

## The Activity Patterns of Some Southern African Crocidura in Captivity

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Baxter R.M., Goulden E.A. & Meester J., 1979: The activity patterns of some southern African *Crocidura* in captivity. Acta theriol., 24, 5: 61—68 [With 1 Fig.]

The activity patterns of three crocidurine shrews, *Crocidura flavescens*, *C. hirta* and *C. mariquensis* were studied in a number of captive specimens. All were predominantly nocturnal, *C. mariquensis* being most and *C. hirta* least active. These differences in levels of activity were tentatively attributed to differing absolute food requirements or different ecological requirements. The overall levels of activity of these shrews were similar to those of other crocidurines and lower than those of soricines.

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### I. INTRODUCTION

The activity patterns of northern hemisphere soricines have been investigated *inter alia* by Crowcroft (1954), Ingles (1960) and Gębczyński (1965) and those of crocidurines by Saint Girons (1959), Rood (1965) and Fons (1975).

Although Meester (1963) made some qualitative observations on the activity patterns of some southern African *Crocidura*, no further data are available for any African soricid. Consequently, when an investigation into the captive biology of three southern African crocidurines, *Crocidura f. flavescens*, (I. Geoffroy, 1827), *C. h. hirta* Peters, 1852 and *C. m. mariquensis* (A. Smith, 1844), was initiated, a study of activity patterns was included. These patterns are here reported.

### II. MATERIALS AND METHODS

The activity of the three species studied was automatically monitored in an activity cage (Baxter & Davis, in press). The cage was an extensively modified version of that of Smit & Langman (1974). The cage was kept indoors under semi-controlled conditions with a 12 hr 12 hr light dark regime.

Shrews placed in the cage were allowed 48 hours to acclimatize before monitoring began. The monitoring periods ranged from three days to nearly ten days and during these periods the shrews were fed a standard laboratory diet, consisting of fat-free minced ox-heart mixed with commercially available muesli

and supplemented with commercially available cat pellets. Water was supplied *ad libitum*. Feeding occurred daily between 16h00 and 17h00 and the other disturbances that may have influenced activity patterns were periodic checks to ensure that the apparatus was functioning normally. No checks were made during the 12 hour dark period.

The data for *C. flavescens* were obtained from a total of 65 days and 3 hours of monitoring using seven single animals (three males, four females), two pairs and a litter group of three, 235 days old. *C. hirta* data were obtained from 16 days of monitoring using two single males and a pair, while those of *C. mariquensis* were obtained from 26 days and 4 hours of monitoring using three single shrews (one male, two females) and one pair. As no age or seasonal differences were readily apparent and because differences between single animals, pairs and the litter group were attributed to the cumulative effect of additional animals, all data were meaned in order to provide an activity profile which appeared to be characteristic of the particular species. All meaned data are reported as a percentage of activity per hour. Szymanski coefficients of activity (Szymanski, 1918) were calculated for each species by dividing its mean daily activity by its mean daily inactivity.

### III. RESULTS

#### 1. *C. flavescens*

Levels of activity varied but the basic pattern of activity remained the same. Males tended to be slightly more active than females and pairs more active than single animals. The litter group was somewhat more active than other animals, either single or paired.

A mean activity profile is recorded in Fig. 1A. *C. flavescens* had a mean nocturnal activity level (25%) of nearly twice its mean diurnal activity level (13%). Overall daily activity amounted to 19% and individuals were inactive for periods of up to seven hours. However, inactive periods usually lasted for one to two hours and active periods for 15–30 minutes at night. During the day animals became less active.

Peak activity occurred during the final hours of night and the first hour of the day (04h00 — 07h00) with a lesser peak in the evening (18h00 — 19h00). Between these peaks activity level remained fairly constant.

The Szymanski coefficient of activity was 0.23.

#### 2. *C. hirta*

The activity profiles of the two males were virtually identical and the profile of the pair showed a slightly elevated activity level.

*C. hirta* is a nocturnal shrew and had a mean nocturnal activity level (19%) considerably higher than mean diurnal activity (3%) (Fig. 1B). Overall daily activity amounted to 11% but periods of continuous inactivity seldom exceeded three hours. This species had the lowest





Fig. 1. The mean activity profiles of *C. flavescens* (A), *C. hirta* (B), and *C. mariquensis* (C).

Broken lines indicate mean diurnal and mean nocturnal levels of activity.

recorded activity level of the three studied. Active periods ranged from 15 to 30 minutes at night but rarely more than five minutes during the day.

Peak activity was after nightfall (18h00 — 19h00) with a lesser, prolonged peak during the final hours of the night (02h00 — 05h00). Between these peaks the activity level was relatively constant. Periods of peak activity did not occur during the day.

The Szymański coefficient of activity was 0,12.

### 3. *C. mariquensis*

Once again, all the profiles showed only marginal differences with single males slightly more active than single females and the pair slightly more active than a single shrew.

*C. mariquensis* exhibited a marked predominance of mean nocturnal activity over mean diurnal activity (37% vs. 8%) and an overall daily activity level of 23%. Periods of inactivity were short, rarely exceeding two hours in duration. Active periods were usually of 30—40 minutes duration during the night but shorter during the day.

Peak activity was found during the final hours of the night (03h00—06h00) with a build-up starting at 01h00. The first daylight hour (06h00—07h00) and the last hour of daylight (17h00—18h00) acted as transition periods between the high nocturnal and low diurnal activity levels.

The Szymanski coefficient of activity was 0,30.

## IV. DISCUSSION

The results show that the three southern African species here studied were predominantly nocturnal and had a low level of activity in captivity. Meester (1963) came to similar conclusions as regards the amount of diurnal activity in the three species studied, while Godfrey (1978) has found that another two *Crocodyra* species (*C. russula* and *C. suaveolens*) are predominantly nocturnal.

An interesting result is that the smaller *C. hirta* (mass: 15 g — 20 g) had a lower overall activity level than *C. flavescens* (mass: 25 g — 30 g). A possible reason for this may be that both forms have similar food sources and therefore *C. flavescens*, with a higher food requirement due to size, will of necessity be more active. This may also explain their largely allopatric distributions as being due to competition for food.

The small *C. mariquensis* (mass: 10 g — 15 g) has the highest overall activity level of the three and the reason for this is not immediately



apparent. Although the smaller size implies a higher metabolic rate, this does not necessarily mean that the absolute food requirements are greater than those of the other two species. *C. flavescens* and *C. hirta* usually occupy similar grassland habitats while *C. mariquensis* is restricted to marshy habitats. This difference in habitat preference may hold the key to the reason for the higher overall activity level of *C. mariquensis*.

Seasonal and age variation of activity patterns is reported by a number of authors (Gębczyńska & Gębczyński 1965; Gębczyński, 1965; Buchalczyk, 1972; Fons, 1975; Saint Girons & Fons, 1978). In the present study activity was recorded under semi-controlled conditions so that seasonal variation was not readily apparent, while age variation was not considered.

Gębczyński (1965) found that in *Sorex araneus* and *S. minutus* activity decreased in winter. Buchalczyk (1972) confirms this. However, Fons (1975) found that the activity of *Suncus etruscus* increased in winter. This difference may be attributable either to genetically based differences between the species concerned or to the direct effect of the much colder environment in which *S. araneus* and *S. minutus* were trapped. One may expect a nocturnal animal to increase its level of activity during winter when nights are longer. Hansen (1957) indeed found that lemmings from Alaska under laboratory conditions experienced reduced activity with increased light. A number of authors (Crowcroft, 1954; 1957; Shillito, 1963; Gębczyński, 1965; 1971; Loxton *et. al.*, 1975) have shown both *Sorex araneus* and *S. minutus* to be predominantly nocturnal, which could be expected to imply increased winter activity. The fact that this is not the case suggests that reduction of activity in winter may not be a response to the environment but a characteristic of the species concerned. This winter reduction of activity may be linked to the soricine characteristic of winter weight reduction and consequent reduction of absolute food requirements as suggested by Mezhhherin (1964), although their relative food consumption increases. A reduction in absolute food requirements may well reduce food-gathering activity and thereby lower the level of general activity.

The short-term rhythms of the three species were all fairly similar and usually of between one and a half and three hours duration. The largest species, *C. flavescens*, tended to have a longer short-term rhythm than the others. Godfrey (1978) reports rhythms of 30–50 minutes duration in the smaller *C. russula* and *C. suaveolens*. Gębczyński (1965) found short-term rhythms ranging from 106–192 minutes in *S. araneus*, with larger individuals having longer rhythms. Crow-



croft (1954; 1957) obtained similar results as well as finding longer rhythms in the larger *N. fodiens* and shorter rhythms in the smaller *S. minutus*. These data correlate well with those reported here.

The short-term rhythm of all three species here studied remained constant when there was a reduction in activity. This may have been partially due to the semi-controlled conditions under which the shrews were kept. These data imply that short-term rhythm is subject to metabolic demands which remain fairly constant under reasonably constant temperature. Lehmann (1976) came to similar conclusions in voles and also found that there was no endogenous oscillation controlling these demands. However, an endogenous oscillation that was synchronized to light intensity was found to control circadian rhythm during summer. During spring and autumn, the circadian oscillation was an integral part of the short-term rhythm. These data imply that seasonal variation in activity of shrews may be more complex than suggested by present evidence. This may be further complicated by physiological differences between the *Crocidurinae* and *Soricinae* (Vogel, 1976).

The Szymanski coefficient of activity (Szymanski, 1918) is an index of activity level. Crowcroft (1954) gives coefficients of 0.70 for *Neomys fodiens*, 1.46 for *Sorex araneus* and 1.36 for *S. minutus*. Ingles (1960) found the coefficient of *S. vagrans obscurus* to be 1.18. The coefficients of these soricines are considerably higher than those of the three southern African species studied. However, *Blarina brevicauda*, another soricine, is active for 16% of the day (Martinsen, 1969) which gives it a coefficient of 0.19, comparable with the coefficients of the southern African forms. Rood (1965) found that *Crocidura suaveolens cassiteridum* has coefficients ranging from 0.13 to 0.24 and Saint Girons (1959) obtained similar results for *C. russula*, which was once again comparable with the three forms here studied.

These results, with the exception of that for *B. brevicauda*, suggest that subfamilial differences in metabolic rates, as reported by Vogel (1976) are manifested in the levels of activity, with the soricines having a higher level than the crocidurines. On account of the small sample size involved, this suggestion must be tentative.

**Acknowledgements:** We would like to thank the South African Council for Scientific and Industrial Research and the University of Natal for financial support towards this project. Mr. R. Brown and Mr. D.P. Campbell of the Dept. of Zoology and in particular Mr. A.R. Davis of the Electronics Workshop, University of Natal, Pietermaritzburg are thanked for their assistance in constructing the apparatus.



## REFERENCES

1. Baxter R.M. & Davis A.R., (in press.): An activity monitoring device for small laboratory animals. *S. Afr. J. Sci.*
2. Buchalczyk A., 1972: Seasonal variations in the activity of shrews. *Acta theriol.*, 17: 221—243.
3. Crowcroft P., 1954: The daily cycle of activity in British shrews. *Proc. zool. Soc. Lond.*, 123: 715—729.
4. Crowcroft P., 1957: The life of the shrew. Max Reinhardt: 1-166. London.
5. Fons R., 1975: Contribution à la connaissance de la musaraigne étrusque *Suncus etruscus* (Savi, 1822). Ph. D. thesis, University of Pierre and Marie Curie. Paris.
6. Gębczyńska Z. & Gębczyński M., 1965: Oxygen consumption in two species of water-shrews. *Acta theriol.*, 10: 209—214.
7. Gębczyński M., 1965: Seasonal and age changes in the metabolism and activity of *Sorex araneus* (Linnaeus, 1758). *Acta theriol.*, 10: 303—331.
8. Gębczyński M., 1971: The rate of metabolism of the lesser shrew. *Acta theriol.*, 16: 329—339.
9. Godfrey G.K., 1978: The activity pattern in white-toothed shrews studied with radar. *Acta theriol.*, 23: 371—380.
10. Hansen R.M., 1957: Influence of day length on activity of the varying lemming. *J. Mammal.*, 38: 218—223.
11. Ingels L.G., 1960: A quantitative study of the activity of the dusky shrew (*Sorex vagrans obscurus*). *Ecology*, 41: 656—660.
12. Lehmann V., 1976: Short-term and circadian rhythms in the behaviour of the vole, *Microtus agrestis* (L.). *Oecologia*, 23: 185—199.
13. Loxton R.G., Raffaelli D. & Begon M., 1975: Coprophagy and the diurnal cycle of the common shrew, *Sorex araneus*. *J. Zool., Lond.*, 177: 449—453.
14. Martinsen D.L., 1969: Energetics and activity patterns of short-tailed shrews (*Blarina*) on restricted diets. *Ecology*, 50: 505—510.
15. Meester J., 1963: A systematic revision of the shrew genus *Crocidura* in southern Africa. *Trans. Mus. Mem.*, 13: 1—127.
16. Mezhzherin V.A., 1964: Dehnel's phenomenon and its possible explanation. *Acta theriol.*, 8: 95—114.[English summary].
17. Rood J.P., 1965: Observations on the home range and activity of the Scilly shrew. *Mammalia*, 29: 507—516.
18. Saint Girons M.C., 1959: Les caractéristiques du rythme nyctéméral d'activité chez quelques petits mammifères. *Mammalia*, 23: 245—276.
19. Saint Girons M.C. & Fons R., 1978: Influence de la sénilité sur le rythme circadien de l'Insectivore *Suncus etruscus* (Savi, 1822). *Mammalia*, 42: 258—260.
20. Shillito (Babington), J.F., 1963: Field observations on the growth, reproduction and activity of a woodland population of the common shrew *Sorex araneus* L. *Proc. zool. Soc. Lond.*, 140: 99—114.
21. Smit H. v. Z. & Langman V.A., 1974: A capacitive method of measuring circadian activity in laboratory animals. *Med. & Biol. Eng.*, 12: 831—835.

22. Szymański J.S., 1918: Die Verteilung der Ruhe- und Aktivitätsperioden bei weissen Ratten und Tanzmäusen. Arch. ges. Physiol., 171: 324. [Seen in Crowcroft, 1954].
23. Vogel P., 1976: Energy consumption of European and African shrews. Acta theriol., 21: 195—206.

Accepted, September 7, 1978.

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WZORCE AKTYWNOŚCI KILKU POŁUDNIOWOAFRYKAŃSKICH  
GATUNKÓW *CROCIDURA* TRZYMANÝCH W NIEWOLI

Streszczenie

Badano aktywność trzech południowoafrykańskich gatunków *Crocidura*: *C. flavescens*, *C. hirta* i *C. mariquensis*, trzymany w niewoli. U *C. flavescens* stwierdzono średnią aktywność dzienną na poziomie 13%, a aktywność nocną na poziomie 25% (Ryc. 1A), u *C. hirta* odpowiednio: 3% i 19% (Ryc. 1B), a u *C. mariquensis*: 8% i 37% (Ryc. 1C). Wysłunięto sugestie, że różnice w poziomie aktywności między tymi gatunkami można przypisać zróżnicowaniu w zapotrzebowaniu na pokarm lub zróżnicowaniu ekologicznych wymagań. Współczynniki aktywności Szymańskiego (Szymański, 1918) dla *C. flavescens*, *C. hirta* i *C. mariquensis* były odpowiednio 0.23, 0.12 i 0.30. Wartości te są zgodne z danymi dla innych *Crocidurinae* i są niższe niż u *Soricinae*.