Observations on the post-natal development of the tiny musk shrew, *Crocidura bicolor*

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Crocidura bicolor is the smallest of southern Africa's *Crocidura* shrews and little is known of its biology. A female, captured in the Kruger National Park, was observed giving birth to two young. The post-natal development of the young reported here was slower than the two previously published incidences. Suggested reasons for the discrepancies are the differential diets of the mothers, their geographical origins and the smaller size of this female.

Crocidura bicolor is die kleinste *Crocidura*-skeerbek in suidelike Afrika en min biologiese inligting is oor hulle beskikbaar. 'n Wyfie wat in die Nasionale Krugerwildtuin gevang is, is waargeneem terwyl sy geboorte geskenk het aan twee kleintjies. Die na-geboortelike ontwikkeling van die kleintjies waarvan hier verslag gedoen word, was stadiger as twee vorige gepubliseerde gevalle. Voorgestelde redes vir die teenstrydighede is die onderskeie diëte van die moeders, hulle geografiese herkomste en die kleiner grootte van hierdie wyfie.

Crocidura bicolor, the tiny musk shrew, is rarely captured because of its extremely small size (3 – 4 g). Most available information is in the form of scattered locality records and morphological measurements (Meester 1963; Rautenbach 1982; Smithers 1983). Ansell (1964) and Dippenaar (1979) have reported on single incidences of post-natal development of this species but no detailed study appears to have been published. Further published information on this rare species is very necessary.

In March 1983, during severe drought conditions, two *Crocidura bicolor* (3,1 g; 2,5 g) were live-trapped (Sherman aluminium live-trap, 230 × 90 × 72 mm) in sparsely covered grasslands, approximately 20 km east of Satara, Kruger National Park. Their presence in that eastern region had previously been established by Coetzee (1963) from owl pellet analysis. The larger individual was retained for identification purposes. Upon her death, seven weeks later, she was identified, using cranial characteristics, as a *Crocidura bicolor* (TM 35905) by the Transvaal Museum. She was extremely small even for this species (Dippenaar *in litt.*) though Meester (1963) notes that specimens from the Transvaal lowveld appear to be smaller than those from elsewhere.

While in captivity, the female gave birth and she and the young were kept in a small plastic laboratory mouse cage, the floor of which was covered with a layer of soil. Rocks, cut grass and a small cardboard tube placed in the cage were regularly used by the female in daily activity. However, none were chosen for nest placement. Instead, she made a slight hollow in the corner of the cage. Water was provided *ad libitum* and a varied live insect diet was provided 2 – 3 times per day. The diet offered was dependent upon our previous night's insect catch. Preferred items were moths, grasshoppers, locusts, caterpillars, cockroaches, praying mantes, dragonflies and crickets. Mealworms, used as a supplement when insect catches were low, were not preferred and dung beetles were refused.

On March 14, at 22h50 the female gave birth to two offspring (sexes undetermined). Parturition of the first young was not seen but that of the second was followed to completion. A typical parturition posture was observed where the female frequently turned and licked her vulval region. When the neonate was partially emerged, she gripped it with her teeth and pulled it out. Twenty minutes elapsed after parturition before she collected the two pups and settled down to suckle.

Physical development of the young was recorded by mass (g) and body length measurements (mm). Initially, the young were weighed using a 100 g Pesola spring balance until a more sensitive triple-beam balance was obtained. The mass of the mother was measured at the same time as that of the young. All length measurements reported are the average of three or four measures taken with Vernier callipers. The physical and behavioural development of the young from Day 0 (birth) to Day 29 are presented in Table 1. At birth, the offspring were totally naked with eyes and ears closed. Movement was uncoordinated but soft squeaks were emitted whenever the mother was not present. The young were able to walk by Day 5. On Day 8, for unknown reasons, one of the pups died. Both Ansell (1964) and Dippenaar (1979) previously reported one of the litter dying in the first week of life. Though carrion feeding is well known in *Crocidura* species (Ansell 1964), the mother made no apparent attempt to eat the dead young. By Day 12 the body of the surviving youngster was totally furred but the eyes were still closed. Eye movement and eyeslits were detectable on Day 14. The eyes were fully opened by Day 17 and the activity of the youngster increased tremendously with much exploration and following of the mother.

Throughout this period, caravanning, (Meester 1963; Dippenaar 1979), was not observed but the young did ride on the mother's back. This back riding may have been an aberrant version of caravanning. The mother tolerated riding and suckling attempts until Day 24 when she started to avoid the young. Though she was never aggressive toward the young, the evasive actions suggest the onset of weaning. The youngster was a smaller replica of the adult by the time it was found dead and undamaged in the cage on Day 29.

The mass of the young doubled during the first five days, but declined by approximately 10% over Days 6 and 7 (Table 1). On Day 8, the smaller of the two young (B) died. Subsequently, the surviving young (A) began a steady but slower mass increase. The second mass decrease came just after the eyes were fully open and the young was noted to be extremely active. Mass again decreased after Day 24. This mass loss in conjunction with the observed behavioural changes in the mother again suggest the onset of weaning. Death at 29 days may have been caused by starvation if the young was maladjusting to the weaning as the mass loss indicates. The post-mortem mass was 0,9 g, 88% of its mass on Day 5. The mass of the mother varied between 2,7 and 3,5 g during the post-natal period, a body mass fluctuation of about 20%.

A comparison of the three published observations on *C. bicolor* post-natal development is presented in Table 2. The considerable range in development rates is immediately obvious. Our observations recorded the longest development times while Ansell (1964) recorded the shortest. Three possible

Table 1 Physical and behavioural development of *Crocidura bicolor* young

Day	Young	Mass (g)	Head-body length (mm)	Head (mm)	Tail (mm)	Behavioural and physical achievements
0	A	0,25[a]	18,7	*	*	naked; eyes and ears closed;
	B	0,25[a]	18,7	*	*	movement uncoordinated; soft squeaking
2	A	0,50[a]	23,8	*	7	unsteady crawling/walking;
	B	0,50[a]	24,0	*	5	nipple clinging/ ?caravanning
5	A	1,05[b,c]	29,55	13,8	11,15	skin turning greyish;
	B	1,0 [b,c]	28,6	12,95	10,55	walking
7	A	0,95	33,0	13,95	11,2	hairs becoming visible
	B	0,90	32,1	14,0	11,6	
8	B	0,90	32,5	14,2	11,45	died
10	A	1,0	33,2	14,8	11,75	back riding observed
12	A	1,05	34,0	15,35	12,8	body totally furred; eyes closed
14	A	1,10	34,3	15,6	12,3	tiny eye slits visible; eye movement detectable
17	A	1,15	37,8	18,2	14,4	eyes open; still suckling but playing with insect food
20	A	1,05	**	**	**	extremely active; ears emerging
24	A	1,20	**	**	**	mother resisting back riding
27	A	1,15	**	**	**	ears fully extended; attacking insect food; still attempting to suckle
29	A	0,90				died

[a] – measurement on a 100 g Pesola spring balance; [b] – stomachs full of milk; [c] – all further mass measurements taken on a triple-beam balance; * – measurements not taken for fear of injuring young; ** – measurements imprecise due to extremely active young

Table 2 A comparison of some post-natal development times (in days) recorded for *Crocidura bicolor* young in this study, by Dippenaar (1979) and by Ansell (1964)

	This study	Dippenaar	Ansell
Location	Kruger Park, S.A.	Groblersdal, S.A.	Kabompo, Zambia
Habitat	Lowveld	Midveld	?
Litter size	2	4	3
Physical development			
hair appearance	9	6–7	6
hair completion	12	10	8
opening of eyes	16	12	10
opening of ears	20	13	11
walking	4–5	3	6–7
Behavioural development			
duration of caravanning	?2–23	3–19	7–14
interest in solid food	17	19	14
weaning	23–27	?	18
active exploration	17	17	11

factors may account for the slower rates we observed. Firstly, the nutritional status of the three females may have been quite different. This could have resulted from the differential diets while in captivity and/or the condition of the females during gestation and at the time of capture. The Satara female was captured during a very severe and prolonged drought when the environmental conditions and food resources were probably very low. Secondly, the three females were from different geographical locations, the Transvaal lowveld and the Transvaal midveld, which are separated by the great escarpment, and Kabompa, Zambia. The differences in development rates shown here may reflect the normal variation for the species throughout its range or alternatively, they may be indicative of geographical variation within the species. Thirdly, the female from the Lowveld was probably substantially smaller than the other two. Unfortunately neither Dippenaar (1979) nor Ansell (1964) reported the original weight or size of their females. However, Dippenaar (*in litt.*) reported that the Satara female's cranial measurements fell just within or below the observed range of variation for the smallest of the southern African *Crocidura* species. This supports Meester's (1963) contention that the lowveld specimens tend to be smaller than other *C. bicolor* from elsewhere in southern Africa. R. Baxter (in Dippenaar 1979) has already suggested that, 'the young of larger females, which tend to produce more milk, grow at a faster rate and that behavioural and physical changes occur earlier in these young than in litters produced by smaller females'.

The fact that this paper, which reports on only a single incident of *C. bicolor* capture, birth and post-natal development, contains previously unknown information, highlights the paucity of knowledge of this species. The tiny musk shrew is noted as occurring in areas of good grass cover and/or where there is vegetation debris (Rautenbach 1982; Smithers 1983). Meester (1963) suggests a distributional correlation with ≥ 500 mm annual rainfall. The *C. bicolor* captures near Satara, which lies between the 500 and 550 mm annual rainfall isohyte (Gertenbach 1980), are consistent with

Meester's suggestion. In contrast to the previous observations, however, the habitat in which they were captured was only sparsely covered with grass (23% aerial cover) and there was no vegetation debris nearby (C.R.B. Watson unpublished data). The foods we recorded being taken are in accordance with the species' reported insectivorous diet. However, foraging behaviour and activity patterns remain largely unknown. The March pregnancy of the Satara female agrees with previously published records which suggest a November to April breeding season (Smithers 1983). The length of the gestation period, however, is unknown. The differences in the post-natal development rates (Table 2) indicate that knowledge of this aspect of their biology is also far from complete. Obviously, more definitive information on the basic biology and ecology of the tiny musk shrew is needed before such intriguing ideas as the possibility of a link between the smaller size of the lowveld specimens, the slower rate of development and geographical variation can be investigated.

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