Cryptoprocta ferox. By Michael Köhncke and Klaus Leonhardt

Cryptoprocta Bennett, 1833

Cryptoprocta Bennett, 1833:46. Type species Cryptoprocta ferox Bennett, 1833, by original designation.

CONTEXT AND CONTENT. Order Carnivora, Family Viverridae, Subfamily Cryptoproctinae (Simpson, 1945). The subfamily includes a single living species.

Cryptoprocta ferox Bennett, 1833

Fossa

Cryptoprocta ferox Bennett, 1833:46. Type locality “from Madagascar.”

Cryptoprocta typicus A. Smith, 1834:34. Type locality Madagascar.

CONTEXT AND CONTENT. Context noted in generic summary above. No subspecies have been recognized.

DIAGNOSIS. Cryptoprocta differs externally from other carnivores of Madagascar in being considerably larger and cat-like (Fig. 1). The combined characters of uniformly colored pelage, large size (largest of Viverridae other than Macroagulida and Viverra), long tail (slightly shorter than head and body), semiplantigrade feet, retractile claws, rounded external ear, and relatively short face render it distinctive among viverrids. C. ferox somewhat resembles a small, short-legged, dark-colored puma (Felis concolor).

GENERAL CHARACTERS. Published measurements are few, and for most the method of measurement and the source of information are omitted. Measurements (in mm) of adult specimens are: length of head and body, 700 to 800; tail, 550 to 750; hindfoot, 120 to 128; body mass ranges from 7 to 12 kg (Albiguen, 1973). Other measurements (in mm) of head and body are 600 to 750 (Haltenerth and Diller, 1977) and 850 to 900 (Grzimek, 1972). Nowak and Paradiso (1983) listed the height at the shoulder as 370 mm. Our measurements of mounted specimens in Rijksmuseum van Natuurlijke Historie, Leiden, indicated that the external ear was about 45 mm long and the hindfoot about 142 mm. Body size increases from the east to the southwest in Madagascar (Ljunquist, 1930). Males are slightly larger than females (Albiguen, 1973).

The reddish-brown pelage blends to grayish on the dorsum; the underparts are nearly beige, and the tail is paler than the flanks. The pelage is without pattern or spots and it resembles the winter pelage of the European roe deer (Capreolus capreolus), but with a reddish tinge. Published details of the coloring of C. ferox differ greatly; however, all authors acknowledge the predominance of reddish brown. Vosseler (1929) stated that the underparts of males in rut are stained reddish, similar to that on males red kangaroos (Macropus rufus), although Albiguen (1973) was unable to confirm this observation. Darker fossas (Decary, 1950; Joleaud, 1924; Ljunquist, 1930) probably are melanistic rather than subspecifically distinct, as proposed by Kaudern (1915). The neonatal pelage is gray or nearly white, but adult coloration is attained after 6 months (Albiguen, 1973; Kaudern, 1915). Body hairs are relatively short, straight, and dense.

DISTRIBUTION. Cryptoprocta ferox occurs throughout Madagascar and on the small island of Saint-Marie (Fig. 2) off the east coast of Madagascar (Kaudern, 1915). On Madagascar, fossas are common near Boulogla (in the NW near Majunga), on the E coast near Morondava, and on the NE coast near Antalaha (Albiguen, 1973). They occur in forested areas including mountains to 2,000 m (Adringitra Mountains), but avoid treeless habitats (central highlands).

FOSSIL RECORD. Grandier (1902) described material from the cave of Andrahomana, 40 km S of Fort Dauphin in southern Madagascar as a new subspecies, C. f. spelea. Pett (1935) redescribed the same subfossil cave material, but regarded it as a separate species and applied the name C. spelea to it. He described

![Image of Cryptoprocta ferox]

Fig. 1. Drawing of Cryptoprocta ferox (from Grassé, 1955).
it on the premise that the earlier appellation was a *nomen nudum*. We consider the earlier name valid because Granddidier (1902:592) gave a short but clear description "de grande taille," and thereby followed the *International Code of Zoological Nomenclature* (1958: Art. 12, 32[a], 45[e]). Lamberton (1939) described the species, *Cryptoprocta antamba*, from subfossil material from near Triandria in southern Madagascar.

Lamberton (1939) joined Petit (1935) in giving specific rank to *Cryptoprocta spelea* and in considering it subfossil. Two skulls labelled *C. spelea* on deposit in the Museum National d’Histoire Naturelle, Paris (nos. 1977–755 and 1977–756), have condylobasal lengths of 152 and 138 mm, respectively. In our opinion, the cranial differences between *C. spelea* and *C. spelea*, as understood and described by Lamberton (1939), can be explained by allometric changes in *C. spelea* with growth; therefore, the validity of *C. spelea* as a separate species is questionable. Skulls, teeth, and postcranial materials identified as *C. spelea* and *C. antamba* from different caves in central, southern, and southwestern Madagascar give no indication of the phylogeny of the Recent population because they are inseparable morphologically. *Palaeopropionodon Filhol*, 1880 (upper Eocene or lower Oligocene, Europe and Asia; *Viverridae*) is similar to *Cryptoprocta* (Simpson, 1945). *Proctotherium Filhol*, 1879 (upper Eocene or lower Oligocene-Miocene, Europe) also has many viverid-like characters but is a member of the *Felidae* (Simpson, 1945). Conversely, Simpson (1945) called *C. ferox* a viverid with many cat-like characters. "Cats and viverrids were closely similar in the early Oligocene..." (Simpson, 1945:229).

**FORM.** The rhinarium is large and prominent as in other viverrids, but the large and rounded external ear with a lateral bursa resembles that of Felidae. The conspicuously long facial vibrissae, some even longer than the head (Bennett, 1855), are arranged as in other carnivores, but the internasal group in *C. ferox* and other viverrids is lacking in the Felidae (Pocock, 1916b). Carpal vibrissae are present as in some other viverrid genera (*Galidia, Herpestes; Carlsson, 1911*). The soles of the feet bear strong pads and are nearly naked (Alburgac, 1970; Milne-Edwards and Granddidier, 1867). The claws are retractile but not hidden in skin sheaths as in Felidae. Periangular skin glands are contained in an anal sac surrounding the anus like a pouch as in Herpestinae (Carlsson, 1911). The anus lies within this pouch which opens to the exterior as a horizontal slit below the tail. A sternal gland that supposedly produces a reddish substance during rut in males (Vosseler, 1929) could not be found by Alburgac (1973). Other scent glands lie near the penis or vulva and on the neck. Alburgac (1973) mentioned that a strong odor emanates from scent glands near the penis. Precoxal glands are absent as in Herpestinae (Carlsson, 1911; Granddidier and Petit, 1932). Scent glands are less developed in females. There are three pairs of teats; the composition of milk is unknown.

The skull of *C. ferox* is constricted behind the orbits (Fig. 3). The postorbital processes of frontal and jugal are short and do not meet to separate the orbit and temporal fossa. The alisphenoid extends some distance between the squamosal and frontal bones, a feature associated with the relatively long braincase and common in other Viverridae (Carlsson, 1911). The facial skull is shorter than in almost all other viverrids, but longer than in any felid. The heavily built masticatory muscles are large and robust at their origins. The sagittal and lambdoidal crests are well developed (Milne-Edwards and Granddidier, 1867), the zygomatic arch extends broadly from the skull, and the internal pterygoid process is elongate and supports the action of the strong internal pterygoid muscle (Carlsson, 1911). An alisphenoid canal is always present (present in Viverridae, except *Galidia* and sometimes *Eupreapis* and *Cynogale*; lacking in Felidae and Hyaenidae, except sometimes present in *Crocuta*; Carlsson, 1911; Flower, 1869; Mixart, 1882; Pocock, 1916c). The carotid canal lies entirely within the basisphenoid, but has no contact with the petrosum (as in all Viverridae but none of the Felidae; Pocock, 1916c). The hypoglossal condyloid foramen is separated from the jugular foramen (= posterior lacerate foramen) by a bony wall as in *Galidia* and Felis; in *Herpestes, Vivera*, and *Partodogrus* both foramina form a single opening (Carlsson, 1911; Petit, 1935). The bulla is typical of that of viverrids (Carlsson, 1911), probably exhibiting greatest affinity with that of *Viverra*. The bulla is united (synostosis) with the basisphenoid (Fig. 3) as in the Viverridae but not among Felidae (Pocock, 1916c). The tympanic bone (= ectotympanic) Lies costolaterally and constitutes the smaller part of the bulla; it is in synostosis with the entotympanic, but is easily distinguished as a separate bone. The tympanic is not inflated and there is no depression or hole in its ventral surface. The external auditory meatus is large, and its rim is more or less smooth and not extended like a spout (Fig. 3). Thus, the tympanic is different from that in Herpestinae. The large caudomedial entotympanic forming the larger part of the bulla is bony, mainly inflated caudally, and flattened on both sides (Flower, 1869). The paroccipital process resembles that of Herpestinae; it is flatly attached to the bulla caudally by its whole anterior surface and does not extend ventrally
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to the bull. The lower jaw is robust; its articular process extends
farther back in its coronoid process (Fig. 3).

The condylobasal length (in mm) for five males (mean and
range) and one female are: 128.7 (115.1 to 139.5) and 117.2,
respectively. The dental formula for the permanent dentition is i
3/3, c 1/1, p 3-4/3-4, m 1/1, total 32 to 36, and for the decid-
uous dentition is i 3/3, c 1/1, p 3/3, total 28.

Carnassials (especially m1) and molars have an almost cat-like
“grade of advancement” (Gregory and Hellman, 1939), whereas
incisors and the remaining premolars are typical of the Viverridae
(Carlson, 1911). The upper canine is developed as in Fels, and P1
and p1 are small or missing in C. ferox; they are present in
most Viverridae, but not in Fidelae. Most authorities refer to
these teeth as being of the second dentition, but the first premolars
are not replaced in fissipeds. Both P2 and p2 have two roots (these
teeth are missing in fells), and P3 has a talon, as in some other
Viverfouri (Carlson in Fidelae (Leche, 1915). The upper carnassial
(P4) is large, sectorial, and of nearly the same shape as that in
Fidelae: M1 is small (as in Fels) and M2 is missing (as in Fidelae,
but in contrast to its presence in most Viverridae).

The similarity of the lower carnassial (m1) with that of the
Fells is related to the absence of the molar and the greatly
reduced talonid; m1 in other Viverridae has a metacodon and larger
talonid. Deciduous incisors are similar to those of other Viverridae;
the deciduous canine is similar to that in Herpetes and Viverrea,
and unlike that of the Fidelae. In the deciduous dentition, dp2 has
two roots, dp3 is similar to that in Fidelae, and dp4 is similar to
that in Genetta.

The postcraniatal skeleton presents no unusual features (Milne-
Edwards and Grandidier, 1867). The vertebral formula is T 7C, 13T,
7L, 3S, and 29 or 30 Ca, total 59 or 60. The clavicle is small, 8
mm long in an adult female (Carlson, 1911), and is fixed by liga-
ments to the sternum and scapula. The entepicondylar foramen of
the humerus is present as in most non-Malagasy viverrids. The
supraspinous fossa of the scapula is larger than the infraspinous one
(ratio 1.5:1), as in Galidia, Herpetes, and Fels. The radius is
shorter than the humerus and the tibia shorter than the femur
(Carlson, 1911).

Certain myological characteristics (Carlson, 1911) are of
interest for comparative studies: overall strong masticating muscula-
ture; existence of an intermediate tendon within the digastric mus-
cle; long origin of the lateralis dorsi over 14 vertebrae; existence
of teres minor and supinator brevis muscles; and unusual muscles
in the soles of the feet (Beddard, 1895; Carlson, 1911).

According to Carlson (1911), herpetine features of the brain
of C. ferox include the presence of a cystic sulcus, a short Sylvian
sulcus (missing in some herpetine species; Radinsky, 1975), and
the absence of a presylvian sulcus. Unlike Herpetinae, there is a
suprasylvian sulcus complete posteriorly and a postcentral sulcus
medially (Radinsky, 1975). Beddard (1895) reluctantly described a
short Sylvian sulcus ("Sulcus presylvicus") but, Carlson (1911)
and Mivart (1885) emphasized that such was the Sylvian sulcus.
This agrees with the figures of the brain provided by Brauer
and Schober (1970).

As typical in carnivores, the left lung has three lobes and the
right four (Carlson, 1911). Features of the circulatory system de-
scribed to date are typical among the Feloidea (Beddard, 1895,
1907, 1909; Carlson, 1910, 1911). The ramification of the aorta
also follows the carnivore pattern (Carlson, 1911).

The tongue is broad and rounded; Carlson, (1911) reported
two circumvallate papillae on each side. Beddard (1895) reported
three. The paucity of papillary tongues on the tongue and palatal
ridges (eight) are reminiscent of Felidae. C. ferox has no
lyssa (Carlson, 1911) in contrast to viverrids and the domestic cat
(Felis catuca). The two parts of the thyroid gland are linked by a
small isthmus (Carlson, 1911). The stomach resembles that of
the domestic cat (Beddard, 1895; Carlson, 1911), being somewhat
elongate with the pyloric port distinctly flattened.

The unique structure of the external genitalia in both sexes
was the primary gland and an os clitoridis (about 16 mm long and
3
mm thick; Lönberg, 1902) and a pair of glandular sacs (glands of
Bartholoni; Carlson, 1911) that form a scrotum-like structure. As
in all Malagasy carnivores, the uterus of C. ferox is paired through-
out its length (duplicule uterus); each opens into the vagina with a
separate cervix. All features of the dentition, exhibits greatest
resemblance to Viverrea; some characteristics of the body are most
similar to those of the Herpetinae.

ONTGENY AND REPRODUCTION. Copulation oc-
curs in September or October (Allibng, 1975) in wild C. ferox and
parturition occurs in December or January (Allibng, 1969), indi-
ating a gestation period of about 90 days. Köhnecke (1985) found
greater morphological affinities to other viverrids than to felds in
the bone macroextraction of fels to 7 weeks of age. Birth of two
or four young takes place in a concealed location such as a den
or beneath a tree (Allibng, 1972). Each neonate weighs about 100
grams (or less) and is furred, but toothless and blind (Allibng, 1969).

Contrary to a statement by Allibng (1973), siblings are not always
of the same sex (Köhnecke and Schildmann, 1977).

Observations in zoos reveal that postnatal development is slow
(Allibng, 1973, 1975). Eyes open after 2 to 3 weeks (Allibng,
1969, 1975), the young first leave the den after 4.5 months, then
weaning takes place (Allibng, 1973). Permanent dentition appears
before 20 months of age (Allibng, 1973; Boller, 1984). Onset of
sexual maturity is not before year 3 (Allibng, 1969). There is a
longevity record of 17 years from the "Zoologischer Garten" in
Hamburg, Germany (Vosseler, 1929), and a male of over 20 years
is still living in the zoo at Duisburg, Federal Republic of Germany.

ECOLOGY. Cryptoprocta ferox is generally regarded as
the main predator of lemurs, but the evidence is based on a single
field observation by woodcutters (Allibng, 1973). Many foods are
taken in captivity: insects, amphibians, reptiles, birds, and small to
medium-sized mammals, including a ring-tailed lemur (Lemur catta;
Allibng, 1973). In some accounts (Decary, 1950; Ljungquist,
1930; Louvel, 1954; Rand, 1935), C. ferox is described as a fierce
predator on domestic animals, especially poultry, but also on goats
and small calves. In the wild, C. ferox probably preys on other
viverrids (Louvel, 1954), but it seems to have no predators of
its own other than man.

Cryptoprocta ferox lives in virtually all climates on Madagas-
car and has no special habitat requirements except the presence
of development; it avoids open treeless regions. Unlike other viverrids
of the island, it is not bound to the tropical rainforests. It is not viewed
as greatly endangered at present, but is definitely declining in numbers
(International Union for the Conservation of Nature and Natural

Sizes of territories or hunting areas for C. ferox have not been
determined, but, in dense populations, each animal is estimated to
require 1 km² (Allibng, 1973).

The tick, Haemaphysalis obtusa, is the only known parasite
(Hoogstraal, 1953).

The zoo at Montpellier, France, was the first to succeed in
breeding (Allibng, 1975) and handrearing (Allibng, 1969) fossas
outside Madagascar. Other than at this zoo, few fossas are held in
captivity.

BEHAVIOR. All C. ferox caught and observed were solitary
except for one instance in which several males were noted with a
female in estrus (Allibng, 1973). Courtship behavior of males has
not been described. Females ready for copulation take a typical
lowered stance during which the outer genital area is extended 2
to 3 cm (Vosseler, 1929). Copulation usually lasts for more than 1
hour (Allibng, 1975) and Lümburg (1916) noted that C. ferox
and Pocobec (1916) takes place on the ground or on horizontal branches. The female
matures during copulation (Allibng, 1975). Pregnancy is recognize-
able only a few days before birth by swelling of the mammary
(Allibng, 1973). Young suckle for about 5 min at a time and put
their forefeet on the belly of the mother while she lies on her side.
Observations of some of the ontogenetic behavior of fossas in captivity
include the first scent-marking by males (from glands in the genital
region) at 7 months of age and by females (from glands in the anal
region) after 9 months (Albinign, 1973). Probably young part from their mothers at 15 to 20 months of age.

Crypentrocta ferox is active mainly at dawn and at night, with a peak of activity in the hours before dawn (Albinign, 1973; Grandidier and Petit, 1932). They also have been observed in the field during the day. In captivity, C. ferox can change to diurnal activity. The mating season (during spring months of September and October in wild C. ferox shifted to April and May in specimens maintained in the "Zoologischer Garten" in Hamburg (Vosseler, 1929).

Intraspecific communication consists of relatively long-lived scent marks made by both sexes, a few acoustical signals (threatening call, made by female during copulation, purring), and visual signals (expression of the face and of the whole body), but nothing is known about their exact messages (Albinign, 1973).

Fossas move in a more digitigrade fashion on the ground and more plantigrade on branches (Albinign, 1973). They climb and jump easily (Grandidier and Petit, 1932). The forefeet are used to capture and pin prey to the ground.

Agonistic behavior has been observed only during mating when aggression, including threatening calls and postures, are evident (Vosseler, 1929). Males are fierce fighters; a female was observed to attack a male in the field and the opponents attempted to bite each other (Albinign, 1973). Fights usually are of short duration, after which the loser flees and the winner follows for a few meters.

GENETICS. The diploid number of chromosomess is 42 (Ever, 1973); those of other Viveridinae range from 24 to 52, whereas those of Felidae range from 36 to 38. Rumpler (pers. comm.) studied the karyotype and found no information "which would allow us to classify Cryptoprocta closer to the viveridios than to the cats."

REMARKS. The name Cryptoprocta refers to the anus (proctum) being hidden (crypto) by an anal pouch. The vernacular name also is spelled "fossa."

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LITERATURE CITED


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