Scand. J. Lab. Anim. Sci. No. 1 . 1994 . Vol. 21

# Tenrecs as laboratory animals

by *Peter Bollen*
Laboratory Animal Science & Welfare, Department of Veterinary Pathology and Infectious Diseases,
Royal Veterinary College, Royal College Street, London NW1 0TU.

*Introduction*

The order *Insectivora* consists of eight families which are distributed all over the world, except for South America and Australia. Common are the families of the hedgehog, the shrew and the mole; less common are elephant shrews, otter shrews and golden moles. The solenodons and tenrecs are exclusively found on tropical islands. The classification "insectivorous" is not fully descriptive since all the families have beside insects, other invertebrates, small reptiles and amphibians, eggs and even new-born mammals on their menu.

The distribution of the different families is as follows:

- Solenodons (Haiti and Cuba)
- Tenrecs (Madagascar)
- Otter shrews (S. W. Africa)
- Golden moles (S. Africa)
- Hedgehogs: Hairy (S. E. Asia)
  Spiny (Eurasia)
- Elephant shrews (Africa)
- Shrews (Eurasia, Africa and N. America)
- Moles (Eurasia and N. America)

General Biology of tenrecs:

Two species of the family *Tenrecidae* are best known: the tailless tenrec (*Tenrec ecaudatus*, figure 1) and the streaked tenrec (*Hemicentetes semispinosus*, figure 2). Tenrecs are probably the only forms which have not deviated much from the common ancestral group of the Eutheria. On Madagascar fossil remains have been found from the Pleistocene and in Africa from the Oligocene.

The tailless tenrec is an inhabitant of the dry, sandy location of Madagascar, where temperature fluctuations occur particular in the dry season. This period from April/May to October/November is fairly cool, but not below 16°C. The tailless tenrec survives this period

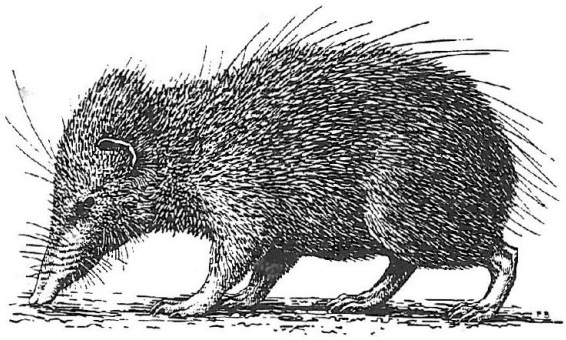

*Figure 1.* Tailless tenrec (*Tenrec ecaudatus*). (From *Grasse*, 1955).

of food shortage by rolling itself up in its ground burrow. It has a decreased body temperature and a breathing rate of approximately one respiration per three minutes. The intestines are empty. The normal body temperature is 34–35°C, but the lowest temperature that has been measured in the torpid state is 13°C.

The streaked tenrec inhabits the permanent moist regions of Madagascar, where the climate is warm and temperatures do not fluctuate much. This animal too has an unique feature in its thermoregulation, although it doesn't exhibit torpidity. The body temperature of the streaked tenrec is 26–30°C. At

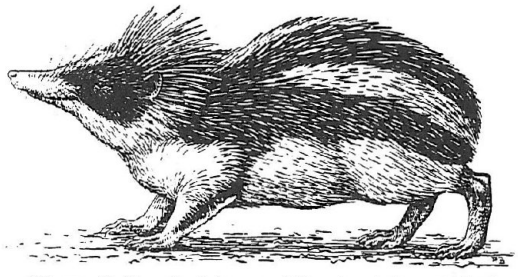

*Figure 2.* Streaked tenrec (*Hemicentetes semispinosus*). (From *Grasse*, 1955).

20°C it rests in its burrow for most of the day and becomes active in the afternoon and evening hours. After midnight it becomes more quiet and the periods of rest increase in length.
Around 16–18°C the animal is much more restless during the night, to generate additional metabolic heat to maintain body temperature. However, if temperatures fall below 16°C (which is very rare in Madagascar), the increased activity will not be sufficient and the animal becomes numb and may die from hypothermia. Dug-out streaked tenrec felt cold and were lethargic, but their intestines were empty, which indicates that they had not been inactive for long.

Sources of Supply:
Tenrecs are only found on Madagascar where they are protected by law. Nevertheless, they are regularly sold alive – or cooked – at weekly markets. The tailless tenrec is easy to obtain, since they are common in dry areas, even in the gardens of Tananarivo, the capital of Madagascar.
The streaked tenrec is less common; this animal can only be found in moist regions at forest edges and brush lands.

Size and Life-span:
The tailless tenrec has a head-rump length (HRL) of 26.5–39 cm. Its nose is long and pointed and the fur is coarse and interpersed with bristless and spines. The mane can be erected. Usually there are 38 teeth, which are sharp and pointed: i 2/3 c 1/1 p 3/3 m 3/3. In captivity they live 2–4 years.
The streaked tenrec is remarkably smaller, but has longer legs, a larger head and a longer snout. Its HRL is 16–19 cm. The tail is not visible and the body is covered with bristles and spines. The ventral side is covered with soft hair. There are 40 teeth: i 3/3 c 1/1 p 3/3 m 3/3. The life expectancy is 1–2 years.

*Husbandry*
Introduction to Captivity:
Tenrecs are usually dug out of their burrows by the inhabitants of Madagascar, and sold on markets. In captivity, when approached with the hand, the tailless tenrec erects its mane of spines and tries to push it against the hand; the spines do not penetrate the skin. The streaked tenrec has the same defence, but here the spines detach easily and stick to the skin. The animals never bite and adapt quickly to being touched by humans.

Housing:
Tenrecs can be housed in groups as they tolerate conspecifics. The tailless tenrec might be kept in breeding pairs in a guinea pig cage (e.g. solid-floored 58 × 58 cm. cage); for the streaked tenrec a Macrolon type IV cage could do. Both should be equipped with a nest-box, since the mammals need a shelter for the day-time. In larger groups usually one family occupies one nest-box, even if there are more boxes available.
Small cages are not recommended because when awake, the animals are quite active to maintain their body temperature. Softwood shavings can be used as bedding. The animals never urinate or defecate in their nest-box; usually they hurry into a corner of the cage, where they scratch a small hole in the bedding. The same corner is used for several days in succession. In general a weekly change of bedding will be sufficient.
General animal house conditions, with a temperature of 20°C and a relative humidity of 50–70 % are suitable. One should ensure that temperatures do not drop under 16°C over long periods, for the animals may die from hypothermia.

Handling and Restraint:
Tenrecs can be picked up after smoothening the spines by stroking from the head to the rear with the hand. The index-finger and the thumb are closed around the neck while the other fingers get hold of the thorax. The hindquarter of the tailless tenrec should be supported with the other hand.

Sexing:
The sexes can not be differentiated externally. The rectum and urogenital ducts open into a common cloaca-like skin fold.

Identification:
Identification is not easy in tenrecs; they have no tail, small ears and have a coarse coat. For temporary identification fur clipping could be a possibility. For permanent identification tattooing the dorsal side of one of the paws can be considered. Ear-tags and paw-rings are not recommendable.

*Feeding*
The major part of the diet of tenrecs consists of worms, snails, arthropods, in particularly grasshoppers. They will also eat lizards, eggs, roots and fruits, although the meat is preferred to the vegetal material. A natural diet like this is not feasible in a laboratory setting. In zoos tenrecs were fed with minced beef, earthworms, bananas and boiled potatoes, but now commercial cat-food seems to be more promising. Additional feeding with culled newborn mice is a possibility. Streaked tenrecs comsume about 40–60 g. daily. This is about one third of their total body weight. Not much is known yet of special nutritional requirements of tenrecs.
The feeding behaviour doesn't change in captivity. After sniffing a worm or some meat the animal grabs it and tears off a piece and gulps it down quickly.
After a meal it frequently regurgitates the food and picks out the pieces of meat to swallow them again. Tenrecs drink water, but are fond of milk. When drinking they lift up the tip of their long nose, and lap the fluid with their tongues.

*Breeding*
The tailless tenrec is a very fertile animal. In the uterus of a female thirtyone foetuses were found. The average litter size however is twelve to fifteen. The female tailless tenrec has twelve pairs of mammae.
The female of the streaked tenrec has only four pairs of mammae, and probably has a maximum litter size of eight.
The offspring are able to run soon after birth; within four weeks they are completely independent. The newly born streaked tenrec is 2.5 cm. long, short haired and has white spines arranged in longitudinal rows on the back; these are lost in the adults. When three weeks old, they measure 9 cm.
The tailless tenrec has been reported to be polyovular (*Nicoll & Racey* 1985). The mating season for the tailless tenrec begins soon after hibernation ends in October/November.

*Potential use in biomedical research*
Since tenrecs are primitive animals with a low phylogenetic development, much work has been done on the development of the nervous system. *Rehkamper, Stephan & Poduschka* (1986) found that the tenrec *Goegale aurita* even had a lower relative brain size than the tenrecs which so far have been found at the bottom of the encephalization scale. However, the early development of the neural tube is basically similar to other mammals, including primates (*Muller & O'Rahilly* 1980). One of the findings of neurological research with tenrecs is the origin of the insular claustrum, which appears to originate from the cortex from which it is separated by the extreme capsule (*Narkiewicz & Mamos* 1990). More recently brain research in the hedgehog tenrec (*Echinops telfari*) has been published (*Kunzle* 1992; *Kunzle & Rehkamper* 1992; *Kunzle & Unger* 1992).
Hibernation is also a relevant subject in biomedical research. The unique features of the torpid status are studied in many disciplines. In medicine hibernation is relevant because of its usefulness to study heart failure. Many hibernating animals are used as a model for the hibernating myocardium, which is a state of chronical hypoperfusion.
Species used in research of the hibernating myocardium are the bat, dormouse, frog, hedgehog, squirrel, swine and human. Far most popular in this type of research is the squirrel.

Tenrecs could provide a useful model in research of hibernation because of their incomplete thermoregulation. The body temperature varies with the environmental temperature, and the tenrec enters a state of lethargy in a short period if temperatures drop. The relevance of introducing tenrecs in the laboratory lays in the setting of normative physiological values of the species and research after low temperature physiology, heart failure, ageing and metabolism. Since tenrecs are the most primitive eutharian mammals, their study could provide further information on physiological evolution.

*References*

*Kunzle H:* Meso-diencephalic regions projecting to spinal cord and dorsal column nuclear complex in the hedgehog tenrec, *Echinops telfairi.* Anat. Embryol. Berl. 1992, *185* (1), 57–68.

*Kunzle H & G Rehkamper:* Distribution of cortical neurons projecting to dorsal column nuclear complex and spinal cord in the hedgehog tenrec, *Echinops telfairi.* Somatosens. Mot. Res. 1992, *9* (3), 185–197.

*Kunzle H & JW Unger:* Neuropeptide Y-like immunoreactive neurons in the suprachiasmatic-subparaventricular region in the hedgehog tenrec. Brain Res. 1992, *576* (2), 322–336.

*Muller F & R O'Rahilly:* The early development of the nervous system in staged insectivore and primate embryos. Journ. Comp. Neurol. 1980, *193* (3), 741–751.

*Narkiewicz O & L Mamos:* Relation of the insular claustrum to the neocortex in *Insectivora.* Journ. Hirnforsch. 1990, *31* (5), 623–633.

*Nicoll ME & PA Racey:* Follicular development, ovulation, fertilization and fetal development in tenrecs (*Tenrec ecaudatus*). Journ. Reprod. Fertil. 1985, *74* (1), 47–55.

*Rehkamper G, H Stephan & W Poduschka:* The brain of *Geogale aurita,* Milne-Edwards and Grandidier 1872 (*Tenrecidea, Insectivora*). Journ. Hirnforsch. 1986, *27* (4), 391–399.

*Further reading*

*Grasse PP:* Traite de zoologie. Tome XVI, fascicule V, volume II (1973, 5th ed.), pp. 843–882; Tome XVII, fascicule II (1955, 2nd ed.), p.p. 1574–1712. Paris: Masson et Cie.

*Grzimek B:* Encyclopaedia of animal life. Vol. 10, pp. 185–193. New York: van Nostrum Rheinholt, 1972.

*Kayser Ch:* The physiology of natural hibernation. Oxford: Pergamon Press, 1961.

*Lyman CP:* Hibernation and torpor in mammals and birds. New York: Academic Press, 1982.