336 680 Fax: +44 1223 336 679	Afrotheria, Tenrecidae, Chrysochloridae	Taxonomy, systematics, paleontology
Dr. Andrew Baker	Philadelphia Zoo, 3400 W. Girard Ave., Philadelphia, PA 19104, USA	baker.andy@phillyzoo.org Voice: +1 215 243-5245 Fax: +1 215 243-0219	Macroscelidea Tubulidentata	Behavior, zoo biology, captive breeding
Dr. Ron Barry	Department of Biology, 44 Campus Ave., Bates College, Lewiston, Maine 04240, USA	rbarry@bates.edu Voice: +1 207786-6109 Fax: +1 207786-8334	Hyracoidea Zimbabwe	Population biology, behavioral ecology
Prof. Nigel Bennett	Department of Zoology and Entomology, University of Pretoria, Pretoria, Gauteng 0002, South Africa	ncbennett@zoology.up.ac.za Voice: +27 12 4202538 Fax: +27 12 3625242	Chrysochloridae Southern Africa	Reproduction, sociobiology, ecology, conservation
Dr. Jonathan Benstead	Aquatic Biology, University of Alabama, P.O. Box 870206, A122 Bevill Bldg., 2017 7th Ave., Tuscaloosa, Alabama 35487, USA	jbenstead@bama.ua.edu Voice: +1 205 348 9034 Fax : +1 205 348 1403	Tenrecidae, *Limnogale mergulus* Madagascar	Freshwater ecology, semi-aquatic mammals
Prof. Paulette Bloomer	Department of Genetics, University of Pretoria, Pretoria, Gauteng Province 0002, South Africa	paulette.bloomer@up.ac.za Voice: +27 12 420-3259 Fax: +27 12 362-5327	Hyracoidea Chrysochloridae South Africa	Molecular ecology, molecular systematics, conservation biology
Dr. Thomas Butynski	Bioko Biodiversity Project Program, Drextel University, P.O. Box 149, Nanyuki 10400, Kenya.	tbutynski@aol.com Voice: +254-2-0733637525 Fax: +254-2-890615	Primates, Rodentia, Artiodactyla, *Rhynchocyon* Botswana, Uganda, Kenya, Tanzania, DRC, Equitorial Guinea	Conservation biology, wildlife ecology, montane forest ecology, primatology
Mr. Ngoni Chiweshe	BirdLife Zimbabwe, P.O. Box RV 100, Runiville, Harare, Zimbabwe	birds@zol.co.zw Voice: +263 4 490208 or 481496 Fax: +263 4 490208	Hyracoidea	Population biology and conservation biology
Mr. Stefan Cilliers	Mapungubwe National Park, P.O. Bix 383, Musiha 0900, South Africa	stefancilliers@absamail.co.za Voice: +27 82 6070182 Fax: +27 15 5342014	Tubulidentata Botswana, Zimbabwe, South Africa	Wildlife Management, capture and care, conservation biology
Mr. Fenton (Woody) Cotterill	Evolutionary Genomics, Department of Botany and Zoology, University of Stellenbosch, Matieland 7603, South Africa	woodyc@sun.ac.za Voice: +27 021 808 3229 Fax: +27 021 808 2405	Macroscelidea Hyracoidea Southeastern Africa	Systematics, evolution, conservation, ecology, data/information mangmt.
Dr. Clare FitzGibbon	RSP Ecoscope, Welltown, Boscastle, Cornwall PL35 ODY, United Kingdom	fitzgibbonc@rpsgroup.com Voice: +44 1840 250762 Fax: +44 1840 250040	Macroscelidea: *Rhynchocyon* and *Petrodromus* Kenya , Tanzania	Conservation Biology, population biology
Dr. Steve Goodman	Field Museum of Natural History, 1400 South Lake Shore Drive, Chicago, Illinois 60605, USA OR WWF, BP 738, Antananarivo (101), Madagascar	sgoodman@fieldmuseum.org sgoodman@wwf.mg Voice: +1 (312) 665-7748 Fax: +1 (312) 665-7754 Voice: +261 20 2234885 Fax: +261 20 2234888	Oryzorictinae Tenrecidae Madagascar	Ecology, txonomy, evolution, Conservation
Dr. Ian Gordon	Environmental Health Division, International Centre of Insect Physiology and Ecology, PO Box 30772, Nairobi, Kenya	igordon@icipe.org Voice: +254 20 856 1309 Voice: +254 20 863 2000 x2050 Fax: +254 20 863 2001	Macroscelidea, *Rhynchocyon* and *Petrodromus* Kenya	Conservation biology, natural resource management, sustainable use

Mr. Mike Griffin	Ministry of Environment and Tourism, Private Bag 13306, Windhoek, Namibia	ssaurus@mweb.com.na Voice: +264 (0)61 237 553 Fax: +264 (0)61 237 552	All taxa Namibia	Taxonomy, biogeography, conservation science
Prof. Kim Howell	Department of Zoology and Marine Biology, University of Dar es Salaam, PO Box 35064, Dar es Salaam, Tanzania	kmhowell@udsm.ac.tz Voice: +255 22 2410462 Fax: None	Macroscelidea, *Rhynchocyon petersi* Eastern Africa	Distribution, ecology, conservation, impact assessment
Ms. Paula Jenkins	Mammal Group, Department of Zoology, The Natural History Museum, Cromwell Road, London SW7 5BD, UK.	P.Jenkins@nhm.ac.uk Voice: +44 20 7942 5578 Fax: +44 20 7942 5054	Tenrecidae Madagascar	Taxonomy, biogeography
Prof. Jonathan Kingdon	The Elms, The Walk, Islip OX5 25D, United Kingdom	Jonathan.kingdon@zoo.ox.ac.uk Voice: +44 068 6537 3815	Afrotheria Primates	Biogeography, human origins
Dr. Peter Lindsey	Save Valley Conservancy, P.O. Box 47, Birchenough Bridge, Zimbabwe	palindsey@gmail.com Voice: +263 (0)24 446 Fax: +263 (0)24 271	Tubulidentata Southern Africa	Conservation biology, ecology, behavioral ecology
Dr. Sarita Maree	Department of Zoology and Entomology, The University of Pretoria, Lynwood Road, Hillcrest, Pretoria 0002, South Africa	smaree@zoology.up.ac.za Voice: +27 12 4202538 Fax: +27 3625242	Chrysochloridae South Africa	Molecular systematics, Taxonomy, phylogenetics
Dr. Martin Nicoll	WWF Madagascar Programme Office, BP 738, Antananarivo 101, Madagascar	menicoll@wwf.mg Voice: +261 20 22 34885 Fax: +261 20 2234888	Oryzorictinae Tenrecidae Madagascar	Conservation, ecology, reproductive biology, energetics
Dr. Link Olson	University of Alaska Museum, 907 Yukon Drive, Fairbanks, AK 99775-6960, USA	link.olson@uaf.edu Voice: +1 907 474-5998 Fax: +1 907 474-5469	Tenrecidae Madagascar	Biogeography, taxonomy, conservation genetics
Prof. Mike Perrin	School of Biological and Conservation Science, University of Natal, Private Bag X01, Scottsville, Pietermaritzburg, KwaZulu-Natal 3209, South Africa	perrin@ukzn.ac.za Voice: +27 33 260 5118 Fax: +27 33 260 5105	Macroscelidea Southern Africa, Uganda	Ecology, conservation biology, behaviour, ecophysiology
Dr. Daniel Rakotondravony	Departement de Biologies Animale, Universite d'Antananarivo, BP 906, Anatananarivo 101, Madagascar	drakotondravony@hotmail.com Voice: +261 20 22 287 33 Fax: +261 20 22 313 98	Tenrecidae Madagascar	Inventory, conservation biology, behaviour, ecophysiology
Prof. Terry Robinson	Department of Zoology, Stellenbosch University, Private Bag X1, Matieland 7602, South Africa	tjr@land.sun.ac.za Voice: +27 21 808-3955 Fax: +27 21 808-2405	Afrotheria South Africa	Cytogenetics, molecular genetics, systematics, evolution
Dr. Erik Seiffert **Webmaster**	Department of Anatomical Sciences, Stony Brook University, Stony Brook, New York 11794-8081, USA	eseiffert@notes.cc.sunysb.edu Voice: +1 631 444 6945 Fax: +1 631 444 3947	Afrotheria	Evolutionary biology, systematics, palaeontology
Prof. Hezy Shoshani	Department of Biology, University of Asmara, PO Box 1220, Asmara, Eritrea	hezy@eol.com.er Voice: +291-1-15 –06-45	Hyracoidea Tubulidentata Horn of Africa (Eritrea)	Taxonomy, conservation biology, ecology, population biology, ecosystem biology
Ms. Voahangy Soarimalala	c/o WWF Ecology Training Programme, WWF, BP 738, Antananarivo 101, Madagascar	etp@wwf.mg	Tenrecidae Madgascar	Conservation biology, taxonomy
Mr. Christopher Stuart	African-Arabian Wildlifve Research Centre, PO Box 6, Loxton, Northern Cape Province 6985, South Africa	aawrc@yebo.co.za Voice: +27 53 3813011 Fax: +27 53 3813001	Afrotheria	Wildlife management, zoogeography
Dr. Andrew Taylor	Department of Zoology and Physiology #3166, 1000 E. University Avenue, University of Wyoming, Laramie, Wyoming 82071, USA	ataylor@op.up.ac.za Voice: +1 307 766 3331 Cell: +1 307 460 0627	Tubulidentata Southern Africa	Mammalogy
Prof. Peter Vogel	Departement of Ecology and Evolution, University of Lausanne, CH 1015 Lausanne, Switzerland	peter.vogel@unil.ch Voice: +41 21 692 41 61 Fax: +41 21 692 41 65	Tenrecidae *Micropotamogale lamottei* Ivory Coast	Ecology, population biology, taxonomy

© PJ Stephenson

The lesser hedgehog tenrec, *Echinops telfairi,* is one of the five spiny tenrecs (sub-family Tenrecinae). *Echinops* is also one of just a handful of tenrecs that are adapted to life in the semi-arid conditions of the spiny forest in south-west Madagascar. It is nocturnal and semi-arboreal, capable of climbing on tree branches. The lesser hedgehog tenrec is omnivorous, feeding primarily on invertebrates and fruits. When food and water are scarce it is capable of entering seasonal torpor. Litter size is relatively high compared with most other tenrecs, with up to 10 young born at once. The dry forest habitat of *Echinops* is under threat from slash and burn agriculture and charcoal production. However, lesser hedgehog tenrecs are the most common tenrec species held in captivity; it is even kept as a pet in some countries.

Guidelines for Authors

Articles, species profiles, news items and announcements are invited on topics relevant to the newsletter's focus. Manuscripts should be sent either by post or email to the Editor, Dr Peter J. Stephenson (c/o WWF International, Avenue du Mont Blanc, 1196 Gland, Switzerland. E-mail: PJStephenson@wwfint.org or afrotherianconservation@yahoo.co.uk). Articles should be under 3,000 words and follow the format of this edition. References should be cited in the text and listed in alphabetical order at the end of the article. Journal titles should be given in full. The Editor reserves the right to edit all contributions for style and content.

Subscription Information

Afrotherian Conservation is available free of charge on the IUCN/SSC Afrotheria Specialist Group website (see above).

People wishing to receive personal copies of *Afrotherian Conservation,* or to be alerted when new editions are posted on the website, should send their name, address and email address to the Editor. Currently only a limited number of hard copies can be distributed. Financial support is being sought by the IUCN/SSC Afrotheria Specialist Group to print and distribute more copies in the future, especially to our colleagues working in Africa and Madagascar who cannot always easily access email and the internet.