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Cynictis penicillata.

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Cynictis Ogilby, 1833

Cynictis Ogilby, 1833:48. Type species *Cynictis steedmanni* Ogilby =*Herpestes penicillatus* G. Cuvier.

CONTEXT AND CONTENT. Order Carnivora, Family Herpestidae, Subfamily Mungotinae (Corbet and Hill, 1986; Gregory and Hellman, 1939; Honacki et al., 1982; Hunt, 1987; Pocock, 1916; Wozencraft, 1989*a*; Wurster and Benirschke, 1968). This classification disagrees with the conventional one which regards the mongooses as a subfamily of Viverridae (Meester et al., 1986; Rosevear, 1974; Simpson, 1945; Stains, 1984). In a survey of a large number of characters, Wozencraft (1989*b*) found no synapomorphies uniting the Viverridae (civets and genets) and Herpestidae (mongooses) and he felt that combining these two families would result in a paraphyletic group. The genus *Cynictis* is monotypic.

Cynictis penicillata Cuvier, 1829

Yellow Mongoose

Herpestes penicillata Cuvier, 1829:158. Type locality "Cape" (designated as Uitenhage, eastern Cape Province by Roberts, 1951:151).

Mangusta Le Vaillantii Smith, 1829:437. Type locality "South Africa."

Cynictis steedmanni Ogilbyi, 1833:49. Type locality "Uitenhage, on the borders of Caffraria," eastern Cape Province, South Africa.

Cynictis typicus Smith, 1834:116. Type locality "South Africa."

Cynictis ogilbyii Smith, 1834:117. Type locality "The Bushman flat and northern parts of Graaf-Reynet [Graaf-Reneit] district," Cape Province, South Africa.

Cynictis lepturus Smith, 1839: Plate 17 and text. Type locality "arid plains towards the Tropic of Capricorn" (= Marico district, Western Transvaal, South Africa, *fide* Roberts, 1951: 154).

Cynictis penicillata pallidior Thomas and Schwann, 1904*a*:175, 1904*b*:5. Type locality "Klipfontein," north of Steinkopf, Little Namaqualand, northwestern Cape Province, South Africa.

Cynictis penicillata intensa Schwann, 1906:104. Type locality "Deelfontein, Cape Colony," north of Richmond, Cape Province, South Africa.

Cynictis penicillata brachyura Roberts, 1924:68. Type locality "Boschkop, near Johannesburg," Transvaal, South Africa.

Cynictis penicillata bradfieldi Roberts 1924:69. Type locality "Quick-born, Okahandja District," Damaraland, Namibia.

Cynictis bradfieldi cinderella Thomas, 1927:375. Type locality "Ondongwa, central Ovamboland," northern Namibia (elevation 1,074 m).

Cynictis penicillata coombsii Roberts 1929:90. Type locality Swarthaak Farm, north of Soutpansberg Mountains, northern Transvaal, South Africa (and not "Swarthoek, Zoutpansberg," as originally described: see Taylor and Meester, 1989).

Cynictis penicillata kalaharica Roberts, 1932:4. Type locality "Kaotwe Pan, Central Kalahari," Botswana.

Cynictis penicillata bechuanae Roberts, 1932:4. Type locality "Gaberones," southeastern Botswana.

Cynictis penicillata karasensis Roberts, 1938:235. Type locality "Kochena, Great Karas Mountains," Great Namaqualand, Namibia.

CONTEXT AND CONTENT. Context as for the genus. As many as 12 subspecies of yellow mongooses have been recognized in the past (Allen, 1939; Ellerman et al., 1953; Roberts, 1951; Shortridge, 1934). On the basis of apparent clines in size and color, *C. penicillata* is currently taken to be monotypic (Coetzee, 1977; Lundholm, 1955; Meester et al., 1986, but see REMARKS).

DIAGNOSIS. Five toes on forefeet, four on hindfeet; skull relatively high, greatest height, measured at external auditory meatus and including anterior part of bulla, just less than half of condylobasal length; orbit completely surrounded by bony ring; anterior part of bulla as large as posterior, in contrast to most mongooses in which it is somewhat smaller; four premolars and two molars in each quadrant; ears relatively large and, unlike most other mongooses, projecting above the line of the head, seldom less than 9% of head and body length (Figs. 1, 2).

FIG. 1. Dorsal, ventral and lateral views of cranium, and lateral view of mandible of *Cynictis penicillata*, female, from Victoria West, Cape Province, South Africa.

FIG. 2. Yellow mongoose, *Cynictis penicillata* (photograph obtained from C. Baker).

The only other diurnal mongoose species within the range of the yellow mongoose with which it may be confused is the slender mongoose *Galerella sanguinea*. Together with the larger ears of *C. penicillata*, the presence of a black tail tip in *G. sanguinea* (as opposed to a white tail tip in the *C. penicillata*) is sufficient to distinguish these two species. Furthermore, the anterior chamber of the bulla is smaller than the posterior in *G. sanguinea*, whereas both chambers are subequal in *C. penicillata*. While *C. penicillata* bears a superficial resemblance, in general coloration and presence of a white tail tip, to Selous' mongoose, *Paracynictis selousi*, the latter is nocturnal and larger in size (up to 75 cm in total length compared to usually <60 cm in *C. penicillata*; skull length always <75 mm in *C. penicillata* compared with 90 mm in *P. selousi*; Skinner and Smithers, 1990).

GENERAL CHARACTERS. Pelage color varies geographically from tawny-yellow in the south (South Africa, Namibia) to greyish-yellow and grizzled in the north (Botswana). The grizzled appearance of northern individuals results from contrasting, alternating black (eumelanin) and pale yellow (phaeomelanin) bands in individual guard hairs. Phaeomelanin bands are a richer orange color and eumelanin bands are reduced in southern specimens. Trend surface analysis of quantitative colorimetric variables of yellow mongoose study skins has shown that southern and northern color types are separated by a zone of rapid color change which corresponds roughly with the southern and western limits of Kalahari sands in Southern Africa (with greyer specimens occurring on Kalahari sands). Specimens from the drier regions of the northwestern Cape Province and Namibia are somewhat paler than specimens from throughout the remainder of the species' range. A white tail tip is present in southern (Fig. 2), but not northern, specimens. Hair length is generally longer in southern specimens than in northern specimens, although it is always longest on the tail, giving the tail a bushy appearance (Fig. 2). Seasonal variation in pelage color in southern specimens results in summer specimens having shorter hairs and a redder, brighter coat than winter specimens. The transitional coat, which appears in November and December, is pale yellow in color, and patchy in appearance owing to the presence of old, moulting, black-tipped guard hairs over the newer summer coat. Seasonal changes are not conspicuous in the greyer-colored northern specimens (Skinner and Smithers, 1990; Taylor et al., 1990*a*).

Because of its relatively large, rounded ears, and bushy tail, the yellow mongoose has a somewhat fox-like, rather than typical mongoose-like, appearance (Shortridge, 1934; Fig. 2). A strip of naked skin is present on the midline of the upper lip, although this does not completely divide the upper lip as it does in most mongoose genera (Pocock, 1916). Five digits are present in the forefoot and four on the hindfoot. The first digit in the forefoot is raised above the rest and does not make an impression in the spoor. The hindfoot sole is somewhat hairy, the forefoot palm being more extensively naked, almost to the wrist (Roberts, 1951). The claws are longer on the front than on the hindfeet (Skinner and Smithers, 1990).

The yellow mongoose is relatively small, compared to most other mongooses, but body size does not differ between males and females (Lynch, 1980). Northern specimens are distinctly smaller than southern specimens. Means, ranges (in parentheses), and sample sizes for body measurements (in mm) and body mass (in grams) of male, northern specimens from Botswana are (Smithers, 1971): total length, 496 (412–582), *n* = 36; length of tail, 210 (181–250), *n* = 36; length of hindfoot (*cum unguis* [with claw]), 67 (61–78), *n* = 38; length of ear, 30 (24–36), *n* = 33; mass, 589 (478–797), *n* = 20. Corresponding measurements of southern specimens of both sexes from Orange Free State, South Africa, are (Lynch, 1980): total length, 580 (526–615), *n* = 20; length of tail, 240 (218–266), *n* = 20; length of hindfoot (*sine unguis* [without claw]: +8 mm to adjust *sine unguis* to *cum unguis*), 71 (66–76), *n* = 20; length of ear, 35 (32–39), *n* = 20; mass, 830 (715–900), *n* = 20.

Means, ranges (in parentheses) and sample sizes of selected body and skull measurements (in mm) of *C. penicillata* are (based on measurements by PJT of specimens from several Southern African museums and the Natural HistoryMuseum, London): length of head and body, 333 (265–460), *n* = 235; length of tail, 228 (150–292), *n* = 234; condylobasal skull length, 65.4 (56.2–73.7), *n* = 283; brain case width, 28.1 (24.8-30.9), *n* = 284; mandibular ramus height, 17.8 (15.2–20.8), *n* = 287; interorbital width, 15.1 (12.6–18.2), *n* = 284; zygomatic width, 39.1 (33.2–44.2), *n* = 278; bulla length, 17.1 (15.0–18.8), *n* = 285; length of fourth upper premolar, 6.03 (4.75–7.30), *n* = 287.

DISTRIBUTION. The yellow mongoose is endemic to and widely distributed throughout Southern Africa, being found in South Africa including the Cape (except for mountainous and forested regions in the south and east), the Orange Free State, western and central Natal, Transvaal (except in the east and parts of the northwest); Botswana (except for the Okavango swamps and the extreme northeastern and eastern parts); extreme western Zimbabwe; Namibia (except for the Namib Desert, the Caprivi strip, and the extreme north). A single record exists from Angola (Mupanda, near the southern border of Angola, between the Cunene and Okavango rivers—Fig. 3; Davis, 1962; Lynch, 1983, 1989; Pringle, 1977; Rautenbach, 1982; Shortridge, 1934; Skinner and Smithers, 1990; Stuart, 1981).

The yellow mongoose has recently expanded its range into the wheatlands of the southwest Cape. The species is particularly common in the western Orange Free State and western Transvaal where population densities are very high. On the other hand, islands occur within the species' distribution, such as the Gaap Plateau in the northern Cape, where yellow mongooses are very scarce or absent (Snyman, 1940; Stuart, 1981).

FOSSIL RECORD. The earliest presence of *C. penicillata* and ancestral forms is recorded in late Cenozoic deposits during the Makapanian mammal age (3×10^6–700,000 years ago), at the fossil sites of Makapansgat and Swartkrans. The species is also recorded from Southern African sites spanning the Cornelian (700,000-125,000 years ago) and Florisian (125,000–12,000 years ago) mammal ages (Hendey, 1974). Savage (1978) recorded *Cynictis* (an unidentified species which may have represented *Paracynictis selousi*, since Savage incorrectly included *selousi* in *Cynictis*) from the early Pleistocene, East African site of Olduvai I.

FORM AND FUNCTION. Like all other herpestids, as well as viverrids, the yellow mongoose possesses a glandular anal sac, consisting of a depressed, glandular area surrounding the anus. A pair of gland orifices opens at a point somewhat higher up in the anal sac than the anus (unlike the situation in most herpestids in which these apertures are level with the anus; Pocock, 1916). Contrary to Pocock's assertion, examination of a frozen, male yellow mongoose (skin and skull deposited in the Transvaal Museum, TM39223) by PJT showed the gland orifices to open close to and on either side of the anus. Two caudally located, glandular depressions, not noted by Pocock (1916), were also noted. The peri-anal area of the anal gland of both sexes is thinly covered by a dark brown, waxy material with an odor closely resembling that of dried beef. The anal sacs of the yellow mongoose contain a milky fluid with a sour, cheesy smell, which has been analyzed by gas-liquid chromatography and mass spectrophotometry, and found to consist of 22 volatile compounds, including short-chain fatty acids, esters, alcohols, aldehydes, organic sulphurous compounds, and the aromatic nitrogenous compound, indole. The odor volatiles of the yellow mongoose are considerably more diverse, and the intersexual differences more complex, than those of *Herpestes auropunctatus* and *H. ichneumon* (Apps et al., 1989). The anal glands function in scent marking of home ranges and in allomarking between colony members (Earle, 1981).

Braincase is pear-shaped, narrowing to the postorbital constriction. Postorbital bars are closed in adults and angled sharply backwards at the postorbital constriction. Rostrum is short and broad, the distance from the front of the eye socket to the incisors being about 30% of the total length of the skull. Zygomatic arch is weak. Supraoccipital crest is low, poorly developed. Sagittal crest is absent or weak. Undeveloped zygomatic arch and sagittal crest suggests relatively weak masseter and temporalis muscles adapted to a diet of soft food. The bulla is dominated by an enlarged, anterior ectotympanic chamber; in other herpestids the caudal entotympanic dominates the bulla. Whereas in other mongooses the septum separating the ectotympanic and entotympanic is vertical, this is an angled partition (from anterodorsal to posteroventral) in *C. penicillata*, a feature shared with most other hyaenids (Fig. 1; Hunt, 1987; Skinner and Smithers, 1990).

The dental formula is i 3/3, c 1/1, p 4/4, m 2/2, total 40. Upper canines are long, sharp, and slightly flattened on the inside, while lower canines are strongly recurved. First upper and lower premolars are small and peg-like, and are sometimes absent, particularly in the lower jaw. The carnassial teeth (PM4 and ml) have retained some slicing ability. The lower first molar has three high, anterior cusps and the hind portion is flattened. The second lower molar is adapted for crushing insects and other soft food, having three cusps in front, a flat central section, and a low cusp at the back. The two upper molars are elongated labio-lingually and lie at right angles to the tooth row (Fig. 1; Skinner and Smithers, 1990).

In terms of their external neuroanatomy the yellow mongoose possesses (in common with *Bdeogale*, *Ichneumia*, and *Paracynictis*) a short presylvian sulcus that delimits a small orbital gyrus and (in common with *Helogale*, *Mungos* and *Suricata*) an undeveloped coronal sulcus (Radinsky, 1975). The ear of *C. penicillata* differs from all other mongoose species, not only on the basis of its larger size, but also in the existence of a small shallow pocket behind the antitragus, which may be an homologue of a similar depression, the marginal bursa, found in the ear of hyaenas (Pocock, 1916).

ONTOGENY AND REPRODUCTION. In the southern Transvaal, matings commence in the first week of July (Earle, 1981). In a sample of 90 female *C. penicillata*, eight were pseudopregnant (Lynch, 1980), indicating the possibility of induced ovulation in the species. Gestation period varies from 42 to 57 days (Ewer, 1973; Zumpt, 1976). Based on the numbers of corpora lutea, embryos, and placental capsules present, two out of 12 pregnant female reproductive tracts analyzed microscopically had suffered prenatal (preimplantation or postimplantation) losses (Lynch, 1980).

The birth season is estimated to occur from August to November (Brand, 1963; Earle, 1977; data from the South African Museum and the Johannesburg City Zoological Gardens cited by Lynch, 1980) and from October to January (Ewer, 1973). The discovery of lactating females during January, February, and March indicates that the birth season probably extends at least until January. Young are born in chambers in the burrows which are devoid of nest material. Females have three pairs of abdominal mammae (Rautenbach, 1982; Skinner and Smithers, 1990; Smithers, 1971; Stuart, 1981).

Litter size may be somewhat higher in the northern parts of the species' range. Average number of fetuses varied from 2 to 5 in Botswana, with a mean of 3.2 (*n* = 6; Smithers, 1971), 2–5 in the Transvaal (Rautenbach, 1982), a mean of 2.3 fetuses in Natal (Rowe-Rowe, 1978) and in the Orange Free State (Lynch, 1980). A mean of 1.8 young/litter was recorded in the Orange Free State (Lynch, 1980). Based on estimates of a mean of 2.3 fetuses/pregnant female, a mean of 1.8 young/litter, and estimates of prenatal losses in 2 of 12 females analyzed, the total loss from ovulation until after parturition is 0.8 ovum, embryo, fetus or young/female.

Each of 41 litters was composed of one sex only. At birth, the male : female sex ratio was 1.6:1, whereas in adults this changed to 1.2:1 (Zumpt, 1976).

The reproductive season may be more prolonged in yellow mongooses from northern regions. From an examination of 676 yellow mongooses collected from the western Transvaal, pregnant females were found from mid-July to the end of December, with a peak in October. In the Orange Free State, pregnant females were recorded between August and November. In Botswana, pregnant females have been collected in February, March, July, October, and November. The presence in the Transvaal Museum collection of two pregnant specimens from Windhoek, Namibia, collected during February, supports the notion of a prolonged breeding season in the north (Lynch, 1980; Smithers, 1971; Zumpt, 1969).

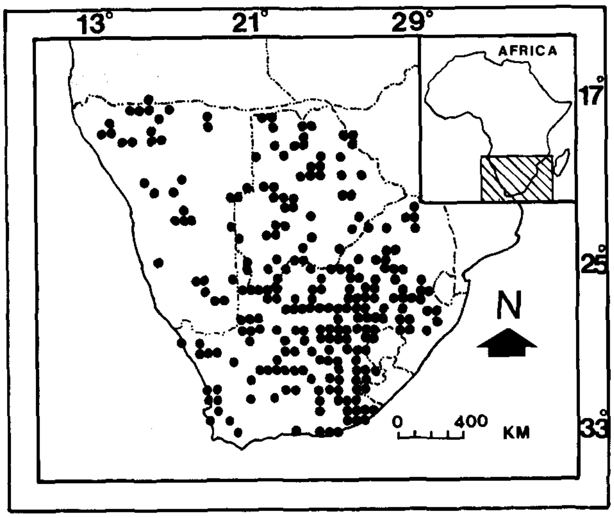

FIG. 3. Geographical distribution of *Cynictis penicillata*.

In the Orange Free State, an increase in adult male reproductive activity (involving several variables including testes, epididymis, accessory gland and endocrine organ masses, and spermatozoa numbers) occurs from about March/April, to a maximum during September/October, followed by a minimum (a period of relative quiescence) in January/February. However, male *Cynictis* do not exhibit pronounced seasonal reproductive periodicity and their reproductive cycle seems to be regulated by the cycle of the female (Lynch, 1980).

Although Snyman (1940) indicated that *C. penicillata* may have more than one litter/season, this has not been substantiated (Lynch, 1980; Zumpt, 1969, 1976). However, postpartum and pseudopregnant females occur in which a second, seasonal ovarian cycle had occurred, suggesting that a second opportunity for breeding exists in cases of failed mating or loss of young (Lynch, 1980). Two females from Windhoek, Namibia (Transvaal Museum, TM39947, TM39949), were collected when pregnant and lactating, suggesting that, at least in northern specimens, some females have two litters/season.

Weaning takes place at about 10 weeks of age (Zumpt, 1976). Lynch (1980) described five morphometric groups (relative age classes) of *Cynictis* and also provided a classification of reproductive groups of male and female individuals (for example, prepubertal, pubertal, pregnant). Using known-age animals, Zumpt (1969) described five age classes. By comparing mean values for zygomatic width of Zumpt's age classes and Lynch's size classes, Lynch's size groups could be approximately calibrated: Lynch's group A matched Zumpt's group I (3–9 months); groups B and C matched group II (9–12 months); group D matched groups III and IV (>1 year); and group E matched group V (unknown age). According to Lynch (1980), 75% of prepubertal females (those having no Graafian follicles in the ovaries) belonged to group A and 25% belonged to group B and C. Twelve percent of pubertal females belonged to group A. Estrus females were all of group D (older than one year). Among males, prepubertal individuals could be subdivided into those in which the spermagenic cycle was incomplete and the seminiferous tubules very small in diameter, and those in which epididymal spermatozoa were present. Individuals of the former group belonged to groups A, B, and C (<1 year old), while those of the latter group, which were probably fertile, belonged to groups C and D (>9–12 months). Males may be physiologically mature at about 9 months of age, but they may not be behaviorally capable of reproducing (Lynch, 1980). Species such as *Herpestes auropunctatus* and *Mungos mungo* have been shown to have sperm in the testis at about 4 months of age. In *Ichneumia albicauda*, incomplete sexual behavior was noted at 15 months, but only at 2 years of age were both sexes sexually mature (Hinton and Dunn, 1967).

ECOLOGY. The yellow mongoose is associated with semi-arid, open habitats within the South West Arid Zone (Davis, 1962), as typified by Karoo scrub in the Cape Province, grassland associations in the Orange Free State, semi-desert scrub in Botswana, and the gravel plains and pro-Namib of Namibia. Where the species occurs in woodland associations, such as *Combretum/Terminalia* scrub of the Kalahari, it is usually associated with open areas such as vleis and grasslands surrounding waterholes. The species extends narrowly into savanna habitats in the northern Transvaal and northwestern Natal, but yellow mongooses are less abundant in savanna than in pure grassland habitats. Yellow mongooses have also been recorded in stands of *Phragmites* reeds along the Keisers and Koning rivers and from fairly dense bushveld in the Fish River valley, Cape Province. The species is entirely absent from desert, forest, and montane habitats. Factors determining the occurrence of *C. penicillata* in an area include: (1) food supply (particularly their principal food source of termites *Hodotermes* and *Trinervitermes*); (2) occurrence of the ground squirrel *Geosciurus capensis* (which is usually responsible for digging the burrows that yellow mongooses cohabit); (3) soft or sandy soils for digging; (4) open country devoid of dense bush (Rautenbach, 1982; Skinner and Smithers, 1990; Snyman, 1940; Stuart, 1981).

The yellow mongoose is a predominantly diurnal, colonial species, occupying permanent burrows which it often cohabits with ground squirrels (*Xerus inaurus*) and suricates (*Suricata suricatta*). *Xerus* and *Suricata* have longer claws and are better adapted to digging than *C. penicillata*, and the yellow mongoose often occupies burrows initially excavated by the other two species. However, the yellow mongoose is capable of excavating its own burrows, and a complex burrow with 66 entrance holes has been found. Burrows vary in structure from simple systems with one or two holes to complex, extensive systems having 40 or more holes. Tunnels are interconnected underground and occur on two or three levels to a depth of about 1.5 m. Enlarged nest chambers are excavated at intervals along the tunnels. Burrow-dwelling confers a significant thermoregulatory advantage, in that the microenvironment is buffered against extremes in ambient temperature. In the Orange Free State in the hottest summer months, where an average, mean maximum ground temperature of 39°C was found, the corresponding soil temperature was 14°C cooler. In the coldest winter months, when a minimum mean of −3.6°C was recorded, soil temperature was 14°C warmer (Earle, 1981; Roberts, 1951; Sclater, 1900; Shortridge, 1934; Skinner and Smithers, 1990; Snyman, 1940).

Mean colony sizes of 3.9 (n = 362 colonies; Zumpt, 1976), 4.1 (n = 8; Lynch, 1980) and 8 (n = 5; Earle, 1981) have been recorded in the southern and western Transvaal and the Orange Free State. In Botswana, colonies of up to eight individuals occur, but the majority consist of one or two individuals (Smithers, 1971). A record of a colony of 50 animals in the Addo area of the Cape (Fitzsimons, 1919) probably resulted from the author confusing *S. suricatta* with *C. penicillata* (Skinner and Smithers, 1990).

Sex ratios of 1:1.2 favoring females (Lynch, 1980; Zumpt, 1976) and 1.2:1 favoring males (Earle, 1981) have been recorded. A yellow mongoose group centers around a family group, consisting of a male and female, their youngest offspring, and two other individuals, usually subadults or very old individuals. The remaining three or four individuals of a group have only a loose association with the group. In many instances, however, burrows may contain single individuals or pairs of individuals (Lynch, 1980; Earle, 1981).

Tagged animals have been observed feeding up to 1.3 km from their burrows (Stuart, 1981). Home ranges vary from 600 to 3,000 m in radius from a colony (Zumpt, 1976). Territories occupy an area of 5–6 ha (Earle, 1981). Yellow mongooses may have 3–5 burrow systems, each of which may be occupied for 6–8 weeks. Actual territory size could cover an area of 3 km^2 or more (A. Rasa, pers. comm.).

Both the yellow mongoose and the suricate are diurnal, insectivorous, and share the same burrows. However, *S. suricatta* is highly social and forages cooperatively while *C. penicillata* is less social and forages individually; *S. suricatta* is strictly diurnal while *C. penicillata* is diurnal and crepuscular, becoming marginally nocturnal in summer; *S. suricatta* is strictly insectivorous (preferring Lepidoptera and Coleoptera) while *C. penicillata* is insectivorous (preferring Isoptera) and carnivorous; *S. suricatta* is confined to open habitat, while *C. penicillata* also occurs in wooded vegetation; *S. suricatta* excavates its own burrows while *C. penicillata* often uses those of *S. suricatta* and the ground squirrel (*Xerus inaurus*). These factors minimize competition and allow coexistence between the two species (Lynch, 1980).

Thirty five species of parasites have been recorded from the yellow mongoose: six species of fleas (including the plague vector, *Xenopsylla pirei*), 10 species of ticks (including the economically important species, *Rhipicephalus appendiculatus*), seven species of mites, two species of lice, nine species of helminthes and a nematode parasite, *Tenuostrongylus cynictis* (Hinton and Dunn, 1967; Lynch, 1980).

Large snakes and water monitor lizards (*Varanus* spp.) prey on young or immature yellow mongooses. Large raptors such as the Tawny Eagle (*Aquila rapax*), Martial Eagle (*Polemaetus bellicosus*) and Wahlberg's Eagle (*Aquila wahlbergi*) are the most important natural predators. Man is the most important predator, as the yellow mongoose has, in the past, been indiscriminantly shot by farmers who (probably mistakenly) considered that yellow mongooses were responsible for killing newborn lambs (Hinton and Dunn, 1967).

The yellow mongoose is an opportunistic feeder, taking insects but also larger, vertebrate prey (Skinner and Smithers, 1990). Stomachs of 20 yellow mongooses in the Cape Province contained beetle (Coleoptera) larvae and adults and locusts (Orthoptera) in the highest occurrence (Stuart, 1981). Other food items included termites, caterpillars, ants, mice, birds, reptiles, grass, and seeds. Fecal samples of the species from Mountain Zebra National Park revealed that the diet consisted predominantly of insects, in particular beetles, grasshoppers, and termites (Du Toit, 1980). Other food items were fruit (*Diospyros lycioides*) and occasional mice or birds. Mice had the highest occurrence in 95 stomachs collected from the Orange Free State, western Transvaal, and northern Cape, with locusts occurring almost as frequently as mice, and termites and beetles also present. The remains of ground squirrels (*Xerus inaurus*), yellow mongooses (*Cynictis penicillata*) and meat from unidentified larger carcasses were also recorded in several stomachs, indicating that the species feeds on carrion (Zumpt, 1968). A yellow mongoose was observed gnawing on the lips and muzzle of a dead ox (Snyman, 1940). In captivity, mothers devoured their young on two occasions, although there was sufficient food in the cages. Food items taken in captivity are, in order of preference: termites, locusts, lean meat, eggs, lizards, boiled meat, beetles, mice, and birds. In the field yellow mongooses have been observed to hunt birds. They have also been observed to eat the aloe-type plant *Chortolirium angolense*, although this may be for the water content (Zumpt, 1968).

In the Transvaal, invertebrates occurred more frequently (87%) than vertebrates (62%) in 76 yellow mongoose stomachs (Herzig-Straschil, 1977). Invertebrates included termites, locusts, and a mixture of other invertebrates. Vertebrates included mammals, birds, and amphibians. The most important invertebrate species was the harvester termite (*Hodotermes* sp.). This corresponds with a sample of 54 stomachs from Botswana, in which *Hodotermes mossambicus* was the most important invertebrate food item (Smithers, 1971). The distribution of *H. mossambicus* corresponds very closely with that of the yellow mongoose (Skinner and Smithers, 1990). Insects had the highest percentage occurrence (91%), followed by murids (15%), scorpions (13%), reptiles (11%), and, at lesser percentages, centipedes, birds, frogs, hunting spiders, and true spiders. Among the insects, termites occurred most frequently (37% of stomachs), followed by dung beetles (33%), crickets and grasshoppers (32%), beetle larvae (28%), and, at much lower percentages, ants and cockroaches (Skinner and Smithers, 1990; Smithers, 1971).

A predominance of termites (in this case *Trinervitermes trinervoides*) in the diet of the yellow mongoose was reflected by their occurrence in 74% of 156 stomachs and/or colons from the Orange Free State (Lynch, 1980). Other important food items were, in order of importance, Orthoptera, Coleoptera, and Lepidoptera. Also present, at lower percentages, were birds, reptiles, amphibians, mammals (including remains of mice, springhares, shrews and hares), Hymenopterans, spiders, Dermapterans, Dipterans, Dictyopterans (including cockroaches), Diplopodans, and Chilopodans. There were no seasonal differences in the proportion of the four most important food items in the diet of the yellow mongoose (Lynch, 1980). Analysis of feces of yellow mongooses from the Vaaldam in the Transvaal showed that, during winter when insects were less abundant, fruit from *Diospiros lycioides* and *Opuntia* sp. were an important food source and could make up as much as 16% of the total food taken (Earle, 1981).

Yellow mongooses prey on hens' eggs and free-ranging chickens (Roberts, 1951). There is no evidence for Fitzsimons' (1919) contention that they kill and eat young lambs (Skinner and Smithers, 1990).

The yellow mongoose is a major carrier of rabies in South Africa and the geographical incidence of this disease in South Africa corresponds closely with the distribution of the species. By 1940, *C. penicillata* had been responsible for the recorded death of some 21 human beings and 5 head of cattle, besides causing some 80 known outbreaks of rabies. A large proportion of human deaths result from curious children approaching infected animals that lose their fear of humans and wander onto farms (Snyman, 1940; Zumpt, 1969, 1976).

The prevalence of rabies in this species is attributed, not to a greater susceptibility to the virus, but rather to their abundance in certain areas and their burrow-dwelling habit which brings individuals into close proximity, thereby increasing the chances of transmitting the virus. There is a high correlation between the seasonal incidence of rabies and the breeding cycle of the yellow mongoose. Annual peaks in incidence of rabies and the pregnancy rate of female yellow mongooses both occur in October. As subadults are forced to leave the colony before the birth of the litter of the current year in October, young animals must compete for the establishment of territories in winter when food supplies are limited. These and other stresses may trigger clinical rabies in the mongoose population (Zumpt, 1969, 1976). However, the hypothesis that subadults are forced to leave the colony before the end of their first year has been challenged by recent evidence which shows that young may remain in their natal colony for several years as helpers (Rasa, pers. comm.).

Rabies outbreaks occur in restricted foci, and the disease can flare up in the same area or farm after intervals of several years. The effectiveness of controlling rabies through the systematic extermination of yellow mongooses (*C. penicillata*), suricates (*S. suricatta*), and ground squirrels (*X. inaurus*) on infected farms has been examined in the past. The most effective method of extermination involved sealing and gassing burrows with cyanide gas, followed by setting traps for the survivors who managed to dig out of the burrows. On two infected, adjacent farms in the Bloemfontein district in the Orange Free State, 1,591 colonies were gassed, and 384 yellow mongooses were trapped over a period of 3 months. Fumigating burrows with phosphine ("Phostoxin") is effective in exterminating yellow mongooses, but also is cruel because it results in a slow, painful death (Zumpt and de Bruyn, 1967). CO and CO_2 have been found to be as effective, but cheaper and less dangerous to use than cyanide gas and phosphine. The effectiveness of eradication in controlling rabies has been questioned, as temporary reduction in size of a localized population is followed by immediate recolonization and exponential population growth (Snyman, 1940; Zumpt, 1976; Zumpt and de Bruyn, 1967).

Methods of trapping yellow mongooses include live-traps, flooding burrows with water, fumigating burrows with sulphur dust or phosphine, excavating burrows, and shooting. Only the latter two techniques were found to be consistently successful (Lynch, 1980).

The yellow mongoose has lived up to 15 years in captivity (Nowak and Paradiso, 1983).

BEHAVIOR. Yellow mongooses are primarily diurnal but are often active on warm, summer nights. Individuals emerge from their burrows before sunrise, sometimes as early as 0600 h. After moving to middens to defecate, they return to their burrows for 30 min before reappearing to sunbathe. While sunbathing, individuals face north–south to gain maximum benefit from the sun. Several sunbathing postures, including standing and sitting positions, are adopted, usually exposing as much of the skin on the stomach and neck as possible. As much as 90 min/day is spent sunbathing. After sunbathing, individuals forage independently although occasionally pairs may be seen together. Foraging involves digging and scratching in the ground and in dung heaps for insect larvae and termites, as well as pursuing and hunting vertebrates such as mice, lizards, and game birds. On hot days, yellow mongooses rest in their burrows from 1100–1430 h, followed by a further foraging period before they retire to their holes between 1730–1830 h (Earle, 1981).

Territories of yellow mongooses correspond closely with their foraging ranges. The dominant male of a colony patrols a territorial demarcation route daily before foraging. Demarcation of yellow mongoose territories occurs primarily by means of anal and cheek glands, and secondarily by means of feces and urine concentrated in middens which are often positioned along territorial borders. Backrubbing is also employed as a visual and olfactory method of marking objects within the territory. Facial glands are used in the vicinity of burrow holes and are thought to be aimed at intracolony communication. Anal glands are used most often for marking and secretions are deposited with the individual in a squat position throughout the territory. On his territory demarcation trip, the dominant male deposits secretions every 5–10 m. Marking occurs more frequently where a territorial border is under greater pressure from adjacent colonies. Only the dominant pair makes any contribution to territory demarcation. The dominant female marks less frequently than the male, but actively assists in defending the territory (Earle, 1981).

Fights between dominant males of adjacent colonies occur frequently and last about 3–4 s, after which each runs back to his own territory. Wounds are inflicted often, as dominant males often have scars on their faces. Within a colony, the dominance hierarchy consists of, in order of decreasing dominance, the dominant male, the dominant female, the youngest offspring, other adults, young adults, and very old animals. Subordinate individuals exhibit submissive behavior towards dominant individuals while the latter exhibit dominance in the absence of submissive behavior from subordinates. To assess their mutual status two individuals approach each other and sniff the facial glands. The most dominant rises higher on its legs while licking or biting the other's neck. The subordinate lies on its side and sometimes emits a high-pitched scream. This behavior only occurs between colonies. A dominant individual marks a submissive individual in his colony by jumping over it and landing, using the anal glands in a standing position. Each dominant male marks the individuals of his colony daily (Earle, 1981).

Matings commence in July. Copulation lasts for about 30–60 s, during which the male makes a soft purring sound while the female bites or licks the male's ears and neck continuously. Dominant females probably only mate with dominant males, while young females mate with dominant and young males (Earle, 1981).

The yellow mongoose is a quiet animal, with only five vocalizations. A high pitched scream is emitted during fighting. A low growl warns off other animals and a very low growl is emitted when an animal is threatened. A short barking sound is emitted in dangerous situations, causing all other animals in hearing range to disappear into their burrows. A soft purring sound is emitted during copulation (Earle, 1981).

The white tail tip of the yellow mongoose is an effective visual signal. The relative bushiness of the tail may also be used in communication. The tail is normally held lower than the back to convey neutrality. Danger is signalled by the tail in a S-position and the tail is very bushy when fleeing danger. When a dominant animal successfully chases an intruder from its territory or exerts its dominance over a subordinate, the tail is held in a satisfied position, with the tail tip held higher than the back and therefore very conspicuous. When an animal is uncertain of itself, for example on entering a new territory, the tail is raised above the back, but with the tip pointing downwards (Earle, 1981).

GENETICS. The karyotype of the yellow mongoose is characterized by a diploid number (2N) of 36, including 17 biarmed autosomes, a very small metacentric Y and a medium-sized, metacentric X. The karyotype of the yellow mongoose can be distinguished from other mongooses by the large number of metacentric chromosomes and the small size of the Y-chromosome. The karyotype is invariant geographically, although a single, supernumerary microchromosome is occasionally detected (Fredga, 1972; Taylor and Meester, unpublished data).

Twenty-eight allelic systems have been analyzed by starch gel electrophoresis in eight yellow mongoose populations. Thirteen loci, representing 10 proteins and enzymes, were polymorphic (alcohol dehydrogenase, catalase, esterase, glucose dehydrogenase, glutamate-oxaloacetate transaminase, glycerol-3-phosphate dehydrogenase, unidentified general protein, phosphogluconate dehydrogenase, phosphoglucomutase, and transferrin). Mean heterozygosity was 3.4%. Different populations were closely related genetically. However, most polymorphic alleles were detected only in single populations, resulting in a high value (0.585) for Wright's F_{ST} statistic. Fewer than one individual/generation was exchanged between local populations, suggesting that gene drift, and not gene flow, is the major factor determining the population genetic structure of yellow mongoose populations (Taylor et al., 1990*b*).

Several yellow mongoose skulls, stored in various Southern African museums, show cranial and dental abnormalities which may be genetic in origin. These include one specimen (Transvaal Museum [TM] 25645; Pretoria) with the infraorbital canal divided by a bony ridge; one specimen (TM 7885) with a modified cusp pattern on the lower second molar; one specimen (Kaffrarian Museum [KM] 14042; King William's Town) with curiously shaped nasals, the right being indented and the left having a protruding bony deposition; one specimen (KM 14061) with elongate infraorbital canals; one specimen (KM 19724) with a supernumerary, right lower second premolar; and one specimen (State Museum [SM] 3547; Windhoek, Namibia) with an additional foramen on the right maxilla, giving a distorted shape to the interorbital constriction.

REMARKS. A recent, craniometric study of the yellow mongoose (Taylor and Meester, in press) resulted in the proposal of three subspecies of yellow mongooses: *C. p. penicillata* from South Africa, *C. p. bradfieldi* from Namibia, *C. p. coombsii* from Botswana and northern Transvaal.

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