



Original investigation

A report on the community of shrews (Mammalia: Soricidae) occurring in the Minkébé Forest, northeastern Gabon

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Abstract

This report presents the results of a study of the shrew community in the newly created Minkébé Protected Area in northeastern Gabon. The previously unstudied park forms part of the large Guineo-Congolian lowland forest block. The principal technique used to capture animals consisted of pitfall traps with drift fences. Three habitat types (marsh, heterogeneous forest and homogeneous forest) were surveyed. Four to seven species were recorded in each habitat, resulting in a total of eleven species for the study area. Several rare and little-known species occur in the park, such as *Crocidura crenata*, *C. goliath*, *C. grassei*, *Suncus remyi*, and *Sylvisorex ollula*. *Crocidura maurisca* is recorded for the first time from Gabon, far outside its previously known range in eastern Africa.

Key words: Soricidae, community, rainforest, Gabon, Africa

Introduction

Over the past few decades knowledge on the small mammals occurring in the vast and forested Guineo-Congolian region (sensu WHITE 1983) of west-central Africa has increased substantially (EMMONS 1975; EMMONS et al. 1983; DUBOST 1968; DUPLANTIER 1989). This area has been cited as having one of the most diverse biotas on the continent (SAYER et al. 1992). Amongst the largest remaining contiguous areas of forest in the Old World tropics is the zone between southern Cameroon, eastern Gabon, and western Congo-Brazzaville, and contains about 200 000 km² of largely intact forest (BROSSET 1990). Several reserves have already been designated across this region,

including the Dja Faunal Reserve in Cameroon, the Dzanga-Sangha Faunal Reserve in southern Central African Republic, the Odzala National Park in Congo-Brazzaville and the recently named Minkébé Protected Area (6 000 km²) in northeastern Gabon. In order to document the largely unknown fauna of the Minkebe forest, an area of about 32 000 km², and subsequently to put the site into a biogeographic context, a biological inventory was organized in February 1998 in the northwestern portion of this protected area. WWF in collaboration with the Direction de la Faune et de la Chasse, are executing a conservation project of the Minkébé region. Here we report on the

findings of the shrews (Family Soricidae) occurring at this survey site.

Information on the Soricidae of the Guineo-Congolian lowland forest zone, particularly from northeastern Gabon, is not extensive. Over the course of several decades, studies of small mammals, including those on shrews, were conducted in the Ivindo River Basin associated with the Institut de Recherches en Ecologie Tropicale research station at M'Passa (= Makokou, BROSET 1988). This work largely involved studies on the population ecology of numerous species of mammals, but specimens were collected to help identify characters to define species limits. Several species new to science were subsequently described from the region (BROSET et al. 1965a, 1965b). The Ivindo forms the drainage of eastern Gabon and is a major tributary of the Ogooué River. This is a different watershed from that of the Ntem River of northeastern Gabon, which drains the western portion of the Minkébé region. More recently field projects on soricid faunas have been conducted in other adjacent regions of this large forest block: Dja Faunal Reserve in Cameroon (COLYN et al. 1996), the Monte Alen National Park in Equatorial Guinea (LASSO et al. 1996), the Dzanga-Sangha Faunal Reserve in Central African Republic (RAY and HUTTERER 1995), and the Korup National Park in Cameroon, the westernmost extension of this forest block (HUTTERER and SCHLITTER 1996). Information on the shrews of these sites provides a biogeographic context with regards to the Minkébé fauna.

Material and methods

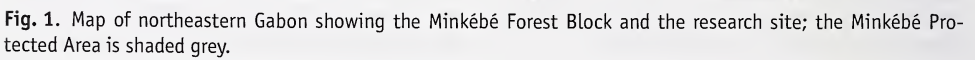
The Minkébé forest is composed of a large block of Guineo-Congolian lowland forest that drains a vast area (Fig. 1). The northern area of the forest is part of the Ntem River watershed and the balance enters into the Ivindo River. The first action to classify a protected zone in this area was in September 1997 when the Gabonese Government set aside 600 000 ha as the Réserve de Minkébé (DE WACHTER 1997). In December 1999 this reserve was gazetted as a protected area.

Our study site was near the northwestern boundary of the Minkébé Protected Area in an area of mixed heterogeneous forest and Maranthaceae forest interdigitated between areas of marshland. This region is part of the Aya River drainage, which forms one of the main tributaries of the Ntem River. Our camp was in place between 5 and 17 February 1998 and was located in the Province de Woleu-N'Tem, 28 km ESE Minvoul, 2° 5.2' N, 12° 22.5' E, 600 m a. s. l. Access to the forest was along a recent prospection trail cut by a survey group from the International Tropical Timber Organization (ITTO). We commenced our march into the forest from the Baka village of Doumasi, along the Ntem and to the east of Minvoul. Our study site was centered on this transect trail, but we also used the numerous elephant trails throughout the zone for access to other areas.

Three distinct habitat types were found adjacent to the camp: marshlands dominated by *Raphia*, heterogeneous forests, and homogeneous forest composed largely of *Gilbertiodendron*. Marsh areas, which experience extreme seasonal flooding, were interdigitated between the two forest types. Some of these marshes cover areas in excess of 30–50 ha. Our trapping devices were placed within a survey area less than 3 km walking distance from the camp.

The principal technique used to capture soricid shrews consisted of pitfall traps with drift fences. A separate pitfall line was installed in each of the habitat types surveyed (marsh, heterogeneous forest, and homogeneous forest), in order to assess possible variation in habitat utilization by these animals. Each line was 100 m long and consisted of 11 buckets (275 mm deep, 285 mm top internal diameter, 220 mm bottom internal diameter), 10 m apart, in operation for ten complete days. Small holes were cut in the bottom of the buckets to allow water drainage. Buckets were sunk to a depth where the rim was even with ground level. A barrier (drift fence) made from plastic sheeting (0.5 m high and 100 m long) was stapled in a vertical position to thin wooden stakes. The drift fence bisected all of the buckets in the line (VOSS and EMMONS 1996). A flange of about 50 mm at the bottom of the standing plastic fence was covered with soil and leaf litter to block animals from moving under the barrier. A bucket-day is defined as one of these devices in use for a 24-hour period (dawn to dawn).

The second technique used to capture animals at the site consisted of three different types of small mammal traps. Fifty traps composed of 33 Sherman traps (9 × 3.5 × 3 inch), 13 National traps



(16 × 5 × 5 inch), and 4 small snap traps, were placed in each of the three habitat types. These lines were run for 10 nights. Traps were baited daily, generally between 15.00 and 17.00 hours, with oil palm nuts, manioc, finely ground peanut butter or dried fish. On any given day the bait used in all of the trap lines was the same. A "trap-night" is defined as one of these devices in use for a 24-hour period (dawn to dawn). Traps and pitfalls were visited at least twice per day, once at dawn and again in the late afternoon, and captured animals were removed.

Captured animals were prepared as standard museum skins with associated skulls and skeletons, as fluid preserved carcasses, or as full skeletons. Voucher specimens are deposited in the Field Museum of Natural History (FMNH), Chicago, and a representative series will be returned to

Gabon. The fieldwork was conducted by SMG and PRN, and the determinations of the collected material were made by RH.

Results

Captures

In total 29 individual shrews of 11 species were captured in the Minkébé study site, covering a body mass range from 1.8 g (*Suncus remyi*) to 76 g (*Crocidura goliath*, Tab. 1). The majority of these individuals were obtained in pitfall traps. Standard small mammal traps yielded only four shrews, and in all cases, except for one,

Table 1. Body mass (g) and external measurements (mm) of eleven species of shrews collected in the Minkébé forest

+ Masses of less than 10 g are accurate ± 0.1 g, between 10 and 50 g ± 0.5 g, and greater than 50 g ± 1.0 g.

* Hind foot measurements do not include the claws.

Species	Museum Number	Sex	Mass+	Total length	Tail length	Hindfoot length*	Ear length
<i>Crocidura batesi</i>	162141	M	15.5	160	61	16	11
<i>Crocidura crenata</i>	162152	F	5.9	165	87	15	11
	162153	M	7.5	165	88	16	11
	162154	M	6.8	166	91	15	10
<i>Crocidura dolichura</i>	162198	M	6.1	152	80	13	10
<i>Crocidura goliath</i>	162144	F	58.0	282	110	25	17
	162145	M	76.0	290	115	27	15
	162184	F	69.0	272	107	26	17
	162185	M	51.0	292	132	26	17
	162186	F	52.0	255	100	23	17
<i>Crocidura grasiei</i>	162140	M	14.0	175	85	17	13
	162193	M	11.5	173	83	18	13
<i>Crocidura maurisca</i>	162196	?	7.2	136	57	15	10
<i>Crocidura olivieri</i>	162137	M	23.5	207	85	19	13
	162187	M	24.5	191	75	16	11
	162188	M	33.0	213	95	18	13
	162192	F	29.5	195	80	17	14
<i>Paracrocidura schoutedeni</i>	162142	F	8.1	115	38	14	9
	162146	F	6.7	115	38	11	8
	162194	M	11.5	125	42	12	10
	162195	F	9.5	114	37	12	9
<i>Suncus remyi</i>	162147	F	1.8	70	18	7	5
<i>Sylvisorex johnstoni</i>	162149	F	3.0	84	33	8	8
	162197	M	3.6	92	32	9	9
<i>Sylvisorex ollula</i>	162138	M	17.5	172	65	16	17
	162139	M	22.0	181	71	17	15
	162189	M	17.5	168	77	15	12
	162190	M	18.0	158	59	14	13
	162191	M	16.0	169	63	14	12

Table 2. Species and numbers of Soricidae captured in the Minkébé forest based on habitat type. All animals were captured in pitfall traps or obtained in live traps (second number after /)

	Marsh	Heterogeneous forest	Homogeneous forest
Cumulative pitfall bucket days	110	110	110
<i>Crocidura batesi</i>	0	1	0
<i>Crocidura crenata</i>	1	0	2
<i>Crocidura dolichura</i>	1	0	0
<i>Crocidura goliath</i>	0/1	3/1	0
<i>Crocidura grassei</i>	1	0	1
<i>Crocidura maurisca</i>	0	0	1
<i>Crocidura olivieri</i>	1	0	2/1
<i>Paracrocidura schoutedeni</i>	3	1	0
<i>Suncus remyi</i>	0	1	1
<i>Sylvisorex johnstoni</i>	0	0	2
<i>Sylvisorex ollula</i>	4	0	0/1
Total number of individuals in pitfalls/traps	11	6	11
Total number of species	7	4	7

these were the larger bodied species (*C. goliath* and *C. olivieri*).

The trap effort with both pitfalls and standard mammal traps was equal in the three habitats sampled (marsh, heterogeneous forest, and homogeneous forest). The number of individuals (11) and species (7) captured in the marsh and homogeneous forest were identical (Tab. 2). Fewer individuals and species were obtained in the heterogeneous forest than in the other two habitat types. For species with more than three captures there was no absolute preference for one of the three habitat types. Of the four specimens of *Paracrocidura schoutedeni* captured, three were in the marsh habitat and a single specimen was taken in the heterogeneous forests. Four individuals of *Sylvisorex ollula* were obtained in pitfall devices placed in the marsh habitat and none in the other two habitat types; however, one individual of this species was captured in a Sherman trap set in the homogeneous forest.

Annotated accounts for selected species

Crocidura batesi Dollman, 1915

This species was described from the "Como River" region of Gabon. It has subsequently been recorded in the Belinga Hills, where it was relatively rare in forested hab-

itat (BROSSET 1988); in Equatorial Guinea (LASSO et al. 1996); and in southern Cameroon (SCHLITTER et al. 1999). The species was also listed as part of the fauna of the Dzanga-Sangha region (RAY and HUTTERER 1995). However, a subsequent study of additional specimens from this region has revealed morphological differences which suggest that this population belongs to a yet undetermined species of *Crocidura*. Our single specimen of *C. batesi* from Minkébé was taken in heterogeneous forest habitat.

Crocidura crenata Brosset, Dubost and Heim de Balsac, 1965 a

The holotype of this animal was obtained in the Belinga area of eastern Gabon and it is also known from near Makokou (BROSSET et al. 1965 a). Subsequently it has been found in the Korup National Park and Dja Faunal Reserve of Cameroon, and regions of the Democratic Republic of Congo (COLYN et al. 1996; HUTTERER and SCHLITTER 1996). The records of *C. crenata* in the Minkébé forest helps to clarify aspects of its geographical distribution in that they provide clear evidence that this species occurs in intermediate areas across this large zone of west-central Africa. This species was not recorded in a recent survey of soricids in the

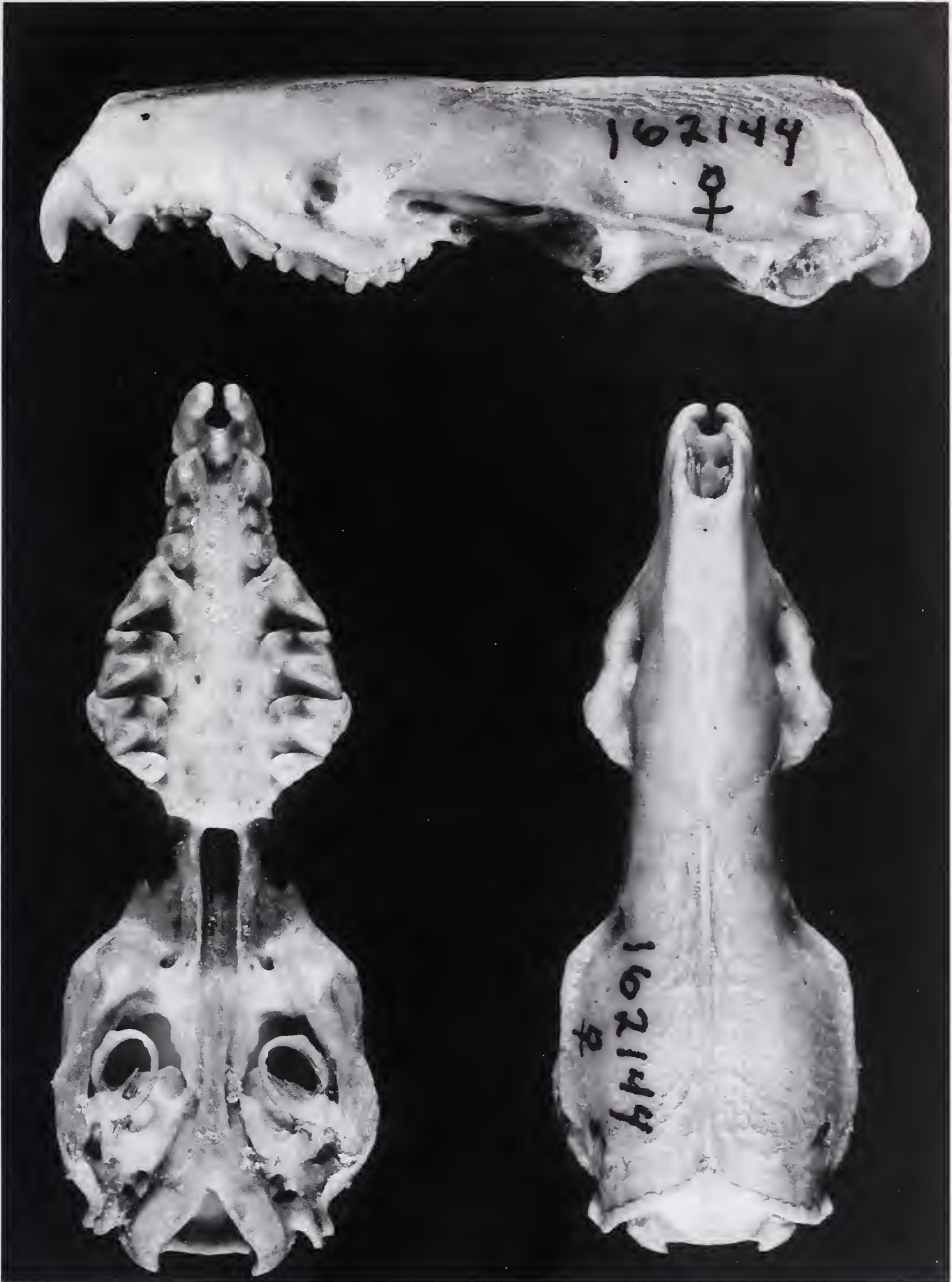


Fig. 2. *Crocidura goliath* (FMNH 162144), female from Minkébé, skull in dorsal, ventral, and lateral view. Condyllo-incisive length 38.4 mm.

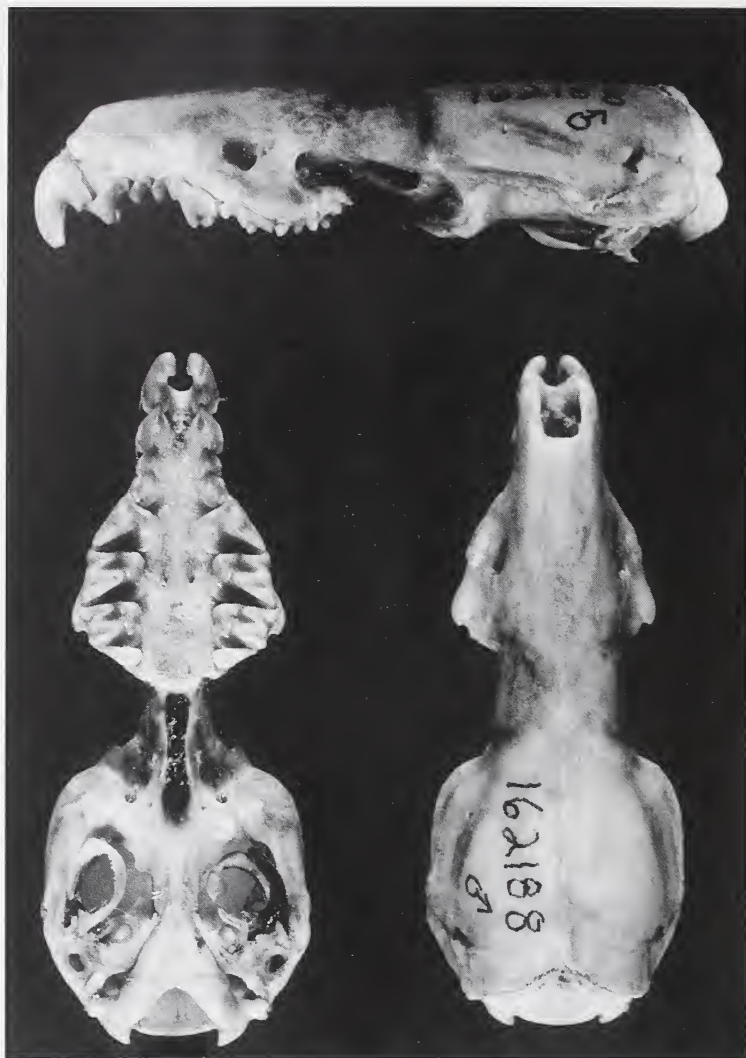


Fig. 3. *Crocidura olivieri* (FMNH 162188), male, skull in dorsal, ventral, and lateral view. Condylar-incisive length 29.6 mm. Compare with *C. goliath*, a species that occurs syntopically in the Minkébé forest.

Monte Alen National Park, Equatorial Guinea (Lasso et al. 1996).

Crocidura goliath (Thomas, 1906)

Several individuals of this giant shrew were taken in both pitfall and Sherman traps in the Minkébé National Park. This included capture sites in both heterogeneous forest and marsh habitat. Of particular interest is that this is the first known syntopic occur-

rence of this species in primary forest habitat with *C. olivieri*. Specimens of both species were captured in marshland in Minkébé (Tab. 2), thus corroborating the distinct species status of these two giant shrews.

For a considerable period, *C. goliath* had been considered as a large forest variant of *C. olivieri*, the common African giant shrew (HEIM DE BALSAC, 1970), partly due to its rarity in museum collections. Recent field-

work has shown that both forms are broadly sympatric, with *C. goliath* being restricted to the high forest regions of the Congo Basin (HUTTERER 1995; LASSO et al. 1996). The Minkébé survey now offers evidence that both species may live even in the same micro-habitat. The external morphology (Tab. 1) and skulls (Figs. 2, 3) of both species are markedly different in these syntopic populations. Obvious differences exist in the

size and robustness of the skull and dentition. Externally, *C. goliath* is distinguished from *C. olivieri* by its long and coarse fur, and a long tail with a low pilosity.

A female *C. goliath* was captured with a single suckling neonate in a Sherman trap placed on the ground next to a downed rotten log.

Crocidura grassei Brosset, Dubost and Heim de Balsac, 1965 b

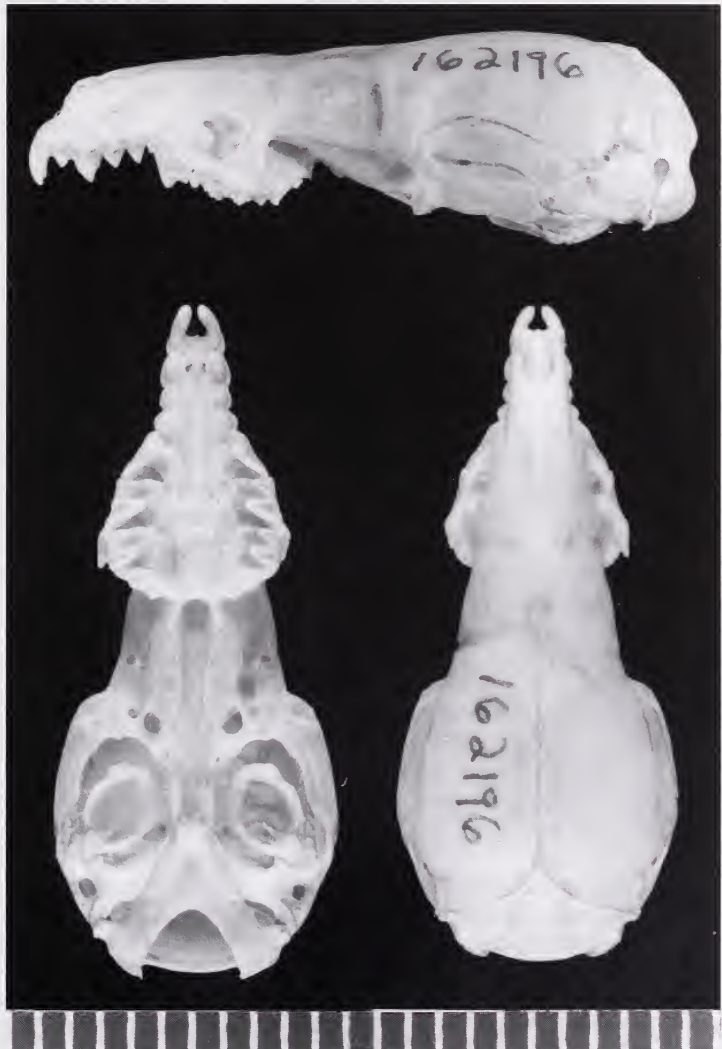


Fig. 4. *Crocidura maurisca* (FMNH 162196) from Minkébé, skull in dorsal, ventral, and lateral view. Condylto-incisive length 21.1 mm.

The holotype of this species was collected at Belinga in eastern Gabon. Subsequently it has been identified from collections made in the Yaoundé region (Cameroon), Boukoko (Central African Republic), Mt. Alen National Park (Equatorial Guinea), and now from the Minkébé region (HUTTERER 1995; LASSO et al. 1996). This is a rare shrew, of which less than ten specimens are known.

Crocidura maurisca Thomas, 1904

The type of this rare shrew was collected at Entebbe, Uganda, and this species has only been documented from Uganda and Kenya (HUTTERER 1995). The single female (FMNH 162196) from Minkébé is a surprisingly new record for Gabon, and extends the range of the species far to the west. This species is characterised by a tail with low pilosity, and by a skull with a slender muzzle and a weak dentition, all of which are expressed in the Gabonese specimen. The skull (Fig. 4) has been compared with typical specimens from East Africa and was found to be very similar, both in measurements and size. Unless further studies, such as biochemical analyses, show otherwise, we consider the Gabonese specimen to represent *C. maurisca*.

HEIM DE BALSAC (1968a) reported a specimen from Yaoundé, southern Cameroon, as belonging to "*Crocidura* aff. *maurisca* Th.", but later (HEIM DE BALSAC 1968b; DIETERLEN and HEIM DE BALSAC 1979) changed this identification to "*C. littoralis* subsp.". The specimen, which is not currently available for study, was then discussed by HUTTERER (1982) in the context of the description of a new species from Lake Manenguba, Cameroon Mts. The holotype of *C. manengubae* Hutterer, 1982 was compared with the Gabonese specimen (FMNH 162196) and found to be generally similar but also different in various cranial characters. The correct allocation of the specimen from Yaoundé, geographically half-way between Lake Manenguba and Minkébé National Park, still remains to be solved.

Suncus remyi Brosset, Dubost and Heim de Balsac, 1965 b

Little new information or material of this extremely diminutive species has been available since its description based on material from the Makokou region. It has subsequently been recorded from the Odzala Reserve, Republic of Congo (COLYN et al. 1996) and now from the Minkébé. Interestingly, it was not identified from material obtained in the Dja Faunal Reserve of Cameroon after nearly 7000 pitfall bucket nights (COLYN et al. 1996).

The single female from the Minkébé collection was obtained in heterogeneous forest. This individual had three enlarged inguinal mammae, an apparently perforated vagina, and no embryos in the uterus. With a body mass of 1.8 g, *Suncus remyi* is equal in size to the European *Suncus etruscus* (Savi, 1822), which is often regarded as the "smallest mammal of the world".

Discussion

The survey of the sorcid fauna near the Minkébé Protected Area was rapid and by no means complete. Firstly, only a small fraction of this huge forest block was visited and a limited number of habitats were inventoried. It is almost certain that with more extensive sampling, particularly within other elevational zones and habitats, the number of shrew species known from the park will increase. Secondly, an examination of the number of previously unrecorded species of shrews recorded during each successive night of pitfall trapping indicates that 10 nights of field work were not sufficient to reach an asymptote (Fig. 5).

The shrew species richness of 11 species documented during a rapid inventory of a single site in the Minkébé forest during 10 days is comparable to that obtained in a wide variety of habitats over several decades in the nearby Makokou forest. The main difference in the species lists from these sites is that *Crocidura maurisca* was not obtained at Makokou. *Crocidura goliath*, which was relatively common at Minkébé is rare at Makokou (reported under the name *C. odorata* by BROSSET 1988), and

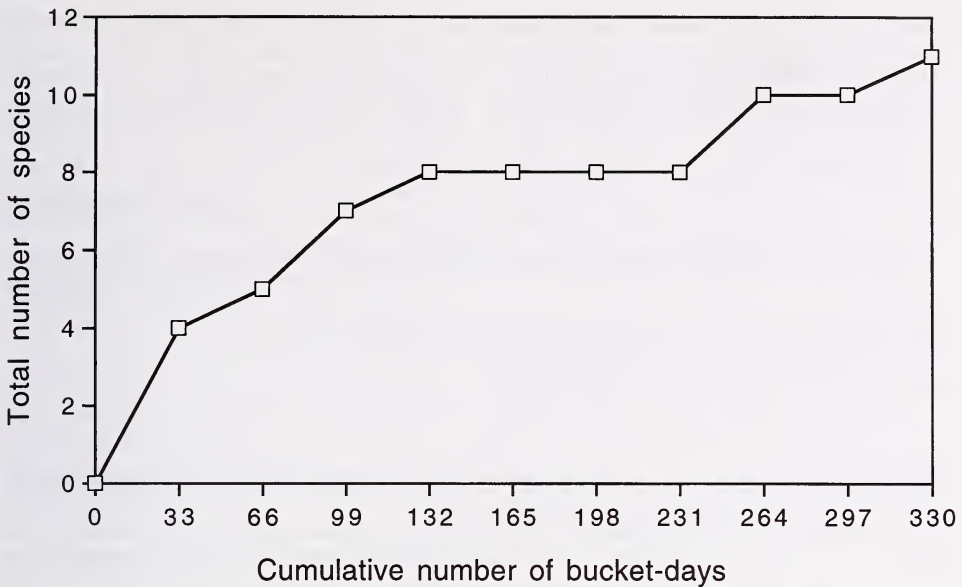


Fig. 5. Species accumulations curve for the shrews over the entire survey period.

C. poensis, the most frequently captured forest shrew at Makokou was not obtained at Minkébé. The latter difference may not be real but merely a result of unresolved taxonomy, as the so-called “*C. poensis* group” is in urgent need of revision. A solution of this problem will require a re-investigation of Brosset’s material from Makokou in the context of such a revision. Further our results from the Minkébé forest are close to those obtained at Dja where 12 species of shrews were captured after nearly 7000 bucket-days (Tab. 3; COLYN et al. 1996). In the case of Makokou, the exact configuration of the “pièges-pots”, the type of trap that researchers there used to capture shrews, and most importantly their depth was not specified (BROSSET 1988). We strongly suspect they were distinctly smaller than the type employed in our Minkébé study. Further, the dimensions of the pitfalls used in COLYN’s et al. (1996) study at Dja were not noted, but they were smaller than those in our study (P. R. NGNEGUEU participated in the Dja study). Thus, what seems to be apparent from these comparisons is that larger pitfall buckets are more

effective for capturing and retaining a wider variety of shrews. We propose that the bucket size of pitfall devices is an important element in the capture rate of African soricids. A parallel case occurs with the Malagasy tenrecs – large buckets (approximately 15 l) are decidedly more efficient in yielding high capture rates of a greater variety of tenrecs than small buckets (GOODMAN and RAKOTONDRAVONY 2000).

Recently an analysis was conducted on the contents of carnivore scats collected in the Central African Republic reserves of Dzanga-Sangha and Dzanga-Ndoki (RAY and HUTTERER 1995). These sites are in an area of forest that is part of the large Guineo-Congolian block encompassing the Minkébé and Dja forests. The scats were collected from a wide variety of habitats over the course of two years from an area of 35 km². Sixteen species of shrews, including one new to science, were identified from these scats. This is one of the highest diversity of soricids recorded anywhere in the world. We are unaware of any systematic work with pitfall devices at these Central African Republic sites.

It has been previously noted that trap capture rate with pitfall devices for lipotyphlans is generally higher after heavy rain (GOODMAN et al. 1996). The inventory of the Minkébé forest was conducted during the dry season, and on two of the 12 days we were at the site rain fell. During the day of 13 February, a shower dropped 38 mm of rain, and there was no increase in pitfall trap success that same night.

A comparison of six sites that have been surveyed for shrews in the Guineo-Congolian forest block indicates that the fauna of Minkébé and the Makokou/Belingá regions

are more similar to one another than either is to any other forest block in this region (Tab. 3). The shrew fauna of Equatorial Guinea is largely a subset of that found at the two Gabonese sites. Further, although the fauna of the Dja is slightly richer than Minkébé there is a large percentage of species shared in common. In contrast, the shrew fauna of the Dzanga-Sangha reserve in Central African Republic is the most diverse and unique of the sites sampled in the region.

Table 3. Geographic distribution (+ recorded, – not recorded) of soricids at several sites in west-central African forests. Taxonomic treatment of species follows HUTTERER (1995).

Site:	Minkébé	Makokou and Bélingá	Equatorial Guinea	Dzanga- Sangha	Dja	Korup
Source of Information:	1	2, 3	4	3	5	6
Species:						
<i>Crocidura</i> sp. indet.	–	–	–	–	+	–
<i>Crocidura attila</i>	–	–	–	–	+	–
<i>Crocidura batesi</i>	+	+	+	^a	–	–
<i>Crocidura crenata</i>	+	+	–	–	+	+
<i>Crocidura denti</i>	–	–	–	+	+	–
<i>Crocidura dolichura</i>	+	+	+	+	+	+
<i>Crocidura hildegardeae</i>	–	–	–	+	–	–
<i>Crocidura goliath</i>	+	+	+	+	+	–
<i>Crocidura grandiceps</i>	–	–	–	–	–	+
<i>Crocidura grassei</i>	+	+	+	–	+	–
<i>Crocidura lamottei</i>	–	–	–	–	–	+
<i>Crocidura littoralis</i>	–	–	–	+	–	–
<i>Crocidura ludia</i>	–	–	–	+	–	–
<i>Crocidura maurisca</i>	+	–	–	–	–	–
<i>Crocidura mutesae</i>	–	–	–	^b	^b	–
<i>Crocidura nigrofusca</i>	–	–	–	^c	–	–
<i>Crocidura olivieri</i>	+	+	+	+	–	–
<i>Crocidura poensis</i>	–	+	–	–	+	+
<i>Paracrocidura schoutedeni</i>	+	+	+	+	+	+
<i>Suncus remyi</i>	+	+	–	+	–	–
<i>Sylvisorex johnstoni</i>	+	+	+	+	+	+
<i>Sylvisorex konganensis</i>	–	–	–	+	–	–
<i>Sylvisorex ollula</i>	+	+	+	+	+	+
<i>Sylvisorex pluvialis</i>	–	–	–	+	–	+
Total number of species	11	11	8	16	12	9

Sources: 1 – this study, 2 – BROSSET (1988), 3 – RAY and HUTTERER (1995), 4 – LASSO et al. (1996), 5 – COLYN et al. (1996), 6 – HUTTERER and SCHLITTER (1996).

Comments: ^a – species identity uncertain, ^b – taxonomic status of *mutesae* still unresolved, ^c – the Dzanga-Sangha population of *nigrofusca* may represent a different species; all problems are under study by RH.

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Zusammenfassung

Bericht über die Artengemeinschaft von Spitzmäusen (Mammalia: Soricidae) im Minkébé Regenwald, Nord-Ost Gabun

In diesem Bericht werden die Ergebnisse einer Studie über die Artengemeinschaft von Spitzmäusen im Minkébé Regenwald im nordöstlichen Gabun mitgeteilt. Diese bislang unerforschte Region ist Teil des großen Guinea-Kongo Regenwaldblocks. Als prinzipielle Fangtechnik wurden Eimerfallen in Kombination mit Driftzäunen verwendet. Drei Lebensraumformen (Marschland, heterogener und homogener Wald) wurden mit Fallenreihen bestückt. In jedem der drei Lebensräume wurden zwischen vier und sieben Spitzmausarten gefangen, im ganzen Gebiet elf Arten. Einige seltene und wenig bekannte Arten wie *Crocridura crenata*, *C. goliath*, *C. grassei*, *Suncus remyi* oder *Sylvisorex ollula* kommen im Park vor. *Crocridura maurisca* wird erstmals für Gabun nachgewiesen, weit außerhalb des bislang bekannten Areals in Ostafrika.

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