SMALL CARNIVORE CONSERVATION

The Newsletter and Journal of the IUCN/SSC
Mustelid, Viverrid & Procyonid Specialist Group

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Genetta rubiginosa from the Shimba Hills, Kenia - Photo: Thomas Engel

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This number is dedicated to the memory of C.B. Powell (1943-1998)

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We are particularly grateful to Walter Rasmussen for reading the manuscripts and improving the English style.

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The aim of this publication is to offer the members of the IUCN/SSC MV&PSG, and those who are concerned with mustelids, viverrids, and procyonids, brief papers, news items, abstracts, and titles of recent literature. All readers are invited to send material to:

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Genets of the Niger Delta, Nigeria

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Introduction

The Niger Delta lies in the transition zone between the Upper Guinea (west of Togo) and Lower Guinea (east of Cross River) rainforest faunas (Fig. 1). It contains disjunct populations of a few mammals from each of those faunas, but has a greater faunal affinity with Lower Guinea. It has been considered a minor centre of endemism on its own accord (Grubb, 1990) and, as a part of the Niger system, it also figures in the traditional view of the Niger as a distributional barrier to supposed west-of-Niger and east-of-Niger species (Happold, 1987).

Very few records of mammals have been available for the delta area and almost none for the delta proper (Happold, 1987). A wildlife survey of the eastern half of the delta during the past few years has produced over a dozen new species records and highlighted internal faunal patterns (Powell, 1995, 1997). The latter includes a newly recognized 'Marsh Forest' or tidal freshwater zone with two large mammals new to Nigeria (the Black-fronted duiker *Cephalophus nigrifrons* Gray, 1871, and the Red colobus monkey *Procolobus badius* s.l. in the form of a new subspecies) and lacking some species such as the Cusimanse *Crossarchus platycephalus* Goldman, 1984, common in the more inland 'Flood Forest' zone. The more noteworthy small carnivore findings were the Long-nosed mongoose *Xenogale naso* De Winton, 1901 (previously known only east of the Cross River; see Colyn & Van Rompaey, 1994) and new information on genets. The latter includes material of particular interest to the MV&P Specialist Group and is the subject of this note. A full account of the carnivores of the Niger Delta is in preparation.

The taxonomy and nomenclature of West African forest genets is unsettled. The shortage of museum material and comparative studies requires recourse to speculative classifications with the result that recent authors have adopted a different system (see Appendix 1 in Van Rompaey & Colyn, 1996). Broadly, we are dealing with two or three groups:

- the widespread and generally large-spotted *pardina* group marked by pale coloured feet and a tail with a long un-ringed tip. They have been called: *G. maculata* Gray, 1830; *G. pardina* I. Geoffroy Saint-Hilaire, 1832; *G. genettoides* Temminck, 1853; and *G. rubiginosa* Pucheran, 1855.
- the high forest and generally small-spotted *servalina* group marked by dark feet and a tail ringed to its tip. The group includes *G. servalina* Pucheran, 1855; *G. cristata* Hayman, 1940; and *G. bini* Rosevear, 1974.
- the rare and problematic *G. poensis* Waterhouse 1838 with dark feet, a pardine-type tail with a long un-ringed tip, and many small, irregular spots some of which coalesce to form a pair of narrow, paraspinal stripes (for a photograph see Hoppe-Dominik, 1990). It may be only a variant of a pardine species, and is treated with that group here.

The most recent overall treatment of Nigerian mammals is by Happold (1987). While noting the difficulty and confusion in genet taxonomy, he tentatively recognizes distinct forest and savanna pardine species (as *G. poensis* and *G. pardina* respectively), and one servaline (*G. bini*) while assigning the other Nigerian servaline (*G. cristata*) to synonymy with the forest pardine *G. poensis*. In a widely used recent reference work, Wozencraft (1993) includes all West African pardine genets (*G. pardina, G. genettoides,* and *G. rubiginosa*), as well as *G. poensis* and the servaline *G. bini*, under the name *G. maculata* which Rosevear (1974) regards as not being available (being pre-occupied by *Viverra maculatus* Kerr, 1792 = *Dasyurops maculatus*, the marsupial Spotted-tailed quoll).

The *servalina* group

The two Nigerian servaline genets are the Crested genet *Genetta cristata* in the Cameroon-Nigeria border area east of the Cross river (Sanderson, 1940; Heard & Van Rompaey, 1990) and the Benin genet *G. bini*, known from a single skin, from west of the Niger River far beyond the delta area (Rosevear, 1974).

They differ from the central African *G. servalina* s.s. by possessing (1) a black spinal stripe and crest running from the mid-back to the tail, and (2) a shorter nuchal crest in *cristata* and forward directed hairs on the back of the neck in *bini*. The body spots of the sole known specimen of *G. bini* are more irregular, larger and fewer than in the other two species (Rosevear, 1974). The skull of *G. cristata* is more oligostenic than that of *G. servalina* s.s. (Crawford-Cabral, 1980-81); no *G. bini* skull was available for comparison.

Fig. 2. Left: Genetta bini; *right:* G. cristata *(specimens from The Natural History Museum, London).*

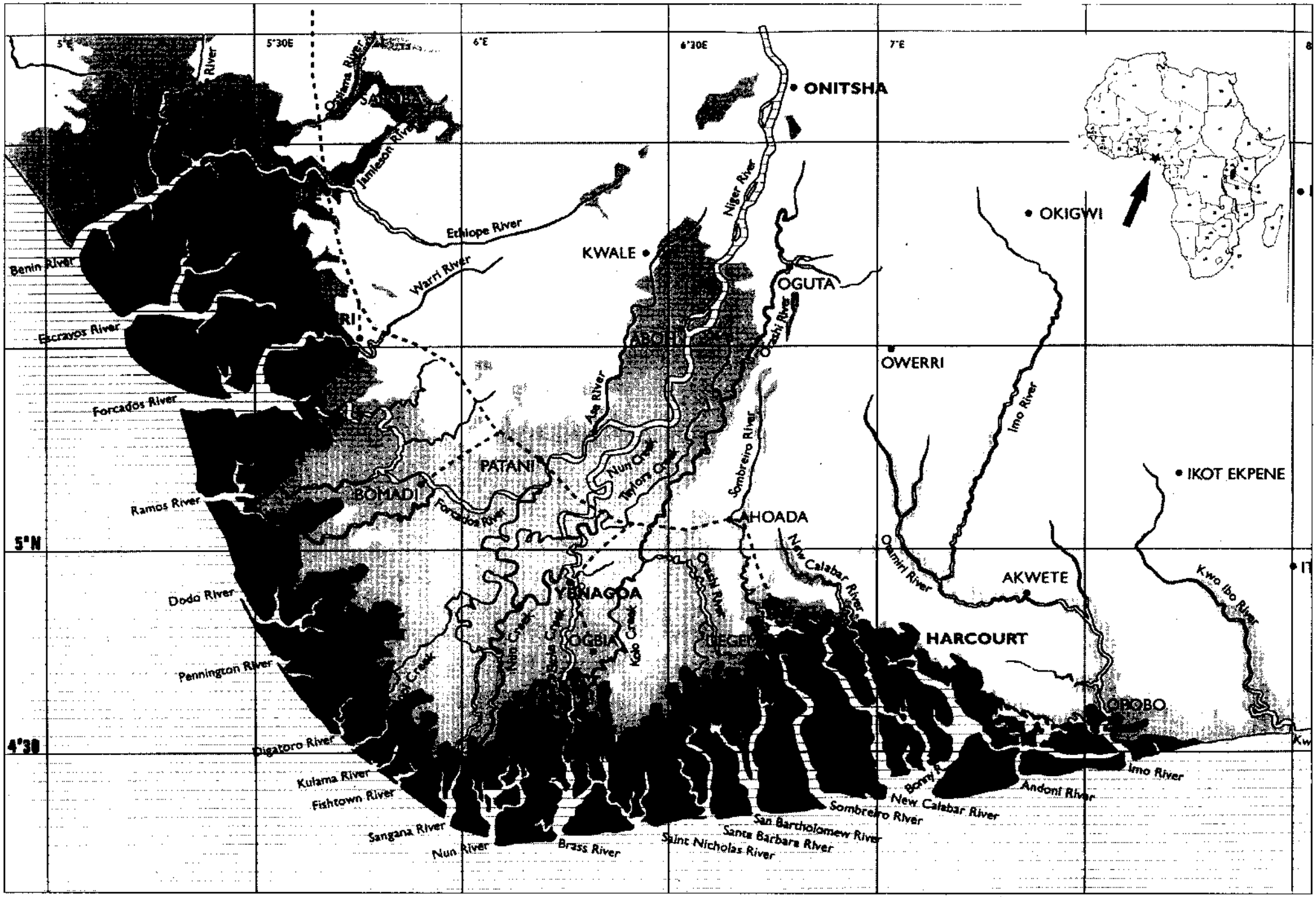

Fig. 1. The Niger Delta; white area: agricultural land; light grey: fresh water swamp forest; dark grey: mangrove forest; black: coastal-barrier island rain forest. Map by WWF-UK.

Genetta cristata was described by Hayman (in Sanderson, 1940) as a subspecies of *G. servalina*. It is now widely treated as a distinct species (Rosevear, 1974; Crawford-Cabral, 1980-81; Heard & Van Rompaey, 1990; IUCN, 1996; IEA, 1998). However Happold (1987) regarded it as "probably a race of *poensis*" (the name he used for the Nigerian forest representative of the *G. pardina* group), and Wozencraft (1993) retained it as a subspecies of *G. servalina*. Shelagh Heard obtained additional material from the Cross River area, gave information on captive juveniles (pelage, behaviour), and mapped known localities, all between the Cross and Sanaga Rivers which are often considered to be zoogeographic boundaries for other animals (Heard & Van Rompaey, 1990).

Genetta bini has not been generally recognized as a distinct species. The type specimen, a 'poor skin' (no skull) from Ohosu Forest Reserve, 65 km northwest of Benin City, was variously treated as indeterminable (Crawford-Cabral, 1980-81), or as belonging to *G. servalina* s.s. (Schlawe, 1981), or the non-servaline *G. maculata* (Wozencraft, 1993). Rosevear (1974:198) himself stated that "whether this is a species or merely a race is open to question" and that his treating it as a new species was influenced by "the wide gap of 750 kilometers separating it from its nearest recorded neighbour (*G. cristata*), across the two faunal barriers of the lower Niger and Cross Rivers". That gap is actually only about 400 km. One of us (HVR) has examined the type specimen (BMNH-50.315) and considers that except for the spots being larger, fewer, and somewhat more irregular than in *G. cristata*, the skin is similar in other aspects (Fig. 2).

In 1993 one of us (CBP) obtained a juvenile genet from Odi, within the Nun-Forcados bifurcation of the Niger river, a site between the known ranges of *G. bini* and *G. cristata*. It was tentatively listed as *G. bini* in an unpublished report (Powell, 1993), using keys in Happold (1987). A photo of the specimen was identified by Daphne Hills (in litt., 11 Oct. 1993) as a probable *G. cristata*.

***Genetta cristata* Hayman, 1940 - Crested genet**

Since 1993 CBP has collected and/or examined over 25 specimens from: **Aseingbene** (RMCA-95.53.M2); **Azama** (RMCA-98.049.M21); **Azikoro** (NDS); **Bomoundi** (BMNH-1994.196); **Elebele** (RMCA-98.049.M19, 98.049.M20); **Fangbe** (BMNH-1994.182); **Gbarantoru** (NDS); **Igovia** (BMNH-1996.317; SBP-655.23.1); **Odi** (NDS); **Ogbia** (NDS); **Okolobiri** (RMCA-95.038.2; RMCA-95.53.M3; 3 NDS's); **Okoroba** (BMNH-1996.320); **Omoku** (RMCA-97.86.M4); **Opu-Ogbogolo** (BMNH-1994.197; BMNH-1995.261); **Port Harcourt, 15 km N. of** (NDS); **Swali** (NDS); **Tombia-Ekpetiama** (BMNH-1994.183; 2 NDS's); **Tungbo** (HVR-P.6; NDS).

Comparison of the skins with Oban and Mamfe material of *G. cristata* in the BMNH does not show any significant differences, or any trend towards characters of the Benin genet. Neither do comparisons of the skull measurements with those of *G. cristata* from east of the Cross River (Table 1). Details will be published later, when material from west of the Niger is available for fuller analysis. Our expectation is that the crested genet should range across the delta and will probably encompass the Benin genet, which may represent an extreme outlier population.

One noteworthy aberrant (?) skin has been seen, which lacks a spinal stripe and thereby resembles *G. servalina*. It is from a juvenile animal obtained at Otuokpoti and kept as a pet by Mr Inemo Warton of Agudama-Ekpetiama; the skin was kept after the animal died several years ago.

	Specimens from E. of the Cross River					Specimens from the Niger Delta				
VAR	N	MIN	MAX	MEAN	SD	N	MIN	MAX	MEAN	SD
GSL	5	95.3	97.4	96.1	0.8	7	87.5	98.8	93.4	4.4
CBL	4	93.0	94.4	93.8	0.6	7	87.4	96.9	92.2	4.3
ROL	5	31.0	33.3	32.0	0.8	8	26.6	32.8	30.2	1.8
PAL	5	41.1	44.2	42.7	1.2	8	39.7	45.0	41.6	1.9
MAX	5	35.6	37.2	36.6	0.6	8	32.7	37.9	34.9	1.6
TYM	5	17.3	18.3	17.7	0.4	8	17.0	18.6	17.9	0.6
CAN	5	13.8	14.7	14.3	0.4	8	13.1	15.0	14.2	0.7
ROB	5	17.3	19.6	18.7	1.0	8	16.3	20.1	18.3	1.4
IOB	5	12.0	14.4	13.0	0.9	7	12.1	13.6	12.9	0.3
PAB	5	24.7	26.2	25.3	0.6	8	22.4	26.0	24.4	1.2
ZYG	5	44.6	46.2	45.6	0.7	7	42.7	48.3	44.5	1.9
BRB	5	29.4	31.3	30.6	0.7	7	28.9	31.5	30.8	0.5
MAS	4	29.8	31.8	30.5	0.9	8	29.2	32.7	30.5	1.1
BRH	5	22.5	26.4	25.1	1.6	7	25.5	26.6	26.0	0.4
MAL	4	62.4	64.6	64.0	0.5	8	59.4	67.1	63.2	2.9
MAN	4	37.2	40.1	39.0	1.3	8	35.3	39.7	37.6	1.4
CMB	4	23.4	25.0	24.0	0.8	8	22.2	26.1	24.0	1.4

Table 1. Basic statistics (in mm) of 17 skull characteristics of 13 adult *Genetta cristata*.
Five specimens from East of the Cross River: **Mamfe**, CA (BMNH-48.796, F); **Massaka**, CA (MMNH-50.949, F); **Mkpot**, NI (BMNH-1992.352, F); **Oban**, NI (BMNH-10.61.12, M); **Okogong**, CA (BMNH-39.323, M). Eight specimens from the Niger Delta, NI: **Aseingbene**, (RMCA-95.53.M2, U); **Elebele** (RMCA-98.049.M20, M; 98.049.M19, M); **Igovia,** (Paimpont-65523.1, M); **Okolobiri,** (RMCA- 95.038.2, U ; 95.53.M3, F); **Omoku** (RMCA-97.86.M4, F), **Tungbo**, (HVR-P.6, M).

The new distribution records presented here show that the crested genet occurs in a minimal area of approximately 3;000 km^2 in the Niger Delta alone. The peripheral records are:

- Northward: eastern floodplain of the River Niger ca. 05°23'N, 06°36'E (Omoku: RMCA-97.86.M4) and 05°25'N, 06°29 (skin from Obiofu, sighted by CBP).
- Westward: Azama, Apoi Clan, ca. 04°53'N, 05°59'E (CBP) and Tungbo ca. 05°07'N, 06°10'E (HVR-P-6).
- Eastward: Opu-Ogbogolo on west bank of Orashi (Engenni) River ca. 04°54'N, 06°34'E (BMNH-1994.197; 1995.261).
- Southward: Okoroba ca. 04°38'N, 06°11'E (BMNH-1996.320) and Ogbia area ca. 04°40'N, 06°21'E (CBP).

Information from hunters who claim to recognize the crested genet as distinct from the large-spotted genet, indicate the species' range is greater and probably extends throughout heavily forested parts of the delta. The range appears to include the tidal freshwater or Marsh Forest Zone (cf Powell, 1995, 1997) but not the mangrove zone and probably not the coastal barrier islands. In most sites where both species occur, hunters distinguish them on the basis of habitat, the crested genet being classed as the forest ('bush') type and the large-spotted genet as the riverside and/or mangrove type.

In the largely deforested zone east of the Orashi River, there is no recent record but two aged skins have been seen in villages north of Port Harcourt (Rukpokwu and Umuechem) and local hunters claim the species is still present. This is the only area (within the region where the crested genet has been collected or seen) where the local languages (Ikwerre and Etche, both of the Igboid group) have a name for the crested genet (*nanwùri*) as distinct from the large-spotted genet (*wekpe*, with phonetic variations according to dialect). The latter is certainly more common and would appear to replace the crested genet outside closed forest habitats.

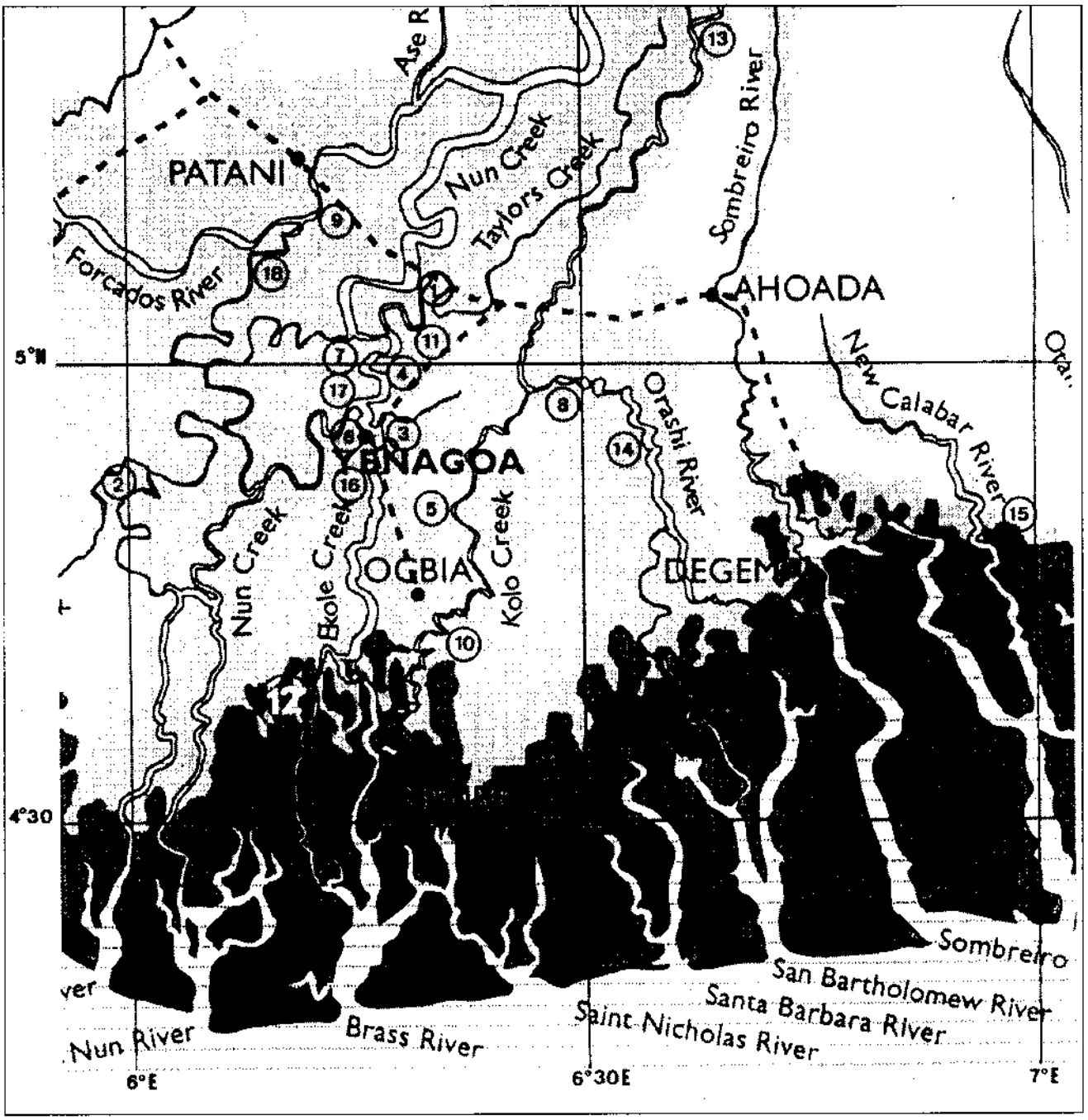

Fig. 3. Records of Genetta cristata *in the Niger Delta, Nigeria: 1: Aseingbene; 2: Azama; 3: Azikoro; 4: Bomoundi; 5: Elebele; 6: Fangbe; 7: Gbarantoru; 8: Igovia; 9: Odi; 10: Ogbia; 11: Okolobiri; 12: Okoroba; 13: Omoku; 14: Opu-Ogbogolo; 15: Port Harcourt, 15 km N of; 16: Swali; 17: Tombia-Ekpetiama; 18: Tungbo.*

The *rubiginosa* group

The identity and proper name for Niger Delta populations of the large-spotted genet *Genetta pardina* s.l. depends on their relationship to populations from wider areas. The options are:

- (a) all West African forest-zone populations are the same species *G. pardina* (type locality: Senegal)
- (b) following Crawford-Cabral (1980-81), populations east of the Volta River (Dahomey Gap) are distinct, in which case the species is *G. rubiginosa*
- (c) following Rosevear (1974), forest and savanna forms may be distinct, in which case Niger Delta population is *G. genettoides*. Rosevear pointed out that the name *G. poensis* has priority if it proves to be only a small-spotted variant of *G. genettoides*.

An analysis of the problem has been difficult due to a shortage of material, especially skulls. Until now no specimen has been available from the eastern half of the delta, two from the western delta (Sapoba FR and Warri), and only a few from neighbouring areas (Togo, western Nigeria, Cross River area, and Cameroon).

***Genetta rubiginosa* Pucheran, 1855 - Large-spotted genet**

The present survey has produced specimens from a wide variety of habitats in the eastern delta. More than 40 specimens have been collected and/or examined from:
Bunu-Bangha (RMCA-96.47.M3; NDS); **Diebu** (BMNH-1995.319; RMCA-95.53.M1); **Etiema** (RMCA-98.049.M6; 98.049.M17); **Igbeta-Ewoama** (RMCA-96.47.M2; 96.52.M1; 97.047.M2; 97.061.M4); **Ihuaba** (BMNH-1996.4); **Odieke** (RMCA-95.010.1); **Okarki** (NDS); **Okoroba** (BMNH-1996.31-6; NDS); **Okpoama** (RMCA-97.086.M2; 97.086.M3; 97.086.M1; 98.017.M1; 98.017.M2; 98.017.M3; 98.017.M4; 98.049.M2; 98.049.M8; 98.049.M9; 98.049.M10; 98.049.M12; 98.049.M13; 98.049.M14; 98.049.M15; 98.049.M16; 98.049.M18); **Onitu** (RMCA-98.049.M3); **Opukuma** (RMCA-98.049.M4); **Opume** (RMCA-95010.2); **Opu-Ogbogolo** (HVR-P-4); **Owelli Town** (RMCA-98.049.M1); **Sapoba** (RMCA-98.049.M5); **Taabaa** (RMCA-97.047.M3; RMCA-97.061.M5); **Yae** (RMCA-96.52.M3).

A comparison of their mean skull size with available measurements from other West African forest regions (Table 2) demonstrates the dichotomy between populations on either side of the Volta River and gives support to Crawford-Cabral's (1980-81) conclusion that specimens from west of the Volta River are larger.

A comparison of the condylobasal length of the male and female specimens from the 'mangrove and tidal zone' shows that there is sexual dimorphism with the males being 5.4% larger (t=3.45; df=20; p=0.0026)(Table 3).

The five 'upland' specimens are smaller than the 'mangrove and tidal zone' specimens. This could be due to the more abundant food supply such as crabs and intertidal fish in the tidal zone and/or the greater pressure from trapping and hunting in the the upland zone causing a difference in age structure in both populations (Table 3).

The skins show the usual wide variation in the colour pattern, with the para-spinal spots being variously discrete or partly confluent, as wide as the spinal stripe or nearly twice as wide, and solid black or brown-centred. The relatively constant features are: a relatively short tail with only 6 to 8 pale rings and

Specimens from W of the Dahomey Gap	*N*	*MIN*	*MAX*	*MEAN*
Senegal (2M,1F,6U)	9	89.9	105.4	94.7
Guinea (3U)	3	88.2	98.1	94.3
Sierra Leone (4M,4F)	8	92.3	99.7	95.5
Liberia (1M,37U)	38	91.7	105.2	97.9
Côte d'Ivoire (1F,2U)	3	98.9	101.9	100.0
Ghana (4M,5F,1U)	10	92.1	102.3	95.8
Specimens from E of the Dahomey Gap				
	N	*MIN*	*MAX*	*MEAN*
Togo (2M,2F)	4	86.1	91.0	88.1
Nigeria, Lagos (1U)	1			88.5
Niger Delta (17M, 9F,1U)	27	83.6	97.1	90.6
Cameroon (1M,1F,3U)	5	80.6	98.5	87.4

Table 2. Measurements of the condylobasal length (in mm) of large-spotted genets from both sides of the Dahomey Gap. M: male; F: female; U: unknown.

Mangrove and tidal zone specimens		*Sex*	*CBL*
RMCA-95.53.M1	Diebu	M	95.6
RMCA-97.061.M4	Igbeta-Ewoama	M	90.2
RMCA-98.017.M1	Okpoama	M	96.2
ON-t322.4	Okpoama	M	92.6
RMCA-98.049.M11	Okpoama	M	97.1
RMCA-98.049.M9	Okpoama	M	91.9
RMCA-98.049.M13	Okpoama	M	91.8
ON-t322.9	Okpoama	M	95.0
ON-t322.10	Okpoama	M	92.4
RMCA-98.049.M18	Okpoama	M	94.1
RMCA-98.049.M8	Okpoama	M	93.7
RMCA-98.049.M10	Okpoama	M	85.0
ON-t322.15	Okpoama	M	92.4
RMCA-98.049.M12	Okpoama	M	95.3
N = 14 X= 93.1 SD = 3.0			
RMCA-96.52.M1	Igbeta-Ewoama	F	83.6
RMCA-97.086.M2	Okpoama	F	92.6
RMCA-97.086.M3	Okpoama	F	93.1
RMCA-97.086.M1	Okpoama	F	88.4
RMCA-98.017.M2	Okpoama	F	88.7
RMCA-98.017.M3	Okpoama	F	84.6
RMCA-98.017.M4	Okpoama	F	86.7
RMCA-98.049.M15	Okpoama	F	88.4
N = 8 X = 88.3 SD = 3.4			
Upland specimens			
RMCA-98.049.M6	Etiema	M	89.2
BMNH-1996.4	Ihuaba	M	86.7
RMCA-98.049.M1	Owelli Town	M	86.0
RMCA-98.049.M3	Onitu	M	87.7
RMCA-98.049.M5	Sapoba	F	87.5

Table 3. Measurements of the condylobasal length (in mm) of Genetta rubiginosa *from the Niger Delta. M: male; F: female; U: unknown*

a dark-coloured tip 75 to 150 mm long. There is not yet any evidence of a *poensis*-like form, such as found in Côte d'Ivoire by Hoppe-Dominik (1990).

The large-spotted genet comes from a wide variety of habitats: mangrove, tidal freshwater swamps, upland riverine swamps, and the relatively dry Ogoni-land. It appears to favour more open habitats and is rare in heavily forested areas except in riverine and tidal situations. Hunters in the mangrove and tidal freshwater zones report it to be abundant, and often refer to its habit of coming to ground at low tide to feed on crabs. The presence of genets in mangrove habitat is not generally recorded in the literature, even Rosevear (1947) did not mention them in his brief listing of mangrove mammals. The only record we can trace is the occurrence of *Genetta* sp., probably the large-spotted genet, in the mangroves of Gabon (European Communities, 1992). However, mangrove residents of the Niger delta consistently list the large-spotted genet as a common mangrove mammal (under the name *punu* or *ewere*) and rank it among the three most abundant species within the mangrove, along with the Mona monkey *Cercopithecus mona* (Schreber, 1774) and the Sitatunga *Tragelaphus spekii* Sclater, 1863.

The *poensis* form

Genetta poensis was described in 1832 by Waterhouse from Fernando Po (=Bioko, Equatorial Guinea) but the locality was doubted by Pocock (1907) and Rosevear (1974). The type specimen together with specimens from Ghana (64 km N. of Kumasi), Liberia (W. of the Upper Cavaly River), and Nigeria (Warri) are held in The Natural History Museum, London. A specimen from Côte d'Ivoire was mentioned and illustrated by Hoppe-Dominik (1990). Crawford-Cabral (1980-81) cites a specimen (Pousargues, 1896) from Mayumba (=Mayombe), Congo (B) in the Natural History Museum in Paris.

Rosevear (1974) provisionally treats *poensis* as a distinct species and Crawford-Cabral (1980-81) does not exclude the possibility that it is a distinct species but until further evidence considers it as a subspecies of *G. pardina*.

If *G. rubiginosa* and *G. pardina* are two distinct species and the latter is distributed only west of the Dahomey Gap (Volta River) then *poensis* cannot, due to its occurrence in Nigeria and Congo (B), be a subspecies of *G. pardina*. With only a few skins (and less skulls) available the problem must remain unsolved.

Acknowledgements

We are indebted to J. Hulselmans and J. Crawford M. Cabral for reading and commenting on the manuscript.

Abbreviations

BMNH	The Natural History Museum, London, UK
CA	Cameroon
F	Female
HVR	H. Van Rompaey Collection, Edegem, Belgium
M	Male
NDS	Non-deposited specimen and specimens seen but lost or not kept
NI	Nigeria
ON	Original number
SBP	Station Biologique Paimpont, Paimpont, France
RMCA	Royal Museum for Central Africa, Tervuren, Belgium
U	Unknown sex

Gazetteer

ASEINGBENE:	ca. 05°05'N, 06°19'E, on right (W) bank of Taylor Creek
AZAMA:	04°53'N, 05°59.5'E, on west (N) bank of Apoi Creek (Aziama on maps)
AZIKORO:	04°53'N, 06°17.5'E, 5 km SE of Yenagoa
BOMOUNDI:	04°59-'N, 06°16+'E, on right (W) bank of Nun River
BUNU-BANGHA:	04°42.5'N, 07°28.5'E, about 12 km ENE of Bori, and a few km W of Imo River
DIEBU:	04°37.5'N, 06°07.5'E
ELEBELE:	04°51.5'N, 06°20.5'E, on left bank of upper reach of Otuaka Creek, 11.5 km SE of Yenagoa
ETIEMA:	04°34'N, 06°22'E, 5 km NW of Nembe
FANGBE:	04°56'N, 06°15'E, on Ekole Creek, between Yenagoa and the Ekole/Nun confluence
GBARANTORU:	ca. 05°00'N, 06°15'E, on the E bank of River Nun, upstream side of Tombia
IGBETA-EWOAMA:	ca. 04°34'N, 06°21'E on the E bank of Opume Creek downstream of mouth of Etiama tributary and ca. 7 km NW of Nembe
IGOVIA:	04°58+'N, 06°29'E, on the S side of Orashi River and 6 km E of Okarki
IHUABA:	05°01.88'N, 06°40.71'E, on the right (W) bank of Sombreiro River
OBIOFU:	05°25'N, 06°29.08'E, on the E bank of the Niger River
ODI:	05°10'N, 06°15'E, on the W bank of the Nun River
ODIEKE:	ca. 05°01'N, 06°27'E on the left (E) bank of Orashi River, about 3 km S of Mbiama
OGBIA:	ca. 04°41'N, 06°21'E
OHOSU Forest Reserve:	06°45'N, 05°15'E

OKARKI:	04°59'N, 06°26'E, on the right (W) bank of the Orashi River, at the divergence of Kolo Creek from the Orashi.
OKOLOBIRI:	05°02'N, 06°19.5'E
OKOROBA:	04°37.86'N, 06°10.45'E, NE of Nembe
OKPOAMA:	ca. 04°18.5'N, 06°17.5'E, on Brass Island
OMOKU:	05°21'N, 06°39'E
ONITU:	05°04.5'N, 06°28.5'E, on the E bank of the Orashi River
OPUKUMA:	05°5.5'N, 06°17'E, on the E bank of the Nun River
OPUME:	04°40'N, 06°20'E, S of Ogbia
OPU-OGBOGOLO:	04°54.2'N, 06°33.9'E, on the W bank of Orashi River
OTUOPOTI:	ca. 04°51'N, 06°15.5'E on the left (E) bank of Ekole Creek, 8 km S of Yenagoa (also OTUOKPOTI)
OWELLI Town:	ca. 06°11'N, 07°28'E
PORT HARCOURT:	04°43'N, 07°10'E
SAPOBA:	ca. 06°06'N, 05°53'E
SWALI:	04°54'N, 06°15'E
TAABAA:	04°44'N, 07°25'E, 8 km NE of Bori (also TABAANGH)
TOMBIA-EKPETIAMA:	05°00'N, 06°15'E, on the E bank of the Nun River, between Yenagoa and Taylor Creek entrance
TUNGBO:	05°07.4'N, 06°10.2'E, on the E bank of Sagbama Creek, 4 km SW of Sagbama/ Forcados confluence, 10.5 km SSW of Patani Bridge
YAE:	04°45+'N, 07°28.5'E, at headwaters of Masea Stream on the right (W) side of lower Imo river
YENAGOA:	04°55.3'N, 06°15.5'E, at junction of Ekole and Epie Creeks

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Obituary: C. B. Powell

Charles Bruce Powell, who died at 55 years of age on the 24th of June 1998, spent much of his life pioneering research into the ecology and biodiversity of the Niger Delta. Born on the 18th of July 1943, Bruce grew up in Moncton, New Brunswick, Canada. At early age, he developed an interest in animals when at the age of 10 a snake in his garden bit his finger and refused to let go! As a child he collected and raised all sorts of animals including birds, bats, field mice, chameleons, and a six-foot snake which the family had to feed with ground beef!

From 1962 to 1965, he attended the Acadia University where he obtained a Biology Honours Degree. He then went to the University of Alberta in Calgary where he obtained his MSc in Ecology. It would seem that it was during his stay at university that he developed an interest in the biology of shrimps, crabs, fish and amphibians. During his period as a student, he spent three long vacations with the Museum of Canada as a student research assistant carrying out a herpetological survey of Western Canada. It was through the museum that he met Rob Oldham who persuaded Bruce to travel to the University of Ibadan in Nigeria to begin a PhD on a West African frog *Bufo regularis*. Bruce agreed to go and this was a decision that was to change the course of his life.

He arrived in Ibadan in 1967 and began his PhD work on *Bufo regularis* but was never to finish his work as he became side-tracked by other areas of research that he felt were far more interesting. In 1973, he was transferred to the University of Benin where he was a lecturer for three years. During his years at Ibadan and Benin he never finished his thesis and produced numerous articles on shrimp biology, most of which have not been published to this day.

From Benin, Bruce went on to the University of Port Harcourt to become a Senior Lecturer. Later on, in 1982 he was invited by the new Rivers State University of Science and Technology to help found the Institute of Pollution Studies. At both these Universities located in Port Harcourt, he taught Systematics, Invertebrate biology, Fisheries, Freshwater and Estuarine Ecology. He was said to be an extremely conscientious lecturer who was highly respected by his students.

Besides lecturing, Bruce was able to spend a considerable amount of his time on research into the biology of the Niger Delta and it was in this area that he really seemed to flourish. The Niger Delta is a vast area of mangroves, freshwater forests and coastal areas with thick forests and innumerable creeks that change course from year to year. It is also an area of West Africa that had scarcely been studied by any biologists being riverine and rather inhospitable for travelling plant and animal collectors and indeed was practically ignored by biologists until Bruce began working there.

Bruce had a friend called Kay Williamson who was putting together a dictionary of one of the local languages; she kept coming across words for which people said "some kind of animal". Kay asked Bruce to accompany her on her field trips so that he could identify the animal in question whenever a new name came up. He discovered that the local people had names for plants and animals that had been unrecorded in the Delta or even Nigeria. This was how he made the exciting discovery of the Niger Delta red colobus monkey which has been confirmed as a subspecies new to science.

Bruce began to branch out from amphibians, shrimps and crabs to become particularly interested in mammals as well and he began to collect specimens and skins to send to museums all over the world. His house became notorious for the animal skins everywhere that covered just about every available surface! Many stories circulated around Port Harcourt about this house full of skins for "Juju" (native medicine). Many people refused to enter his house and those who did got told off if they touched any of the skins that were possibly very valuable to science!

The Niger Delta is the main oil producing area of Nigeria and is now rapidly being developed with devastating consequences for its unique wildlife. Local people accuse the oil companies of pollution and destruction to their forests and fisheries, which affects their livelihoods. Environmental issues have become very explosive and many of the environmental NGOs who championed the cause of the local people, came to Bruce for evidence to support their claims against the oil companies. Bruce being acutely aware of how fast the Niger Delta was being degraded in places and feeling strongly about the injustice to local people, assisted key NGOs mainly by ensuring that the publicity they generated was accurate rather than being pure propaganda.

On one occasion, two environmental activists running away from the state security police came to Bruce for protection. They hid in his house for several days and then left the country. Bruce insisted in seeing them off against their advice and was later thrown into jail for three days by the state security agents. However, when they went to his house to search for evidence of seditious activity, they saw all the animal skins, decided against a search and released Bruce!

For the rest of his life that he was to spend in the Niger Delta, Bruce was involved in many activities. He began to publish many articles on shrimp and the ecology of the Niger Delta. He also carried out many ecological studies on the activities of the oil companies and the effects of oil pollution on the ecology of the mangrove forests. In the last years of his life, he was seconded by RSUST to work with the newly set up Niger Delta Environmental Survey (NDES) where he set up and guided their scientific research.

As a result of his scientific work, far more is known about the Delta now than even 10 years ago. His work on the ecology of the Delta has resulted in some very exciting discoveries. These include many new species of mammals, plants, and fish and a new vegetation classification system that has important implications for the future management of the Delta. These discoveries have elevated the importance of the Niger Delta globally as well as within Nigeria.

Even though Bruce was able to document a great deal of new knowledge about the Delta, he was always conscious of the great body of knowledge within the local people which was still largely untapped, and how much still remained to be known about the Delta scientifically. Bruce spent a great deal of time in communities in the Delta over the years developing trust with local rulers, hunters and various village groups gradually drawing out the extensive knowledge local people have of the Delta. They were only too happy to talk to someone who was prepared to listen and as a result he was able to develop much of the current scientific knowledge of the Delta. Bruce will be missed by many people in the Delta ranging from university lecturers, students and environmentalists to oil workers and people in many of the villages.

Some colleagues of his in Nigeria wrote:
"The longer we live here, the more we respect people like you who stuck it out a long time, at great personal cost. It's an inspiration to people like us and, more importantly, to young Nigerian scientists. We regret we didn't see you more but you know how weird animal people get stuck in little ratholes of existence, work, writing, exasperation, etc.
Thanks for bringing attention to the Niger Delta with your still-astounding confirmation of the red colobus monkey's occurrence. Maybe things are screwed up, and not the way you might like to see them, but you got the ball rolling and hopefully it will be straightened out and there will be something there in 100 years for scientists to appreciate and study. The world has you to thank for getting the ball rolling, and everyone who matters knows it, whether they're willing to admit it or not. Few people are a legend in their own time, but count yourself amongst them."

Another one wrote:
"What I liked and admired about Bruce was that he lived his life on his terms and as he wanted. There really was not an inch of side to him. Because even when he was being the grumpy old bastard he seemed to be at times he was just winding you up to drop all your own pretences and pretensions. It's a lesson to us to live our lives and not waste them. His name is going to be around for quite awhile yet I suspect."

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Notes on the diet of four species of viverrid in a limited area of southern Namaqualand, Northern Cape, South Africa

Chris and Tilde STUART

Random sampling of carnivore scats was carried out on the farm « Sewefontein » (3119CA) on the western escarpment of Northern Cape Province, South Africa. The area lies at approximately 700 m ASL and falls within a winter rainfall regime. The vegetation lies within a transition zone, with elements of both 'fynbos' (Cape macchia) and 'karroid scrub' being dominant. Much of the vegetation ranged from 30 cm to 80 cm in height, with taller bushes and small trees along the water courses, and there were extensive areas in the valley bottom cleared for the cultivation of grain and lupins. The fringing ridges had extensive areas of bare, deeply incised rock.

Of the twelve carnivore species known to occur in the study area, five were viverrids but one of which was only an occasional visitor from the neighbouring plains, *Suricata suricatta* and no scats were collected.

As will be observed from the tables not all months are represented. This is the result of the authors being absent from the study area and not a reflection on the presence or absence of the carnivores on the farm during those periods. Very little has been recorded on the diet of carnivores in this region (see Stuart, 1981 ; Skinner & Smithers, 1990) and although the following notes are not complete or comprehensive we felt them still worth committing to paper.

***Atilax paludinosus* Marsh mongoose**

Observations over a period of six years indicated that at least three individual *Atilax* occupied the study area. These are solitary and nocturnal foragers, with scats being deposited in small middens within the home range or scattered at random along pathways. This large mongoose took a wide range of invertebrate prey, with coleopterans and crustaceans (freshwater crabs) being of particular importance. Amphibian prey was dominated by two species (the most common in the valley), *Xenopus laevis* and *Rana angolensis*. The single tortoise record was of a hatchling *Chersine angulata*. The four lizards recorded (three in January and one in December) were all skinks (*Mabuya* probably *capensis*). Most bird remains were of small unidentified passerines but two samples taken in January included the feathers of *Francolinus capensis*. This latter was abundant in the study area. Although no effort was made to identify rodents to species level if only hair was present, in several cases teeth and bones allowed us to make identifications by comparison with reference material. *Otomys irroratus* and *O. unisulcatus* were present in the January, July and November samples, and the single record for May was of *Rhabdomys pumilio*. The single shrew in the July sample was identified as *Crocidura cyaneae*. In the case of the lagomorphs, all were *Lepus saxatilis*. Of particular interest was the presence of the remains of two small carnivores in the November sample, namely *Cynictis penicillata* and *Galerella pulverulenta*. Given its larger size, *Atilax* is easily capable of overpowering these two carnivores but it is possible that they had been scavenged, particularly as both are diurnal species, whereas the marsh mongoose is almost exclusively nocturnal. The same may apply to the single hyrax (*Procavia capensis*) record for January. The occurrence of sheep wool in three of the January samples and two of those from December almost certainly indicates scavenging from dead animals. *Atilax* tracks were observed around sheep and cattle carcasses in the district on several occasions, and we surmise that the principle attractions were fly maggots and various species of beetle.

***Galerella pulverulenta* Cape grey mongoose**

During the course of a low-key live trapping programme nine individual *Galerella* were captured and marked within the study area, probably a fairly true reflection of the population size. This is a diurnal and solitary forager, and scats are deposited at random within the home range. Insect remains made up a major part of the scats analysed in these samples, with coleopterans and termites (mainly *Hodotermes*) making up by far the majority. Lizards were sampled in all months except July, with the majority being skinks (*Mabuya*-probably *capensis*) but *Pedioplanis* sp., *Cordylus cataphractus* and *Pseudocordylus* sp. were also recorded. None of the snakes were identified to species level but the tortoise scales in a September scat were of *Homopus signatus* and those in October were from a juvenile *Chersine angulata*. Rodent occurrences were lower than expected, with *Otomys unisulcatus* and *Aethomys namaquensis* remains dominating. The single *Hystrix africaeaustralis* occurrence in May almost certainly indicates a case of scavenging as this small carnivore would not attack a porcupine under normal circumstances. Both leporid records from May were of *Lepus saxatilis*. The single elephant shrew recorded in May was *Elephantulus edwardii*, one of two species occurring in the study area. Both the common duiker (*Sylvicapra grimmia*) and sheep remains are almost certainly a result of scavenging.

***Cynictis penicillata* Yellow mongoose**

Although these mongooses are colonial burrowers (approximately eight individuals in two warrens were present in the study area) they are solitary, diurnal foragers. Scats are deposited at middens within close proximity to the warren. Invertebrates, mainly coleopterans, *Hodotermes* sp., orthopterans, scorpions and solifugids, were obviously of major importance in this species diet. From August to December lizards featured strongly in the scat samples with skinks (*Mabuya*-probably *capensis* and *variegata*) making up approximately half of the total, with *Cordylus cataphractus* and *Pedioplanis* sp. also being present. Of the eight snake records only two were identified, as *Leptotyphlops* sp. The single tortoise record, from the September sample, was a juvenile *Chersine angulata*. Birds were of considerable importance from September to December, particularly October (remains in more than half of sample) and November (slightly less than half of scats) and this coincides closely with the breeding season of many bird species in the area. Most bird remains (feathers, feet and claws) were of small passerines and included fledglings, but in several samples bird egg-shell fragments were identified. No attempt was made to identify birds to species level. Rodents were of frequent occurrence in the samples, with *Otomys unisulcatus* remains dominating. The two lagomorph records (October and November) were of leverets (teeth in scats, as well as hair and claws) and although *Lepus*, they could have been *capensis* or *saxatilis*. The presence of sheep wool in a number of

Table 1:
Atilax paludinosus Occurrence of prey items in monthly scat samples

Food item	January	May	July	August	October	November	December
Insects:							
Coleoptera	32	3	3	1	0	9	3
Hodotermes	4	0	0	0	0	3	2
Formicidae	13	0	0	0	0	4	1
Orthoptera	11	0	0	0	0	1	0
Dragonfly nymphs	3	1	0	0	0	0	2
Unid.insect fragments	2	0	1	0	0	0	1
Other invertebrates:							
Scorpions	1	0	0	0	1	0	1
Crabs	23	4	5	1	0	6	2
Reptiles:							
Lizards	3	0	0	0	0	0	1
Snakes	2	0	0	0	1	3	0
Tortoise	1	0	0	0	0	0	0
Amphibians:	29	4	5	1	0	6	4
Birds:	15	0	0	0	1	4	0
Mammals:							
Rodents	13	1	5	0	1	5	0
Lagomorphs	3	0	0	0	0	0	1
Shrew	0	0	1	0	0	0	0
Carnivores	0	0	0	0	0	2	0
Hyrax	1	0	0	0	0	0	0
Sheep	3	0	0	0	0	0	2
Vegetation:							
Grass	10	1	3	1	1	3	3
Scat totals	33	4	5	1	1	9	4

Table 2:
Galerella pulverulenta Occurrence of prey items in monthly scat samples

Food item	January	May	June	July	August	Sept	October	November	December
Insects:									
Coleoptera	3	23	3	2	7	1	3	14	0
Hodo-&Trinoverternes	1	19	3	1	7	2	1	12	13
Formicidae	1	13	1	0	0	2	2	2	6
Orthoptera	0	9	0	0	1	0	2	7	9
Unid.insectfragments	0	8	2	1	4	3	5	3	7
Other invertebrates:									
Scorpions	1	2	1	0	0	1	2	3	6
Solifugidae	0	1	0	0	0	0	1	1	3
Myriopoda	1	3	0	0	0	2	1	5	
Reptiles:									
Lizards	2	4	1	0	3	1	2	1	4
Snakes	0	1	0	0	0	1	1	1	0
Tortoise	0	0	0	0	0	1	1	0	0
Amphibians:	0	0	0	0	0	1	0	0	0
Birds:	0	1	0	0	1	0	0	0	3
Mammals:									
Rodents	3	10	0	0	2	1	2	9	8
Lagomorphs	0	2	0	0	0	0	0	0	0
Elephantshrew	0	1	0	0	0	0	0	0	0
Hyrax	0	0	0	0	0	0	0	0	1
Common duiker	0	0	0	0	1	0	0	0	0
Sheep	0	1	0	0	1	0	0	0	0
Vegetation:									
Grass	0	2	0	0	0	1	2	2	0
Seeds	0	3	0	0	0	0	0	1	2
Scat totals	3	35	3	2	10	4	5	20	22

Table 3:
Cynictis penicillata Occurence of prey items in monthly scat samples

Food item	June	July	August	September	October	November	December
Insects:							
Coleoptera	Present	10	21	62	40	77	65
Hodotermes	Present	11	23	62	37	85	82
Formicidae	Present	None	None	9	5	10	1
Orthoptera	Present	None	None	17	43	80	70
Lepidoptera	None	None	None	None	3	None	None
Unid.insect fragments	Present	1	None	10	7	14	12
Other invertebrates:							
Scorpions	Present	3	6	41	32	41	39
Solifugidae	0	1	0	9	11	26	13
Myriopoda	Present	0	0	12	5	6	6
Reptiles:							
Lizards	Present	0	4	19	11	13	17
Snakes	0	0	0	2	0	4	2
Tortoise	0	0	0	1	0	0	0
Mammals:							
Rodent	Present	8	11	42	14	24	20
Lagomorphs	0	0	0	0	1	1	0
Sheep	0	0	0	3	1	3	2
Common duiker	0	0	0	0	0	1	0
Scat totals:	Mixed	12	27	62	44	99	91

Table 4:
Genetta genetta
Occurence of prey items in monthly scat samples

Food item	January	May	June	July	August	November	December
Insects:							
Coleoptera	1	Present	3	1	11	1	4
Hodotermes	1	Present	0	0	0	0	0
Formicidae	0	0	0	0	0	0	1
Orthoptera	0	0	0	0	0	2	6
Unid. insect fragments	0	0	1	0	0	0	0
Other invertebrates:							
Scorpions	0	Present	0	0	2	1	4
Solifugidae	0	Present	0	0	1	0	1
Myriopoda	1	Present	0	0	0	0	0
Reptiles:							
Lizards	0	Present	0	0	6	1	0
Snakes	1	0	0	0	0	0	2
Birds:	0	Present	0	0	2	1	2
Mammals:							
Rodent	1	Present	1	1	11	3	6
Lagomorphs	0	Present	0	0	0	0	0
Vegetation:							
Grass	0	Present	0	0	5	0	3
Seed	0	Present	0	0	1	0	4
Scat totals	1	ca.24	3	1	11	3	9

samples, and common duiker (*Sylvicapra grimmia*) hair in one November scat almost certainly indicates scavenging.

Genetta genetta Common genet

A solitary, nocturnal hunter with perhaps two to four individuals being present in the study area. Scats may be deposited on small middens or at random along pathways within the home range. Although only small samples were collected and analysed, it is clear that invertebrates and in particular coleopterans were of particular importance. Lizards were significant in the August sample, of which four were identified as skinks (*Mabuya* sp.) and two as legless lizards (*Acontias meleagris*). Rodent remains occurred in all monthly samples, with *Otomys unisulcatus* making up the majority of identifications, with one record of *Rhabdomys pumilio*. This was the only viverrid that seemed to be deliberately feeding on wild fruits, with the seeds of wild olive (*Olea europaea* subsp. *africana*) and 'skilpadbessie' (*Nylandtia spinosa*) being identified. Both fruits have large seeds with a fruit-coating, and are eaten in large quantities by a canid, *Otocyon megalotis*, occurring within the study area, as well as several frugivorous bird species.

General comment

Although the four viverrid species occurring in the study area have a generally similar diet, *Atilax paludinosus* is the only one to feed on quantities of freshwater crabs and frogs. *Atilax* and *Genetta genetta* are strictly nocturnal hunters, with *Cynictis penicillata* and *Galerella pulverulenta* being diurnally active. The latter two mongooses are largely separated by their favoured habitats, the former showing a strong preference for more open terrain with sparse vegetation cover (offered in the form of open agricultural land in the study area) and *Galerella* rarely venturing far from rock cover. Although far from comprehensive this brief study gives a first insight into the diet of four common viverrids occurring on the western escarpment of South Africa.

Acknowledgement

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Red panda in Darjeeling at Singalila National Park and adjoining forest : A status report

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Abstract

The Darjeeling area is very rich in biodiversity. The unexplored tracts of east Himalayan moist temperate forest give shelter to a large variety of flora and fauna. The Singalila National Park (28.6 km^2) of Darjeeling, situated at altitudes between 2,000 and 3,600 m, is typical red panda habitat. This cool, humid region consists of birch, hemlock, rhododendron, magnolia, and oak, whilst 80 or 90 species of mammals and more than 500 species of birds are found in the area. Hunting, trapping, habitat fragmentation and disturbance have resulted in a sharp reduction in the red panda population in the wild. A survey was conducted which indicated that there may be no more than 26 red pandas in the Singalila NP and its adjoining areas. This substantiates the need for further assessment and efforts for the maintenance of a viable population of the red panda through *in* and *ex situ* measures.

Introduction

The red panda is the monotypic member of family Ailuridae. As a carnivore, adapted to a diet of bamboo, the red panda occupies a highly specialised niche. The geographical range of the nominate form of the red panda, *Ailurus fulgens fulgens*, extends from eastern Nepal through west Bengal, Sikkim, Arunachal Pradesh, Bhutan, and into China. It ranges at altitudes of 1,500-4,000 m ASL(Catton, 1990 ; Prater, 1988) sharing its habitat with the snow leopard and the tiger. Throughout its range the red panda is believed to be endangered (IUCN, 1996). In recent years hunting, trapping, habitat fragmentation and disturbance have resulted in a sharp decline in the red panda population in the wild (Glatston, 1994).

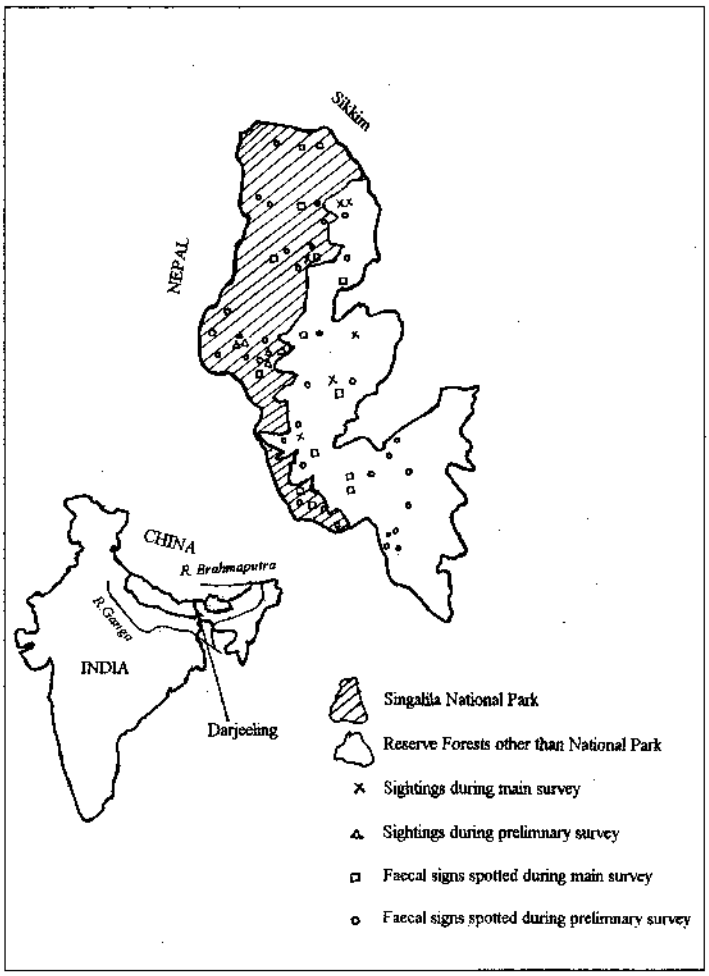
Threats to red pandas and red panda habitat in the Darjeeling area are (Anon., undated) :

- Fire : fire has swept large areas of the park in the past. Outbreaks of fire in the late 19th and early 20th century caused considerable damage to the forests resulting in the extermination of the Silver fir (*Abies densa*) and some other trees.
- Grazing : concessions were given to the Khasmahal tenants to allow grazing above 2,550 m ASL. This has reduced the undergrowth and caused considerable damage to the flora. In addition, branches are cut for firewood.
- Landslips : the area is prone to landslips which are facilitated by forest destruction, overgrazing, unterraced cultivation, poor drainage provision and the excavation of pits or quarries.
- Hunting : there has been large scale hunting in the past to supply zoological collections, trade having increased in the 1960s after the creation of Darjeeling Zoo. Trade was reduced after the Wildlife (Protection) Act was passed in 1972. When the Act was made more enforceable in the 1980s there was a sharp decrease in trade although some illegal hunting probably still occurs (Walker, 1990).

Methods

The survey area

The survey was conducted in the Singalila NP and the adjoining forest, an area of 174.88 km^2 (78.6 km^2 park and 96.28 km^2 continuous forest). The park lies in the eastern part of the Great Himalayan Range on the border of Nepal, west Bengal and Sikkim. It lies between 27°13' and 27°14'N and between 88°01' and 88°07'E. The altitude ranges between 1,500-3,600 m. The terrain is varied. The park has temperate and sub-alpine climates. In temperate areas the mean summer temperatures range as high as 17°C, in winter as low as –1°C. In the sub-alpine zone the temperatures are lower. The annual rainfall in the area is up to 330 cm in some areas, with maximum rainfall occurring in the period June to August. Humidity is very high throughout the year (average 83-96%). There is regular snowfall above 3,300 m altitude.



Singalila N.P. and its adjoining areas in Darjeeling, India

The vegetation can be grouped as follows : (1) Upper hill forests : broad leafed forest of oaks, maples, magnolias, etc., and some maling bamboo (2) Mixed coniferous forests : oaks, hemlocks, firs, and rhododendrons. This area is invaded by pure bamboo brakes consisting of one or more species of Arundinaria, viz. *A. aristata, A. maling*, etc. (3) Sub-alpine forests : birch, fir and rhododendron, with areas of aristata and maling bamboo.

In addition to the red panda (*Ailurus fulgens fulgens*), the park area has 80-90 recorded species of mammals, 50-60 species of fish, 5-6 species of leeches, 35-40 species of amphibians, 500-550 species of birds and at least 76 species of snakes (Dhaundyal, 1988).

Preliminary survey

A preliminary survey was conducted over a three month period to estimate the occurrence of red pandas in the area. This survey was conducted with the help of forest staff. These people generally have a good knowledge of the red panda but to ensure this they were given extra training in the zoo. During the survey period all sightings and signs of red pandas were recorded on a daily basis. To facilitate recording all participants in the survey were furnished with a form on which they recorded age, sex, and other details (vegetation, etc.). They were asked to send the report back immediately. In case of a direct sighting, they were asked to radio the information back. Faeces were collected and sent back for identification.

Main survey

The survey area was divided into thirteen blocks. Care was taken to exclude snow covered areas except for those in which the preliminary survey had indicated that red pandas were present. The high ridges below the snow line were included in the survey but the blocks were larger. Lower altitudes, where the animal has never been reported, were excluded from the survey. The total area of potential red panda habitat surveyed was 100.26 km^2. Each block was surveyed by 2-5 persons under the leadership of an officer of the Forest Department. The team leaders were asked to ensure that their teams covered a distance of 20 km on the survey day. The teams were asked to survey from higher to lower altitude, with team members walking in parallel transects to cover the maximum possible area. Areas of probable habitat were observed more intently in order to increase the chance of sighting the animal. The date chosen for the survey was 4th March. Surveys attempted earlier in the year would have been impossible due to snow cover, whilst the results of a survey later in the year would have been distorted by the nesting behaviour of pregnant females (Pradhan *et al.*, 1994).

Results

Preliminary survey

The reports were compiled and plotted on a map to assess the distribution on sightings. During compilation it was found that three pandas were sighted at the same place on one occasion. This could have been a mother with young. On other occasions only single animals were reported. The observations of the foresters were also taken into account. Reports by local people that the animals shifted at lower elevation during winter, were also considered. This cannot be overruled because wild animals tend to migrate to lower altitudes because the supply of food becomes restricted in snowbound areas. Still, a few animals may continue to stay there, while the overall population moves towards lower altitudes.

Main survey

In typical red panda habitat, an animal can be sighted up to a distance of 15 m. This means that an observer on a transect covered a strip 30 m wide. Thus, for a team of three members, the area covered will be at least 90 m wide. This means that, for each 20 km traversed, an area of 20 x 0.9 = 1.8 km^2 was covered. The total area covered by the 13 teams according to this calculation was 23.4 km^2 (1.8 x 13). During the survey the teams sighted 6 pandas. This means that in an area of 23.4 km^2 there were six animals which gives a density of one panda per 3.9 km^2 (23.4/6). This is a little lower than Yonzon's estimate of one panda per 2.9 km^2 in Nepal. At this density the number of pandas in the whole area surveyed can be estimated at around 26 animals (100.26/3.9).

Discussion

The red panda inhabits relatively inaccessible and hilly terrain. It is arboreal and crepuscular or nocturnal; it is therefore highly likely that some animals were missed by the survey. Furthermore, the survey was conducted in areas with the highest possibility of finding pandas, but poor forest patches within these areas were also included. In addition, as some areas of the park are subject to human disturbance, panda density is probably lower here. This means that the density of red pandas over the whole area may be lower than presented above.

Conclusion

As mentioned above, the red panda is fully protected in India and has been placed in Schedule-I of the Wildlife (Protection) Act. Prior to that, the red panda population suffered a lot with a large number of specimens collected for zoos, etc. -it is estimated that hundreds of animals were captured in the 1960s (Bahuguna, 1995). Information received indicates at least 500 animals were traded in the 1960s, and this figure excludes animals dying during trapping or transit. Even if 40% of these animals originated from across the Nepal border, at least 300 red panda were trapped in the Singalila area. This gives an estimated capture rate of at least 30 animals per year. To support a harvest rate of this magnitude the breeding population in the area must have been at least 50 pairs. This is four times as many red pandas as are estimated living in the park today.

The population of red pandas in the Singalila area is not only substantially smaller than in former times, its small size also puts it at risk of loss of genetic diversity through inbreeding. It is therefore of prime importance that we utilise both *ex situ* and *in situ* measures to preserve the red panda for the future (Bahugna, 1993; Glatston, 1994).

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Seeds on the roundabout – tropical forest regeneration by *Genetta rubiginosa*

Thomas R. ENGEL

Introduction

The maintenance of tropical forest biocoenoses depends, among other factors, on the dispersal of seeds by animals, and frugivory occurs even among carnivores (Carnivora; e.g. Ulbrich, 1928 [p. 91]; Janzen, 1983; Herrera 1989; Pendje, 1994; Knight, 1995; Traveset, 1995; Clevenger, 1996). The large-spotted Rusty-spotted genet *Genetta rubiginosa* Pucheran, 1855 (sensu Crawford-Cabral & Pacheco, 1989 (1992); see Engel, 1998) seems basically considered as carnivorous and insectivorous (compare e.g. Ingles, 1965; Rowe & Rowe, 1978; Ikeda et al., 1982; Haltenorth & Diller, 1988; Dorst & Dandelot, 1990; Skinner & Smithers, 1990; Estes, 1991; Apps, 1992; Walker, 1992; note at least the priority of animal food for all listings) or omnivorous (Bearder, 1972). Nevertheless, according to these sources, genets seem also frugivorous (though usually to a minor degree) and thus can support plants in their seed dispersal and rejuvenation.

During a study on natural forest regeneration and comparative seed dispersal, huge accumulations of seeds and other food remains were found at two latrine sites exclusively used by genets (compare Fig. 1; see also Engel, 1998).

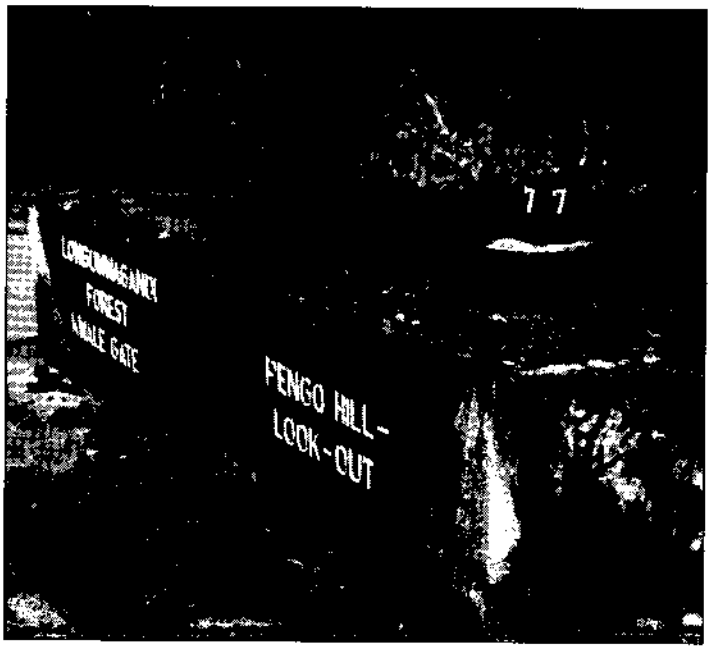

Fig. 1. Latrine full of seeds on a roundabout before the study.

This paper examines the role of genets in plant rejuvenation in an East African species-rich tropical mixed forest-bushland-grassland biocoenosis, describes endozoochory, and gives new information about fruit diet spectra in particular and latrine use in general. Detailed information will be given about the availability of fruit food (*from the view of the genets*) and the phenology of seed dispersal by genets (*from the view of plants*), numbers of diaspores per defecation and of (diaspore) species per defecation, and the type, condition and viability of dispersed seeds. Food preferences and gut passage times were achieved by feeding experiments. Parts of their biology, but in particular the synecological role of genets for the maintenance of the biocoenosis will be discussed.

Material and methods

Investigations were carried out in the Shimba Hills National Reserve (coastal Kenya). Details on the data source were already described (see Engel, 1998). 514 fecal samples were collected within a period of 31 months (Fig. 2) from a concrete roundabout (Fig. 1) and from a concrete floor inside Pengo Hill Lookout building. Lacking proper records for June 1994 for the two main genet latrines (see Engel, 1998), one genet defecation analysis from another roundabout was included to avoid a lack of phenological information. In total, 519 defecations were analysed, whereby four originated from trapped animals. 499 defecations were analysed qualitatively and 20 fresh undisturbed droppings were analysed also quantitatively. Part of the material was documented in slides and/or kept for identification.

Table 1. Occurrence of various food items (presence/absence data type) in 515 *G. rubiginosa* defecations during 31 months at two exclusively genet latrines and in four defecations of trapped genets. Many defecations had mixed contents.

Food item	Occurrence	
Details	Actual	Relative %
Diaspores (excl. exocarp only):	383	**73.8**
Intact seeds	382	73.6
Open fruit (with intact diaspore[s] inside)	1	0.2
Chewed seeds (only together with intact seeds)	1	0.2
Seeds with other defects than chewed	0	0
Still closed, unchewed fruits	0	0
Arthropoda (grasshopper, millipede, ant or termite, etc.):	427	**82.3**
Few remains, one individual (only crab shell and leg)	1	0.3*
Few remains, one species (more than one individual)	14	3.7*
Few remains, several species	83	21.9*
Less than half of fecal content, one species	12	3.1*
Less than half of fecal content, several species	113	29.8*
Main fecal content, several species	89	23.5*
Other food remains:	229	**44.1**
Small mammals (c.f. murids; hairs, bones, teeth, claws)	164	31.6
Reptile (skins, scales, bones)	5	0.9
Bird (feather, etc.)	1	0.2
Snail shell	1	0.2
Green grass leaves	71	13.7
Other plant parts (dicotyledonous leaves)	2	0.4

* for 115 of 519 defecations (of 427 with arthropods respectively) arthropods (all insects) were recorded without further classification; thus percentages of the detailed classifications of arthropod occurrence were based on 379 investigations only (= 100 %; including 17.7 % without arthropods)

Table 2. Monthly and annual phenology of fruit utilization (*'genet's view'*), seed dispersal (*'plant's view'*) respectively, as recorded at two genet latrines.

Details are given for the fruit (fs) and seed (ss) size (estimated length by width in *mm*), for the consumption of fruits also by humans (ed), for the average number of seeds per defecation (ans, frequency class 1 = 1 - 5 seeds, 2 = 6 - 30, 3 = more than 30), and for the annual and total number of defecations with diaspores of these plant species. The most favoured species are highlighted according to the frequency of utilization/dispersal; (? = unknown).

month	plant (diaspore) species	plant family	fs	ss	ed	ans	93	94	95	total
Jan	Annonaceae type D+	Annonaceae	?	8x5	?	1	-	1		1
	Bridelia micrantha	Euphorbiaceae	9x6	7x4	x	3	-	10	1	11
	Canthium type LONG+	Rubiaceae	?	10x3	x	1	-	1		1
	Keetia venosa	Rubiaceae	8x8	6x6	x	3	-	14	12	26
	Keetia zanzibarica	Rubiaceae	12x9	9x6	x	3	-	5	9	14
	Rytigynia type BIG+	Rubiaceae	?	14x7	x	?	-	1		1
	Rytigynia microphylla	Rubiaceae	9x9	7x4	x	?	-	1		1
Feb	***Keetia venosa***	*for all empty cells: see above!*				3	-	8	39	47
	Keetia zanzibarica					3	-		9	9
	Manilkara cf *sansibarensis*	Sapotaceae	?	10x5	x[1]	1	-		1	1
Mar	*Ficus* sp	Moraceae	?	1x1	?	3	-	1		1
	cf *Hirtella zanzibarica*	Rosaceae	20x10	?	x	1	-		1	1
	Keetia venosa					3	-	11	2	13
	Keetia zanzibarica					3	-	4		4
	Manilkara* cf *sansibarensis					3	-	35	31	66
	Polysphaeria parvifolia	Rubiaceae	9x7	5x5	x	1	-		1	1
	Tricalysia microphylla	Rubiaceae	8x6	4x3	-[2]	1	-		1	1
Apr	*Landolphia* sp	Apocynaceae	40x40	16x8	x	1	-		1	1
	Manilkara* cf *sansibarensis					2	-	13	1	14
	Zanha golungensis	Sapindaceae	25x15	20x10	-	1	-		1	1
May	*Landolphia* sp					1	-		1	1
	Manilkara cf *sansibarensis*					2	-	4		4
Jun	BBBQ+	unidentified	?	?	?	1		1[7]		1
	Bridelia micrantha					3	3		11	14
	GGGE+ (exocarp only)	unidentified	?	?	?	-			1	1
	Manilkara cf *sansibarensis*					2			1	1
	Olea woodiana	Oleaceae	9x5	6x3	-	2		1[7]		1
Jul	*Bridelia micrantha*					3	1		7	8
	Gonatopus boivinii	Araceae	9x6	4x3	-	2		1		1
	Keetia zanzibarica					1		1		1
	Rytigynia microphylla					3		2		2
	Rytigynia type D+	Rubiaceae	?	9x5	x	3		6		6
Aug	***Bridelia micrantha***					3	2	1	12	15
	Diospyros squarrosa[5]	Ebenaceae	?	9x5	-	1	1[5]			1
	cf *Hirtella zanzibarica*[5]					1	1[5]			1
	Keetia venosa[5]					1	2[5]			2
	Keetia zanzibarica					2	2			2
	Olea woodiana					3	1			1
	Rytigynia type BIG+,[5]					?	1[5]			1
	Rytigynia microphylla					3	5	5	7	17
	Rytigynia sp	Rubiaceae	?	?	x	3		1	2	3
	***Rytigynia* type D+**					3	14	6	6	26
	Vismia orientalis	Guttiferae	6x6	4x1	-[3]	?			1	1

month	plant (diaspore) species	plant family	fs	ss	ed	ans	93	94	95	total
Sep	*Bridelia micrantha*					3			3	3
	Canthium mombazense	Rubiaceae	9x7	6x3	x	2	1			1
	EAAO[+]	unidentified	?	8x4	?	?	1			1
	Rytigynia microphylla					3	3		10	13
	Rytigynia type D[+]					3	2		6	8
	Vismia orientalis					?	1	1		2
Oct	*Allophylus pervillei*	Sapindaceae	6x6	3x4	x	1		1		1
	Bridelia micrantha					3			1	1
	Croton sylvaticus	Euphorbiaceae	9x9	7x6	-	1		1		1
	EAAO[+]					3	7	2	4	13
	GGGA[+]	unidentified	?	?	?	?	2			2
	GGGF[+]	unidentified	?	5x2	?	1			1	1
	Grewia hexamita	Tiliaceae	7x7	6x6	x[4]	3		2	2	4
	Manilkara cf *sansibarensis*					1	1			1
	Olea woodiana					3	4			4
	Psychotria amboniana	Rubiaceae	7x6	4x3	x	3		2		2
	Rytigynia type BIG[+]					?	1			1
	Rytigynia microphylla					1			1	1
	Rytigynia sp	Rubiaceae	?	?	x	3	3			3
	Rytigynia type E[+]	Rubiaceae	?	7x4	x	1		1		1
	Toddalia asiatica	Rutaceae	9x6	3x2	x	3	2		4	6
Nov	BBBV[+]	unidentified	?	6x4	?	1			1	1
	Bridelia micrantha					3		1		1
	Canthium type LONG[+]					2			1	1
	EAAO[+]					2		1	2	3
	Flueggea virosa[6]	Euphorbiaceae	5x5	2x1	-	3		1		1
	GGGC[+]	unidentified	?	?	?	?		1		1
	Grewia hexamita					3		1	1	2
	Keetia zanzibarica					3		5		5
	Polysphaeria parvifolia					2		1		1
	Toddalia asiatica					2		1	5	6
Dec	*Artocarpus heterophyllus**	Moraceae	big	big**	x	-		1		1
	Bridelia micrantha					3	2	8	2	12
	Canthium type LONG[+]					1		1		1
	*Carica papaya**	Caricaceae	big	4x3	x	2		2		2
	Keetia zanzibarica					3		14	2	16
	*Mangifera indica**	Anacardiaceae	big	big**	x	-		1		1
	Momordica leiocarpa *	Cucurbitaceae	60x25	14x8	?	2		3		3
	Musa sp*	Musaceae	big	-**	x	-		3		3
	(*Passiflora edulis**)	Passifloraceae	50x50	4x3	x	1		1		1
	*Tabernaemontana elegans**	Apocynaceae	big	12x9	x	2		2		2
	*Tabernaemontana pachysiphon**	Apocynaceae	big	13x6	-	2		1		1
	sum: 43 plant/diaspore taxa (35 found at latrines, 8 achieved from feeding experiments*, **)									

[+] unidentified; nomenclature as labelled in the seed catalogue of the author

* fed in feeding experiments, seeds not found in wild droppings; passion (in brackets) was hardly eaten.

** swallowed mesocarp only as seeds are too big (Jack fruit, mango) or have no seeds (banana).

[1] edible after Beentje, 1994 (not tested by the author)

[2] slightly bitter-hot to tasteless

[3] taste is resinous, hardly edible for humans

[4] edible after Palgrave, 1993 (but not after the experience of the author, though fruits might have been unripe?)

[5] phenology doubtful, the single or few seeds might be old remains from former months without cleaning the sites

[6] defecated by trapped genet without previous feeding

[7] one genet defecation with two taxa from another roundabout

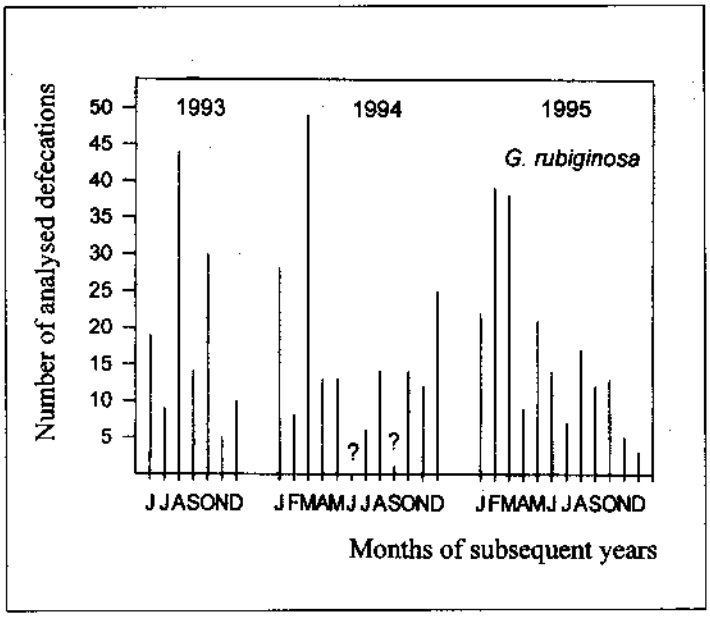

Fig. 2. Summarized utilization of two genet latrines and frequency and phenology of data collection (? = lacking proper data; see also text).

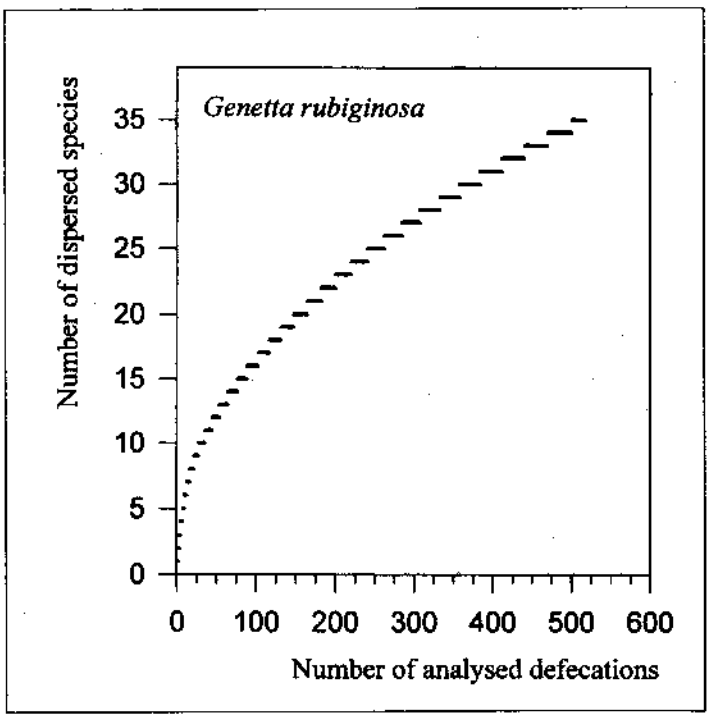

Fig. 3. Total number of samples and via diaspores dispersed species in relation to the analysed number of defecations (curve, sensu Shinozaki).

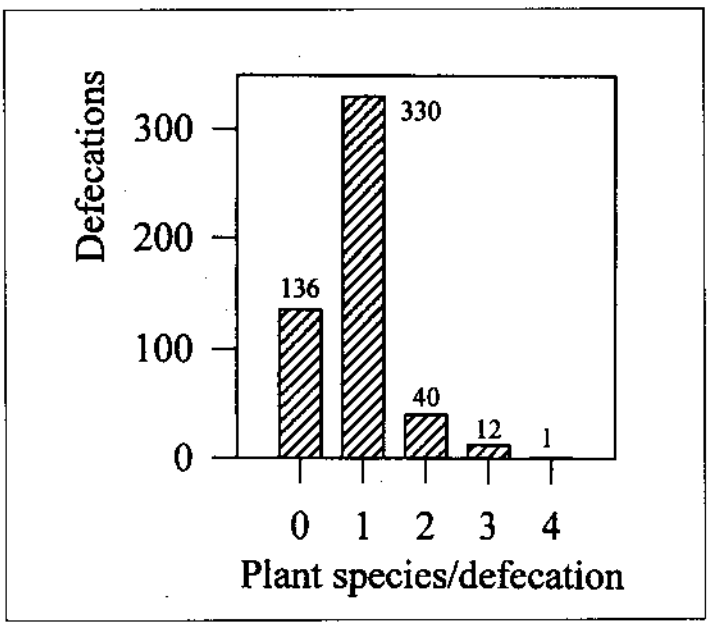

Fig. 4. Frequency of distribution of number of plant species found as diaspores per defecation.

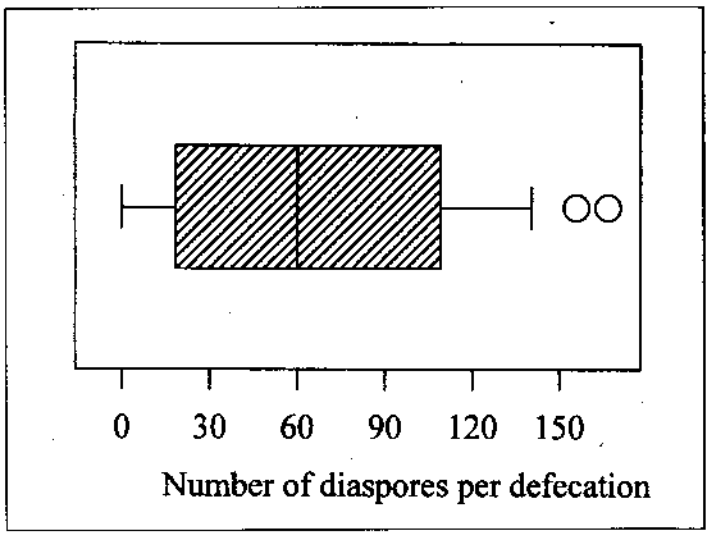

Fig. 5. Boxplot of numbers of diaspores per defecation.

Additional information about the food spectra, food preference, handling and gut passage time was achieved by six independent feeding experiments in December 1994 basically with two trapped (see Engel, 1998) and temporarily kept individuals. The animals were offered a variety of wild or commercial fleshy fruit species ad libitum. To achieve seed gut passage times, remaining fruits of the particular taxa were removed once the animal stopped feeding. One genet (female, 1.7 kg, snout tip to anus length 46 cm, total length to tail end 88 cm, 20 cm from front paw tip to upside shoulder) was found killed by a motor vehicle and the gut was investigated.

Since 1994, general viability of seeds from faeces was tested by monthly incubation of a mixture of soil and seed containing faeces from the two latrines in plastic bags. Regular watering of the open and water permeable bags ended in 1996.

The number of total available fruiting species is based on results achieved from investigations of 33 frugivorous (and a few basically granivorous) species and some data from four groups of taxa as e.g. small 'birds' or 'unidentified viverrids', which utilized in total a maximum of 549 diaspore taxa during the same period (as far as identified; pers. unpubl. data). Few species considered as actually fruiting at a particular month might have fruited before as data from granivores could have consisted also of negligible few older seeds. Identifications were made by comparison with a diaspore catalogue build-up from fruiting plants; identification of the corresponding pressed plant specimens was kindly done by S. Mathenge and Q. Luke (Nairobi).

Results

Fecal contents. 74 % of 519 defecations from the field carried diaspores (see Table 1) which usually made up the bulk of the content when present. 82 % of 519 defecations inclusive such with diaspores had remains of arthropods (basically insects, in particular termites or ants and grasshoppers, but also small millipedes, dung beetles, etc.), some hairs, bone, teeth remains

and few claws of small rodents (c.f. mice, etc.) and grass leaves; a few defecations had remains of reptiles (c.f. snakes,...) and once parts of a small snail shell and bird remains (compare Table 1). One chewed crab ('land crabs' are present in the park) was defecated by a trapped genet.

Dispersed plant species. In total, diaspores of 35 plant taxa were found in 383 of 515 defecations from the latrines and in one of four defecations of trapped genets (Fig. 3 *[see cover]*, Table 2; incl. one unidentified exocarp counted as 'diaspore'). Fruits of eight more species were eaten in feeding experiments (compare Table 2). For the Jack fruit (*Artocarpus heterophyllus*) and mangoes (*Mangifera indica*), seeds were too large to be swallowed and only the mesocarp was eaten. The biggest seeds swallowed (dispersed respectively) and found in field faeces reached up to 1 by 2 cm and belonged to *Landolphia* spp (probably *L. kirkii*), *Zanha golungensis* (both species with seeds with firmly attached mesocarp) and small specimen of c.f. *Hirtella zanzibarica*. However, these were very rare exceptions of single seeds, regularly found seeds had roughly the size and shape of peas (e.g. *Keetia venosa*) or sunflowers (e.g. *Manilkara* c.f. *sansibarensis*), and many species have even smaller seeds (e.g. most *Rytigynia* and the *Canthium* taxa, compare Table 2). Apart from dispersal by bushbabies with their comparatively small home range, seeds of *Manilkara* c.f. *sansibarensis* were dispersed by genets in high quantities, but were not dispersed by more frugivorous, wide-ranging and intensively investigated elephants, baboons or African civets (unpubl. data). The road-killed animal contained no diaspores, but one trapped genet defecated wild seeds of *Flueggea* [formerly *Securinega*] *virosa*.

Number of plant species per defecation. In average (± SE), there were only diaspores of 0.87 (± 0.03) plant species per dropping (see Fig. 4). There were also only 1.17 (± 0.02) species per dropping on average even if only 383 defecations with diaspores were considered. The rarefaction-plot (Fig. 3, sensu Shinozaki, see Achtziger et al., 1992) further shows the average number of species to be expected as diaspores after sampling a certain number of defecations from the field.

Number of seeds per defecation. In 20 quantitatively and qualitatively investigated fresh field droppings, the average (mean ± SE) was 63 (± 12) diaspores per dropping (for median see also Fig. 5; min 0, max 167; based on 17 defecations with 12 [diaspore] taxa plus three droppings without diaspores), 75 (± 12) diaspores respectively in 17 totally investigated droppings all with diaspores (min 1, max 167; 12 taxa). In particular the more frequent species (dark highlighted, compare Table 2) were also found with many seeds per dropping. The highest number of seeds of one taxa found in one dropping belonged to *Rytigynia microphylla* (144 seeds;

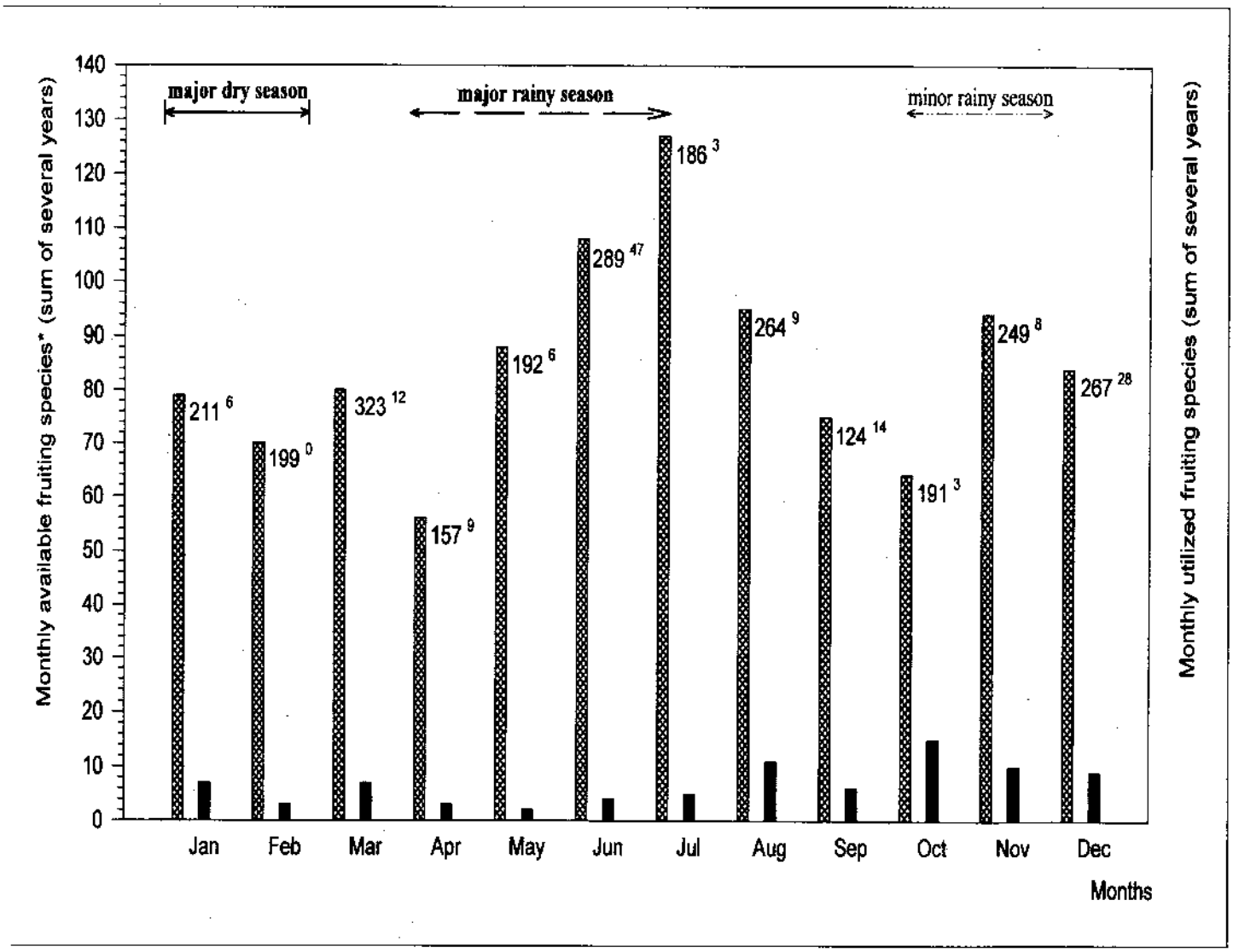

Fig. 6. Phenology of zoochorous plant species actually offering fruits (and/or seeds*; crossed columns) and their utilization by genets (black columns). The total number of available species is based on data of comparative seed dispersal (and seed predation) by up to 37 animal taxa including genets (and a few granivores); the number of total samples (next to columns) include data of feeding experiments (raised figures); *see 'material and methods'.*

plus 23 seeds of "*Rytigynia* type D" in the same faeces). The approximate average number of dispersed seeds per defecation is given in frequency classes for each taxa (per month) in Table 2.

Phenology of fruit utilisation and seed dispersal. The monthly (and yearly) dispersal of the different plant species via their diaspores, absolute times of proof respectively, is shown in Table 2 (for relative frequencies compare with Fig. 2). On average (± SE) 6.4 taxa (± 1.1) were dispersed per month (Table 2; sum of several years without feeding results; range: 2 [May] to 15 [October]). The proportion of monthly utilised and dispersed taxa of available fruiting species is very low (Fig. 6). In some months, seeds of any plant species were hardly found in the defecations (e.g. around May; Table 2, Fig. 6) and there was great variation from year to year (compare Table 2 with Fig. 2).

Condition, viability and germination of dispersed diaspores. Still-closed fruits, and seeds with obvious primary defects (not caused by genets) never occurred in the droppings (Table 1). Only three out of many more than 2331 investigated seeds of the 38 plant taxa from genet faeces (incl. some from feeding experiments) were chewed (<< 0.1 %). Considering also quantitatively analysed defecations (from the field only), still 99.8 % of 1814 diaspores of 24 taxa were not chewed. At least, only three seeds of *Manilkara* c.f. *sansibarensis* were found slightly chewed in one field defecation, whereas 20 further *Manilkara* seeds in the same dropping were intact. All other seeds were still physically intact after passing the gut. Seeds of many species were viable and germinated after passing through the guts of genets; i.e. seeds of *M.* c.f. *sansibarensis*, *Keetia* spp., *B. micrantha*, *Rytigynia* spp, *Canthium* spp., and *O. woodiana* all regularly germinated in high numbers. Even on the concrete of the latrines some seeds started germinating in and around decomposed old genet faeces; also humus had evolved from former dung and had accumulated in crevices, providing 'safe sites' for germination. Regeneration (of c.f. *Keetia*) took also place at the base of the roundabout under the latrine.

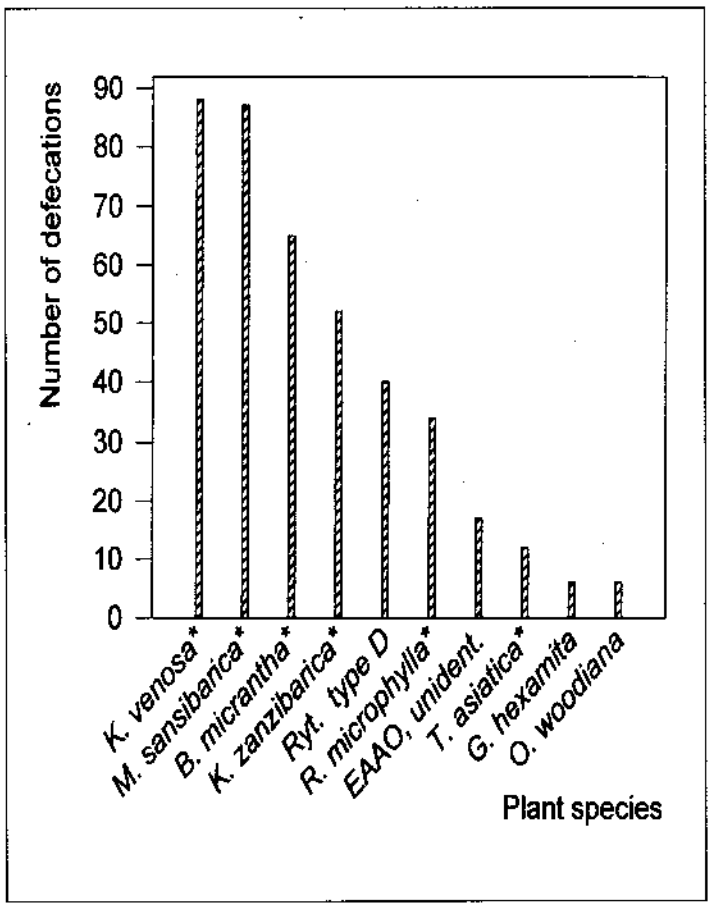

Fig. 7. Frequency of genet defecations with diaspores of the ten most utilized and dispersed plant taxa found at latrines (presence/absence data). Marked species (*) are sweet and fleshy and eaten by humans as well.

Fruit types, fruit preference and handling. Fruits whose seeds were regularly found in the faeces contain one, two or a few seeds, are indehiscent, and have an edible pericarp. In the field the most frequently eaten fruits were small and tasty, had a fleshy and/or slimy mesocarp (or aril) and are also eaten by the author or other humans (Fig. 7, Table 2). Some fruits, although their seeds were found in field droppings, were not eaten in feeding experiments (e.g. *Toddalia asiatica*, refused by three genets, *F. virosa*, refused by two genets); other fruits, like those of *Ficus* spp., *Lantana camara* (Verbenaceae), *Synsepalum* [*Pachystella*] *brevipes* (Sapotaceae), *Hoslundia opposita* (Labiaceae) were also refused each by one genet, or hardly eaten like passion fruit (*Passiflora edulis*, disliked by two genets). Seven seeds of *Momordica leiocarpa* and 26 of papaya (*Carica papaya*) were either regurgitated or spat out, but not defecated. Nevertheless, due to its slimy aril, papaya seeds were usually swallowed without chewing (as are most other diaspores) and defecated in high numbers.

Gut passage times in the captive individuals varied highly between the same individual and among different animals. Hairs of rodents fed on before capture still occurred in the faeces after six days (unfortunately this female gave birth *[successfully; before Christmas at the beginning of the dry season]* and refused food for two days before). Out of three individuals used for feeding experiments, two fed on fruits. Seeds of *T. elegans* appeared after less than 21.5 hours and, for the other animal, after around 12 to 18 hours. Some papaya seeds appeared after 18 hours, others after less than 24 hours. Six passion seeds (usually disliked) occurred after (much ?) less than 12 hours. On one occasion, bones of previously eaten meat occurred after five hours. In conclusion, all seeds of previously eaten fruits had passed through the digestive tracts of both individuals after less than 24 hours.

Discussion

Reliability of results. Due to a few difficulties during data collection and with the field methods in general, real numbers of defecations, their phenology, relative content and average figures per defecation might be slightly different (compare Engel, 1998). Nevertheless, any possible error was minor, and at least had no effect on the general dietary spectra and seed dispersal observed.

Dietary spectra. Meat, banana and poultry eggs were the preferred foods of captive animals. In the field, however, at certain times the bulk of the diet remains found in faeces consisted of many seeds of one fruit species (Fig. 4) with little animal matter. In the Shimba Hills genets seem to live on a mixed diet of fruits, arthropods (basically insects plus occasional millipedes), a few other invertebrates, small mammals, a few other vertebrates, and occasionally green grass leaves (for grass leaves see also Rowe-Rowe, 1971,1978; this is also known for the White-tailed mongoose [*Ichneumia albicauda*] and the Marsh mongoose [*Atilax paludinosus*]). The animal food remains are not yet entirely identified; spiders for example were taken in other areas (Skinner & Smithers, 1990), but were so far not detected here. Some hairs might originate from grooming and do not necessarily

indicate mammalian prey; nevertheless, many hairs were grey and these were often found together with small rodent remains. Very few seeds found in genet stomachs (i.e. when found together with rodent remains) could also have originated from ingested rodents carrying (even older) still intact diaspores (compare Engel, 1997), but the vast majority of seeds as found here in higher numbers in many defecations must have been due to frugivory and could certainly not originate from coincidental 'by-product feeding'.

Phenology and utilisation of available fruits. In the Shimba Hills, there is plenty of fleshy fruit available all through the year (Engel, 1997). On the one hand, from several hundred species available genets dispersed (much) less than 10 % of the total number. On the other hand, spat-out seeds and species with fruits containing seeds too big to be swallowed are hardly detectable by dung analysis, thus the diet might include more species of fruits (plants with large seeds occur and even without dispersal, such plants can also gain for their seed germination when frugivores just open the exocarp; unpubl. data). However, pericarp remains of large-seeded fruits were not found in any defecation. Genets seem comparatively conservative in their diet (compare also Rowe-Rowe, 1971) and changes might only be caused by changes in fruit availability or by other nutritional needs. A small part of the monthly (and in particular the considerable yearly) variation might be explained by variations in fruit availability, but most of the dispersed diaspores were available in each year and dispersal basically might have depended on the varying choice of the genets. To gather information on their food spectra and habits, many samples over long periods were necessary. Nevertheless, as the Shinozaki-method and other methods do not allow an extrapolation to estimate species saturation, it is still unclear how far further investigations would have provided considerable more evidence of dispersal for more plant species. At over 50 other basically civet latrines outside the forests, only a few of the defecations might have been caused by genets as well, but defecations of unknown origin (probably viverrid) hardly carried any further diaspore species and are not considered here. In conclusion, the (main ?) feeding and defecation activities (particularly in the forests) might have remained unknown, some further) plant species might have been not fruiting during the study (for certain plants fruiting occurs very irregularly) and food preference might change according to the actual fruit offer. Therefore, it seems likely that further plant species probably gain from the fruit feeding or dispersal by genets.

Quality of seed dispersal. Genets cannot handle or manipulate diaspores in their mouth with their paws and, with their typically carnivore dentition and scissor-like fixed jaws, they are almost unable to chew seeds. Thus, unlike with e.g. baboons or elephants (unpubl. data), seeds are hardly destroyed by genets. In terms of seed condition after endozoochory, genets are high quality dispersers similar to civets or bushbabies (unpubl. data). This is also in accordance with intact dispersed seeds found for other small carnivores including *G. genetta* (compare Herrera, 1989). In addition, the genets seem to avoid dispersing defective (but see *Manilkara* above) or insect-infested diaspores. After passing through genet guts, seeds failed germination in some quantitative, comparative germination tests (unpubl. data). However, such tests are difficult to interpret (compare also Engel, 1997). At least, although it is still not fully understood how far gut passage might influence seed viability and germination, it is important in the positive sense, that numerous seeds had germinated in the bags despite the passage through genets' digestive tracts.

Gut passage time and range of seed dispersal. According to the few data from feeding experiments, genets had comparatively long gut passage times (for delayed gut passage times see also Engel, 1997), which, for mobile and wide ranging genets (compare Estes, 1991), could result in long-distance dispersal. For comparison, other frugivores of similar size had shorter gut passage times ranging around few hours (unpubl. data for bushbabies and Two-spotted palm civets; see also Charles-Dominique, 1978). However, lacking permanent observation (the exact time of feeding and defecation was often unknown), the gut passage times might be shorter than the maximum possible periods mentioned, and under natural conditions seed passage might be much faster.

Habitat and niche utilization. The most utilised Rubiaceae species and most other seeds belonged to solitary shrubs and smaller sub-canopy trees. Fruits of these much preferred species were rarely found on the ground and most of these fruits are probably collected at heights of one to a few meters. *T. asiatica* and *Landolphia* spp. are climbers. Some plants utilised produce fruits high above the ground in the forests, but most species are low and grow outside closed forests or at the forest edge. Co-existing viverrids and herpestids are basically (or even entirely) terrestrial, or basically arboreal (compare Engel, 1998); only genets are completely both and able to utilize food from arboreal and terrestrial sources from various habitat types - although it seems they make little use of their potential (compare Fig. 6).

Conclusions

Provided that all faeces from the roundabout and the Pengo Hill building floor belonged to Rusty-spotted genets as assumed and shown (Engel, 1998), *G. rubiginosa* can be very much more frugivorous than previously known (compare Table 1 with data e.g. from Rowe & Rowe, 1978 or Skinner & Smithers, 1990). According to these findings from the Shimba Hills, here Rusty-spotted genets seem omnivorous or even basically frugivorous, but not basically carnivorous or insectivorous. The addiction of Rusty-spotted genets to sugar or honey and jam (compare Rowe-Rowe, 1971) also indicates a high potential for feeding on sweet fruits in the field. *G. rubiginosa* seems to play a considerable role for seed dispersal in the biocoenosis of the Shimba Hills with its species-rich mixed vegetation. Genets contribute to seed dispersal and plant rejuvenation almost entirely without seed predation. Genets are not limited to one habitat type and can disperse seeds even into different habitats. However, as long as other more effective seed dispersers in respect of diaspore diet spectra, dispersal distance, between habitat transfer and dispersal turnover are present (i.e. baboons, civets or elephants) their importance for natural forest and general plant rejuvenation and regeneration seems comparatively minor for most plant species. Nevertheless, outside parks, the small, inconspicuous and agile genets still survive in areas where elephants, baboons or other more effective dispersers have already gone. In terms of forest's life span, genets and others might still support 'their' plants in the future when large dispersers are finally extinct. Both in the past and now genets could play an important pioneer role for plants' colonisations of disturbed and, in particular, of exposed sites. Among other locations (for *G. genetta* compare also Palomares, 1993), genets might deposit seeds at solitary and topmost exposed rocks, which is what a roundabout probably looks like to a genet. On very rare occasions, seeds were deposited on roundabouts by baboons as well, but for the many mammals of the Shimba Hills Rusty-spotted genets frequently are the experts for topmost seed deposition.

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Notes on the behavior of the Ring-tailed mongoose, *Galidia elegans*, at Ranomafana National Park, Madagascar

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Galidiinae represent a unique sub-family of Herpestidae endemic to Madagascar, thought to be closely related to the African subfamily Herpestinae (Rood, 1987). The Galidiinae contain five species of mongooses in four genera (*Galidia, Galidictis, Salanoia,* and *Mungotictis*) all of which are gregarious, a rare trait among small carnivores (Rood, 1987). Despite their unique phylogenetic history, complex social systems, and the potential roles they may play in the ecosystem, behavioral and ecological studies of them have been few (see Albignac 1972, 1973) and detailed morphometrics have not been previously available. This is a report on some observations of the most common of these species, *Galidia elegans*, collected during a two-month survey of Carnivora at Ranomafana National Park. The observations include data from trapping, radio-tracking, and incidental observations of free ranging *Galidia elegans elegans* Fig. 1).

Study site and methods

The study site was located at Ranomafana National Park RNP) in southeastern Madagascar. The park consists of 43,500 ha of submontane rain forest ranging in altitude from 500-1,500 m (Wright, 1997). Although abundant rain falls throughout the year (2,300 to 4,000 mm per year), it is most copious between the months of December and March (Wright, 1997). Temperatures are also seasonal, ranging from 4° to 12°C between June and September with an average of 21°C during the rest of the year (Wright, 1997). Data were collected from June to August 1997, at Vatoharanana, a site of primary forest within RNP (Overdorff, 1996).

Fourteen days were spent systematically trapping carnivores using a simple grid system design. The grid consisted of four parallel line transects marked with flagging tape and spaced 150 meters apart. Five Have-A-Heart® box traps were placed every 150 meters along each transect, alternately baited with canned fish or a live young chicken. Traps were set at dusk (16.00 hrs) and checked and reset every eight hours giving a total of 1,040 trap nights. A trap night refers to the number of traps multiplied by the number of trapping periods (Jones *et al.*, 1996).

When a mongoose was captured it was placed in a handling bag which I designed for this study (Fig. 2). The bag restricts movement, allowing for easy handling and administration of anaesthetic with minimum trauma to the animal. The bag was made of heavy denim material sewn into a cone shape with three drawstrings equally spaced along the length of the bag. A wide shirt was sewn onto the base of the bag which fits over the end of the trap for easy transfer of the animal into the bag. Near the tip of the cone was a narrow strip of mesh which allowed the handler to see the position of the animal and to identify ear identification tags of recaptured animals.

Fig. 1. Malagasy ring-tailed mongoose, Galidia elegans. *Illustration by author.*

After being weighed using a portable spring scale accurate to 10 g, animals captured for the first time were anaesthetized using Telazol® (equal parts tiletamine hydrochloride and zolazepam hydrochloride; A. H. Robbins, Richmond, VA 23220) to minimize shock due to handling. The dosage used was 0.1 cc of Veterinarian Recommended Mix/kg of body weight. The animals responded with no adverse side effects to the drug. All animals began to regain muscle control after 40 minutes and reached complete recovery within 3-4 hours. Once tranquillized, morphometrics, gender, and reproductive condition were recorded for each animal captured. Measurements were taken using calipers and a flexible tape measure accurate to 1 mm (Table 1). Before being released, ear tags with identification numbers were placed in both ears for future identification. Seven captured individuals of *Galidia elegans* were also fitted with radio collars. The mark recapture method was used to get an estimate of *Galidia* density at the site.

After the fourteen days of systematic trapping, additional traps were placed along trails within the area to estimate home range size and movement of animals. Ecological and behavioral data were gathered through radio-tracking and incidental observations.

Results

Description and morphometrics

The *Galidia elegans* of RNP have red/brown coats fading to a dark brown to almost black on the abdomen, snout and feet. The throat, ears, and face are lighter than the rest of the body, grizzled with black and tan hairs. Each animal had six or seven black tail rings, six being more common. Table 2 provides information on morphometric data collected for all individuals captured during the study.

Description of measurements

Age class was estimated by relative size and tooth wear.
Trunk length is measured dorsally from the base of the tail to the base of the skull.
Tail length is measured from the tip of the tail to the junction of the tail and perianal area
Crown/Snout is measured dorsally from the nuchal crest area to the tip of the snout.
Skull Width is measured from the widest points of the skull.
Hind Limb Length is measured from the groin area to the end of the longest digit excluding nail.
Hind Foot Length is measured from the heel to the end of the longest digit excluding nail.
Front Limb Length is measured from the axillary region to the end of the longest digit excluding nail.
Front Foot Length is measured from the edge of the wrist to the tip of the longest digit excluding nail.
Upper canine is a measurement from gum line to tip of the largest upper canine.
Lower canine is a measurement from gum line to tip of the largest lower canine.
Testicle width and length is a measurement of the length and width of the testicles.

Table 1. Description of measurements.

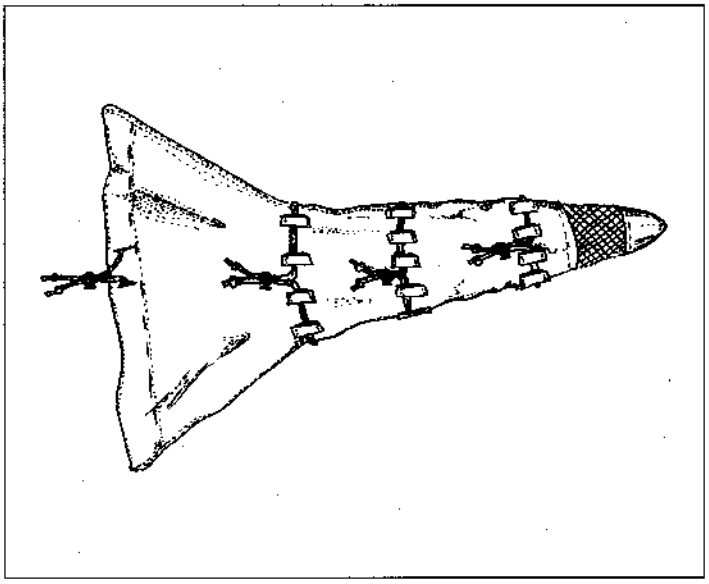

Fig. 2. Handling bag designed by author.

Body weight of adult males averaged 992 g and ranged from 900 g to 1,085 g (n=8). Only two adult females were captured during the study, likely due to trapping biases. Because of this small sample size no statistical analyses for comparison could be performed. The weights of both females (760 g and 890 g) were under the range observed for the eight captured adult males.

Previous literature on these animals has described them as being sexually monomorphic (Nowak, 1991). Although the sample size of captured adult females was small, observations of uncaptured animals also suggest that *Galidia elegans* is a sexually dimorphic species.

Nowak (1991) stated that dissection revealed anal scent glands present in males but not in females. However, females clearly had a musky odor. On one occasion a trapped female turned her back towards the observer with tail erect, and released a fine spray of musky smelling liquid, suggesting that females also carry scent glands closely associated with their external genitalia.

Home range and relative density

Absolute abundance estimations of the population did not seem feasible because of the small number of animals captured and because the assumption of equal catchability was violated (Krebs, 1989). The capture success was extremely male biased but was unlikely to be proportional to the population sex ratios. This conclusion is supported by observations of free-ranging animals. Because of these problems, abundance and density indices were used. Only trapping done within the systematic study was used to calculate the indices. During 1,040 trap nights, 10 individuals were captured. The density index was calculated to be 37 animals per km^2. This estimate may be higher than the actual density in the area because it assumes that the animals are free mixing with the entire population and does not consider effects of territoriality. However, these indices will be useful for monitoring changes of this population and for comparison of relative abundance and densities of populations in other areas, if similar methods are employed.

Two additional animals were captured outside of the trapping grid within the study area. All animals captured during

the study except the subadult male (797/798) were located on at least three occasions through trapping, observation, and radio-tracking. The locations suggest that the 11 animals shared a large territory of approximately 20 ha bisected by a stream.

Behavior and ecology

Individuals were observed travelling and foraging solitarily, in male/female pairs, or as small family groups. Family groups consisted of a male and female, most recent offspring and occasionally an older juvenile offspring. Juvenile females were captured from two family groups also containing a much smaller offspring (=200 g). Tooth wear of these older juveniles suggests that they were less than a year old (6-8 months). It is therefore possible that females of this species produce offspring twice a year.

Breeding twice per year would be possible given the 75 day gestation period (Albignac, 1969) and length of breeding season reported by Larkin & Roberts (1979). They state that mating occurs from April to November and births occur from July to February. Albignac (1969), however, reports that females produce one offspring per year during October to December. He also noted male/female pairs traveling with two young but suggested that the older juveniles were offspring from the previous year. It is unlikely however that the juvenile female (724/725) weighing 390 g (less than 1/2 the weight of the adult female often seen with it, was more than a year old, or that it was a year older than the younger sibling weighing ca. 200 g.

Sub-terrestrial dens were found at the base of large trees or along stream banks. Many entrances and exits were observed for each den. As in foraging, animals used the dens solitarily, in pairs, or in small family groups. Though the animals sometimes used the same den during subsequent nights, they frequently changed sites, possibly to avoid parasites or predators. Radio-tracking revealed that the animals used the dens to rest at night and during midday. The animals were primarily diurnal but sometimes active at night.

No scats were found for diet analysis, however, some information on diet could be obtained through observation. The *Galidia* were often found in traps baited with live young chickens which they readily devoured, suggesting vertebrates may be an important part of the diet. Evidence that rodents are eaten by *Galidia* include an adult female seen eating a *Rattus rattus* and *Galidia* footprints found around a *Neomys rufus* (Malagasy red forest rat) den. A pile of crab and crayfish exoskeletons were found near a *Galidia* den located at a stream bank, suggesting aquatic invertebrates may also be eaten by them. The mongooses are adept swimmers and were often observed along stream banks, wet from swimming. During radio-tracking follows, the animals would often cross the stream several times in one day. Aquatic vertebrates and invertebrates may constitute an important part of their diet. The *Galidia* are also scavengers and could often be seen searching for food scraps around the research camp. They would eat almost any food scraps including jam suggesting that they may occasionally consume fruit.

During *ad libitum* observations and during radio-tracking follows social interactions between animals were observed. Contact calls were observed between all members of a family group, particularly between the youngest offspring and the adults. This call consisted of a soft laughing sound and was relayed between individuals.

ID No. Left/Right	Sex	Age Class	Weight	Trunk	Tail	Crown/ Snout	Skull Width	Hind Limb	Hind Foot	Front Limb	Front Foot	Upper Canine	Lower Canine	Testicle Width	Testicle Length
792/793	M	A	950g	28.7	25.4	8.02	3.59	15.3	6.19	12.5	4.11	0.64	0.76	1.09	1.70
703/702	M	A	980g	30.5	25.7	8.80	3.92	18.0	6.80	11.9	3.99	0.69	0.80	1.18	1.50
753/754	M	A	1,000g	27.5	25.1	8.44	4.02	16.6	6.06	11.1	4.50	0.80	0.99	0.85	1.41
677/676	M	A	1,085g	29.1	26.9	9.10	3.77	16.3	6.95	11.4	4.30	0.93	0.80	1.10	1.15
678/679	M	A	1,015g	32.3	27.1	8.30	3.65	14.0	6.59	12.5	4.20	0.81	0.83	1.01	1.47
680/681	M	A	1,000g	25.7	27.2	9.22	3.53	17.5	7.00	14.2	4.40	0.82	1.00	0.91	1.55
601/602	M	A	900g	29.0	27.5	7.87	3.81	14.0	5.52	11.5	3.13	0.79	0.87	0.87	1.35
711/721	M	A	1,005g	29.0	26.8		4.30	17.3	6.32	13.4	3.80	0.69	0.71	0.99	1.63
797/798	M	SA	890g	29.1	24.0	9.90			6.12			0.87		0.79	1.43
778/779	F	A	760g	27.9	26.0	7.41	3.95	15.9	5.75	11.4	3.30	0.74	0.84	N/A	N/A
755/751	F	A	890g	27.2	25.5	7.70	3.49	17.0	5.91	11.2	3.12	0.72	0.81	N/A	N/A
674/675	F	Juv	585g	24.6	21.2	7.10	3.12	15.6	4.91	9.50	3.86	0.50	0.40	N/A	N/A
724/725	F	Juv	390g	24.5	23.0	7.85	3.25	13.0	5.70	10.5	4.40	0.45	0.34	N/A	N/A

Table 2. Morphometric data of captured Galidia elegans.

Aggressive interactions were observed on five occasions between two adult males (753/754 and an unidentified individual), who often frequented the research cabin in search of food scraps. One male was clearly dominant to the other (753/754). A distinctive submissive posture was displayed to the dominant animal whenever the two males came into close contact. During this display, the front limbs were bent so that the animal's chest was almost touching the ground. The head was held upwards with the snout pointed towards and almost touching the side of the dominant animal's face. The ears were held back and teeth were bearing. When approached aggressively, a submissive animal would often give a loud, high pitched, screeching call. The same call would also be given when the trap door would suddenly close behind the animal. A separate threat call («mmm-CHA) was also noted, given by an adult male when an observer came too close to the youngest offspring or often directed towards an observer when approaching a trapped animal.

Discussion

Though *Galidia elegans elegans* are not in immediate threat of extinction, they depend on rain forest habitat and healthy riparian ecosystems, making them vulnerable to the rapid loss of such habitat in Madagascar. Further research on their distribution, ecology, and ranging patterns is necessary if we are to properly manage and ensure the health of their populations.

The mongoose species of Madagascar represent a unique subfamily with unique genera within the Herpestidae. Sociality is a rare trait for rain forest carnivores, yet is common to all of the mongooses of Madagascar (Albignac, 1973). Because of poor visibility and dense vegetation, little research has been done on the ecology or behavior of any rain forest mongooses. Radio-tracking, however, can be a feasible technique to facilitate tracking animals in a rain forest environment.

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Madagascar field project

I am conducting a field project to determine the home range and dietary composition of Madagascar's two largest carnivores, *Fossa fossana* (Malagasy civet) and *Cryptoprocta ferox* (fossa). My field site is situated in the southeast of Madagascar in an area of mid altitude montane rain forest. The nearest town is Vondrozo, 25 km away and the nearest large town is Farafangana on the coast. This area of forest, which is known as Vevembe, has no protection; indeed, there is a forest station a few kilometers from camp which houses the men who produce timber for the commercants from Farafangana. Hunting is less of a threat to the local fauna. However, since I began studies in May two *Eulmur fulvus albocollaris* (White-collared brown lemurs) were killed on the road less than 100 m from camp. My field work thus far involved trapping small mammals (mainly *Microgale*, shrew tenrec species) to determine prey density and availability and cutting a grid system of transects to use as reference points for radio-tracking studies. We caught and radio-collared three *Fossa fossana* at the end of July but owing to personnel difficulties I have no one following the animals at the moment. We hope to catch up to 12 more *Fossa fossana* and also the *Cryptoprocta ferox* who lives in the area and whose tracks we have found by the river. Radio-tracking will continue for one year to investigate seasonal differences in home range size and ranging patterns.

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Movements and fruit selection of two Paradoxurinae species in a dry evergreen forest in Southern Thailand

Lon I. GRASSMAN Jr.

Introduction

The civets (Viverridae) are diverse and important animals in tropical communities, but are probably the least understood of the Carnivora (Wemmer and Watling, 1986; Rabinowitz, 1991a; Macdonald & Wise, 1979). Although ranging throughout much of Asia there is a noticeable lack of baseline ecological data available on the subfamily Paradoxurinae. The only previous comprehensive ecological study on palm civets remains Rabinowitz's (1991a) work in western Thailand. Prior to this, information on palm civet ecology has consisted of either anecdotal accounts or irregular, casual observations (Bartels, 1964). It was the intention of this study to add to the paucity of knowledge available on two species of the Paradoxurinae: Common palm civet *Paradoxurus hermaphroditus* and Masked palm civet *Paguma larvata*.

Study area

Kaeng Krachan National Park (KKNP), is Thailand's largest national park at 2,915 km^2. Located in south-central Thailand, KKNP occupies approximately half of Petchaburi and part of Prachuab Khiri Khan Provinces, with its western border adjacent to Myanmar on the Tenassarim mountain range (Fig. 1). The general topography consists primarily of forested hills rising into mountains westward. Khao Panoem Thung is the highest peak within the park at 1,200 m. The subtropical forest consists of dry and wet evergreen (85%), mixed deciduous (10%) and dry dipterocarp (5%) species (TISTR, 1989). Wet evergreen generally occupies elevations above 500 m, while dry evergreen can be found below 500 m. Mixed deciduous occurs mainly in the eastern, more level terrain, and dry dipterocarp is found intermittently on steep grades of approximately 300 to 400 m. Dominant evergreen species include *Tetrameles nudiflora, Acrocarpus fraxinifolius, Aphandmixis polystachya, Elaeocarpus grandiflorus, Stereospermum fimbriatum, Barrington macrostachya* and *Crateva magna* (TISTR, 1989).

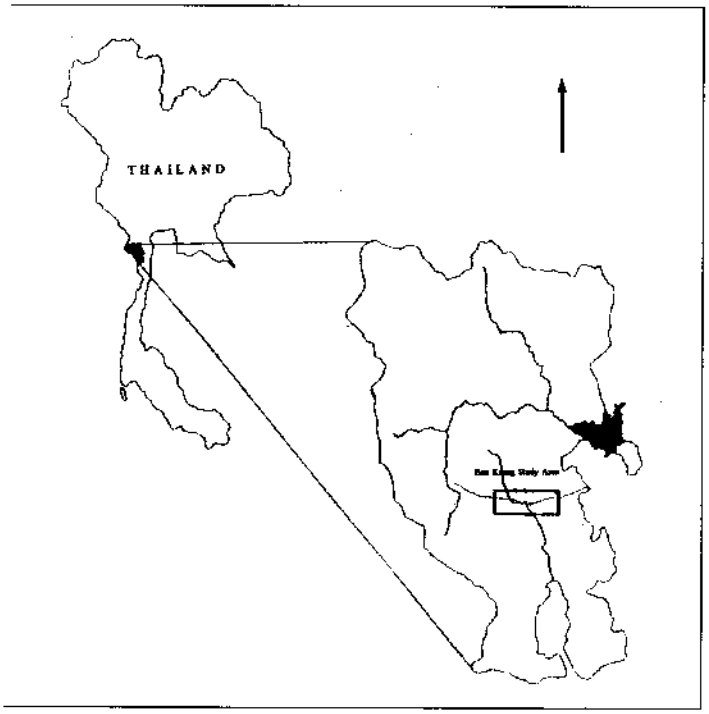

Fig. 1. Kaeng Krachan National Park (KKNP) and Ban Krang Study Area

*Radio-collared Masked palm civet (*Paguma larvata*) MPC 900 with field assistant Mr. Sean Austin*

The climate of KKNP was essentially under the influence of seasonal monsoons. There are two distinct seasons: June through October for the wet season, and November through May for the dry season (Cummings, 1992). Average yearly precipitation in Petchaburi Province is 1,000 mm, with June through September accounting for over 90% (Gray *et al.*, 1994). Temperatures range from lows of 25°C in December to highs of 30°C in May, with an overall average of 28°C.

The region containes a mix of Sundaic and Indochinese fauna due to the convergence of these two zoogeographic subregions. Some of the larger mammalian species present in KKNP include: elephant *Elaphus maximus*, gaur *Bos gaurus*, sambar *Cervus unicolor*, barking deer *Muntiacus muntjak*, tapir *Tapirus indicus*, tiger *Panthera tigris*, and leopard *P. pardus*.

The study area was delegated to the south-central portion of the park at the Ban Krang Camping Area. Encompassing 60 km^2, the area consisted of hilly/mountainous terrain at 500 - 800 m elevation, primarily of seasonal evergreen forest. The main park road running east and west, some smaller trails, and the Pranburi River were included within the study area. The site was chosen due to its central location, abundant civet sign, and low number of visiting tourists in the area. In addition, steeper terrain to the west would have rendered the logistics of a telemetric study very difficult, while the lower elevations within the study site were more conducive for radio-telemetry.

Methods

Three large wooden-log (200 x 90 x 100 cm), six medium steel mesh (150 x 40 x 50 cm), and four small Tomahawk (107 x

40 x 40 cm) box traps were used to capture the palm civets used in this study. All traps consisted of single door openings which were tripped by a foot treadle. Domestic chickens were used as live bait in the rear of the traps. Traps were set along the main road, trails and riverbanks where civet sign occurred in the form of spoor or feces. Carnivore musk concentrate was periodically applied to increase the attractiveness of the set. Traps were visited daily to feed and water bait chickens and check for captures. If, after three weeks, there were no captures a trap was considered unsuccessful and moved to a new location.

Captured civets were anesthetized via intramuscular injection with a hand held syringe at 25 mg/kg Calyoso (Ketamine Hydrochloride) (Gedeon Richter, Hungary). All animals were injected in the hindquarters through side openings in the traps. Recumbency time and attempted versus actual drug dosage rates were recorded (Table I).

During the first 30 minutes of sedation each animal was fitted with a radio-collar and biological data collected. Eyes were kept moist with ophthalmic gel (Vidsic gel, Berth) and animals were then sexed, aged, weighed and head and body length, tail length, ear length, front foot spoor, and hind foot length measured to the nearest centimeter. Upper canine length was measured to the nearest millimeter and overall dentition was checked for possible injuries obtained during the time in the trap. If abrasive injuries were present a topical antiseptic was applied (Duphacycline, Suphar Inc.) and multi-vitamin booster shot injected (Biocatalin, Fatro, Italy). Individuals were aged using tooth wear, eruption (i.e. presence or absence of deciduous teeth), body size and overall body condition. Four age classifications were assigned: juvenile (J), young adult (YA), prime adult (PA), and old adult (OA). After data collection and collaring, animals were placed back into the traps to recover. When all reflexes and natural behavior returned (2 - 4 hours) the trap door was opened to release the civet.

Adult animals were fitted with a butyl, collar-mounted radio transmitter (Wildlife Materials, Inc.) at 142 MHz to obtain information on movements and activity patterns. Young adults were fitted with extra space in the collar to allow for future growth, but juveniles were not collared. Each transmitter contained an activity switch activated by head movements. Signal range varied from 1 to 15 km depending upon the obstruction of terrain and the elevation at which the signal was received. An internal lithium battery provided a constant pulse signal for

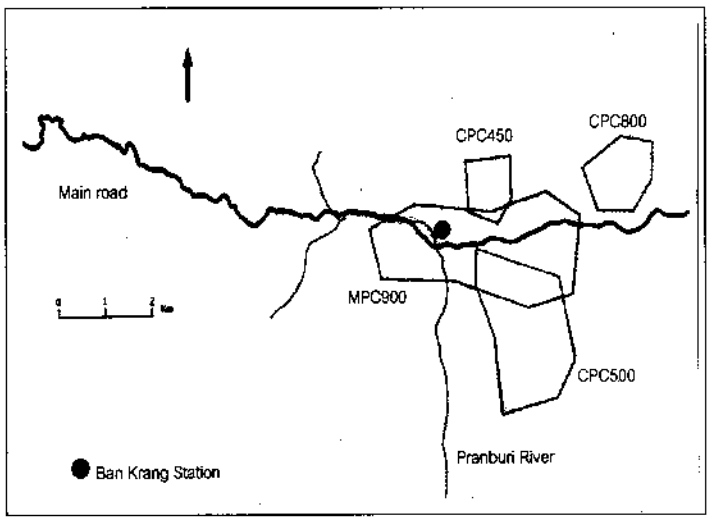

Fig. 2. Overall home ranges of palm civets at Ban Krang study area

ID	Weight (kg)	Ketamine hydrochloride Attempted dosage (mg/kg)	Actual dosage	Reaction time (in min.) Time to recumbency	Time to "head up"
CPC500	4.0	25	25	5.5	39
CPC450	4.0	25	25	8	12
CPC800	3.5	25	28	4.2	52
MPC900	6.0	25	25	8.5	31

Table 1. Immobilization parameters of study palm civets.

approximately 1.5 years. All tracking was done on the ground with hilltop stations used frequently for establishing first bearings when lower elevations could not receive a signal.

Palm civets were radio-tracked intermittently during a 24-hour period, with once a month continuous 24-hour tracking done on a single animal. Civets were considered active or non-active based upon signal integrity and pulse frequency. The convex polygon method (Mohr, 1947) was used for annual and seasonal home range size (HRS) and home range overlap estimates. If the overlapping rate of a home range was < 10 % it was considered exclusive, while > 10 % was regarded as overlapping (Sakaguchi, 1994). All plotted points were considered part of a home range, even those where only a small amount of time was spent (Lopez, 1985). Movements were calculated by measuring the linear distance between consecutive 24 hour radio locations (Bailey, 1993; Rabinowitz, 1989). Due to varying topography and a non-linear route the distances covered between consecutive days were actually greater than expressed.

Analysis of fruit selection for palm civets was accomplished by the collection and examination of fecal contents. Feces were collected to examine species of fruit consumed. Fruit seeds were separated from other vegetable and fecal matter and identified with botanical key and reference collection. Analysis focused on frequency of occurrence in the dry and wet seasons.

Although palm civets, as omnivorous carnivores, were capable of consuming animal matter, only feces with fruit matter could be determined with accuracy to have originated from palm civets. Feces containing mammalian or other vertebrate remains which might have possibly come from palm civets might also have been produced by other carnivores such as yellow-throated marten *Martes flavigula*, crab-eating mongoose *Herpestes urva*, large Indian civet *Viverra zibetha*, and small Indian civet *Viverricula indica*, among others, and thus could not be accepted with any degree of confidence. Civitries (agglomerations of old and fresh feces) were encountered only occasionally and did not include feces with fruit remains. Only feces which were deposited strung lengthwise, and not coiled were accepted as originating from palm civets as noted by Bartels (1964).

Results

Between December, 1995 and March, 1997 two adult male and one adult female common palm civets and one adult male masked palm civet were captured, radio-collared and tracked for nine to sixteen months. All civets were aged as prime adults and released in good physical condition (Table 2). A total of 469 radio locations were recorded for these four animals to calculate HRS.

The HRS of male common palm civets CPC500 and CPC450 were 3.4 (N=165) and 1.1 km^2 (N=183) respectively,

while female CPC800 showed a range of 1.4 km² (N=66). Male masked palm civet MPC900 showed an overall HRS of 5.9 km² (N=52) (Table 3, Fig. 2). Overlapping home ranges occurred between CPC450 and MPC900 (0.1 km²) and MPC900 and CPC500 (1.1 km²) (Table 4). CPC800 occupied a home range independent from the other study palm civets. There were small increases in home range size during the wet season for palm civets (mean increase: 8%).

All palm civet home ranges encompassed a free water source during the wet season and a shift in home range use did occur for male common palm civet CPC500 when his water source, a small stream, dried up during the dry season. This civet extended his home range north to encompass the Pranburi River. Palm civets locations were distributed widely throughout their home range habitat with marked increases given to locations and waterways. Elevation and terrain were not apparent factors in influencing civet locations.

Palm civets were located on consecutive days 218 times, of which 42 showed no movement from the previous days location. The remaining 176 times when movement occurred a mean one-day movement of 0.48 km (range: 0.1 - 2.6) was recorded. The mean daily movement of CPC450 was 0.21 km (range: 0.1 - 0.8, N= 70), while CPC500 showed a mean of 0.63 km (range: 0.2 - 2.6, N= 51) and CPC800 0.48 km (range: 0.1 - 1.3, N= 24). MPC900 showed a mean daily movement of 0.88 km (range: 0.25 - 2.2, N= 31) (Table 3).

Palm civets were active 738 (45.6%) of 1,617 activity readings. Daily activity levels indicated that palm civets were strongly nocturnal with peak activity occurring between 18:01 to 06:00 (mean: 70%) (Fig. 3). Activity levels dropped rapidly after daybreak to their lowest level (8%) around mid-day. The highest average monthly activity (51%) was recorded during May, while the lowest (43.5%) recorded during January.

Palm civets were shown to feed upon at least thirteen fruit species within the study area (Table 5). *Ficus* spp., *Passiflora foetida*, and *Polyalthia* spp. dominated frequency of occurrence at 24.0, 20.0 and 18.0 % respectively. Fruits from ten families were represented, including two unidentified yet separate species of legume (Leguminosaceae). Feces were collected from April through February. Grass was present in 12.7 % of fecal samples, while digested insect remains were found in 17.0 % of samples.

Discussion

The overall HRS of common palm civets CPC450 (1.1 km²), CPC500 (3.4 km²) and CPC800 (1.4 km²) were smaller than that for common palm civets in Huai Kha Khaeng where two

			Body measurements					
ID	Sex	Age	Weight (kg)	HB (cm)	TL (cm)	HF (cm)	E (cm)	URC (mm)
CPC500	M	PA	4.0	68	51	9.5	4.1	12
CPC450	M	PA	4.0	60	46	9.2	4.1	11
CPC800	F	PA	3.5	61	49	8	5	10
MPC900	M	PA	6	73	55	10	4.5	13

Table 2. Physical parameters of palm civets M = male; F = female; PA= prime adult; HB= head and body length; TL = tail length; HF = hind foot length; E= ear length; URC = upper right canine length

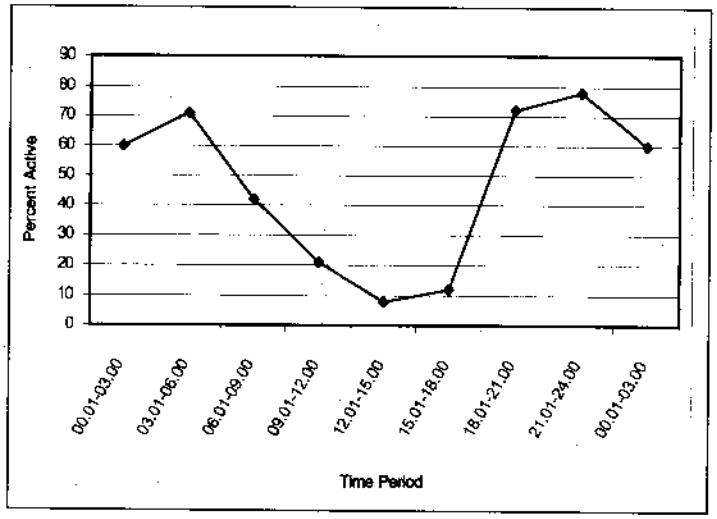

Fig. 3. Mean activity pattern of palm civets in KKNP. (N = 1,617 activity readings)

males showed an overall HRS of 17 and 4.25 km² (Rabinowitz, 1991a); although the large 17 km² HRS for the one male was influenced by a shift in his range. Male masked palm civet MPC900's overall HRS (5.9 km²) was shown to be larger than that of a female masked palm civet in Huai Kha Khaeng (3.7 km²).

The smaller HRS of KKNP common palm civets may have been due primarily to habitat composition. Rabinowitz (1991a) found palm civets to utilize mixed deciduous and dry evergreen forest proportionately more than dry dipterocarp which had a lower abundance of known food items. It would appear these civets had to enlarge their home ranges to accomodate adequate resource-rich forest types. KKNP palm civets ranged in a relatively rich, uniform forest type which appeared to satisfy dietary requirements within a smaller HRS.

The homogenous evergreen habitat of KKNP resulted in little seasonal home range use change. Palm civets in Huai Kha Khaeng were threatened seasonally with extreme environmental fluctuations such as fire and flooding which were important influences in altering HRS. A male common palm civet shifted his movements during fires and established a new home range, while a female masked palm civet showed larger than average daily movements during the fire season (Rabinowitz, 1991a). The fire prone dry dipterocarp forest of Huai Kha Khaeng, which was a major influence on civet movements and home range, occurred at very low levels (5%) in KKNP. Palm civets of KKNP were not subjected to the same environmental stresses of Huai Kha Khaeng civets.

Sexual, size, and habitat differences may explain the larger (5.9 km²) HRS of male masked palm civet MPC900 compared to the Huai Kha Khaeng female's range (3.7 km²). MPC900 weighed twice as much as this female (6.0 versus 3.0 kg) and was expected to occupy a larger home range based on the relationship between body size and home range use (Swihart *et al.*, 1988). In addition, males were expected to establish larger ranges as proposed by Sandell (1989), as is the case for males of many other carnivore species. Finally, the habitat composition of the Huai Kha Khaeng female consisted primarily of dry evergreen (67%) and mixed deciduous (30%) forest which likely provided adequate resources within her small range.

The modest expansion of palm civet HRS during the wet season (mean increase: 12%) contrasts with data for Huai Kha

ID	Overall home range size (km^2)	Wet season (km^2)	Dry season (km^2)	Mean daily movements (km)
CPC450	1.1	1.1	0.8	0.21
CPC500	3.4	3.4	3.0	0.63
CPC800	1.4	1.4	1.4	0.48
MPC900	5.9	5.9	3.6	0.88

Table 3. Overall home range size, seasonal size and mean daily movements of palm civets in KKNP, Thailand.

ID #	Palm civet ID #			
	CPC450	CPC500	MPC900	CPC800
CPC450	—	—	10%	—
CPC500	—	—	32%	—
MPC900	2%	18%	—	—
CPC800	—	—	—	—

Table 4. Home range overlap between sympatric palm civets in KKNP. (For each cell, the numbers represent the amount by which the animal in the column overlapped the home range of the animal in the row).

Khaeng where civets generally showed decreased HRS during the wet season, but increased activity. Palm civets in KKNP both increased HRS and activity during the wet season. Rabinowitz (1991a) contends that increased activity during the wet season may be due to palm civets feeding on abundant, localized fruits. In KKNP, the increase in HRS may have been due to increased foraging sorties for fruits which were not centrally abundant, although this could not be determined with the data.

A free water source was encompassed within all palm civet home ranges and appeared to be a prerequisite to civet territories as witnessed by the shift in home range of male CPC500 to include a water source when his original source, a small stream, dried up. Although palm civet omnivorous/frugivorous diets likely provided adequate moisture to sustain life, the utilization of free water was an important aspect of civet HRS.

Data were insufficient to draw correlates between HRS and intraspecific overlap between palm civets. Sign, in the form of feces and spoor, indicated the presence of several viverrid species within the home ranges of study civets. Both inter- and intraspecific overlap appears to have occurred at a high rate. Sympatric viverrids have been shown to coexist through habitat and resource partitioning (Rabinowitz, 1991b; Waser, 1989; Ikeda *et al.*, 1982) and abundant viverrid sign within the study area would appear to coincide with these findings.

A mean one-day movement of 0.48 km for palm civets in KKNP was less than the mean for two common palm and one masked palm civets in Huai Kha Khaeng (0.78 km) (Rabinowitz, 1991a) however, discounting the extremely small overall HRS (1.1 km^2) and mean one-day movement (0.21 km) of CPC450, the remaining data coincide well with Huai Kha Khaeng civets. While Rabinowitz recorded greatest daily movement during seasonal fire and flooding, KKNP palm civet movements were essentially consistent throughout the length of this study, with only slight increases in daily movement during the peak wet season coinciding with increases in activity. The dominant factors influencing the consistent movements of KKNP palm civets were likely stable habitat combined with limited environmental stress. Seasonal variation in movements was not necessary to fulfil palm civet living requirements as the habitat presumably remained sufficiently productive year-round.

Palm civets exhibited a nocturnal activity pattern with only very occasional diurnal activity. Overall activity (45.6%) was less than overall activity rates reported for Huai Kha Khaeng civets (55%) (Rabinowitz, 1991a). The nocturnal habits of palm civets have been reported by Bartels (1964), Rabinowitz (1991a) and van Schaik & Griffiths (1996). The marked decrease in diurnal activity levels appear to substantiate these reports. The lower activity levels for KKNP palm civets than for Huai Kha Khaeng civets may have been due to a less disruptive habitat (seasonal stresses) as discussed previously. High activity levels during May (51%) coincide with Rabinowitz as possibly due to increases in foraging on ripened fruits during the beginning of the wet season.

Palm civets have been shown to utilize fruits as a major component of their diets (Bartels, 1964; Rabinowitz, 1991a; Charles-Dominique, 1978; Wemmer & Watling, 1986; Heydon & Bulloh, 1996). While these authors report on the occurrence of fruits in palm civet diets, only Rabinowitz (1991a) identified consumed species through fecal analysis.

Although palm civet feces were collected from April through February (10 months), the highest occurrence of feces observed occurred between May through November (7 months) during the wet, productive season. Leighton & Leighton (1983) state that specialized frugivores may be forced to vacate an area when their fruit source is depleted, while those with fixed home ranges respond to periods of low fruit availability by increasing their dietary proportion on non-fruit foods and of aseasonal fruit types. The data for KKNP palm civets seem to support this statement as all study palm civets exhibited stable home ranges during the less productive dry season. A likely consequence was increased use of other food types both floral and faunal.

The heavy utilization of *Ficus* spp. in palm civet feces (24.0 %) may have been due to the lengthy season of productivity

Species	N	Frequency of occurrence
Moraceae		
Ficus spp. (two species)	12	24 %
Passifloraceae		
Passiflora foetida	10	20 %
P. edules	2	4 %
Annonaceae		
Polyalthia spp.	9	18 %
Meliaceae		
Aphanamixis polystachya	5	10 %
Myrtaceae		
Eugenia spp.	4	8 %
Elaeocarpaceae		
Elaeocarpus spp.	3	6 %
Leguminosaceae		
(two species)	2	4 %
Guttiferaceae		
Garcinia spp.	1	2 %
Solanaceae		
Solanum spp.	1	2 %
Sapotaceae		
(one species)	1	2 %
Total:	50	

Table 5. Frequency of occurrence of fruit species identified in palm civet feces (N= 50) from Ban Krang Study Area, KKNP.

these species exhibit. Leighton & Leighton (1983) report how several species of figs produce crops asynchronously and aseasonally thus resulting in a continual food source. KKNP palm civets utilized figs virtually year-round, and figs were likely important food supplements during the dry season.

While seed dispersal in tropical communities may be accomplished through a variety of faunal species, particularly birds, the capacity palm civets play in seed dispersal appears to be substantial. Rabinowitz (1991a) reports that Huai Kha Khaeng civets were shown to feed on a non-juicy fruit *Cassia fistula*, not known to have been utilized by other frugivores in the area. He adds that the subsequent deposition of this and other fruit species may have played an important role in the dispersal of these tree species. Although *Cassia* spp. was not identified from palm civet feces in this study, the presence of thirteen other fruit species would appear to substantiate the importance of palm civets as agents of seed dispersal.

ACKNOWLEDGEMENTS

I am indebted to Dr. J.F. Maxwell of the Chiang Mai Herbarium for his assistance with fecal seed identification. I thank Umaporn Grassman, Kwanchai Sukgao and Sean Austin for assistance with fieldwork. Permission for this study was granted by Royal Forest Department, National Parks Department and National Research Council of Thailand. This research was funded by Societa Zoologica La Torbiera.

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Carnivore Conservation Symposium

The symposium is organized by Drs. J. L. Gittleman, S. M. Funk, D. W. Macdonald, and R. K. Wayne and is held at the Meeting Rooms, The Zoological Society of London, Regent's Park, London NW1 4RY, UK on Friday 20 and Saturday 21 November 1998.

It is open to everyone and speakers and discussants will be encouraged to focus on some of the following questions:

- What methods and approaches are effective in monitoring and studying carnivores?
- Are particular carnivore species more vulnerable to extinction than others?
- What characteristics (e.g. genetic, life-history, ecological) influence relative vulnerability and chances of extinction in carnivores?
- Should broader approaches (e.g. community or phylogenetic) be used for carnivore conservation rather than species-by-species solutions?

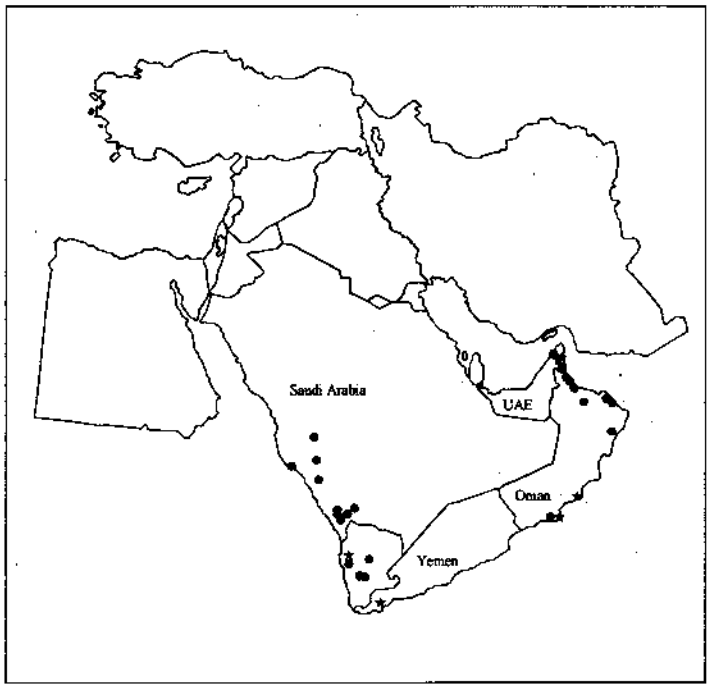
For booking and enquiries please contact: Assistant Editor, The Zoological Society of London. Regent's Park, London NW1 4RY, UK. Or e-mail Stephan M. Funk : stephan.funk@ucl.ac.uk
Http://www.gene.ucl.ac.uk/cee/ccs.html

A short note on the Arabian Peninsula distribution of the White-tailed mongoose

Chris and Tilde STUART

The distribution map for the white-tailed mongoose (*Ichneumia albicauda*) shown in Harrison & Bates (1991) indicates two areas of concentration for this herpestid, namely in northern Oman and extending into the eastern United Emirates, and in the extreme south-west. This latter area is mainly associated with the better-watered highlands and westward-flowing wadis in Yemen and Saudi Arabia. The first record for the intervening area falling between these two population «centres» was recorded as a road casualty in Jebel Qara, Dhofar during 1989, noted in Harrison & Bates (1989).

The authors have collected and observed this mongoose along Wadi Shawka, northern United Arab Emirates, as well as on the Tihama coastal plain of western Yemen. The apparent distributional gaps of this species along much of the southern Omani and Hadramawt (Yemen) coastal plains would appear to be more a case of under-recording than absence. On a recent trip (February 1998) along the entire coastal plain of Oman two new localities for the white-tailed mongoose were established, based on clear tracks (photographic records). Both records were associated with pools of permanent water at the mouths of seasonally flowing wadis, namely Khor Dhirif (Al Jawarah; 18°56.26'N, 57°20.60'E WGS84) and Khor Rawri (17°02.70'N, 54°25.77'E). At the first mentioned locality fresh tracks of this mongoose were also observed along the tidal high water mark.



Distribution of Ichneumia albicauda *in Arabia.*
● *Records from Harrison&Bates, 1991*
★ *New records from Oman, Yemen and United Arab Emirates (1996-98)*

It is our belief that the white-tailed mongoose will be found along much of the length of the southern Arabian coastline, with small permanent populations located along the principal wadi beds, with extensive use being made of the inter-tidal zone between estuaries. In parts of Southern and East Africa the marsh mongoose (*Atilax paludinosus*) exploits the food resources found along the coastline, using this zone to extend its range into otherwise arid and unsuitable habitat. Small populations centre on estuaries, with dispersal both inland along the watercourse and along the narrow coastal margin. The white-tailed mongoose in southern Arabia would appear to have developed a similar distributional and foraging strategy.

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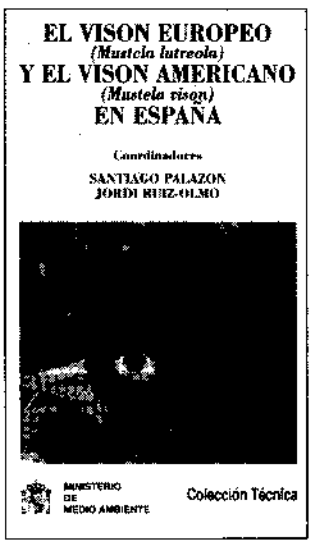
Harrison, D. L. & Bates, P. J. 1991. *The mammals of Arabia.* Harrison Zoological museum, Sevenoaks, UK.

African-Arabian Wildlife Research Centre, Box 1022, Umm-al-Quwain, United Arab Emirates

Recent publication



The European and American mink in Spain

Palazon, S. & Ruiz-Olmo, J., eds. 1997. *El visón europeo* Mustela lutreola *y el visón americano* Mustela americano *en España.* Parques nacionales. Ministerio de Medio Ambiente. 133 pp.

This book gives for the European mink a short history of its former distribution, its actual distribution in Spain, morphometrics of the skull, habitat, characteristics of Spanish specimens, biology, factors responsible for its decline, and recommendations for its conservation. The part on the American mink is chiefly concerned with its distribution in Spain with a note on its diet.

Surely a useful publication on the rare and endangered European mink for anyone who reads Spanish and is concerned with both mink species in Europe. For both species there are short English summaries which would have profitted from corrections by an English speaking person.

ERRATUM: In number 18 on page 10 three photographs are attributed to Ravi Chellam. Mr. Chellam has informed us that the three pictures are camera trap pictures and that the traps were all set by Divya Mudappa.

Red Panda Captive Management news

Appreciation is conveyed to the contributors of the following articles:

EEP News

The *fulgens* population in Europe numbered around 180 individuals at the end of 1997. These animals were housed in 59 institutions in 18 countries. This number of animals represents the number envisaged in Europe in the year 2000 in the Global Captive Breeding Master plan which was published in 1993. Having reached this number the EEP has been trying to slow the rate of population growth since 1996. The approach taken to population limitation has been two-fold:

- to raise the age at which the first young are produced
- to limit population size in successfully breeding pairs

This has meant that young pandas are usually held in same sex groups for 2-3 years before being paired up for breeding. On mainland Europe there are a number of zoos currently holding same sex pairs or trios. At the other end of reproductive life zoos holding pandas which have produced 8 or more offspring are being asked to stop their animals from breeding. Currently the breeding ban has only been requested in three zoos. However over the next few years this will become more prevalent.

There are two ways in which breeding can be inhibited. Either the breeding pair can be separated from January until April or the female can be treated with a contraceptive. Proligeston was tried on the female panda in Rotterdam Zoo. More information on contraceptive use in female red pandas in needed.

IRPMG News

In the last 12 months the International Red Panda Management Group has been active in their support of the Indian red panda breeding programme. This support covers the areas of training, education and research.

KEEPER TRAINING PROGRAMME

In order to promote good husbandry and management techniques for red pandas in India, a special training programme has been developed in Marwell Zoo, England. It is the intention that the key zoo personnel who work with red pandas should attend this course. 1997 saw the arrival of the first two trainees; K. Moktan from Darjeeling and C. Lachungpa from Gangtok.

EDUCATION AND AWARENESS PROGRAMME

The Australasian red panda programme in cooperation with the Zoo Outreach Organisation in India has been involved in the development of an education package for distribution to visitors in the Padmaja Naidu Himalayan Zoo in Darjeeling and schoolchildren in the area. In addition, a children's school "kit" with red panda theme is being designed with a container holding pencil, eraser, ruler and other items children require for school, include a message about red panda. A full colour red panda poster is in production in Sydney for distribution in the Himalayan region.

Research in India

Support has been given to Sunita Pradhan in the last stages of her research project on red pandas in the Singalila National Park, West Bengal. Sunita has submitted the following report:

RESEARCH ON RED PANDA IN SINGALILA NATIONAL PARK.

This project began in October 1993. The primary objectives were to document the occurrence of red pandas in the Singalila National Park and adjacent areas and to make an in depth study of its status and ecology. The study area was located in the eastern part of the Himalayas in the district of Darjeeling, West Bengal. The park has an area of 108.7 km^2 and is bounded by Nepal in the west and Sikkim in the north. The intensive study area comprises three separate sites and covers an area of 25 km^2. A preliminary survey of the park was carried out from October 1993 to September 1994.

The distribution, abundance, habitat use, food, feeding habits and conservation problems were studied in the intensive study area. After the field study ended in October 1995 there were many data to be analysed. Nutritional analyses had to be made of the food plants collected. In 1997 additional socio- economic data were collected from settlements in the buffer zone of the park.

Preliminary results indicate that the red panda is distributed throughout the entire park but is most prevalent in the rhododendron and sub-alpine forests. Some parts of the park were more conducive to red pandas in terms of protection, habitat availability and breeding population. Analysis of habitat variables indicate altitude, bamboo density and bamboo height are key factors in habitat selection by red pandas. Faecal analyses showed that both species of bamboo found in the park were an important part of the diet of the red pandas.

CAPTIVE BREEDING MASTER PLAN FOR INDIAN ZOOS

The programme to promote the long term conservation of the red panda in India has both in situ and ex situ components. The ex situ component is the establishment of a viable population of red pandas in zoos situated in the Himalayan region. The Padmaja Naidu Himalayan Zoo in Darjeeling already has a good, breeding group of red pandas. In 1997 a pair of red pandas were also sent to the new zoo in Gangtok, Sikkim.

The population of captive red pandas in India is already significant. In order to facilitate the development of a viable zoo population which is both genetically diverse and demographically stable a good captive breeding master plan was required. A draft master plan was completed and was discussed with members of the Indian Zoo community in 1997 and is currently undergoing a review process.

RED PANDA SPECIAL INTEREST GROUP

CBSG, India announces the start of a Red Panda SIG. The group will consist of specialists, as well as enthusiasts, with a special interest in the conservation and management of the Red Panda in India. Members will be expected to contribute and disseminate information, promote awareness of the need for special conservation measures for Red Panda and organise educational activities in India.

RED PANDA PHVA

CBSG, India, through the activities of the Red Panda SIG, will be promoting the need for a Population and Habitat Viability Assessment Workshop for Red Panda in 1999. Interested persons may write to:
Sally Walker, CBSG India, POBox 1683, Coimbatore, 641 004 (or by email at zooreach@giasmd01.vsnl.net.in).

Reported by Carol Bach

ASMP Regional Coorsinator for the Red Panda,
Taronga Zoo, PO Box 20, Mosman NSW 2088, Australia

Mustelids

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Belgium

The aim of the Newsletter is to promote communication between all interested in mustelid, viverrid and procyonid conservation and to stimulate conservation related activities for the species involved.

**In order to do so we should be financially independent.
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