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Message from the Chair

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Chair, IUCN/SSC Afrotheria Specialist Group

Welcome to the IUCN/SSC Afrotheria Specialist Group's first newsletter. Because we are a new group, and our name might not be familiar to many readers, I want to review what we are, our mission, and some of our goals.

Over the last few years, there has been increasing molecular evidence for an ancient radiation of mammals in Africa - the Afrotheria (see Bibliography section). The living representatives of this radiation, being far out on the branches of the evolutionary tree, show little superficial resemblance to one another. The diversity of form between the elephants, sea cows, hyraxes, aardvark, sengis or elephant-shrews, tenrecs, and golden-moles does not intuitively suggest a grouping of mammals. Indeed, some biologists still do not accept the Afrotheria. In any case, we have adopted the name and taxonomy because it serves our purpose well.

The elephants and sea cows already have their own IUCN Specialist Groups, so we do not include them in our new group. The remaining mammals are the smaller representatives of the Afrotheria, which are only found in the Ethiopian biogeographical region (unlike the elephants and sea cows). In addition, these smaller Afrotheres are often obscure, and thus they are frequently overlooked - especially by conservation organisations.

Our mission is to facilitate the conservation of hyraxes, the aardvark, sengis, golden-moles, tenrecs, and their habitats. We will do this by providing sound scientific advice and guidance to conservationists, governments, and other interested groups. We will also raise public awareness and develop research and conservation programmes.

We have already accomplished some of our goals, including establishing our membership and internal organisation, defining our mission (above), and establishing a newsletter and World Wide Web site (see page 8). The most challenging objectives, however, are still ahead. We need to agree on the taxonomy within each group of Afrotheres (how many species are there?), update the IUCN Redlist of threatened and endangered species, and develop and implement conservation plans, including education and research projects.

Because the Afrotheria includes such diverse mammals, there are very few of us that are knowledgeable on more than one or two groups. To function effectively, I have organised our group around Section Co-ordinators, one for each mammal taxon (see page 14). I have relied largely on the expertise of these co-ordinators to assemble our diverse membership. My job, with the help of our new newsletter, will be to give our efforts some cohesion.

Our objectives are ambitious, especially for a group of volunteers who have many other responsibilities. However, I believe that if we keep our focus, set realistic deadlines, and all contribute a modest amount of time, we will succeed. I look forward to working with all of our members and, as opportunities arise, other experts who are interested in our mission. ❖

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Species Profile:

The Large-eared tenrec

(Geogale aurita)

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The Large-eared tenrec, *Geogale aurita*, is a small, terrestrial tenrec (Lipotyphla: Tenrecidae) of the subfamily Oryzictinae. Traditionally this animal was placed in its own

subfamily, the Geogalinae, largely because of its peculiar dentition (e.g. Butler 1985). *Geogale* is a monotypic genus that may have been among the first tenrecs to evolve: fossils attributed to this genus have been discovered in the Miocene deposits of Kenya (Butler & Hopwood 1957) but their identification is contentious (Poduschka & Poduschka 1985; Olson in press).

Geogale, like all tenrecs, exhibits a number of characteristics probably typical of the earliest eutherian mammals. Such plesiomorphic traits include nocturnal activity patterns, small body size, the retention of a common urogenital opening or cloaca, abdominal testes, poor eyesight and a dependence on auditory and olfactory sensing, and relatively low body temperature and metabolic rate (Eisenberg & Gould 1970). Wild-caught *Geogale* range in body mass from 5.0-8.5g, with a mean of 6.6 g, making them one of the smallest tenrecs (Stephenson 1991, 1993). Total length is 90-105 mm (head/body length 60-75 mm; tail length about 30 mm) (see Garbutt 1999). The pelage is soft, short, and dense. Upperparts are pale grey and underparts creamy-white, sometimes with flecks of orange on the flanks. The tail is scaly and covered in fine hairs. The dentition deviates from the typical pattern in that it has only 34 teeth as compared to other tenrecs that generally have 36.

Geogale is found in the arid south and south-west of Madagascar from south of the Tsiribihina River (Nicoll & Rathbun 1990). They occur in dry deciduous forest, gallery forest, and spiny bush. At the eastern most limit of their range, they have reportedly been found in south-eastern rain forest areas around Andohahela (Nicoll & Rathbun 1990; Garbutt 1999), though this does not seem to be their optimum habitat. The highest known densities of *Geogale* have been found in the Réserve Spéciale de Beza Mahafaly, where it may be associated with riverine gallery forest dominated by *Tamarindus indica* and other Leguminous trees. There is also a report of this species along the east coast near Fenoarivo based on a single specimen which was named as a distinct subspecies, *G. a. orientalis* (Grandidier & Petit 1930). A recent survey of the littoral forests of this zone did not turn up any evidence of this animal (Rakotondravony *et al.* 1998), and its status is obscure.

In the daytime during the dry season *Geogale* can often be found torpid in rotting wood (Gould & Eisenberg 1966; Stephenson 1991). Animals are usually found on their own, though occasionally male-female pairs are found in close proximity to one another (Stephenson 1991). Their diet consists of invertebrates, with a marked preference for termites (Nicoll & Rathbun 1990; Stephenson *et al.* 1994). The large ears are extended during feeding and appear to be used in searching for prey. In the Beza Mahafaly area considerable number of *Geogale* are consumed by two different species of owl, *Tyto alba* and *Asio madagascariensis* (Goodman *et al.* 1993a, 1993b). Snakes such as *Madagascarophus colubrina* are common in the dead wood where *Geogale* are found (Stephenson 1991) and might feed on these mammals. Other predators occurring within the range of *Geogale* and assumed to pose a threat include carnivores such as *Mungotictis decemlineata*.

Geogale is one of the most heterothermic tenrecs, with body temperature paralleling ambient temperature at all times of the year, though body temperature is more elevated during pregnancy and lactation (Stephenson & Racey 1993a). Resting metabolic rate or RMR is 53 % of the value expected for a mammal of this body mass, and lower than expected even when compared to other tenrecs (Stephenson & Racey 1993a,

1993b). This low RMR may be a function of the termite-based diet or the hot, dry climate of its habitat (see Racey & Stephenson 1996). RMR and daily energy expenditure in *Geogale* increase during pregnancy and lactation (Stephenson & Racey 1993a). The species appears to enter daily torpor in all seasons, though probably more frequently in the austral winter. However, individuals held in captivity feed and drink throughout the winter (Stephenson *et al.* 1994).



Geogale aurita. Photo: PJ Stephenson

The reproductive biology of *Geogale* is better understood than for any other oryzorictine tenrec (see Stephenson 1993; Stephenson *et al.* 1994). Mating occurs between late September and March. Copulation is associated with a coital lock, the male being held for up to 21 minutes. Gestation varies between 54 and 69 days. This variability may result from the occurrence of torpor: since *G. aurita* is heterothermic it is probable that when females enter torpor during pregnancy the development of the litter is arrested, a phenomenon only previously recorded in heterothermic bats. However, the ability to reproduce at low levels of RMR and body temperature, and to become heterothermic even during pregnancy and lactation, may reduce the total cost of reproduction in an environment of climatic extremes (Stephenson & Racey 1993a).

Litter size ranges from 1-5 neonates which are small (0.5-0.8 g) and highly altricial, being born naked with both their eyes and their auditory meatus closed (Stephenson 1993). Neonates from smaller litters are heavier than those from larger litters and exhibit significantly faster growth rates. Eye opening occurs at between 21 and 33 days, and the young are weaned soon afterwards. This rate of postnatal development is similar to other oryzorictines but slower than shrews of similar body mass (Stephenson 1993). Longevity in the wild is unknown but captive animals have lived for more than two and a half years (Stephenson *et al.* 1994).

Geogale is unique among tenrecs in that it exhibits post-partum oestrus with females able to suckle a first litter whilst a second is developing in the uterus (Stephenson 1993). Although this is common in small members of the Soricidae it is unknown in any other Tenrecidae. It may represent an adaptation to an unpredictable environment, optimising reproductive output while seasonally favourable conditions prevail (Stephenson 1993). The energetic cost of post-partum oestrus is less than normal pregnancy and lactation combined so there is also an energy saving associated with this reproductive strategy (Stephenson & Racey 1993a).

Geogale aurita does not appear to be threatened, though its apparent dependence on forests means its distribution is liable to be reduced if habitat loss increases. It is recorded from several protected areas including Réserve Spéciale de Beza Mahafaly, Parc National de Zombitse-Vohibasia, and Parc National d'Andohahela (parcel 2), as well as the Kirindy/CFPF Forest (Nicoll & Langrand 1989; Garbutt 1999).

References

- Butler, P. M. 1985. The history of African insectivores. *Acta Zoologica Fennica*, 173:215-217.
- Butler, P. M. and Hopwood, A. T. 1957. Insectivora and Chiroptera from the Miocene rocks of Kenya Colony. *Fossil Mammals of Africa*, 13:1-35.
- 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.
- Goodman, S. M., Langrand, O. and Raxworthy, C. J. 1993a. The food habits of the Barn Owl *Tyto alba* at three sites on Madagascar. *Ostrich*, 64:160-171.
- Goodman, S. M., Langrand, O. and Raxworthy, C. J. 1993b. Food habits of the Madagascar Long-eared Owl *Asio madagascariensis* in two habitats in southern Madagascar. *Ostrich*, 64:79-85.
- Gould, E. and Eisenberg, J.F. 1966. Notes on the biology of the Tenrecidae. *Journal of Mammalogy*, 47:660-686.
- Grandidier, G. and Petit, G. 1930. Etude d'un mammifère insectivore malgache. Le *Geogale aurita* Alph. Milne-Edwards et Alfred Grandidier. Faune des Colonies Françaises. Société d'Éditions, Paris.
- Nicoll, M.E. and Langrand, O. 1989. *Madagascar: Revue de la Conservation et des Aires Protégées*. WWF, Gland.
- Nicoll, M.E. and Rathbun, G. 1990. *African Insectivora and Elephant-Shrews. An Action Plan for their Conservation*. IUCN, Gland.
- Olson, L. In press. Phylogeny of the Tenrecidae (Mammalia, Lipotyphla): morphological support for a single invasion of Madagascar. *Zoological Journal of the Linnean Society*.
- Poduschka, W. and Poduschka, C. 1985. Zur frage des gattungsnamens von "*Geogale alettris* Butler und Hopwood, 1957 (Mammalia: Insectivora) aus dem Miozän Ostafrikas. *Zeitschrift für Säugetierkunde*, 50:129-140.
- Racey, P.A. and Stephenson, P.J. 1996. Reproductive and energetic differentiation of the Tenrecidae of Madagascar. Pp. 307-319 in W.R. Lourenço (ed.), *Biogéographie de Madagascar*. Editions de l'ORSTOM, Paris.
- Rakotondravony, D., Goodman, S. M., Duplantier, J.-M. and Soarimalala, V. 1998. Les petits mammifères. Pp. 197-212 in J. Ratsirarson and S. M. Goodman (eds.) Inventaire biologique de la forêt littorale de Tampolo (Fenoarivo Atsinanana), *Recherches pour le Développement, Série Sciences Biologiques*, no. 14, Centre d'Information et de Documentation Scientifique et Technique, Antananarivo.
- Stephenson, P.J. 1991. Reproductive Energetics of the Tenrecidae (Mammalia: Insectivora). PhD thesis, University of Aberdeen, Aberdeen.
- Stephenson, P.J. 1993. Reproductive biology of the large-eared tenrec, *Geogale aurita* (Insectivora: Tenrecidae). *Mammalia*, 57:553-563.
- Stephenson, P.J. and Racey, P.A. 1993a. Reproductive energetics of the Tenrecidae (Mammalia: Insectivora). I. The large-eared tenrec, *Geogale aurita*. *Physiological Zoology*, 66:643-663.
- Stephenson, P.J. and Racey, P.A. 1993b. Reproductive energetics of the Tenrecidae (Mammalia: Insectivora), II; the shrew-tenrecs, *Microgale spp.* *Physiological Zoology*, 66:664-685.
- Stephenson, P.J., Racey, P.A. and Rakotondraparany, F. 1994. Maintenance and reproduction of tenrecs (Tenrecidae) at Parc Tsimbazaza, Madagascar. *International Zoo Yearbook*, 33: 94-201.

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Article:

The reality of afrotherian monophyly, and some of its implications for the evolution and conservation of Afro-Arabia's endemic placental mammals

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For well over a century, morphologists and palaeontologists have been scrutinising the anatomy of living and extinct placental mammals, searching for information that might provide phylogenetic structure to the apparent explosion of placental evolution that occurred just after the extinction of the dinosaurs at the Cretaceous-Tertiary boundary. These studies helped to reveal the primary morphological evidence attesting to the monophyly of most placental orders, but weaker hypotheses of interordinal relationships have been matters of perennial debate. For both morphological and biogeographic reasons, the supraordinal affinities of endemic African placentals have long been among the more baffling problems facing placental systematists. For example, over the course of the last half-century many morphologists came to believe that sengis, golden moles, and tenrecs were closely related to different placental groups of Laurasian origin [i.e., sengis were generally aligned with lagomorphs and rodents, while tenrecs and golden moles were considered to be close relatives of shrews, true moles, hedgehogs, and *Solenodon* (e.g., Butler 1988; MacPhee & Novacek 1993; Novacek 1986; Novacek 1992; Szalay 1977)], and yet their entire evolutionary histories were incongruously restricted to the Afro-Malagasy domain. In a similar vein, some researchers considered hyracooids to be close relatives of Laurasian perissodactyls (e.g., Fischer 1989; Fischer & Tassy 1993; Prothero 1993), but the fossil record of Hyracoidea was entirely restricted to Afro-Arabia throughout the early

Cenozoic (Rasmussen 1989), while that of Perissodactyla was entirely restricted to northern continents. Given prevailing phylogenetic assumptions, these were certainly peculiar biogeographic patterns, but in the absence of any compelling morphological information that would group the endemic African taxa together as a clade to the exclusion of their alleged Laurasian relatives, most palaeontologists considered the past and present location of the African endemics to be most parsimoniously explicable by multiple early Cenozoic faunal exchanges across the expansive Tethys Sea that then separated the Afro-Arabian plate from northern continents.

Phylogenetic studies conducted over the last decade have left it clear that the solution to these biogeographic puzzles probably lay not so clearly in available details of bony anatomy or tooth structure, but rather in patterns of variation in nucleotide sequences. An abundance of DNA evidence, from nuclear and mitochondrial genes to protein sequence signatures, have all converged on a surprising, but seemingly irrefutable, answer – paenungulates (that is, elephants, hyraxes, and sea cows), sengis, armadillo, golden moles, and tenrecs are all more closely related to each other than to any other extant placental mammal (Madsen *et al.* 2001; Murphy *et al.* 2001a; Murphy *et al.* 2001b; e.g., Springer *et al.* 1997; Stanhope *et al.* 1998a; Stanhope *et al.* 1998b; van Dijk *et al.* 2001). Statistical measures of support for the monophyly of this clade are remarkably robust, and often stronger than those supporting other well-accepted placental orders; these data argue for a long period of common ancestry to the exclusion of other placentals. As palaeontological information indicates that terrestrial members of this clade were entirely restricted to Afro-Arabia until the latest Paleogene (indeed, some afrotherians apparently never left Africa), it seems that afrotherians' relatedness may be most parsimoniously explained by a 100 million-year-old (Murphy *et al.* 2001b) single origin on the Afro-Arabian continent, perhaps related to the broadly contemporaneous tectonic events on the Gondwanan landmass that isolated Afro-Arabia as an "island continent" until late in the Cenozoic. It is, of course, this ancient African origin that inspired Stanhope *et al.* (1998b) to erect the superordinal name "Afrotheria"; other supraordinal placental clades that are now well-supported by molecular data are "Laurasiatheria" (an endemic Laurasian group containing perissodactyls, artiodactyls, carnivorans, pangolins, and bats, as well as true moles, shrews, hedgehogs, and solenodons) and "Euarchontoglires" (also of Laurasian origin, and containing the "euarchontan" primates, flying lemurs, and tree shrews as well as rabbits and rodents, which are grouped together in "Glires"). Most recent studies place Xenarthra (the group containing sloths, anteaters, and armadillos) as the sister group of Laurasiatheria and Euarchontoglires (the latter two of which have been grouped together as "Boreoeutheria").

From an evolutionary perspective, these relationships are remarkable for having demonstrated that previous hypotheses of placental supraordinal relationships were based in large part either on retained primitive features, or on detailed instances of morphological convergence. In this regard the afrotherian radiation provides elegant examples of convergent adaptations that evolved in isolation under selection pressures similar to those that influenced the placental radiation on northern continents. Among other forms, the African and Laurasian clades independently produced habitually aquatic forms (laurasiatherian cetaceans

vs. afrotherian sirenians), dedicated large-bodied herbivores (perissodactyls vs. extinct hyracoids), semi-aquatic pachyderms (tapirs vs. the extinct proboscidean *Moeritherium*), small-bodied fossorial insectivores (true moles vs. golden moles), zalambdodont insectivores (*Solenodon* vs. golden moles and tenrecs), and large-bodied myrmecophagous forms (pangolins vs. armadillo). It is also interesting that, in some cases, these adaptations were occurring almost simultaneously on the different landmasses – for instance, fossil evidence documents that sirenians and cetaceans were both making their transition from semi-terrestrial to habitual aquatic behaviour during the early Eocene (e.g., Domning 2001; Gingerich *et al.* 2001). Given available evidence it appears that the afrotherian radiation never produced dedicated gliders, flying forms, or large-bodied carnivorous taxa, but it is anybody's guess what surprises the poorly known afrotherian fossil record holds in store.

Despite the overwhelming support for afrotherian monophyly, relationships within the group are less well resolved. Paenungulata is well-supported by a considerable amount of morphological and molecular evidence, and its monophyly is not controversial; a clade containing tenrecs and golden moles [termed "Afrosoricida" by Stanhope *et al.* (1998b)] also seems to be well-supported by both molecular and morphological evidence. The position of Tubulidentata and Macroscelidea remain unresolved, however, and will prove to be pivotal for understanding the origin of living and extinct afrotherian orders as well as Afrotheria as a whole. From a morphological perspective, Tubulidentata is nothing if not enigmatic; *Orycteropus*' simple cranial morphology, highly modified dentition, and poor fossil record have helped to obscure its higher-level relationships for centuries (e.g., Patterson 1975). The armadillo's combination of seemingly plesiomorphic and highly autapomorphic morphological traits limits the confidence we can have in its phylogenetic placement based on morphology, but it is clear that living and extinct sengis exhibit cranial, dental, and postcranial features that would appear to align them with paenungulates to the exclusion of the seemingly more generalised tenrecs and golden moles. Many of these features, particularly those of the dentition, are "ungulate"-like, and appear to be related to an increased emphasis on herbivory [an inference that may



North African sengi, *Elephantulus rozeti*.
Illustration by Stephanie Mansourian

be supported by the retention of a caecum facilitating hind gut fermentation in extant macroscelideans (Woodall 1987)]. The results of Murphy *et al.*'s (2001b) most recent molecular phylogenetic analysis suggest that Macroscelidea is not the sister taxon of Paenungulata, however, but rather is the closest ordinal relative of tenrecs and golden moles; this clade was, in turn, found to be more closely related to Tubulidentata than to Paenungulata (incidentally, Waddell *et al.* (2001) recently named this larger aardvark-sengi-tenrec-golden mole clade "Afroinsectiphillia", and the more restricted sengi-tenrec-golden mole clade "Afroinsectivora"). If these relationships are correct, then two alternative adaptive scenarios emerge -- either 1) the morphological features that macroscelideans and paenungulates share were acquired convergently, and both groups are independently descended from "insectivore"-like ancestors; or 2) the "ungulate"-like features that paenungulates share with sengis are plesiomorphic within Afrotheria, and tenrecs and golden moles have secondarily evolved "insectivore"-like morphological adaptations from a more "ungulate"-like ancestor. The latter possibility presents an evolutionary scenario that few would have imagined in years past, for it requires a number of seemingly improbable evolutionary reversals to the primitive placental morphotype; on the other hand, this scenario is compelling in that it would imply that afrotherian monophyly may actually be supported by morphological features that have simply been "erased" during the evolutionary history of tenrecs and golden moles. It is, however, perhaps too early to rule out the possibility that the morphological evidence for afrotherian interrelationships is providing the correct phylogenetic signal, whereas the signal from the available molecular data is misleading; indeed, the maximum likelihood bootstrap support for Murphy *et al.*'s (2001b) placement of Tubulidentata and Macroscelidea is weak enough as to leave some room for doubt. Evolutionary problems such as these are particularly difficult to evaluate given the notoriously poor early fossil record of afrotherian evolution on the Afro-Arabian landmass; their resolution will ultimately depend in large part on continued palaeontological exploration that would provide a window into the early (e.g. late Cretaceous) evolutionary history of this clade.

Why is any of this important for conservation? The recognition of afrotherian monophyly finally provides a strong foundation for a more accurate understanding of the evolutionary and temporal context of afrotherians' adaptations, past and present distributions, and constraints and vulnerabilities vis-à-vis sympatric species with very different evolutionary histories. And although our understanding of Afrotheria is still very much in its infancy, the recognition of afrotherian monophyly has already elucidated a number of unique phylogenetic patterns in morphology and physiology that had previously gone unrecognized. For instance, afrotherians evidently evolved from a common ancestor with a very primitive (or perhaps secondarily primitive) reproductive system -- unlike many members of Boreoeutheria, most male afrotherians are more similar to monotremes than to marsupials and most other placentals in being primitively primary testicond [that is, the testes are not descended and lie either caudal to the kidneys or near the dorsal abdominal wall (Werdelin & Nilsson 1999)]. Similarly, some afrotherians are unlike many boreoeutherians in exhibiting low core body temperatures

[indeed, some of the lowest yet recorded among marsupials or placentals (Lovegrove *et al.* 2001)], daily heterothermy, and in some cases poor thermoregulatory capabilities. Physiological characteristics such as these can constrain both activity cycles and geographic expansion and/or migration in the face of changing ecological conditions, and it is possible that these sorts of constraints in turn limit the ecological flexibility of afrotherians -- particularly those small-bodied forms that fall under the conservation mission of this specialist group.

Given these considerations, it is perhaps not surprising that an examination of the Cenozoic Afro-Arabian fossil record reveals that, in some respects, the evolutionary history of afrotherians forms an interesting parallel with other historically Gondwanan groups such as Marsupialia and the now extinct endemic non-xenarthran placentals of South America. All three of these groups enjoyed considerable evolutionary success in their "splendid isolation" from other, more distantly related, competitors, but the establishment of terrestrial exchange routes (i.e., between Afro-Arabia and Eurasia in the later Oligocene and early Miocene, and between North and South America in the Pliocene) led to an influx of laurasiatherian competitors that ultimately decimated endemic taxonomic diversity. Whether this was due to laurasiatherians having more "advanced" physiological or cognitive capacities will always be a matter of debate, but it is clear that the introduction of these competitors led many afrotherians to become extremely specialised, and in that regard even more prone to extinction given habitat loss. And while the analogy of afrotherians being the "marsupials" of the placental radiation should not be taken too far, it is obvious that these taxa have suffered considerable taxonomic losses over the course of the last 25 or so million years. Thirty-six million years ago one could have observed ten or more different hyracoid species, spanning the gamut from tapir- to guinea pig-sized forms, coexisting in a single area in north Africa alongside at least four or five different proboscidean species, and three or four different species of Macroscelidea. Now the order Hyracoidea has been reduced to a single small-bodied clade of recent origin, and other afrotherians haven't fared much better -- it is important to remember that if it were not for a single fortuitous dispersal to Madagascar, where tenrecids managed to radiate in their "secondary isolation", we would presumably have at least 27 fewer afrotherian species (more than a third of the afrotherian species covered by this specialist group), and our understanding of tenrecid diversity would be based entirely on the highly specialized potamogalines. And so, while it is disturbing that, of the few remaining extant afrotherian species, 38 were placed on the IUCN's 2000 Red List, at least these taxa have, as yet, managed to avoid the unfortunate fate dealt the endemic South American placentals -- somehow they are managing to hang on. In this regard it is fortuitous that we may have happened upon this new phylogenetic understanding of Afrotheria just in time to develop more appropriate conservation plans that will help to ensure their continued survival.

References

- Butler, P.M. 1988. Phylogeny of the insectivores. Pp. 117-141 in M.J. Benton (ed.): The Phylogeny and

- Classification of the Tetrapods, Volume 2: Mammals. Clarendon Press, Oxford.
- Domning, D.P. 2001. The earliest known fully quadrupedal sirenian. *Nature*, 413:625-627.
- Fischer, M.S. 1989. Hyracoidea, the sister-group of perissodactyls. Pp. 37-56 in D.R. Prothero and R.M. Schoch (eds.): *The Evolution of Perissodactyls*. Oxford University Press, New York.
- Fischer, M.S. and Tassy, P. 1993. The interrelations between Proboscidea, Sirenia, Hyracoidea, and Mesaxonia: the morphological evidence. Pp. 217-243 in F.S. Szalay, M.J. Novacek and M.C. McKenna (eds.): *Mammal Phylogeny: Placentals*. Springer Verlag, New York.
- Gingerich, P.D., ul Haq, M., Zalmout, I.S., Khan, I.H. and Malkani, M.S. 2001. Origin of whales from early artiodactyls: Hands and feet of Eocene Protocetidae from Pakistan. *Science*, 293:2239-2243.
- Lovegrove, B.G., Raman, J. and Perrin, M.R. 2001. Heterothermy in elephant shrews, *Elephantulus* spp. (Macroscelidea): daily torpor or hibernation? *Journal of Comparative Physiology B*, 171:1-10.
- MacPhee, R.D.E. and Novacek, M.J. 1993. Definition and relationships of Lipotyphla. Pp. 13-31 in S. Szalay, M.J. Novacek and M.C. McKenna (eds.), *Mammal Phylogeny: Placentals*. Springer-Verlag, Berlin.
- Madsen, O., Scally, M., Douady, C.J., Kao, D.J., DeBry, R.W., Adkins, R., Amrine, H.M., Stanhope, M.J., de Jong, W.W. and Springer, M.S. 2001. Parallel adaptive radiations in two major clades of placental mammals. *Nature*, 409:610-614.
- Murphy, W.J., Eizirik, E., Johnson, W.E., Zhang, Y.P., Ryder, O.A. and O'Brien, S.J. 2001a. Molecular phylogenetics and the origins of placental mammals. *Nature*, 409:614-618.
- Murphy, W.J., Eizirik, E., O'Brien, S.J., Madsen, O., Scally, M., Douady, C.J., Teeling, E., Ryder, O.A., Stanhope, M.J., de Jong, W.W. and Springer, M.S. 2001b. Resolution of the early placental mammal radiation using Bayesian phylogenetics. *Science*, 294:2348-2351.
- Novacek, M.J. 1986. The skull of leptictid insectivorans and the higher-level classification of eutherian mammals. *Bulletin of the American Museum of Natural History*, 183:1-112.
- Novacek, M.J. 1992. Mammalian phylogeny: shaking the tree. *Nature*, 356:121-125.
- Patterson, B. 1975. The fossil aardvarks (Mammalia: Tubulidentata). *Bulletin of the Museum of Comparative Zoology*, 147:185-237.
- Prothero, D.R. 1993. Ungulate phylogeny: Molecular vs. morphological evidence. Pp. 173-181 in F.S. Szalay, M.J. Novacek and M.C. McKenna (eds.), *Mammal Phylogeny: Placentals*. Springer-Verlag, Berlin.
- Rasmussen, D.T. 1989. The evolution of the Hyracoidea: a review of the fossil evidence. Pp. 57-78 in D.R. Prothero and R.M. Schoch (eds.), *The Evolution of Perissodactyls*. Oxford University Press, New York.
- Springer, M.S., Cleven, G.C., Madsen, O., de Jong, W.W., Waddell, V.G., Amrine, H.M. and Stanhope, M.J. 1997. Endemic African mammals shake the phylogenetic tree. *Nature*, 388:61-64.
- Stanhope, M.J., Madsen, O., Waddell, V.G., Cleven, G.C., de Jong, W.W. and Springer, M.S. 1998a. Highly congruent molecular support for a diverse superordinal clade of endemic African mammals. *Mol. Phylogenet. Evol.*, 9:501-508.
- Stanhope, M.J., Waddell, V.G., Madsen, O., de Jong, W.W., Hedges, S.B., Cleven, G.C., Kao, D. and Springer, M.S. 1998b. Molecular evidence for multiple origins of Insectivora and for a new order of endemic African insectivore mammals. *Proceedings of the National Academy of Science, USA*, 95:9967-9972.
- Szalay, F.S. 1977. Phylogenetic relationships and a classification of the eutherian Mammalia. Pp. 375-394 in M.K. Hecht, P.C. Goody and B.M. Hecht (eds.), *Major Patterns of Vertebrate Evolution*. Plenum Press, New York.
- van Dijk, M.A.R., Madsen, O., Catzeflis, F., Stanhope, M.J., de Jong, W.W. and Pagel, M. 2001. Protein sequence signatures support the African clade of mammals. *Proceedings of the National Academy of Science, USA*, 98:188-193.
- Waddell, P.J., Kishino, H. and Ota, R. 2001. A phylogenetic foundation for comparative mammalian genomics. *Genome Informatics*, 12:141-154.
- Werdelin, L. and Nilsson, Å. 1999. The evolution of the scrotum and testicular descent in mammals: A phylogenetic view. *Journal of Theoretical Biology*, 196:61-72.
- Woodall, P.F. 1987. Digestive tract dimensions and body mass of elephant shrews (Macroscelididae) and the effects of season and habitat. *Mammalia*, 51:537-545. ❖

Article:

Dassie census in the Matobo Hills, Zimbabwe

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This report is a preliminary summary of a census of dassies that was conducted in Matobo Hills, Zimbabwe, between 26 April and 23 May 2001. Two dassie species are found in Matobo Hills, (*Heterohyrax brucei* and *Procavia capensis*) and they have been censused every year since 1992. For more information on previous surveys, methods and study sites see Barry (1993, 1994), Barry & Barry (1996) and Barry & Mundy (1998).

The census was conducted at 28 sampling sites (20 sites in national parks land; 4 on commercial farmlands and 4 on communal lands). Sketch maps and data forms for each sampling site were used for the third year-running, following Barry and Mundy (1998). The census area at each sampling site was measured using a Range Finder. Positions of each site were recorded using a Global Positioning System. The counting duration at each sampling site varied between 102-182 minutes. Each count started at dawn and was conducted by 2 people. Weather conditions were generally good with rain recorded on only one of the survey days.

Table 1. Total numbers of dassies (*Heterohyrax brucei* and *Procavia capensis*) recorded in the three land-use areas in the Matobo Hills. Land uses: NP = national park (20 sites); CFL = commercial farmland (4 sites); CL = communal land (4 sites). Age categories: pup = < 3 months; juvenile = 1 year (born the previous year); sub-adult = 2 years; adult = 3+ years.

Land use	Species	Age categories				Total
		Ad.	Sub. ad.	Juv.	Pup	
NP	Hb	363	61	48	156	628
	Pc	235	41	29	82	387
CFL	Hb	52	12	14	24	102
	Pc	41	3	7	26	77
CL	Hb	28	3	3	7	41
	Pc	44	11	4	21	80
Overall	Hb	443	76	65	187	771
	Pc	320	55	40	129	544

The total number of dassies recorded during this survey (see Table 1) represents an 18% increase in the previous year's figures. This implies the dassies are recovering from a disease outbreak that reduced populations in 1998/99; in addition, no dead or sick animals were observed. The census showed increases in all age-groups of *Heterohyrax brucei* in all three land-use areas (increases ranging from 29% in national parks to 68.3% in communal lands). The *Procavia capensis* populations had declined in two land-use areas (by 12% in national parks and 10% in commercial farmlands), but had increased by 43% on communal lands. Both species showed an increase in pups and juveniles. The survey results therefore indicate that *Heterohyrax brucei* is recovering from the population crash more speedily than *Procavia capensis*.

Three pups (2 *Heterohyrax* and one *Procavia*) at one site were observed with unusual pelage colorations – they were partial albinos. One of the *Heterohyrax* pups had snow-white forehead, neck and legs, while the other two pups had snow-white crests. Such fur coloration has not been recorded in Matobo Hills since the start of the project.

Acknowledgements

I would like to thank the Raptor Research Group for financially sponsoring the project. The Warden (Matobo National Park) was very helpful, especially through the provision of accommodation. Her senior staff are also thanked for helping us in many ways, including the delivery of the project fuel to our base station at the start of the project.

References

- Barry, R.E. 1993. Dassies of the Matobo National Park. *Zimb. Sci. News*, 27:55-57.
- Barry, R.E. 1994. Synchronous parturition of *Procavia capensis* and *Heterohyrax brucei* during drought in Zimbabwe. *South African Journal of Wildlife Research*, 24:1-5.
- Barry, R.E. and Barry, L.M. 1996. Species composition and age structure of remains of hyraxes (Hyracoidea: Procaviidae) at nests of Black Eagles. *J. Mammol.* 77:702-

707.

- Barry, R.E. and Mundy, P. J. 1998. Population dynamics of two species of hyraxes in the Matobo National park, Zimbabwe. *African Journal of Ecology*, 36:221-233. ❖



Rock hyrax or dassie, *Heterohyrax brucei*.
Illustration by Stephanie Mansourian.

Article:

The ecological importance of the Aardvark

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Aardvark, *Oryzomys afer*, are sparsely scattered throughout the savannah of the southern parts of Africa. Rarely seen, these nocturnal creatures roam the savannah plains in search of ants or a tasty termite mound to help satisfy their huge appetites. Few people understand the ecological importance of the aardvark and as their natural habitat continues to decline, a simple, yet integrated system may be lost.

When I first encountered this unique animal in the veld, I thought it to be somewhat like a giant rat. The ears resemble those of a donkey, the long snout that of a pig, the tail of a rat, and the claws similar to a bear's. The aardvark's powerful limbs and claws make it an exceptional digger. I have seen aardvark that started digging in sandy loam soil disappear beneath the surface within three minutes. It is these digging abilities that make the aardvark unpopular amongst farmers. The huge holes and burrows dug by aardvark can devastate dam walls and seriously damage motor vehicles and tractors that are accidentally driven into them in the veld. Although aardvark have a wide habitat tolerance they are not common and any farmer should be proud to have them on his farm. Their distribution is governed by the availability of food in their undisturbed natural savannah habitat. Ants and termites largely constitute the diet of the aardvark. Bearing in mind that termites can cause a huge grass foliage decrease and thus a decrease in the carrying capacity of the veld, aardvark and other insect

feeders like aardwolf are hugely beneficial to pastoral farmers.

The ecological role of the aardvark is not limited to the reduction of ant and termite harvesting of crops and grass. Aardvarks indirectly facilitate an environment suitable for other animal species. With its strong claws, an aardvark can easily break and penetrate the hard crust of a termite mound. A recent study indicates that aardvark utilise more termite mounds during the cold winter months than during summer months. This may either be due to the decrease in ant activity and availability during the cold nights or because termite mounds provide a better source of energy during the period of greatest need. During cold months the availability of above ground termites such as the harvester termites, *Hodotermes mossamicus*, are very scarce and it can often be seen how aardwolf follow aardvark to feed at termite mounds once the aardvark has left. The following day, Ant-eating chats, *Myrmecocichla formicivora*, also utilise the open termite mounds to feed on the left over dead termites scattered around. Aardvark thus facilitates the supplementary feeding of these species during the harsh winter months. Old excavated mounds may also be utilised by various species as hideouts. The Cape centipede-eater or Black-headed snake, *Aparallactus capensis*, and Common egg-eater, *Dasypeltis scabra*, are also often found in old termite mounds where they hibernate and hide during cold winter months. Occasionally have I also found the Pygmy mouse, *Mus minutoides*, and the Big-eared mouse, *Malacothrix typica*, inhabiting or seeking refuge in old termite mounds. Termite mounds that have been opened by aardvark provide a safe refuge for many species, especially if the mound has been "cleaned out" by an aardvark and no longer houses termites. The Lesser dwarf shrew, *Suncus varilla*, one of the smallest and lightest mammal species on earth, nests deep within old opened termite mounds. These small shrews move through bigger termite tunnels within the mound and construct a neat, round nest of broad grass leaflets. Nesting within the mounds provides a safe microclimate, especially since the small shrews are sensitive to temperature changes.

Aardvark burrows are also utilised by many species who are often unable to make their own. These include species such as the Ant-eating chats, jackals, hyenas, warthogs, aardwolves, mongooses, Black-footed cats and porcupine. Smithers (1971) recorded 17 species of mammals that utilise aardvark burrows and mentioned that the survival of some of these species may depend on the shelter which these burrows can provide. The Ant-eating chat often uses and occupies a burrow by creating a nesting site in the roof near the entrance. This occurs especially in dryer habitats where other nesting sites and protective vegetation becomes scarce.

The survival of the aardvark and its vital, yet simple, ecological links with other animals depends on the conservation of natural habitat with a sufficient food source. Farmers play a major role in the conservation of these areas, and may in the long-term benefit from protecting the ecologically important aardvark.

Reference

Smithers, R.H.N. 1971. The Mammals of Botswana. Mus. mem. Natl Mus. Monum. Rhod., 4:1-340. ❖

Afrotheria News

New research project looks at the behavioural ecology of the Bushveld sengi

I have started a research project on the behavioural ecology of the bushveld sengi (*Elephantulus intufi*) near the Erongo Mountains in Namibia. My study is located at the Erongo Wilderness Lodge near Omaruru, where these sengis not only occupy bushveld habitats but also boulder fields at the base of large granite outcrops. In January 2001 I developed trapping, tagging, and radio-collaring methods and collected preliminary information on their spatial organisation. I also developed similar methods to concurrently research the behavioural ecology of dassie-rats (*Petromus typicus*), squirrel-like rodents that live on the granite outcrops next to the sengis. In September and October 2001 I successfully radio-collared several individuals of each species and began to determine their spatial relationships, as well as observe individual and social behaviours. Preliminary results indicate that *E. intufi*, like other sengis so far studied, is monogamous. Many of its behaviours are very similar to those of *E. rufescens* that I studied in Kenya in the 1970s, including their use of trails through leaf litter. They also shelter in relatively open situations such as among boulders or at the base of dense bushes; they build no nests. Care of the 1 or 2 precocial neonates, which shelter at different locations than the parents, is brief and minimal. However, *E. rufescens* was more diurnal than *E. intufi*, making behavioural observation of the latter more difficult. I plan on returning to Namibia to continue my studies in April 2002 for three months.

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Afrotheria on the Web

The IUCN/SSC Afrotherian Specialist Group has a new website. Check it out on:

<http://www.calacademy.org/research/bmammals/afrotheria/ASG.html>

The home page shows a map of Africa and Madagascar. By clicking on a photograph of a member of each of the 5 taxa covered by the group, the map displays the taxa's range. Pages available on the website are:

- What is Afrotheria? – explaining more about the Specialist Group
- Group Mission and Goals – what we are aiming to do
- Group Members – all the names and addresses
- Afrotherian Systematics – all you need to know about

- the taxonomic details of the group's target mammals
- Newsletter – the web-posted version of *Afrotherian Conservation*
- Photogallery - this page is under development but will have photos of species from all 5 taxa
- IUCN Specialist Groups – details of other specialist groups dealing with mammals.

If you have any comments, suggestions or contributions for this great new website, contact the Afrotheria SG Webmaster, Erik Seiffert (address on page 14).

Another website worth a visit is **tenrec.org**. David Kupitz has done a great job putting together a site for tenrec enthusiasts entitled *Tenrec Resources and Information*. The target audience appears to be people who keep tenrecs in captivity. The site provides a bibliography with abstracts (mostly on captive breeding), a message board for the exchange of information, a gallery of photos, and a studbook for the Lesser hedgehog tenrec, *Echinops telfairi*. The material throughout the site reflects the predominance of *Echinops* in captive colonies both in zoos and private collections. However, some of the references are relevant to other tenrecs and it is a useful site for those who want to find out more about these fascinating Afrotherians!

Do you know of any other web sites featuring the Afrotheria? If so, drop a line to the Editor and we'll highlight them in the next *Afrotherian Conservation*.

New molecular evidence for timing of mammalian colonisation of Madagascar

A recent paper published in *Molecular Phylogenetics and Evolution* (Douady *et al.* 2002) has shed new light on the timing of the mammalian colonisation of Madagascar. Tenrecs were the first mammals to invade Madagascar from mainland Africa. Genetic studies into four species of tenrec (*Micropotamogale lamottei*, *Tenrec ecaudatus*, *Echinops telfairi*, and *Oryzorictes talpoides*), suggest that otter shrews and Malagasy tenrecs split from each other approximately 53 millions years ago, whereas the two Malagasy families (Oryzorictinae and Tenrecinae) diverged around 37 millions years ago. The research therefore suggests that tenrecs colonised Madagascar between 37 and 53 million years ago. However, if the fossil record is also taken in to account, it appears that there may have been a second dispersal event, meaning the modern day tenrec fauna on Madagascar probably arose from two invasions.

ANNOUNCEMENTS

Management Plan for the Arabuko-Sokoke Forest

A six year Integrated Conservation and Development Project at Arabuko-Sokoke Forest on the Kenyan coast (home to the Golden-rumped sengi and Four-toed sengi) has just come to an end. It was funded by the European Union and administered by BirdLife International. Among its most important outputs is a 25 year Strategic Management Plan. From 1st May, a limited number of hard copies of this Management Plan can be obtained from Nature Kenya, P.O. Box 44486, 00100 GPO Nairobi, Kenya or as a pdf file from roger.safford@birdlife.org.uk

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Seeking Giant Sengi Sightings

We are collecting information on the distribution and status of the Black-and-rufous sengi (*Rhynchocyon petersi*) and Chequered sengi (*R. cirnei*) from central and eastern Africa. Even if you believe your sightings and habitat information may not be of interest, please send us your observations because little is known about the status of these two species.

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ABSTRACTS

This section presents abstracts from recent papers on the Afrotheria.

Behaviour of the Aquatic Tenrec

Benstead, J.P., Barnes, K.H. and Pringle, C.M. 2001. Diet, activity patterns, foraging movement and responses to deforestation of the aquatic tenrec *Linnogale mergulus* (Lipotyphla: Tenrecidae) in eastern Madagascar. *Journal of Zoology, London*, 254: 119-129.

The aquatic or web-footed tenrec *Linnogale mergulus* is a semi-aquatic lipotyphlan insectivore known only from stream habitats of eastern Madagascar. *Linnogale* is considered a high conservation priority because of its rarity, suspected vulnerability to habitat degradation, and unique ecological niche on the island. However, its ecology and behaviour remain poorly understood. Quantitative faecal analysis and radiotracking were used to study the diet and foraging activity of *Linnogale* in eastern Madagascar. Faecal pellet counts along forest and zero-canopy streams were also conducted to examine the response of aquatic tenrec populations to catchment deforestation. Faecal analysis indicated that the diet of *Linnogale* consists mainly of larval and adult aquatic insects, larval anurans and crayfishes. The most important prey were Ephemeroptera, Odonata and Trichoptera larvae. Diets did not differ substantially between forest and zero-canopy streams. Radio-tracking of two individuals indicated that *Linnogale* is strictly nocturnal and remains in streamside burrows during daylight. Nocturnal movement was restricted solely to stream channels and consisted of active foraging by swimming and diving. Distance travelled per night ranged from 200 to 1550 m along the stream channel (means 1067 and 860 m, respectively). The total lengths of stream channel used by the two aquatic tenrecs during each radio-tracking study were 1160 and 505 m, respectively. Faecal pellet counts along forest and zero-canopy streams suggested that *Linnogale* was at least as abundant in zero-canopy streams. This finding suggests that *Linnogale* is not an obligate forest species; however, it preys on benthic communities that are extremely vulnerable to sedimentation. Control of excessive sedimentation and maintenance of healthy benthic communities are essential to *Linnogale* conservation. We include an updated list of known sites for *Linnogale* and recommend the use of faecal pellet surveys to assess the current distribution of the species.

Aardvark Feeding Ecology

Taylor, W.A., Lindsey, P.A. and Skinner, J.D. 2002. The feeding ecology of the aardvark *Orycteropus afer*. *Journal of Arid Environments*, 50 : 135-152.

Thirteen aardvarks (*Orycteropus afer*) were radio tagged at Tussen die Riviere Nature Reserve in the Nama Karoo between 1996 and 1998. Faecal contents were analysed and four habituated aardvarks closely followed to investigate feeding ecology. The diet of the aardvark consisted entirely of ants and termites, with ants predominating in all seasons and years. *Anoplolepis custodiens* was the most important prey species in all months, followed by *Trinervitermes trinervoides*. Termites were fed on more often in winter than summer at a time when ant numbers were generally reduced and the aardvarks may have been experiencing difficulty in meeting their nutritional requirements relative to summer. Predation from epigeal mounds took place at this time, coinciding with the presence of alates.

Genetic Diversity in Hyrax Populations

Gerlach, G. and Hoeck, H.N. 2001. Island on the plains: Metapopulation dynamics and female biased dispersal in hyraxes (Hyracoidea) in the Serengeti National Park. *Molecular Ecology*, 10: 2307-2317.

Two species of hyrax, *Heterohyrax brucei* and *Procavia johnstoni*, inhabit rock outcrops, or kopjes, in the Serengeti National Park, Tanzania. Such distinct island habitats provide an excellent model to investigate natural metapopulation dynamics with distinct small populations with extinction and colonization events, as well as migration between populations. Allele frequencies, genetic variability and genetic distances between populations were calculated based on DNA microsatellite markers. The genetic diversity in both species of hyrax, especially *P. johnstoni*, was surprisingly low: allelic diversity ranged from 2 to 7 alleles per locus. This may have been induced by colonization by a small number of individuals from single source populations. F-statistics, assignment tests and calculations of pairwise relatedness all indicated female-biased dispersal in *H. brucei* but not *P. johnstoni*. Values of FIS in *P. johnstoni* showed an excess of homozygotes indicative of high rates of inbreeding; evidence for inbreeding could not be detected in *H. brucei*. Although female dispersal patterns in *H. brucei* seem to prevent inbreeding and consequently reduce risk of local extinction, this seems not to be the case in *P. johnstoni*.

BIBLIOGRAPHY:

Recent Afrotheria publications (since 1998)

The following section represents a bibliography of publications on the Afrotheria that have been produced since 1998. This list is not exhaustive. Authors are invited to send details of any omissions or new publications to the Editor. Reprints of recent papers would also be welcome, as some can be added to the Abstracts section in future editions of *Afrotherian Conservation*.

Afrotheria (General)

- Cutler, J. B., Dumas, A., and Wynn, R.M. 1998. Immunohistochemical analysis of the interhemal membrane of the elephant shrew. *Gynecologic and Obstetric Investigation*, 46:46-48.
- De Jong, W. W. 1998. Molecules remodel the mammalian tree. *Trends in Ecology and Evolution*, 13:270-275.
- Emerson, G., Kilpatrick, C.W, McNiff, B.E., Ottenwalder, J. and Allard, M.W. 1999. Phylogenetic relationships of the order Insectivora based on complete 12S rRNA sequences from mitochondria. *Cladistics*, 15:221-230.
- Gheerbrant, E. 1998. The oldest known proboscidean and the role of Africa in the radiation of modern orders of placentals. *Bulletin of the Geological Society of Denmark*, 44:181-185.
- Hedges, S. B. 2001. Afrotheria: Plate tectonics meets genomics. *Proceedings of the National Academy of Sciences USA*, 98:1-2.
- Liu, F. R. and Miyamoto, M.M. 1999. Phylogenetic assessment of molecular and morphological data for eutherian mammals. *Systematic Biology*, 48:54-64.
- Madsen, O., Scally, M., Douady, C.J., Kao, D.J., Debry, R.W., Adkins, R., Amrine, H.M., Stanhope, M.J., de Jong, W.W. and Springer, M.S. 2001. Parallel adaptive radiations in two major clades of placental mammals. *Nature (London)*, 409:610-614.
- Murphy, W. J., Eizirik, E., Johnson, W.E., Zhang, Y.P., Ryder, O.A. and Brien, S.J. 2001. Molecular phylogenetics and the origins of placental mammals. *Nature (London)*, 409:614-617.
- Nowak, R. M. (ed.) 1999. *Walker's mammals of the world, Sixth Edition. Volume I and II*. The Johns Hopkins University Press, Baltimore.
- Perkins, S. 2001. Genes seem to link unlikely relatives. *Science News*, 159:4.
- Shoshani, J. and McKenna, M.C. 1998. Higher taxonomic relationships among extant mammals based on morphology, with selected comparisons of results from molecular data. *Molecular Phylogenetics and Evolution*, 9:572-584.
- Springer, M. S., Amrine, H.M., Burk, A. and Stanhope, M.J. 1999. Additional support for Afrotheria and Paenungulata, the performance of mitochondrial versus nuclear genes, and the impact of data partitions with heterogeneous base compounds. *Systematic Biology*, 48:65-75.
- Stanhope, M. J., Waddell, V.G., Cleven, G.C., de Jong, W.W. and Springer, M.S. 1998a. Highly congruent molecular

- support for a diverse superordinal clade of endemic African mammals. *Molecular Phylogenetics and Evolution*, 9:501-508.
- Stanhope, M. J., Waddell, V.G., Madsen, O., de Jong, W.W., Hedges, S.B., Cleven, G.C., Kao, D. and Springer, M.S. 1998b. Molecular evidence for multiple origins of Insectivora and for a new order of endemic African insectivore mammals. *Proceedings of the National Academy of Sciences USA*, 95:9967-9972.
- van Dijk, M. A. M., Madsen, O., Catzeflis, F., Stanhope, M.J., de Jong, W.W. and Pagel, M. 2001. Protein sequence signatures support the African clade of mammals. *Proceedings of the National Academy of Sciences USA*, 98:188-193.
- Waddell, P. J., Okada, N., and Hasegawa, M. 1999. Towards resolving the interordinal relationships of placental mammals. *Systematic Biology*, 48:1-5.
- Werdelin, L. and Nilsson, A. 1999. The evolution of the scrotum and testicular descent in mammals: a phylogenetic view. *Journal of Theoretical Biology*, 196:61-72.

Chrysochloridae (Golden moles)

- Bronner, G.N. 2000. New species and subspecies of golden mole (Chrysochloridae: *Amblysomus*) from Mpumalanga, South Africa. *Mammalia*, 64:41-54.
- Bronner, G.N. and Perrin, M.R. 2001. Family Chrysochloridae. Pp. 748 – 749 in D. MacDonald (ed.), *The New Encyclopaedia of Mammals*. Oxford New Encyclopaedia Series, Oxford University Press, Oxford.
- Mason, M.J. 2001. Middle ear structures in fossorial mammals: a comparison with non-fossorial species. *Journal of Zoology (London)*, 255:467-486.
- Mason, M.J. and Narins, P.M. 2001. Seismic use by fossorial mammals. *American Zoologist*, 41:1171-1184.
- Narins, P.M., Lewis, E.R., Jarvis, J. and O'Riain, J. 1998. The use of seismic signals by fossorial southern African mammals: a neuroethological gold mine. *Brain Research Bulletin*, 44:641-646.
- Seymour, R.S., Withers, P.C. and Weathers, W.W. 1998. Energetics of burrowing, running, and free-living in the Namib desert golden mole (*Remitalpa namibensis*). *Journal of Zoology (London)*, 244:107-117.

Hyracoidea (Hyraxes or dassies)

- Barry, R.E. and Mundy, P. J. 1998. Population dynamics of two species of hyraxes in the Matobo National park, Zimbabwe. *African Journal of Ecology*, 36:221-233
- Barry, R. and Shoshani, J. 2000. *Heterohyrax brucei*. *Mammalian Species*, 645:1-7.
- Gerlach, G. and Hoeck, H.N. 2001. Island on the plains: Metapopulation dynamics and female biased dispersal in hyraxes (Hyracoidea) in the Serengeti National Park. *Molecular Ecology*, 10: 2307-2317.
- Hoeck, H.H. 2001. Hyraxes. Pp. 448-451 in D. Macdonald (ed.), *The New Encyclopedia of Mammals*. Oxford University Press, Oxford.
- Kotler, B.P., Brown, J.S. and Knight M.H. 1999. Habitat and patch use by hyraxes: there's no place like home? *Ecology Letters*, 2:82-88.
- Shoshani, J. 1998. Hyraxes. Pp. 188-189 in E. Gould, and G. McKay (eds.), *Encyclopedia of Mammals*. Academic Press, San

Diego.

- Shoshani, J. 2001. Hyraxes in Eritrea. *Abstracts of papers and posters, Eight International Theriological Congress, Sun City (South Africa)*, 12-17 August 2001, Abstract no. 332, page 126
- Shoshani, J. and McKenna, M.C. 1998. Higher taxonomic relationships among extant mammals based on morphology, with selected comparisons of results from molecular data. *Molecular Phylogenetics and Evolution, Special Issue*, 9 (3):572-584.

Macroscelidea (Sengis or elephant-shrews)

- Avery, D. M. 1998. An assessment of the Lower Pleistocene micromammalian fauna from Swartkrans Members 1-3, Gauteng, South Africa. *Geobios*, 31:393-414.
- Bauer, C. R. 2001. Impact of commercial and subsistence practices on the Arabuko-Sokoke Forest in coastal Kenya, using an endemic mammal as an indicator species. M.Sc. Thesis. Eastern Kentucky University, Richmond.
- Burgess, N. D., Kock, D., Cockle, A., FitzGibbon, C., Jenkins, P. and Honess, P. 2000. Mammals. Pages 173-190 and 401-406 in N. D. Burgess and G. P. Clarke (eds.), *Coastal forests of Eastern Africa*. IUCN, Gland.
- Chitaukali, W. N., Burda, H. and Kock, D. 1999. Small mammals of the Nyika Plateau, Malawi.
- Cunningham, A. B. 1998. The ecological footprint of the wooden rhino - Kenya's carvings. *Africa - Environment and Wildlife*, 6:43-50.
- Dunbar, R. I. M. and Bever, J. 1998. Neocortex size predicts group size in carnivores and some insectivores. *Ethology*, 104:695-708.
- Eccard, J. A., Walther, R.B. and Milton, S.J. 2000. How livestock grazing affects vegetation structures and small mammal distribution in the semi-arid Karoo. *Journal of Arid Environments*, 46:103-106.
- Koontz, F. W., Wellington, J.L. and Weldon, P.J. 1999. The sternal gland of the rufous elephant-shrew, *Elephantulus rufescens* (Macroscelidea, Mammalia): anatomy, maturation, and secretion composition. Pp. 163-171 in R. E. Johnson, D. Muller-Schwarze and P. W. Sorenson (eds.), *Advances in Chemical Signals in Vertebrates*. Plenum Publishers, New York.
- Lovegrove, B. G., Lawes, M.J. and Roxburgh, L. 1999. Confirmation of pleisiomorphic daily torpor in mammals: the round-eared elephant shrew *Macroscelides proboscideus* (Macroscelidea). *Journal of Comparative Physiology B*, 169:453-460.
- Lovegrove, B. G., Raman, J. and Perrin, M.R. 2001a. Daily torpor in elephant shrews (Macroscelidea: *Elephantulus* spp.) in response to food deprivation. *Journal of Comparative Physiology B*, 171:11-21.
- Lovegrove, B. G., Raman, J. and Perrin, M.R. 2001b. Heterothermy in elephant shrews, *Elephantulus* spp. (Macroscelidea): daily torpor or hibernation? *Journal of Comparative Physiology B*, 171:1-10.
- Monadjem, A. 1998. Distributional patterns and conservation status of mammals of Swaziland, southern Africa. *Koedoe*, 41:45-59.
- Newbery, C. H. 1999. A key to the Soricidae, Macroscelididae, Gliridae and Muridae of Gauteng, North West Province, Mpumalanga and the Northern Province, South Africa. *Koedoe*, 42:51-55.
- Raman, J. 1999. *Molecular systematics of seven southern African elephant-shrew species*. Ph.D. Thesis. University of Natal, Pietermaritzburg, South Africa.

- Rathbun, G. B. 1998. Elephant shrews - Hounded to extinction? *Africa - Environment and Wildlife*, 6:45.
- Rathbun, G.B. 2001. Elephant-shrews. Pages 716-721 in D. Macdonald (ed.), *The New Encyclopedia of Mammals*. Oxford University Press, Oxford, England.
- Rathbun, G.B. 2001. *Petrodromus tetradactylus*. *American Society of Mammalogists, Mammalian Species*, No. 682: 1-6.
- Rathbun, G. B. and Kyalo, S.N. 2000. Golden-rumped elephant-shrew. Pp. 125-129, 340-341 in R. P. Reading and B. Miller (eds.), *Endangered Animals, A Reference Guide to Conflicting Issues*. Greenwood Press, Westport, Connecticut.
- Rathbun, G.B. and Woodall, P. 2001. Bibliography on elephant-shrews. *Journal of Mammalogy*, 82:618-619.
- Unger, R. 1999. *Verhalten, Aktivität und Ernährung von Kurzohr-Rüsselspringern, Macroscelides proboscideus, Smith 1829 (Macroscelididae) im Tiergarten Schonbrunn*. Diplomarbeit Thesis. Universität Wien, Wien.
- Unger, R. 2000. Anmerkungen zur Handaufzucht von kurzohr-rüsselspringern, *Macroscelides proboscideus* (Shaw, 1800). *Zeitschrift der Kölner Zoo*, 43:121-126.
- Unger, R. and Kratochvil, H. 1999. Feeding preferences of short-eared elephant shrews (*Macroscelides proboscideus*, Smith 1829). *Zoology*, 102(Suppl. II):87.
- Unger, R. and Schratter, D. 2000. Nahrungspräferenzen von Kurzohr-Rüsselspringern, *Macroscelides proboscideus* (Shaw, 1800) im Tiergarten Sonbrunn. *Zoologische Garten*, 70:60-69.
- Taylor, P. 1998. *The smaller mammals of KwaZulu-Natal*. University of Natal Press, Pietermaritzburg, South Africa.

Tenrecidae (Tenrecs and otter-shrews)

- Andreone F, Randrianirina J E, Jenkins P D & Aprea G 2000. Species diversity of Amphibia, Reptilia and Lipotyphla (Mammalia) at Ambolokopatrika, a rainforest between the Anjanharibe-Sud and Marojejy massifs, NE Madagascar. *Biodiversity and Conservation*, 9: 1587-1622.
- Asher, R. J. 1999. A morphological basis for assessing the phylogeny of the 'Tenrecoidea' (Mammalia, Lipotyphla). *Cladistics*, 15, 231-252.
- Benstead, J.P., Barnes, K.H. and Pringle, C.M. 2001. Diet, activity patterns, foraging movement and responses to deforestation of the aquatic tenrec *Limnogale mergulus* (Lipotyphla: Tenrecidae) in eastern Madagascar. *Journal of Zoology, London*, 254, 119-129.
- Douady, C.J., Catzeflis, F., Kao, D.J., Springer, M.S. and Stanhope, M.J. 2002. Molecular evidence for the monophyly of Tenrecidae (Mammalia) and the timing of the colonization of Madagascar by Malagasy tenrecs. *Molecular Phylogenetics and Evolution*, 22: 357-363.
- Ganzhorn, J.U., Goodman, S.M., Ramannamanjato, J.B., Rakotodravony, D., Rakotosamimanana, B. and Vallan, D. 2000. Vertebrate species in fragmented littoral forests of Madagascar. Pp. 155-164 in W. R. Lourenço and S. M. Goodman (eds.), *Diversité et Endémisme à Madagascar*. Mémoires de la Société de Biogéographie, Paris.
- Goodman, S.M. and Jenkins, P.D. 1998. Chapter 10 The Insectivores of the Réserve Spéciale d'Anjanharibe-Sud, Madagascar. Pp. 139-161 in S.M. Goodman (ed.), *A floral and faunal inventory of the eastern slopes of the Réserve Spéciale d'Anjanharibe-Sud, Madagascar: with reference to elevational variation*. *Fieldiana, Zoology* (90): 1-246.
- Goodman, S.M. and Jenkins, P.D. 2000. Tenrecs (Lipotyphla: Tenrecidae) of the Parc National de

- Marojejy, Madagascar. Pp. 201-229 in S.M. Goodman (ed.), A Floral and Faunal Inventory of the Parc National de Marojejy, Madagascar: with reference to elevational variation. *Fieldiana: Zoology*, new series (97): 201-229.
- Goodman, S.M., Jenkins, P.D. and Pidgeon, M. 1999. Chapter 13 Lipotyphla (Tenrecidae and Soricidae) of the Réserve Naturelle Intégrale d'Andohahela, Madagascar. Pp. 187- 216 in S.M. Goodman (ed.) *A floral and faunal inventory of the eastern slopes of the Réserve Naturelle Intégrale d'Andohahela, Madagascar: with reference to elevational variation. Fieldiana Zoology, New Series* (94):1-297.
- Goodman, S.M., Jenkins, P.D. and Rakotondravony, D. 2000. The biogeography of rodents (Rodentia: Muridae: Nesomyinae) and tenrecids (Lipotyphla: Tenrecidae) in the eastern forests of Madagascar: an assessment of altitudinal zonation along a latitudinal gradient. pp. 127-138 in W.R. Lourenço W R & S.M. Goodman (eds.) *Diversité et Endémisme à Madagascar*. Mémoires de la Société de Biogéographie, Paris.
- Goodman, S. M. and Rakotondravony, D. 2000. The effects of forest fragmentation and isolation on insectivorous small mammals (Lipotyphla) on the Central High Plateau of Madagascar. *Journal Zoology, London*, 250, 193-200.
- Goodman, S. M., D. Rakotondravony, L. E. Olson, E. Razafimahatratra and Soarimalala, V. 1998. Les insectivores et les rongeurs. Pp. 80-93 in D. Rakotondravony & S. M. Goodman (eds.), *Inventaire biologique. Forêt d'Andranomay, Anjozorobe. Recherches pour le Développement, Série Sciences biologiques, n°13*. WWF-Centre d'Information et de Documentation Scientifique et technique, Antananarivo,
- 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.
- Goodman, S. M. and Rasolonandrasana, B.P.N. 2001. Elevation zonation of birds, insectivores, rodents, and primates on the slopes of the Andringitra Massif, Madagascar. *Journal Natural History*, 35:285-305.
- Goodman, S M, Rasolonandrasana, B.P.N. and Jenkins, P.D. 1999. Les Insectivores (Ordre Lipotyphyla). Pp. 119-134 in S.M. Goodman & B.P.N. Rasolonandrasana (eds.), *Inventaire biologique de la réserve spéciale du pic d'Ivohibe et du couloir forestier qui la relie au Parc national d'Andringitra. Recherches pour le Développement, Série Sciences biologiques* (15).
- Jenkins, P.D. and Goodman, S.M. 1999 A new species of *Microgale* (Lipotyphla, Tenrecidae) from isolated forest in southwestern Madagascar. *Bulletin of the Natural History Museum London (Zoology)*, 65 (2): 155 – 164.
- Mouchaty, S. K., Gullberg, A., Janke, A. and Arnason, U. 2000. Phylogenetic position of the Tenrecs (Mammalia: Tenrecidae) of Madagascar based on analysis of the complete mitochondrial genome sequence of *Echinops telfairi*. *Zoologica Scripta*, 29: 307-317.
- Rakotondravony, D. and Goodman, S.M. 2000. Les effets de la fragmentation forestière et de l'isolement sur les communautés de Mammifères (Lipotyphla) dans le Haut Plateau Central de Madagascar. Pp. 49-62 in J. Ratsirarson et S. M. Goodman (eds.), *Inventaire biologique, Monographie de la forêt d'Ambohitantely*. Eds. *Recherches pour le Développement, Série Sciences Biologiques*, no. 16.
- Rakotondravony, D., Goodman, S. M., Duplantier, J.-M. and Soarimalala, V. 1998a. Les petits mammifères. Pp. 197-212 in J. Ratsirarson & S. M. Goodman (eds.), *Inventaire biologique de la forêt littorale de Tampolo (Fenoarivo Atsinanana), ed. Recherches pour le Développement, Série Sciences Biologiques, no. 14*. Centre d'Information et de Documentation Scientifique et Technique, Antananarivo.
- Rasolonandrasana, B.P. and Goodman, S.M. 2000. Importance du couloir forestier situé entre le Parc National d'Andringitra et la Réserve Spéciale du Pic d'Ivohibe pour la conservation des Vertébrés terrestres. Pp. 139-154 in W. R. Lourenço & S. M. Goodman (eds.), *Diversité et endémisme à Madagascar*. Mémoires de la Société de Biogéographie, Paris.
- Sanchez-Villagra, M.R and Asher, R.J. 2002. Cranio-sensory adaptations in small faunivorous semiaquatic mammals, with special reference to olfaction and the trigeminal system. *Mammalia*, 66 : 93-109.

Tubulidentata (Aardvark)

- Arnason, U., Gullberg, A. & Janke, A. 1999. The mitochondrial DNA molecule of the aardvark, *Orycteropus afer*, and the position of the Tubulidentata in the eutherian tree. *Proceedings of the Royal Society London B*, 266, 339-345.
- Nel, P.J., Taylor, W.A, Meltzer, D.G.A. and Haupt, M.A. 2000. Capture and immobilisation of aardvark (*Orycteropus afer*) using different drug combinations. *J. Sth. Afr. Vet. Ass.* 71: 58-63.
- Taylor, W.A. & Skinner, J.D. 2000. Associative feeding between Aardwolves (*Proteles cristatus*) and Aardvarks (*Orycteropus afer*). *Mammal Review*, 30: 141-143.
- Taylor, W.A. & Skinner, J.D. 2001. Associative feeding between Anteating Chats *Myrmecocichla formicivora* and Aardvarks *Orycteropus afer*. *Ostrich*, 72: 199-200
- Taylor, W.A., Lindsey, P.A. & Skinner, J.D. 2001. The feeding ecology of the aardvark *Orycteropus afer*. *Journal of Arid Environments*, 48:551-568.



Aardvark, *Orycteropus afer*
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